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Abstract: This paper examines the reasoning mechanism behind the consumer acceptance of genetically modified foods (GMFs) in China, and investigates influence of source credibility on consumer acceptance of GMFs. Based on the original Persuasion Model—which was developed by Carl Hovland, an American psychologist and pioneer in the study of communication and its effect on attitudes and beliefs—we conducted a survey using multistage sampling from 1167 urban residents, which were proportionally selected from six cities in three economic regions (south, central, and north) in the Jiangsu province through face to face interviews. Mixed-process regression that could correct endogeneity and ordered probit model were used to test the impact of source credibility on consumers' acceptance of GMFs. Our major finding was that consumer acceptance of GMFs is affected by such factors as information source credibility, general attitudes, gender, and education levels. The reliability of biotechnology research institutes, government offices devoted to management of GM organisms (GMOs), and GMO technological experts have expedited urban consumer acceptance of GM soybean oil. However, public acceptance can also decrease as faith in the environmental organization. We also found that ignorance of the endogeneity of above mentioned source significantly undervalued its effect on consumers' acceptance. Moreover, the remaining three sources (non-GMO experts, food companies, and anonymous information found on the Internet) had almost no effect on consumer acceptance. Surprisingly, the more educated people in our survey were more skeptical towards GMFs. Our results contribute to the behavioral literature on consumer attitudes toward GMFs by developing a reasoning mechanism determining consumer acceptance of GMFs. Particularly, this paper quantitatively studied the influence of different source credibility on consumer acceptance of GMFs by using mixed-process regression to correct endogeneity in information sources, while taking into consideration of information asymmetry and specific preference in the use of information sources.

Keywords: China; source credibility; genetically modified foods; consumer acceptance

1. Introduction

Over the past decades, genetic modification, as a core outcome of biotechnology, has been developing rapidly in varietal breeding and industrial applications. However, there has been increasing discussion about genetically modified foods (GMFs) among politicians, activists, and consumers around the world, and it has severely restricted the research and development and industrial

development of genetically modified technology (GMT) in China [1]. In fact, a lot of research indicate that the degree of public trust is a useful indicator of the potential success of GMT, not only in the institutions promoting and regulating the technology, but also in the activity being regulated, and even in the information provided by these institutions [2]. However, more and more activists and consumers have become concerned about the health risks of GMFs since the Ministry of Agriculture of the central government of China granted three biosafety certifications for two Bt rice cultivars and one phytase maize in November 2009. The news media has followed this trend and enthusiastically reported on the ensuing fierce dispute, but little reported information has been scientifically confirmed. This has resulted in a negative view of GMFs, due to dissemination of faulty information throughout the country. Various inconsistent information sources have left a sense of scientific uncertainty in the public mind, and there is a lack of efficient risk and benefit communication in the field of GM technology [3]. As results, consumers show different degrees of trust, depending on the source from which they receive information. Therefore, it is of important practical significance to analyze the influence of source credibility on consumer acceptance of GMFs in China for the scientific propaganda, research and development, and industrial development of GMT.

Scholars at home and abroad have carried out valuable research on the relationship between trust and consumer attitudes towards GMFs. The consensus is that consumers have limited knowledge of GMFs, and in this case, social trust (such as trusting in institutions or knowledge) may play a key role in attitude toward GMFs [4–12]. Qiu et al. (2007) [13] showed that consumer trust in public authorities has a significantly positive effect on consumer acceptance of GMFs in China. However, social trust refers to the willingness of a population to rely on experts and institutions in the management of risks and technologies, which is a unidimensional sociopolitical attitude. Furthermore, the measured social trust variables represent the participant opinions of how well certain risks are managed, rather than the extent to which institutions can be trusted to maximize activities geared toward protecting the public. In the words of Siegrist et al. (2000) [14], who measured social trust, "The responsible authorities accurately control whether legal regulations and restrictions are upheld".

In order to utilize the trust concept for explaining public perceptions of new technologies, some scholars have distinguished source credibility from social trust. Frewer et al. (2003) [2] indicated that perceptions of information source characteristics contributed very little to attitude change, and perhaps most tellingly, the extent to which people trusted the information sources appeared to the driven by people's attitudes about GMFs, rather than trust influencing the way that people reacted to the information. However, through theory analysis, Costa-Font et al. (2008) [15] thought that in countries where limited knowledge of GM food exists, one would expect to find information searchers with very positive (negative) information conveyed with optimistic (pessimistic) attitudes. So, they believed that the level of consumer trust in the different sources of information must be considered. Holding this view, Salazar-Ordoez and Sayadi (2013) [16] found the public of Spain regarded their scientists and government as credible information sources regarding GM technology, because they believed that scientists and government are motivated by the welfare of their citizens. Hunt and Frewer (2013) [17] analyzed the factors influencing levels of trust, and indicated that perceptions of "vested interest" and "degree of knowledge" are important elements, although probably not exhaustive. In addition, Lobb et al. (2007) [18] indicated that trust in food safety information provided by media reduces the likelihood to purchase, but trust in the food chain and independent sources shows a positive, albeit nonsignificant, impact.

In conclusion, the current literature on GMFs has made significant contributions, but the following problems have not been solved. First, empirical examination of the impact of source credibility on consumer attitude toward GMFs has provided mixed results, and has not taken endogeneity of source credibility into consideration. In other words, source credibility may be driven by people's attitudes toward GMFs. Second, the reasoning mechanism behind different sources of information influencing consumer attitude of GMFs has not been defined. Third, the process by which individuals acquire messages regarding GMFs has not yet been clearly defined. The current literature on GMFs ignores

information asymmetry and specific preference, and supposes that consumers can utilize all available information sources. However, consumers lack of access to all the information sources because of information asymmetry, and they also have specific preferences. In another word, consumers are limited or selective in the use of information sources [19].

The academic implications are as follows. To develop the reasoning mechanism, which determines the consumer acceptance of GMFs. Particularly, we quantitatively studied the influence of different source credibility leading to consumer acceptance of GMFs, using mixed-process regression to correct endogeneity in information sources, while taking into consideration of information asymmetry and specific preference in the use of information sources.

2. Theoretical Framework

The Persuasion Model, which is based on the information communication process, was developed by American psychologist Carl Hovland in 1959, building on the theory of Information Transition and Social Judgment. He regarded attitude change as a process in which outside information affected the attitude of the individual, and focused on which mechanisms and factors affect consumer attitudes. This model studied influences on the strength and direction of attitude change, and emphatically discussed the external mechanisms affecting attitude change [20].

Hovland (1959) [20] enumerated the mechanisms of the Persuasion Model. In the process of attitude change, the emotions tied to being persuaded fluctuate with new pieces of learned information. When the received information contradicts the initial attitude of a community, the public will be nervous, triggering the consistency mechanism. The Congruity Theory argues that there are several ways to ease this tension, contradicting being one of the most effective. According to the Cognitive Response Theory, all of the information that an individual receives is taken into consideration, but attitude change mainly depends on the quantity and nature of the individual's reaction to the information. If this retort process is disturbed, the individual is successfully persuaded to make an attitude change. Otherwise, the individual retains the initial attitude through various means, such as belittling the information source, distorting information, or refusing it altogether. What is more, Hovland (1959) [20] indicates that there are four factors affecting attitude change, including the persuader (information source), the persuasion information (communication), the persuasion situation, and the persuasion objects (audience). It is worth noting that the top three factors are external stimuli, and the persuader plays a particularly important role.

The most important factor is source credibility, which is dependent on authority and reliability. A high credibility source is evidently much more likely to have a positive effect on recipient attitudes than a low credibility source, which has been explained by such depth-of-processing theories as the Elaboration Likelihood Model [21]. Source credibility generally varies as an experimental factor in studies of attitude change: (1) people with expertise are more effective at persuading others, and the higher the source credibility, the more effective the persuasion; (2) if the information source is perceived to combat the vested interest of the provider, the public will happily receive the information and will be willing to change their attitude; (3) the opposite is also true: if the information source is perceived to have a vested interest in promoting a particular view, especially if it is perceived to be deliberately biased in a particular direction, their credibility is more likely to be questioned by the consumer; and (4) deliberate written attempts to influence public opinion (also referred to as propaganda, advertising, editorials, and even tweeting or blogging) are often resisted due to psychological resistance [2,22,23].

Additionally, psychological factors, such as individual differences, can influence attitude change, as well.

China's Ministry of Agriculture oversees China's overall GM organisms (GMO) safety management. This study is based on the results of monitoring and management of agricultural GMO applications by the Center of Agriculture's Genetically Modified Organisms' safety management and policy research organization of Nanjing Agricultural University (AGGMO) from 2010 to 2014. There are seven information sources. These include biotechnology research institutes (Biotechnology Research

Institute at the Chinese Academy of Agricultural Sciences, Jiangsu Academy of Agricultural Sciences, and so on), government offices devoted to management of GMOs (Ministry of Agriculture GMOs safety management office, Jiangsu GMOs safety management office, and so on), GMO technological experts, environmental organizations (green peace), anonymous information found on the Internet, food companies, and non-GMO experts.

According to a long-term statistical investigation of AGGMO and the current literature, we can draw the following conclusions.

Firstly, biotechnology research institutes, government offices devoted to management of GMOs, and GMO technological experts have more effective influence than any other sources, and are more likely to convince consumers to accept GMFs. All of these entities are both professional and credible, and they often post objective and useful information, such as the development of transgenic technology at home and abroad, and information about consumer attitudes toward GMFs and purchasing behavior.

Secondly, the persuasion of environmental organizations is also effective, but environmentalists are more likely to curb consumer reception of GMFs. Environmentalists often post negative information about potential health and ecological risks, or reports about a local government or consumers who are against GMFs.

Thirdly, the persuasion of anonymous articles on the Internet, food companies, and non-GMO technological experts have no effect on public acceptance of GMFs. Their influence is weaker for three reasons. To begin with, in general, anonymous information found on the Internet is perceived to be deliberately biased in a particular direction, and the public will therefore refuse such information, due to psychological resistance. Additionally, food companies are often perceived to have a vested interest in promoting a particular view, so consumers are likely to doubt the reliability of their statements, even if their perspective is objective. Finally, the information coming from non-GMO experts is usually neither accurate nor authoritative due to their inexperience with transgenic technology.

3. Research Methodology

3.1. Survey and Sampling

Based on previous studies [2,5,6,9,13], a provincial representative survey was conducted, using multistage sampling, in July 2014. This study used face-to-face interviews to select 1167 respondents from six cities in three economic regions (south, central, and north) in the Jiangsu province, and we collected 1000 valid samples (valid return rate is 85.69%).

Phase I was region selection. There are three reasons that the Jiangsu province was selected as the survey region. The population density and proportion of urban residents is relatively high in Jiangsu. Secondly, consumers in this province are more familiar with GMFs, which gave the survey results important research value. Thirdly, the social and economic development of the province is markedly progressive from south to north, which is similar to China's social and economic development from east to west.

Phase II was city selection. Using hierarchical cluster and K-average algorithms, 13 cities in the Jiangsu province were classified into six groups, based on the permanent population in a given district at the year-end and per capita disposable income. Using stratified sampling, six cities were selected, namely Nanjing (250), Wuxi (200), Nantong (200), Xuzhou (150), Lianyungang (100), and Suqian (100), taking into consideration distribution, population, and sample size.

Phase III was consumer selection. The following criteria were selected for inclusion in the study. The age of the respondent had to be between 20 and 70 years, the individual had to be a resident of the urban population, and have some food purchasing experience, which excluded undergraduate students. According to the Jiangsu Statistical Yearbook (2013), urban residents were divided by age and then stratified proportion sampling was used to determine the sample of each age group for the six sample cities.

All data were collected in markets, supermarkets, traditional primary product markets, and recreational squares of urban districts. These places were chosen for the following reasons: (1) past

experience suggests that consumers here are at different levels of consumption and (2) the consumers here are from various strata of society. These choices avoided the problem of biased selection of samples, which occurs when samples are selected from one single place where only consumers at a certain level of consumption are focused on [24].

In order to test the representativeness of the sample, this study compared the sample index with the Jiangsu Bureau of Statistics (2013), including such items as family members and annual average household disposable income.

Mean number of family members was 3.31, which is consistent with the average household size (3.02) of the six urban cities in 2012. Their statistical results were obtained through one-way ANOVA. In the short term, household size was a very stable variable, which means the sampling result of household size was consistent with population. In addition, based on average household disposable income for the sample in 2013, we calculated the approximate urban per capita disposable income of the district (3.085), which is also similar to that (2.846) of the six cities in 2012.

Finally, the sample consisted of 1000 urban residents, 565 (56.50%) of whom were female, which complies with the statistic that women are the main decision-makers in household food consumption. Mean age was 40 years (range: 20–69). The sample was stratified by educational background (approximately 42.60% of respondents had completed junior middle school or below, 34.7% had finished senior high school and a technical secondary school, and 22.7% of participants had attended a junior college, undergraduate institution, or above), as well as by occupation (enterprises, 52.80%; agencies andorganizations, 3.40%; institutions, 21.30%; and others, 22.20%) according to the Jiangsu Statistical Yearbook.

3.2. Analytical Procedures

Based on Hovland's Persuasion Model, the following equation was established:

$$y = \partial_i + \beta_i IS_i + \theta_i X + \delta_i A + \mu_i \quad (1)$$

where y is the dependent variable of consumer acceptance of soybean oil from GM soybeans. IS_i is the credibility of the information source. X represents demographic variables, including age (young, middle-aged, and elderly), gender, education (junior middle school and below, senior high school and technical secondary school or junior college, and undergraduate education and above), health, disposable household income (low-income, lower-income, middle-income, higher-income, and high-income groups). A represents the general attitudes embedded in the mind that influence the thoughts about a specific product [5]. Based on the current literature, general attitudes consist of the following sub-dimensional attitudes: science and technology, nature, food neophobia, and traditional food [5,7,25,26]. The variables see Table 1.

Table 1. List of the variables with definitions.

Symbol	Variable	Description	Expect-Ation
y	Consumer acceptance of soybean oil from GM soybeans	1 = strongly opposed; 2 = relatively opposed; 3 = neutral or indifferent; 4 = relatively acceptable; 5 = completely acceptable	
Matrix IS	Source credibility		
IS_1	Biotechnology research institutes	1 = complete distrust; 2 = relativedistrust; 3 = neutral or indifferent; 4 = relative trust; 5 = complete trust	+
IS_2	Government offices devoted to management of GMOs		+
IS_3	GMO technological experts		+
IS_4	Environmental organization		−
IS_5	Non-GMO experts		/
IS_6	Food companies		/
IS_7	Anonymous information found on the Internet		/

Table 1. *Cont.*

Symbol	Variable	Description		Expect-Ation
Matrix X	Demographic variables			
Age	Age	1 = young people (20–44); 2 = middle-aged people (45–59); 3 = elderly people (60–69)		−
Gender	Gender	0 = male; 1 = female		−
Edu	Education	1 = junior middle school and below; 2 = senior high school and technical secondary school; 3 = junior college & undergraduate education and above		−
Health	Health	1 = best; 2 = well; 3 = poor; 4 = incapacitated		/
Income	Household disposable income	1 = low-income groups (10–25 thousand); 2 = lower-income groups (30–68 thousand); 3 = middle-income groups (70–80 thousand); 4 = higher-income groups (90–190 thousand); 5 = high-income groups (200–1600 thousand); the proportion of each group was 0.1, 0.3, 0.2, 0.3 and 0.1		−
Matrix A	General attitude			
A_1	Science and technology:	The quality of life has been improved, due to the process of scientific and technology.	1 = complete disapprobation; 2 = relativedisapprobation; 3 = neutral or indifferent; 4 = relative approval; 5 = complete approval	+
A_2	Nature	Human activities seriously upset the ecological balance.		−
A_3	Food neophobia	New food products are worth trying.		+
A_4	Traditional food	Traditional food is more important for a healthy lifestyle.		−

There may be endogeneity for the variable of source credibility, so estimated results from using Model (1) to estimate directly were considered biased and non-consistent. There are two reasons for the endogeneity. One is omitted variables, which means there are some variables influencing both consumer acceptance of GM food and source credibility, e.g., the GMF public opinion of "China's golden rice" breaking out in 2012 in China would greatly reduce both consumer acceptance of GM food and source credibility. But these variables are generally difficult to measure, so they have to be put into the disturbing term. Another reason is simultaneous endogeneity, which means consumer acceptance of GM food as an explanatory variable would influence source credibility in turn. For example, some consumers holding a negative or neutral attitude would reduce (or increase) their trust in source information, due to the negative or positive presentation of that information on transgenic technology application.

Roodman (2011) [27] indicated that the literature has historically focused on multistage procedures for fitting mixed models, which are more efficient computationally than maximum likelihood, if less so statistically. On the contrary, when higher dimensional cumulative normal distributions are estimated, direct maximum likelihood estimation is made more practical by faster computers and simulated likelihood methods. However, Roodman (2011) [27] countered this argument with the mixed-process regression. So, in order to correct endogeneity of source credibility, our mixed-process regression is as follows:

$$\begin{cases} y = f\left(IS_i, X, F, A, \mu_i\right) \\ IS_i = f_{ij}(iv_{i1}, \ldots\ldots, iv_{ij}) \end{cases} \quad (2)$$

where iv_{ij} are instrumental variables of information source. First, two instrumental variables were selected to correct endogeneity of biotechnology research institutes (IS_1): (1) scientific research

institutions have made significant contributions to the development of science and technology innovation (iv_{11}); (2) information about the popularization of science from biotechnology research institutesis based on fact and justified, such as Biotechnology Research Institute at the Chinese Academy of Agricultural Sciences (iv_{12}). Second, the instrumental variables of government offices devoted to management of GMOs (IS_2) are as follows: (1) the Chinese government has good executionto deal with the problem of food safety(iv_{21}); (2) whether joining the communist party of China or not (iv_{22}). Third, there are also two instrumental variables for GMO technological experts (IS_3): (1) technology innovation can effectively solve practical problems during social and economic development (iv_{31}); (2) transgenic technology can improve agricultural production pattern sand ecological environment. At last, the instrumental variable of environmental organization (IS_4) is that Greenpeace has made a great contribution in terms of environmental protection (iv_{41}). All of the instrumental variables use Likert 5-scale (1 = completely no agreement, 5 = completely agreement), except for iv_{22} (0 = no, 1 = yes). It is obvious that these instrumental variables would have an effect on consumer acceptance of GM food indirectly by affecting source credibility, rather than directly influencing consumer acceptance. In addition, there are no instrumental variables for non-GMO experts, food companies, and anonymous information providers on the Internet, due to the fact that most respondents do not trust in these information sources resulting from statistical analysis.

4. Results

4.1. Descriptive Analysis

According to the reviewed studies [13,28], this paper classified GMFs into three groups (edible purpose, function of transcribed gene, and source of transcribed gene). Our study also created seven categories for GMFs.

Our findings are shown in Table 2. In regards to the first group, consumers may be more likely to accept GMFs when eaten indirectly. Consumer acceptance of soybean oil from GM soybeans or livestock (aquatic) products fed with GM maize accounts for about 13.80% and 18.50% of sales in these categories in China, respectively. On the contrary, the proportions of consumers who report that they refuse to use these products are 60.50% and 44.10%, respectively. Secondly, consumers are more likely to accept pest-resistant or herbicide-resistant GM crops, rather than those that improve the nutritional factor of the food. From the perspective of function of transcribed gene, consumers who approve of nutrition-improving GM crops and pest- resistant or herbicide-resistant GM crops accounted for about 26.70% and 34.60% of the population, respectively. On the contrary, the proportions of the population who refuse to use these items are 31.90%and 24.30%, respectively. Finally, consumers are more likely to accept GM crops created from another plant species, rather than from an animal body or microbe. Consumers who were reported to accept GM crops created from another plant species, an animal body, or a microbe totaled 31.93%, 15.54%, and 17.23% of those polled, respectively. On the contrary, the proportion of consumers who reported to reject these foods comprised 22.69%, 29.42%, and 28.58% of the population, respectively.

Ultimately, we found that consumer attitudes toward GMFs are more clearly understood from the perspective of edible purpose (products that are consumed indirectly). However, a higher proportion of consumers had neutral or indifferent attitudes about GMFs when viewed from the perspective of the function and source of transcribed gene. On this premise, we chose soybean oil made from GM soybeans as our research object, in order to examine the influence of source credibility on consumer acceptance of GMFs. It is worth noting that livestock or fish fed with GM maize are already commonly sold in China. Since there is, as of yet, no mandatory labeling required on these products, consumers are unable to identify which products have been fed with GM maize, and which have not. Of course, consumers in our study were informed before the surveys were administered.

Table 2. Consumers' acceptance of genetically modified foods (GMFs) (%).

GMFs Classification		Strongly Opposed	Relatively Opposed	Neutral or Indifferent	Relatively Acceptable	Completely Acceptable
Edible purpose	(1) soybean oil from GM soybeans	26.3	34.2	25.7	11.1	2.7
	(2) livestock or aquatic products fed with GM maize	18.3	25.8	37.4	16.6	1.9
Function of transcribed gene	(3) nutrition improving GM crops	12.4	19.5	41.4	25.2	1.5
	(4) pest or herbicide resistant GM crops	9.5	14.8	41.1	28.2	6.4
Source of transcribed gene	(5) GM crops created from another plant species	10.0	12.6	45.4	21.4	10.5
	(6) GM crops created from an animal body	15.1	14.3	55.0	11.8	3.7
	(7) GM crops created from a microbe	14.7	13.9	54.2	12.6	4.6

Source: Author's survey in 2014.

In addition, consumers can obtain information about GMFs from different sources. Not every consumer will utilize all available information sources, and many prefer specific information sources (Table 3). Obviously, there are differences between the credibility of different sources of information (Table 3). The most trusted information sources from amongst our respondents were environmental organizations, biotechnology research institutes, and government offices devoted to management of GMOs. Consumers who trusted these sources accounted for about 49.40%, 49.25%, and 48.07% of the sample, respectively. GMO technological experts were the second most trusted information sources, holding approximately 37.81% of the public's trust. Few respondents reported trust in non-GMO experts, food companies, or anonymous information found on the Internet.

Table 3. Source credibility.

Source Information	Sample of Each Source	Credibility (%)				
		Complete Distrust	RelativeDistrust	Neutral or Indifferent	Relative Trust	Complete Trust
Biotechnology research institutes	599	2.3	7.7	40.7	44.2	5.0
Government offices devoted to management of GMOs.	545	6.8	9.7	35.4	42.6	5.5
GMO technological experts	365	7.1	13.7	41.4	31.8	6.0
Environmental organization	415	2.7	3.6	44.3	40.5	8.9
Non-GMO experts	265	6.4	23.4	44.5	19.6	6.0
Food companies	446	11.7	33.9	47.3	7.2	0.0
Anonymous information found on the Internet	397	10.8	21.4	53.7	13.4	0.8

Source: Author's survey in 2014.

4.2. Testing of Mixed-Process and Ordered Probit Model

Our mixed-process regression with CMP (conditional (recursive) mixed-process estimator) and ordered probit regression were conducted with Stata 12.1 using the maximum likelihood method. Estimated results are presented in Tables 4 and 5.

First of all, test results of Hausman (Atanhrho, Tables 4 and 5) showed that there was endogeneity indeed for research institutes, GM regulators, GM experts, and environmental organization. Furthermore, the instrumental variables had a significant effect on the information source in each model. In addition, estimated results of mixed-process regression were compared with that of ordered probit model. It turned out that by ignoring endogeneity of source credibility, the impact of source credibility on consumer acceptance of GM food would be under estimated significantly. For example,

the estimated results of mixed-process regression and ordered probit regression of "biotechnology research institute", respectively, were 0.687 and 0.363. The estimated results (see Tables 4 and 5) were inconsistent with theorized expectations, and the details were as follows.

Firstly, the estimated coefficients of biotechnology research institutes (IS_1), government offices devoted to management of GMOs (IS_2), and GMO technological experts (IS_3) were respectively 0.682, 0.810, and 0.811 (see Table 4), which were significantly positive at the 1% level. The results showed that the more respondents trusted in these sources, the higher the probability of consumer acceptance of soybean oil from GM soybeans. Secondly, the estimated coefficient of environmental organizations (IS_4) was −1.582, which was significantly negative at the 1% level. The results showed that the more respondents trusted in environmental organizations, the lower the probability of their acceptance of soybean oil from GM soybeans. Thirdly, the estimated coefficients of anonymous information found on the Internet (IS_5), food companies (IS_6), and non-GMO experts (IS_7) were not found to be significant even at the 10% level. The results showed that none of the three had much effect on consumer acceptance. The estimated results also found that the estimated coefficients of gender (gen) and education (edu) were negative, and were significant at the 1% or 5% level in almost all of the seven models. These results have shown that gender and education have a negative effect on consumer acceptance. On the one hand, men are more likely to accept soybean oil from GM soybeans than are women. On the other hand, in general, the higher the education of the consumer, the lower their acceptance of soybean oil from GM soybeans. However, age, health, and household disposable income have not been shown to be significantly correlated.

In addition, the estimated parameters of science and technology (A_1) and food neophobia (A_3) were positive and those of nature (A_2) and traditional food (A_4) were negative; most parameters were found to be significant. This means that the more science and technology is viewed as a life improvement, or the more willing a consumer is to try new food products, the more willingly a consumer will accept soybean oil from GM soybeans. On the contrary, the more disruptive human activities are perceived to be based one cological balance, or the more traditional food is viewed as an important factor of a healthy lifestyle, the less willing the consumer will be to accept soybean oil from GM soybeans.

Table 4. Estimates of influence of source credibility on consumers acceptance to GM soybean oil.

Symbol	Variable	Biotechnology Research Institute		Government Offices Devoted to Management of GMOs		GMO Technological Experts	
		Mixed Process	Ordered Probit	Mixed Process	Ordered Probit	Mixed Process	Ordered Probit
IS_1	IS_1	0.682 *** (0.1200)	0.363 *** (0.0708)				
IS_2	IS_2			0.810 *** (0.0995)	0.377 *** (0.0589)		
IS_3	IS_3					0.811 *** (0.1150)	0.374 *** (0.0725)
age	Age	−0.0581 (0.0701)	−0.0445 (0.0731)	−0.0521 (0.0633)	−0.00581 (0.0720)	0.0041 (0.0906)	0.0766 (0.1040)
gen	Gender	−0.185 * (0.0950)	−0.206 ** (0.0977)	−0.177 ** (0.0896)	−0.219 ** (0.0984)	−0.0926 (0.1090)	−0.139 (0.1220)
edu	Education	−0.494 *** (0.0686)	−0.495 *** (0.0711)	−0.526 *** (0.0690)	−0.537 *** (0.0770)	−0.646 *** (0.0899)	−0.713 *** (0.0933)
hea	Health	0.270 *** (0.0959)	0.292 *** (0.0970)	0.0137 (0.0953)	0.0284 (0.1050)	0.00531 (0.1060)	0.00263 (0.1190)
inc	Household disposable income	−0.0259 (0.0410)	−0.035 (0.0422)	0.0112 (0.0362)	0.0131 (0.0414)	0.0327 (0.0465)	0.0439 (0.0526)
A_{i1}	Science and technology	0.498 *** (0.0553)	0.537 *** (0.0530)	0.328 *** (0.0539)	0.405 *** (0.0494)	0.347 *** (0.0622)	0.434 *** (0.0577)
A_{i2}	Nature	−0.702 *** (0.0691)	−0.740 *** (0.0695)	−0.556 *** (0.0715)	−0.654 *** (0.0698)	−0.522 *** (0.0931)	−0.656 *** (0.0858)
A_{i3}	Food neophobia	0.137 ** (0.0649)	0.155 ** (0.0670)	0.124 ** (0.0578)	0.153 ** (0.0662)	0.0684 (0.0651)	0.0503 (0.0768)
A_{i4}	Health	−0.419 *** (0.0998)	−0.445 *** (0.1030)	−0.430 *** (0.0899)	−0.524 *** (0.0952)	−0.373 *** (0.1090)	−0.395 *** (0.1280)
Test of instrumental variables	iv_{11}	1.333 *** (0.1250)					
	iv_{12}	0.109 ** (0.0553)					
	iv_{21}			0.927 *** (0.1100)			
	iv_{22}			0.230 *** (0.0478)			
	iv_{31}					0.898 *** (0.1770)	

Table 4. *Cont.*

Symbol	Variable	Biotechnology Research Institute		Government Offices Devoted to Management of GMOs		GMO Technological Experts	
		Mixed Process	Ordered Probit	Mixed Process	Ordered Probit	Mixed Process	Ordered Probit
	iv_{32}					0.225 *** (0.0583)	
	Atanhrho Constant	−0.326 *** (0.1180)		−0.561 *** (0.1350)		−0.598 *** (0.1950)	
cut_1		−2.686 *** (0.698)		−2.332 *** (0.685)		−2.837 *** (0.876)	
cut_2		−1.387 ** (0.675)		−1.094 * (0.643)		−1.484 * (0.799)	
cut_3		0.0340 (0.649)		0.0213 (0.602)		−0.162 (0.731)	
cut_4		1.219 * (0.636)		1.193 ** (0.570)		0.574 (0.717)	
Sample		599		545		365	
Log likelihood/Log pseudo likelihood		−1229.3092	−573.19742	−1263.709	−611.681	−823.97365	−368.5021

Note 1. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, the standard deviation of in parentheses is robust standard error; Note 2. Data are from Author's survey in 2014.

Table 5. The influence of source credibility on consumer acceptance to soybean oil from GM soybeans (2).

Symbol	Variable	Environmental Organization		Non-GMO Experts	Food Conpanies	Anonymous Information Provider on the Internet
		Mixed-Process	Ordered Probit	Ordered Probit		
IS_4	IS_4	−1.582 *** (0.0587)	−0.883 *** (0.0916)			
IS_5	IS_5			0.0419 (0.0777)		
IS_6	IS_6				0.076 (0.0655)	
IS_7	IS_7					−0.0508 (0.0766)
age	Age	−0.00926 (0.0563)	−0.0382 (0.1010)	−0.0204 (0.1220)	−0.363 *** (0.0818)	−0.138 (0.0949)

Table 5. *Cont.*

Symbol	Variable	Environmental Organization		Non-GMO Experts	Food Conpanies	Anonymous Information Provider on the Internet
		Mixed-Process	Ordered Probit		Ordered Probit	
gen	Gender	−0.249 *** (0.0839)	−0.467 *** (0.1190)	−0.418 *** (0.1510)	−0.559 *** (0.1120)	−0.550 *** (0.1210)
edu	Education	−0.386 *** (0.0652)	−0.670 *** (0.0885)	−0.694 *** (0.1160)	−0.553 *** (0.0817)	−0.592 *** (0.0836)
hea	Health	0.168 * (0.0906)	0.336 *** (0.1200)	0.00174 (0.1500)	0.117 (0.1030)	−0.16 (0.1160)
inc	Household disposable income	0.0101 (0.0284)	0.0234 (0.0522)	−0.0393 (0.0710)	−0.0187 (0.0472)	−0.0383 (0.0495)
A_{i1}	Science and technology	0.240 *** (0.0489)	0.412 *** (0.0663)	0.484 *** (0.0752)	0.127 (0.1020)	0.489 *** (0.0606)
A_{i2}	Nature	−0.0523 (0.0952)	−0.548 *** (0.0884)	−0.670 *** (0.1080)	−0.464 *** (0.0739)	−0.711 *** (0.0779)
A_{i3}	Food neophobia	0.121 *** (0.0404)	0.215 *** (0.0666)	0.200 ** (0.0814)	0.114 (0.0775)	0.116 * (0.0691)
A_{i4}	Health	−0.145 * (0.0799)	−0.297 ** (0.1280)	−0.511 *** (0.1300)	−0.756 *** (0.1230)	−0.508 *** (0.1390)
Test of instrumental variables	iv_{41}	0.328 *** (0.0732)				
	Atanhrho Constant	1.539 *** (0.4270)				
cut_1		−6.945 *** (0.781)				
cut_2		−6.161 *** (0.680)				
cut_3		−5.160 *** (0.569)				
cut_4		−4.716 *** (0.562)				
Sample		415		265	446	397
Log likelihood/Log pseudo likelihood		−840.67537	−375.32642	−280.73229	−459.62313	−394.06698

Note 1. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, the standard deviation of in parentheses is robust standard error; Note 2. Data are from Author's survey in 2014.

5. Discussion

In this study, we tested our claim that the reasoning mechanism determines the consumer acceptance of GMFs and is affected by such factors as information source credibility, general attitudes, gender and education levels. Particularly, we used mixed-process regression correcting endogeneity in information sources to examine the influence of source credibility on consumer acceptance of GMFs, and obtained some valuable and interesting results.

This study employed a large representative sample of 1167 urban residents proportionally selected from six cities in three economic regions (south, central, and north) in the Jiangsu province. The findings from our survey suggested that consumers prefer to ingest GMFs indirectly, in the form of pest-resistant or herbicide-resistant GM crops or GM crops created from another plant species, rather than directly eating nutrition improved GM crops or those originating from an animal body or microbe. In addition, consumer attitudes toward GMFs are more clearly understood from the perspective of edible purpose, rather than the perspective of the function and source of transcribed gene. One possible explanation is that urban consumers lack knowledge about genetic engineering and biotechnology, and thus tend to be neutral or indifferent towards GMFs. As rational, economic individuals, consumers do not generally care about the applications of biotechnology in agricultural production; they are simply concerned with whether eating GMFs holds any potential risk.

Our findings suggest that, just as we predicted in our theoretical analysis, credibility of biotechnology research institutes, government offices devoted to management of GMOs, and GMO technological experts have a positive effect on consumer acceptance of GMFs, which indicate that as urban consumers hold more faith in these three information sources, the more possible consumer acceptance of GM soybean oil. Just as theoretically predicted, all three were professional and credible, and often posted objective information, such as the development of transgenic technology at home and abroad and information on consumer attitudes toward GMFs and purchasing behavior. Therefore, the power of persuasion held by these entities is more effective, and they can help consumers to accept GMFs. These views are consistent with Salazar-Ordoez and Sayadi (2013) [16], who found the public of Spain regard the scientists and government branch as the credible information sources regarding GM technology, but they ignored endogeneity of source credibility in their empirical analysis and could not explain the reasoning mechanism. However, the views are inconsistent with Frewer et al. [2], who indicated information source characteristics contributed very little to attitude change. On the contrary, credibility of environmental organization has a negative effect on consumer acceptance, which demonstrates that as trust in environmental organization increases, consumer acceptance of GM soybean oil will decrease. As theoretically predicted, environmental institutions are also credible, but they have traditionally posted negative information about the potential health and ecological risks of GMOs, or information about local government or consumers opposing GMFs. This study confirmed that environmental organizations are, thus, likely to discourage consumers from being receptive of GMFs. Moreover, the remaining three sources (non-GMO experts, food companies, and anonymous information found on the Internet) had almost no effect on consumer acceptance in this study. This also verifies our theoretical expectations. In general, these information sources are perceived to be deliberately biased in a particular direction, perceived to have a vested interest in promoting a particular view, and are typically neither accurate nor authoritative, so consumers are likely to doubt their reliability, due to psychological resistance. The results are similar to Lobb et al. (2007) [18], who indicated that trust in food safety information provided by media reduces the likelihood to purchase, but trust in the food chain and independent sources shows a positive, albeit nonsignificant, impact. Consistent with previous literature, general attitudes variables such asscience and technology (A_1) and food neophobia (A_3) were found to positively affect consumer acceptance of GMFs, while nature (A_2) and traditional food (A_4) had a negative effect on GMFs acceptance. It should be no surprise that consumers apply their preexisting general attitudes about other life issues to evaluate the new subject of GMFs. The results are also similar to that of Chen and Li (2007), Costa-Font and Gil (2009), Prati et al. (2012), and Chen et al. (2015) [5,6,9,12].

Furthermore, the existing results have shown that on the one hand, men are more likely to accept soybean oil from GM soybeans than are women, which is validated by the results of Qiu et al. (2007) [13]. On the other hand, in general, the higher the education of the consumer, the lower their acceptance of soybean oil from GM soybeans, which is similar to Hoban's (1998) conclusions [29]. One possible reason is that higher education will increase awareness of perceived risks of GMFs. However, age, health, and household disposable income have not been shown to be significantly correlated. At present, the conclusions of demographic variables affecting consumer acceptance have yet to reach agreement at home and abroad.

In summary, this paper has attempted to contribute to the behavioral literature on consumers' attitude toward GMFs by developing a reasoning mechanism to determine consumer acceptance of GMFs, and especially examines the influence of different source credibility on consumer acceptance of GMFs by using a mixed-process regression to correct endogeneity in information sources, and has obtained some valuable and interesting results.

Further, the following policy countermeasures are proposed. On the one hand, the regulation and supervision of information sources should be further strengthened. Increased governmental authority over the publication of GM technology and information about GMFs would result in standardization of the objectivity, authenticity, and completeness of information, and would avoid the spread of faulty information. Specifically, entities that spin information, spread false rumors, fabricate data, or twist the results of foreign research should be punished seriously, whether through economic or administrative penalties. Additionally, public supervisory windows should be set up on a government portal website. If an information source is suspect, consumers can report it at any time. On the other hand, it is essential to intensify the publication and improve the negative media environment of GM information dissemination. The responsibilities for dynamic management of GM information should be given to an appropriate department, with the following specific functions: (1) the recent research progress at home and abroad should be collected and sorted regularly; (2) the controversy about transgenic technology and GMFs at home and abroad should be monitored, and the research results and experimental data referred to by related events should be reverified, in order to avoid the spread of out-of-context information, or the bending of the truth; (3) recent research progress about transgenic technology and GMFs at home and abroad should be released to the public in a timely manner by a credible information sources, such as government offices devoted to management of GMOs, or GMO technological experts; (4) an expert think-tank should be established, in order to objectively contradict distorted information about transgenic technology or GMFs; and, lastly, (5) question and answer windows should be established on a government portal website, in order to allow registered citizens to ask questions about transgenic technology and GMFs.

It is important to mention a few caveats to the successful completion of this research. We note (1) the absence of an investigation into the degree of consumers' attitude change toward GMFs affected by source credibility, which is difficult to measure; and (2) the restriction to soybean oil made from GM soybeans as the sole product considered. Thus, it would appear as particularly relevant to improve the study by expanding this approach to other GMFs. However, there is, as of yet, no mandatory labeling required on other GMFs, except for soybean oil made from GM soybeans in China now.

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