Attitudes of Urban Female Consumers toward Food Production Practices in the Republic of Korea

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Abstract

Socioeconomic, demographic and location characteristics and also opinions and views of South Korean urban females were analyzed to understand how these characteristics influence preferences for foods produced through different food production practices. Employing the generalized ordinal logistic model, it is found that education of the respondent and locations of the household have significant influence on preferences. Age and income influence these preferences to a certain extent and respondents' opinions on the use of pesticides and importance of other food attributes have greater influence on preferences for foods produced by different practices.

Introduction

Sustainable food production practices are gaining popularity worldwide because of the environmental concerns and decrease in productivity associated with conventional food production practices, which rely heavily on synthetic chemical inputs (Reganold et al., 1990; Rains et al., 2011). Reduction in productivity, which is mainly due to soil degradation and loss of biodiversity, is driving governments across the globe to adopt policies that are directed to increase agricultural productivity and, thus, increase food supply self-sufficiency. Adoption of sustainable practices is one of the ways to minimize the damages inflicted by conventional practices and is also an effective strategy to assure a self-sufficient in food supply (Tilman et al., 2002).

Since 1960s, the Republic of Korea has transformed from an agrarian-based to an industrialized economy. However, the goal of attaining self-sufficiency in food production has

always been a priority for South Korea (Kihl and Park, 1981). Since the available land is limited and conventional food production practices are responsible for the decreased productivity of the land, the next best option for the country is to adopt sustainable production practices. According to a new UN report, low input farming projects that do not rely on chemical fertilizers and pesticides have been very successful in significantly increasing food production in South East Asia, Africa, and South America (Tom Levitt, 2011). Sustainable methods include non-conventional practices like organic farming, precision farming, and reduction in the synthetic chemical input use, all aimed at increasing the land productivity and regaining environmental health (Rains et al., 2011). Adoption of sustainable food production practices by farmers is the most important step in the implementation of such policies. Efforts to influence the adoption processes need help from the society as well. A farmer who engages in sustainable farming practices is more influenced by his social standing (Cutforth et al., 2001), than actual yield or quality of produce obtained by such practices. The yields obtained, which may initially be lower than those obtained using conventional practices, may affect, in turn, his social standing, because 'better yields' are obtained by 'better farmers'. The environmental or social benefits of his sustainable practices may not be involved in determining his social standing (Normal et al., 1997). A clear understanding about the benefits of sustainable practices will increase the support for sustainable farms, which in turn can have a tremendous cultural influence on society. Public who are aware of the need for a healthy environment can influence policy makers, educators, and farmers in implementing sustainable food production practices (Fazio et al., 2007). Therefore, studies on societal effects are as important as studies on the technical aspects of these practices (Reed 2004).

If consumers demand sustainably grown foods, then farmers and researchers also will focus on stainable food production practices (Klinkenbourg, 1995), because consumer needs

determine the success of a production chain. Perceptions of food quality have changed greatly and can be decisive in the purchasing process (Linnemann et al 2006). Government policy makers can create awareness among consumers regarding the benefits of sustainable practices; so that the demand for foods produced using such practices may also increase, eventually inducing the widespread adoption of these practices. Providing information about foods on product labels is known to influence consumers' knowledge and purchasing patterns (Caswell and Mojduszka 1996). Over and above such influences, consumer needs and wishes are shaped by individual preferences and different socio-economic factors. Information gathered from consumers proved essential to integrate consumer's preferences in food product development in an effective and timely manner (Jongen, Linnemann and Dekker 1999).

This paper examines how the attitudes of Korean consumers toward foods produced by non-conventional methods and conventional methods change with their socio-economic, demographic characteristics as well as their opinions toward specific food production practices and food characteristics. The results of this study will also help creating profiles of consumers who will be willing to buy foods produced through these food production practices.

Data

The study uses data collected through a survey conducted in seven urban centers (Seoul, Incheon, Daejeon, Daegu, Busan, Ulsan and Kwangju) of the Republic of Korea in September 2007. The survey, implemented by a commercial market research company, involved 1,100 women responsible for food shopping and meal preparation. The survey instrument was prepared by the team of Korean and American researchers. Respondents provided socioeconomic and demographic information, shared opinions and views regarding certain food attributes, aims of new agricultural and food technologies and expressed their willingness/unwillingness to buy genetically modified (GM) foods having certain attributes. Four equations were estimated and

the empirical estimations use 850 observations after the deletion of incomplete responses. Table 1 shows descriptive statistics and variable definitions.

The dependent variable in all four equations is categorical with seven ordered responses (Likert-scale) ranging from a value of "one" that represents "strongly disagree" and to a value of "seven" that indicates "strongly agree" with a statement. The four statements are ("I prefer to eat foods produced…"): 1) using conventional production practices (Conven), 2) using modified practices with need-based pesticide applications (Modified), 3) using nonconventional practices without synthetic pesticides (Nonconpestfree), and 4) using nonconventional methods with latest technologies (Nonconlatest). The explanatory variables include socioeconomic and demographic characteristics such as household income, age, education, occupation, presence of children, location and also variables constructed from respondents' opinions and views.

Several earlier studies (for example, Roberts, 1996; Carrigan and Attalla, 2001; Maignan and Ferrel, 2001) have concluded that sustainable foods are mainly purchased by specific consumer segments. They find that consumers, referred to as ethical consumers, in this segment are usually middle aged, well educated, have a prestigious job, with high income, and are well informed. So, age, education, occupation and income are proven to have some influence on the choices of consumers with regard to the purchase of sustainably produced foods. This study includes occupation as four dummy variables that represent white collar jobs, blue collar jobs, homemakers (reference job) and jobs classified as "others." Location variables are West, East and Seoul, the capital. West includes cities of Daejeon, Incheon and Kwangju and East includes Busan, Ulsan and Daegu. Since Seoul is the largest urban area with more than 20% of the total population in South Korea, it is used as the reference location. Consumers from different locations may have varied opinions regarding the different types of food production practices. Presence of children in the household may influence a respondent's view regarding a particular

food production practice, since the concern about the safety of foods might increase when there are children in the household.

Some previous studies maintain that demographics alone are not sufficient to explain behavioral pattern of such consumers (Roberts, 1995; Diamantopoulos, 2003). According to Roberts (1996), attitudes, and behavioral and personality characteristics of the consumers are also important to identify those consumers who will be willing to try sustainable foods. Another study by Robinson and Smith (2002) also emphasize the significance of attitudes and beliefs in explaining the purchase intentions toward sustainable foods. Following the previous research, this study employs some variables constructed from the opinions and views of consumers.

Variables “Techfert”, “Techpest” and “Secfdsupp” are constructed based on the agreement with the statement that new agricultural and food technologies should focus on “reducing the amount of fertilizer used in food production”, “reducing the amount of pesticide used in food production” and “assuring security of national food supply”, respectively. The responses are scored on a seven point Likert-type scale with “one” for “strongly disagree” and “seven” for “strongly agree”. The variables are included because modified and nonconventional practices of food production aim to reduce the amount of fertilizers and pesticides and also help a country to ensure a secured food supply.

Another set of variables, i.e., “Morevit”, “Pestfree” and “Org” are created using the responses to the question that asks how important to the respondent is it that the food “have vitamins”, “be pesticide free” and “be organic produce”, respectively. Sustainable food production practices include organic farming, which avoids the use of synthetic pesticides and the latest technologies being developed can enrich foods with vitamins.

Nonconventional methods may include latest technologies like GM to produce foods that can have all the ingredients essential for human health. Therefore, two opinion variables are

included to get the information about consumers' willingness to pay for GM foods. They are "Gmhealth" and "Gmpest" and are constructed based on the responses to statement "I would buy GM foods if they are healthier" and "if they contain less pesticide residues", respectively. These categorical variables are measured on a seven point Likert-type scale where "one" represents "definitely yes" and "seven" for "definitely no".

The Empirical Model

In this study, the dependent variables assume more than two values. Therefore, a binary logistic regression is inadequate to model the equations. The ordinal logistic regression is an extension of the binary logistic regression that takes into account the ordering of responses used in this study. The ordering applies a seven step Likert-type scale, where the responses were measured with "one" for "strongly disagree" to "seven" for "strongly agree". In ordinal logistic regression, when we consider the probability of an event, we also need to consider the probabilities of all events that are ordered. For example in this study, in order to model the odds of the event that a respondent strongly agrees with a statement, the odds of other events like including strongly disagrees with the statement are also need to be considered. Therefore, the probabilities are calculated cumulatively.

The empirical equation takes the following form (see Table 1 for full variable definition):

$$Y = \alpha + b_1\,\text{income} + b_2\,\text{education} + b_3\,\text{age} + b_4\,\text{child} + b_5\,\text{white} + b_6\,\text{blue} + b_7\,\text{others} + b_8\,\text{east} + b_9\,\text{west} + b_{10}\,\text{techfert} + b_{11}\,\text{techpest} + b_{12}\,\text{secfdsupp} + b_{13}\,\text{morevit} + b_{14}\,\text{pestfree} + \varepsilon,$$

where Y is the event being modeled, which is about the agreement with a food production method. Since we have four production methods in this study, we estimate four separate models. In addition to the above listed variables, for equation on nonconventional method without the use of synthetic pesticides, the variable "Org" and for equation on nonconventional method using latest technologies, the variables "Gmhealth" and "Gmpest" are also incorporated into the model.

The modeling of an event includes modeling of the following odds of Y,

Y_1= prob(value=1)/ prob(value>1)

Y_2= prob(value=1 or 2)/ prob(value>2)

Y_3= prob(value=1 or 2 or 3)/ prob(value>3)

Y_4= prob(value=1 or 2 or 3 or 4)/ prob(value>4)

Y_5= prob(value=1 or 2 or 3 or 4 or 5)/ prob(value>5)

Y_6= prob(value=1 or 2 or 3 or 4 or 5 or 6)/ prob(value>6).

The seventh (last) category does not have odds, as the cumulative probability of having a value of 1, 2, 3, 4, 5, 6, or 7, is one (Norusis, 2010).

The ordinal logistic model then takes the form of $Yi = \alpha_i - b_j x_j$, where *i* represents the number of categories not including the last one and *j* represents the explanatory variables (1,2,……,14). Each category has a different intercept, but the slope coefficients are the same across different categories according to the assumption of parallel regression. If the coefficient for a particular explanatory variable has a positive sign, then the likelihood of higher categories are more likely to occur. But, if it is negative, lower categories are more likely to occur, given an increase in the value of that explanatory variable if it is continuous or changing the value from zero to one, if it is a binary variable. The results are also interpreted based on the marginal effects and predicted probabilities.

Estimations of the four equations using the ordinal logistic regression show the violation of parallel regression assumption, meaning that the slope coefficients are not the same across different categories. This violation is noticed in the case of two equations on nonconventional methods of food production. The usual interpretation from an ordinal logistic regression results is that the assumption holds. Multinomial logistic regression is suggested to solve this problem, because it estimates a different slope coefficient for each category. However, this approach does

not take into account the ordering of responses (Wooldridge, 2010) and is less parsimonious. The generalized ordinal logistic regression is an alternative (Williams, 2010) that estimates different coefficients only for the variables that are found to violate the parallel regression assumption, while keeping the coefficients for other variables same across categories. We follow the latter approach to estimate generalized logistic regression and report the results. Estimation is done using the STATA software.

Empirical results

This section describes results from the estimation of four equations using the generalized logistic procedure in STATA. The Brant test was applied to identify the explanatory variables that violate the parallel regression assumption (Williams, 2010), with a significance level of 0.05. The violations are noticed in the case of two equations, i.e., equations on nonconventional food practices (Nonconpestfree and Nonconlatest). The variables thus diagnosed are allowed to have different coefficients across various categories. For Nonconpestfree equation, the diagnosed variables are Income, East and West. In the Nonconlatest equation East and West are the problematic variables. All models are globally significant with the rejection of the respective null models (high chi-square values). The low value of McFadden's pseudo R-square are not uncommon in cross sectional studies, previous studies also report low values (for example, Brierley, 2008; Hank and Schaan, 2008).

A glance at the mean values of the dependent variables (Table 1) will give a picture of the overall agreement with the statements. On an average, consumers prefer foods produced through nonconventional methods without the use of synthetic pesticides and also methods using latest technologies. However, consumers generally do not prefer to eat foods produced through conventional methods and modified methods employing need-based pesticide application.

Results from the current study are presented separately for each equation. First, results are presented with the interpretation of variables that do not violate the parallel regression assumption (Table 2) and are followed by that of variables which seem to violate such assumption (Table 3).

Preference for foods produced through conventional methods (Conven)

Table 2 provides the estimated parameters of the variables. An increase in educational attainment reduces the likelihood of preference for foods produced. As explained in some previous studies (Roberts, 1996; Carrigan and Attalla, 2001) ethical consumers who prefer sustainable foods are on an average well educated. Respondents from the West part of the country are more likely to prefer conventionally produced foods compared to those from Seoul. This can be attributed to availability of sustainable foods and of information about its benefits in the capital city. Also, Seoul has 10 million inhabitants and majority of consumers that belong to the group of ethical consumers may be residing in this city. According to Vermer and Verbeke (2006), consumers, who think that the availability of sustainable foods is low, tend to have low intentions to purchase such foods.

Among the opinion variables, Techpest and Pestfree are statistically significant. Respondents who think that new agricultural and food technologies should focus on reducing the amount of pesticides are less likely to prefer foods produced through conventional methods. Similarly, respondents who consider it important to have pest-free foods are also less likely to prefer these foods. The results show that consumers with preferences similar to respondents are aware of the fact that conventional methods employ pesticides and other chemicals in food production. A study by Thilmany et al. (2008) concludes that consumers who attach importance to pest-free foods are willing to pay a premium for local attributes of foods. Predicted

probabilities at the average of explanatory variables across seven categories are given in Table 4. Probability of strongly disagree is 0.42 and cumulative probability for disagreement is 0.82. The figures explain that, on an average, respondents are less likely to prefer to eat foods produced through conventional methods of food production.

Preference for foods produced through modified practices employing need-based pesticide applications (Modified)

Respondents with high levels of educational attainment are less likely to prefer foods produced through this method. The result is in agreement with results of the study by Roberts (1996). Regarding the geographical variation, respondents from West and East parts of the country are more likely to prefer foods produced using modified practices compared to respondents from Seoul. Particular occupational category is also found to be significant. Here, respondents in blue collar jobs are more likely to prefer the foods compared to respondents who are homemakers. The predicted cumulative probability (Table 4) of disagreement is 0.63, or slightly less than that calculated for the first equation. A probable reason might be the fact that in this food production method pesticides are applied only when they are needed.

Preference for foods produced through nonconventional (unconventional?) food practices without any synthetic pesticides (Nonconpestfree)

Table 2 shows estimated coefficients that do not differ across different categories of the dependent variable. An increase in educational level of the respondents increases their likelihood of preferring foods produced through nonconventional methods without the use of synthetic pesticides. Respondents in other jobs (i.e., other than white and blue collar jobs) are less likely to prefer these foods than homemakers. Some of the opinion variables also are statistically significant in explaining the likelihood of preference for foods purchased through

nonconventional practices. Respondents, who think that new agricultural and food technologies should focus on reducing the amount of pesticides (Techpest) and those, who think technologies should focus on assuring the security of national food supply (Secfdsupp) are more likely to prefer foods produced through the considered method. A study by Tilman et al. (2002) suggests that sustainable production method is an effective strategy to be self sufficient in food production and self-sufficiency leads to security in food supply. Another opinion variable (Org) verifies respondents' attitudes toward organic produce. Respondents who attach importance to organic produce are also more likely to prefer foods produced using nonconventional methods without the use of synthetic pesticides. The result is supported by the fact that organic method of cultivation avoids the use of synthetic chemicals.

Table 3 shows estimated coefficients for the variables that are found to violate parallel regression assumption. In that case, each variable has different estimated coefficients for each of its seven categories. Income, East and West violate the assumption and have different estimates. A consistently negative estimate for Income in all categories informs that an increase in household income increases the likelihood of being in the seventh category, i.e., strongly agree. The result implies that an increase in income increases the preference for nonconventional foods. Regarding the geographical locations, respondents from the east are less likely to fall into the first category (strongly disagree), but at the same time more likely to fall in the sixth category than the last category, compared to respondents from Seoul. Residents of the West region are more likely to be classified in the second category and less likely in the fifth and sixth categories compared to Seoul residents. The predicted cumulative probability (Table 4) of agreement is 0.84 (for categories 5, 6 and 7), which indicates high preference for the considered foods in general.

*Preference for foods produced through nonconventional food practices using the latest technologies (*Nonconlatest)

Table 2 shows estimated coefficients that do not differ across different categories of the dependent variable. The age variable is statistically significant in the equation. An increase in age of respondents increases the preference for the foods considered in this section. An increase in the educational level of respondents increases their likelihood of preferring foods produced through nonconventional methods using the latest technologies. Respondents in jobs other than white and blue collar jobs are less likely to prefer these foods than homemakers. Among the opinion variables, Techpest, Secfdsupp, Pestfree and Gmhealth are statistically significant. Respondents who think that new agricultural and food technologies should focus on reducing the amount of pesticides (Techpest) and those who think technologies should focus on assuring the security of national food supply (Secfdsupp) are more likely to prefer foods produced through the considered method. Respondents, who attach importance to pest-free foods (Pestfree) are also more likely to prefer such foods, whereas respondents willing to buy GM foods if they are healthier (Gmhealth) are less likely to prefer these foods.

Table 3 shows estimated coefficients for variables that are found to violate the parallel regression assumption. East and West variables violate the assumption and have different estimates. Respondents from the eastern part of the country are less likely to be in the fifth category than the last category, compared to respondents from Seoul. Residents of West region are more likely to fall into the second category, but, less likely to be in the fifth and sixth category compared to Seoul residents. The predicted cumulative probability (Table 4) of agreement (for categories 5, 6 and 7) is 0.80, which translates, in general, into a high preference for foods produced using the latest technology.

Conclusions and Implications

Overall, the results from this study are consistent with those of some previous studies (for example, Roberts, 1996; Carrigan and Attalla, 2001; Vermeir and Verbeke, 2006; Thilmany et al., 2008). Education and West are the only variables that are consistently, statistically significant in all equations. The higher the educational level, the higher the likelihood that respondents prefer foods produced through nonconventional methods without the use of synthetic pesticides or using latest technologies while respondents are less likely to prefer foods produced through conventional and modified practices. Respondents from West region are more likely to prefer foods from conventional or modified practices, while less likely to prefer foods produced through other two methods, compared to Seoul residents.

Among the occupational variables, homemakers are more likely to prefer foods produced through nonconventional methods than respondents in jobs other than white and blue collar jobs and less likely to prefer foods produced through modified practices than respondents in blue collar jobs. Age is significant in the case of fourth equation and as respondents' age, they are more likely to prefer foods produced through nonconventional practices with latest technologies.

Opinion variables also have significant influences on the preferences. Techpest and Pestfree (see Table 1 for full description) have negative estimates in first equation (which means that respondents with a positive attitudes toward these statements are less likely to prefer these foods), whereas these variables have positive estimates in fourth equation (which translates into the increased likelihood of those respondents preferring the foods under this category). Techpest is significant in third equation also with a positive estimate. Secfdsupp increases the likelihood of preferring foods produced by nonconventional methods. Org is significant and positive in the third equation, where as Gmhealth is significant and negative in fourth equation.

For a better summary of the results, predicted probabilities for a hypothetical situation are calculated and reported in Table 5. The profile consists of respondents from households with a monthly income of $4,000, who are homemakers with 13 years of education, and are 41 years old. The households are located in Seoul and have children. All the opinion variables are included at their mean values. Table 5 shows cumulative probabilities excluding the neutral category, which is listed as the fourth. The cumulative probability that these hypothetical respondents do not prefer foods produced through conventional methods is about 0.87 and foods produced by modified practices is about 0.72. The probabilities for preferring foods produced by nonconventional methods without the use of synthetic pesticides is about 0.73 and for preferring foods produced by nonconventional practices using latest technologies is about 0.85. From these results it is clear that an average respondent prefers foods produced through nonconventional methods, which use food production methods related to the sustainable production practices.

The results from this study have policy implications for government and also for marketing agencies. Both these agencies may want to increase the consumption of foods produced through nonconventional and also by modified practices, so that farmers are assured of a sustaining market for their produce. Probabilities for different profiles of respondents can be calculated to identify the segments that prefer or do not prefer a particular type of food. Based on such knowledge, agencies involved in promotion of foods produced by nonconventional and modified practices locate segments to increase the awareness of specific consumers. Apart from the socioeconomic and demographic variables, consumers' attitudes also play a role in the market promotion of these foods and in the education of consumers regarding the food benefits. For example, respondents who agree with the objective of new agricultural and food technologies in reducing the amount of pesticides prefer foods produced through nonconventional practices. Following an observation by Vermer and Verbeke (2006), to promote

such foods, marketers and government policy makers should direct their efforts to make those respondents feel that what they think is right. Coordinated efforts by both marketers and government policy makers will increase the consumption production of such foods, which in turn will benefit both consumers and farmers in future leading to sustainable agricultural development in the country.

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Table 1. Descriptive statistics of variables included in the empirical equation.

Variable name	Description and units of measurement	Mean or share[a]	Std dev.
Dependent variable (categorical with seven responses)			
	I prefer to eat food produced using		
Conven[b]	Conventional production practices	2.24881	0.0516623
Modified[b]	Modified practices with need-based pesticide application	3.059524	0.062296
Nonconpestfree[b]	Nonconventional practices without synthetic pesticides	5.482143	0.0555625
Nonconlatest[b]	Nonconventional practices with latest technologies	5.447619	0.0547906
Independent variables			
Socio-economic factors			
Income	Monthly household income in US$	3640.714	39.82066
Educ	Respondent's education in years	13.06071	0.0741785
White	= 1 if the respondent has a white collar job and 0 otherwise	0.2714286	0.0153526
Blue	= 1 if the respondent has a blue collar job and 0 otherwise	0.275	0.0154154
Homemaker[c]	= 1 if the respondent is a homemaker and 0 otherwise	0.4200913	0.4938553
Others	= 1 if the respondent's job is not included in any of the above categories and 0 otherwise	0.0345238	0.006303
Demographic variables			
Age	Age in years	41.2881	0.2854531
Child	= 1 if the household has children, 0 otherwise	.6595238	0.0163598
Household location			
East	=1 household located in Daegu, Ulsan, or Busan, 0 otherwise	0.2428571	0.0148041
West	=1 household located in Incheon, Daejeon or Kwangju, 0 otherwise	0.2642857	0.0152234
Seoul[c]	=1 household located in Seoul, 0 otherwise	0.4828767	0.4999922
Opinion variables			
	New agricultural and food technologies should focus on		
Techfert[d]	Reducing the amount of fertilizers used in production	5.602381	0.0441735
Techpest[d]	Reducing the amount of pesticides used	5.708333	0.0428089
Secfdsupp[d]	Assuring the security of national food supply	5.589286	0.0392423
	How important to you is it that food		
Morevit[e]	Have vitamins	5.238095	0.0509346
Pestfree[e]	Be pesticide free	5.613095	0.0438521
Org[e]	Be organic	5.363095	0.0468403
	I would buy GM foods if they		
Gmhealth[f]	Are healthier	3.82619	0.0716954
Gmpest[f]	Contained less pesticide residues	3.883333	0.0688683

[a] Share in case of a binary variable; [b]1=strongly disagree,…….., 7=strongly agree ; [c] Reference variable;
[d] 1=strongly disagree,…….., 7=strongly agree; [e] 1=not important at all,……., 7=very important;
[f] 1=definitely yes,…..., 7=definitely not

Table 2. Estimates (from the generalized logistic regression) with respect to the variables which do not violate the parallel regression assumption (same coefficients across three categories)

Variable	Estimated parameters from the equations			
	Conven	Modified	Nonconpestfree	Nonconlatest
Income	-0.0000545	-0.0000162	-	-0.0000491
	(-0.86)	(-0.27)		(-0.80)
Educ	-0.0678**	-0.0742**	0.0877**	0.0942***
	(-1.97)	(-2.27)	(2.56)	(2.77)
White	-0.0798	0.00529	0.0698	-0.0810
	(-0.50)	(0.03)	(0.44)	(-0.52)
Blue	0.135	0.303**	-0.111	-0.0382
	(0.85)	(1.98)	(-0.70)	(-0.24)
Others	-0.387	0.250	-0.878**	-0.987***
	(-1.08)	(0.77)	(-2.47)	(-2.86)
Age	0.00198	-0.00266	0.00924	0.0175**
	(0.23)	(-0.31)	(1.06)	(2.03)
Child	-0.151	-0.0475	0.152	0.193
	(-1.04)	(-0.33)	(1.06)	(1.36)
East	0.271	0.553***	-	-
	(1.63)	(3.48)		
West	0.359**	0.552***	-	-
	(2.30)	(3.56)		
Techfert	0.0869	0.00530	0.125	0.110
	(1.02)	(0.07)	(1.57)	(1.42)
Techpest	-0.165*	-0.00790	0.216***	0.162**
	(-1.94)	(-0.10)	(2.60)	(1.98)
Secfdsupp	-0.0993	0.00154	0.142**	0.157**
	(-1.52)	(0.02)	(2.11)	(2.35)
Morevit	-0.0155	-0.0131	-0.0476	0.0818
	(-0.30)	(-0.26)	(-0.91)	(1.60)
Pestfree	-0.190***	-0.0334	0.0683	0.147**
	(-3.28)	(-0.60)	(0.97)	(2.50)
Org	-	-	0.181***	-
			(2.81)	
Gmhealth	-	-	-	-0.148**
				(-2.41)
Gmpest	-	-	-	0.0779
				(1.24)
LR chi2	53.22	33.52	170.46[#]	144.32[#]
Pseudo R2	0.021	0.011	0.069	0.056

Note: *, ** and *** denote statistical significance at 10%, 5%, and 1% levels, respectively

[#] denote Wald chi2

T-statistic is in parenthesis

Table 3. Estimates (from the generalized logistic regression) with respect to the variables which violate the parallel regression assumption (different coefficients across three categories)

Category/ Explanatory Variable	Equations and categories[a]				
	Nonconpestfree			Nonconlatest	
	Income	East	West	East	West
1	-0.000823***	-1.090**	-0.532	0.240	0.226
	(-4.77)	(-2.11)	(-0.98)	(0.50)	(0.50)
2	-0.000268**	0.224	0.777**	0.385	0.763**
	(-2.46)	(0.69)	(2.14)	(1.17)	(2.17)
3	-0.000231**	0.100	0.411	0.139	0.433
	(-2.51)	(0.35)	(1.41)	(0.51)	(1.54)
4	-0.0000586	-0.204	0.0198	-0.104	-0.160
	(-0.74)	(-0.93)	(0.09)	(-0.48)	(-0.77)
5	-0.000154**	-0.129	-0.802***	-0.373**	-0.700***
	(-2.21)	(-0.67)	(-4.35)	(-2.00)	(-3.83)
6	-0.0000706	0.530***	-0.456**	0.113	-0.832***
	(-0.96)	(2.77)	(-2.23)	(0.60)	(-3.86)

[a] Category 7 is the base outcome

Note: ** and *** denote statistical significance at 5%, and 1% levels, respectively

T-statistic is in parenthesis

Table 4. Predicted probabilities of respondents falling into a category (calculated at the mean values of explanatory variables)

Category	Predicted probabilities of falling into a category with respect to equation			
	Conven	Modified	Nonconpestfree	Nonconlatest
1	0.416	0.238	0.031	0.029
2	0.272	0.232	0.022	0.033
3	0.137	0.165	0.028	0.035
4	0.086	0.142	0.086	0.104
5	0.049	0.100	0.202	0.197
6	0.021	0.077	0.334	0.316
7	0.019	0.046	0.302	0.286

Table 5. Predicted probabilities of respondents falling into a category (calculated based on a hypothetical situation)

Category	Predicted probabilities of falling into a category with respect to equation			
	Conven	Modified	Nonconpestfree	Nonconlatest
1	0.504	0.318	0.003	0.025
2	0.255	0.252	0.019	0.038
3	0.112	0.152	0.139	0.023
4	0.065	0.117	0.012	0.065
5	0.036	0.076	0.099	0.124
6	0.015	0.054	0.373	0.334
7	0.013	0.031	0.355	0.392

Situation: Respondents are from households with a monthly income of $4000; with an education of 13years; homemakers (homemaker=1); have children in the households (child=1); from households located in Seoul (seoul=1); with opinion variables at their mean values