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IMPORTANCE OF REDUCED FOOD POISONING FROM EATING CONTAMINATED VEGETABLES, FRUITS AND NUTS: AN APPLICATION OF THE MULTINOMIAL LOGIT TECHNIQUE

ZNACZENIE ZMNIEJSZENIA RYZYKA ZATRUĆ POKARMOWYCH W WYNIKU SPOŻYCIA WARZYW, OWOCÓW I ORZECHÓW: ZASTOSOWANIE TECHNIKI MULTILOGITOWEJ

Key words: survey, Republic of Korea, utility, urban centers
Słowa kluczowe: badania ankietowe, Republika Korei, użyteczność, obszary wielkomiejskie

Abstract. The study identifies factors influencing the importance consumers in the Republic of Korea attach to food poisoning resulting from eating vegetables, fruits, or nuts. Survey data collected from 1,100 females residing in the seven major urban centers are used to estimate the equations. Results are used to calculate probabilities associated with the specific opinions held by respondents with regard to, among others, demographic and economic characteristics and preferences about food and food production methods.

Introduction

The purpose of this paper is to examine factors that influence the importance consumers in the Republic of Korea attach to the possibility of food poisoning resulting from eating vegetables, fruits, or nuts. Koreans consume between 800-1,000 grams of vegetables daily [WHO 2003] making them as a nation one of the leading vegetable consumers in the world. Fruit consumption has increased rapidly in the last two decades [WHO 2003], and imports have increased nut consumption. While the high consumption of domestic and imported vegetables and fruits, which provide five and four percent of daily energy intake respectively, is highly recommended from the public health standpoint, it may increase the risk of food-born illness due to microbial contamination of produce. Fruit and vegetable production is almost one-third of the country's total agricultural production [USDA 2008].

Attitudes toward the risk of poisoning due to consumption of contaminated food have recently been the focus of attention because of the increasing costs of illness outbreaks. The immediate costs of an outbreak are due to the recall of produce, which affect growers, shippers, distributors and retailers. Additional costs result from the demand contraction, which affect a region or the whole country. In the case of fresh, perishable vegetables or fruits, a recall often implies a total loss to a producer. The supply chain participants often have to implement a new safety monitoring system, a promotion or consumer education program, and offer price discounts to regain market share.

The threat of food poisoning

The changing supply and distribution network of vegetables, fruits, and nuts has altered the level of food poisoning risk. To remain competitive, many retailers search for produce suppliers world-wide and use the global distribution networks to deliver a variety of items to their local stores. The risk of food poisoning has been exacerbated by changes in consumer purchasing and consumption behavior including the increased demand for eating out and partially prepared products including fresh-cut salad ingredients and snacking nuts. Moreover, consumer demand for fresh fruits, vegetables, and nuts increases in response to the growing body of scientific evidence linking the consumption of such items with the protection against some diseases and improved health. Consequently, the lengthening distance (both in terms of space and time) between harvest in the field and the final consumer, the concentration in distribution and retailing, and consumer preference for health-enhancing, conveniently-prepared food have raised the risk of wide-spread outbreaks of food poisonings. Recent examples of such outbreaks include the contamination of spinach by *E.coli* bacteria in California in 2006 [U.S. Food and Drug Administration 2006] or the warning about Salmonella contaminated tomatoes in 2008 [U.S. Food and Drug Administration 2008].

Conceptual framework

Individual behavior is assumed to be driven by the expected satisfaction from choices and decisions. Economists assume that a consumer has the ability to select among options and chooses the one that provides the highest level of satisfaction or utility. By choosing among multiple options, a consumer identifies the option with the highest utility although she may not be able to exactly quantify the difference in utility between the best and the second-best choice. This measurement problem has immediate practical consequences because it complicates the quantification of observed consumer behavior. The unobserved cognitive process that leads to a purchase or consumption decision is, therefore, assumed to reflect the utility associated with the choice, but does not indicate the utility gain as compared to the second-best choice. In empirical studies, it is assumed that the utility gain or distance between two choices can be measured by equal intervals subject to time and income constraints, while the observed decision is the one that maximizes utility.

Consumer studies commonly apply multiple scales to measure abstract concepts such as the like or dislike of a food, agreement or disagreement with a statement about food, or importance or unimportance of a food attribute, among others. The scale consists of an odd number of steps, where the middle step implies a neutral choice (neither/nor) and the steps prior or after it define a specific consumer's feeling.

This study assumes that consumers derive utility from avoiding being poisoned by microbial contamination of fruits, vegetables or nuts. Consumer preferences with this regard are reflected in the importance of the expressed concern about poisonings from eating the three foods. Vegetables are an essential part of the Korean diet, while fruits have gained in popularity as incomes have increased. Nuts are consumed in various forms and rising incomes increased demand for this item, which is produced domestically in an inadequate volume.

The survey implementation and results

In September 2007, 1,100 Korean women living in seven urban centers were interviewed by a commercial marketing firm. The sample was drawn to assure its correctness in terms of demographic characteristics. The seven urban centers include Seoul, Busan, Incheon, Ulsan, Daegu, Daejeon, and Gwangju. The questions probed for consumer views and opinions about a variety of food attributes, food production technologies, food shopping, preparation and eating habits, among others. Details about the economic and socio-demographic characteristics of the respondent and family were also gathered. More than 34 percent of respondents graduated from high school, 59 percent of households consisted of four persons, 40 percent of respondents were housewives, and 39 percent were 41-45 years old.

Empirical model specification

From the practical standpoint, it is of interest to learn the factors that cause a respondent to change her views about the importance of food poisoning resulting from eating vegetables, fruits, or nuts. This study assumes that because of the different consumption volume, consumption frequency, and different eating occasion the importance of food poisoning resulting from eating these three items can be modeled as independent events. Multinomial logit technique [Greene 2003] offers a suitable approach to quantify the effects of individual consumer characteristics and habits and opinions reflecting preferences with regard to the issue at hand.

The applied approach to the specification and estimation of the empirical model was largely driven by the available data. The importance attached by Korean consumers to the reduction of the possibility of food poisoning by consuming contaminated vegetables, fruits, or nuts was investigated by re-specifying the dependent variable. Initially, respondents indicated the importance on the seven-step scale, where the option „four" was equivalent to a view that the issue was neither important nor unimportant. It has been assumed that indeed three choices mattered in this case, namely, whether a respondent thought the issue was important, remained neutral or perceived the issue as unimportant. Therefore, the original responses were re-coded creating three categories describing the consumer's view of the issue: important, neutral, or unimportant.

The economic and socio-demographic information was coded in a fashion similar to other consumer survey data. Views and opinions were coded using a multiple-step scale capturing difficult-to-measure abstract emotions, yet allowing respondents to express their feelings about issues relevant to the food supply and distribution system.

Estimation results

The specification of three categories describing the degree of attached importance to food poisoning due to microbial contamination of vegetables, fruits, or nuts and the applied multinomial estimation technique required testing of the statistical correctness of such specification. The Hausman test verifies if the independence of the estimated ratios (for example, in this study, the ratio of expressing the view that poisoning from microbial fruit contamination is unimportant vs. not having an opinion, or not having an opinion vs. attaching importance, etc.) [Hensher, Rose, Greene 2005, Greene 2003]. Results of the test for the independence of irrelevant alternatives support the correctness of the multinomial technique application.

Estimation results of the three relationships between food poisoning importance and consumer characteristics and expressed opinions show that socio-economic and demographic characteristics of respondents were infrequently statistically significant and the importance of food poisoning was more often associated with opinions about food and food consumption. This overall tendency indicates how difficult it remains to communicate with consumers about the possibility of food poisoning due to consumption of fruits, vegetables, or nuts, and how unpredictable are possible consumer reactions and their demonstration in purchasing behavior.

In the case of microbial contamination resulting from eating fresh vegetables, respondents with more than high school education were less likely to consider the threat of food poisoning from this particular source as important. Also, compared to Seoul residents, those from the eastern part of the country viewed the issue as less important and more likely to have a neutral view. It appears that respondents with strong preferences for healthy foods (even if it was genetically modified (GM)), less pesticide use, dislike for conventional production practices, seeing/eating vegetables with soil particles, and wanting research to focus on technologies limiting pesticide use were more likely to view the importance of microbial vegetable contamination as important rather than being neutral. Respondents who had no opinion about the risk from eating vegetables containing soil particles or about trusting public officials about food quality were less likely to view microbial vegetable contamination as important and more likely to remain neutral on this issue.

Korean consumers with more than high school education, residents of western urban centers, or those preparing dry fruit at home were less likely to view fruit microbial contamination as important and more likely to represent a neutral stand on the issue. The opposite was confirmed for respondents making fruit preserves at home, willing to buy GM food if it was healthier, or not having an opinion about the use of conventional production practices. Those drying fruit at home, willing to buy GM food produced using less pesticides, preferring the conventional production practices, believing fruit consumption prevented some cancers, and perceiving risky soil fumigation to kill insects were less likely to see fruit microbial contamination as important and more likely to view it as unimportant.

Microbial contamination of nuts as a source of food-born illness was less important and more likely associated with a neutral stand when a respondent had more than high school education, did not have an opinion about buying GM food if healthier, or did not have an opinion if new technologies should focus on pesticide use reduction. However, the opposite view was associated with the middle income respondents, those willing to buy GM food if it was healthier than conventional food, or believed that eating fruits and vegetables prevented heart disease. Such respondent characteristics/views as having more than high school education, no opinion if they would buy GM food if it was healthier, willing to buy GM food if produced using less pesticide, preferred conventional production practices, and had no opinion if new technologies should focus on pesticide use reduction increased probability that she perceived microbial contamination of nuts as less important and more likely as unimportant. Respondents willing to buy GM food if it was healthier than conventional food, did not believe that eating more fruits and vegetables prevents stroke, disagreed that the new technologies should focus on pesticide use reduction, and did not trust public officials in statements about food quality were more likely to view microbial contamination of nuts as important rather than unimportant. The following factors increase the probability of a respondent viewing the microbial nut contamination as unimportant rather than having a neutral point of view: education at a level higher than high school, middle income level, no preference of food produced with fewer pesticides, or believing that eating fruits and vegetables reduced heart disease. The opposite was true if a respondent had no opinion regarding the use of pesticides on as-needed basis or that eating fruits and vegetables containing soil particles was a threat, did not believe that eating fruit and vegetables prevented stroke, disagreed that new technologies should focus on pesticide use reduction, or did not trust public officials' statements about food quality.

Table 1. Estimated marginal probabilities and probabilities by the level of expressed importance of reduction of food poisoning[a]

Variable name and definition	Expressed importance of food poisoning		
	not important	neither important nor uni-important	important
Microbial contamination of vegetables			
Age	-0.0023	0.0031	-0.0008
East, includes cities of Incheon, Daejeon, and Gwangju	0.0913	0.2703	0.6384
West, includes cities of Ulsan, Busan and Daegu	0.1281	0.1840	0.6879
Seoul	0.1087	0.1939	0.6974
Will buy GM foods if healthier	0.2417	0.1733	0.5850
Will buy GM foods if contain less pesticide residue	0.0687	0.1728	0.7585
Prefer to eat food not produced using conventional production practices	0.0726	0.1283	0.7991
Prefer to eat food produced using pesticides only when need – no opinion	0.1102	0.2906	0.5993
Do not believe that eating more fruits and vegetables helps reduce the risk of stroke	0.1401	0.3332	0.5267
Risk from eating raw fruits or vegetables that contain soil particles	0.1354	0.1216	0.7430
Risk from eating raw fruits or vegetables that contain soil particles - no opinion	0.0870	0.3225	0.5905
New technologies should not focus on reducing pesticide use	0.2532	0.1546	0.5922
New technologies should focus on reducing pesticide use - no opinion	0.0874	0.3019	0.6107
Do not trust public health officials about food quality	0.1491	0.2022	0.6487
Microbial contamination of fruits			
Age	0.0005	-0.0029	0.0024
East, includes cities of Incheon, Daejeon, and Gwangju	0.0759	0.3337	0.5904
West, includes cities of Ulsan, Busan and Daegu	0.0215	0.3879	0.5906
Seoul	0.0525	0.3127	0.6348
Will buy GM foods if healthier	0.1397	0.3354	0.5249
Prefer to eat food not produced using conventional production practices	0.0301	0.2835	0.6864
Prefer to eat food produced using pesticides only when needed – no opinion	0.0499	0.4656	0.4845
Dry fruit at home	0.0351	0.4294	0.5355
New technologies should focus on reducing pesticide use	0.1270	0.3496	0.5235
New technologies should focus on reducing pesticide use – no opinion	0.0362	0.4606	0.5032
Trust public health officials about food quality – noopinion	0.0395	0.4161	0.5444
Risk from eating foods fumigated to kill insects	0.0363	0.2846	0.6791
Microbial contamination of nuts			
Age	0.0331	0.2930	0.6740
East, includes cities of Incheon, Daejeon, and Gwangju	0.0603	0.3045	0.6352
West, includes cities of Ulsan, Busan and Daegu	0.0362	0.3380	0.6258
Seoul	0.0501	0.2730	0.6769
Will buy GM foods if healthier	0.1365	0.2376	0.6259
Will buy GM foods if healthier - no opinion	0.0230	0.3853	0.6917
Do not prefer to eat food produced using pesticides only when needed	0.0506	0.2045	0.7450
Prefer to eat food produced using pesticides only when needed – no opinion	0.0558	0.3650	0.5791
Believe that eating more fruits and vegetables helps reduce the risk of heart disease	0.0567	0.1526	0.7907
Do not believe that eating more fruits and vegetables helps reduce the risk of stroke	0.0789	0.3938	0.5273
New technologies should not focus on reducing pesticide use	0.1192	0.3500	0.5308
Do not trust public health officials about food quality	0.0955	0.3302	0.5743

[a] probabilities for binary variables were calculated for the values 1 and 0. For example, the location variable assumed the value of 1 when the respondent resided in a given region and 0 otherwise; the corresponding probability for a resident of East selecting the option „not important" is 0.
Source: own calculations.

The statistically significant factors associated with the view that microbial contamination of foods posed a threat were relatively consistent with preferences and opinions held by respondents. Overall, those who preferred healthier food, food produced using less pesticides or supporting technologies that focused on reduced use of pesticides as well as respondents perceiving the presence of soil particles in fruits and vegetables were more likely to view microbial contamination as a threat of food-born illness. Respondents with more relaxed attitudes were more likely to be classified as being neutral or perceiving microbial contamination as unimportant.

However, to make recommendations for food producers and distributors it is necessary to calculate specific probabilities linking consumer characteristics or views with perceptions of a poisoning threat resulting from eating the three food items considered in this study. Table 1 shows the calculated marginal probabilities (for continuous variables) or probabilities (for binary variables) only for those variables that were statistically significant. The probability associated with age suggests varying influence on the importance of food poisoning across the three foods. For example, as respondents aged they were more likely to fall into the neutral category in the case of vegetables as a source of food poisoning, but less likely in the case of fruits, and, in the case of nuts, they were most likely to feel it was an important issue. Although residents at the three locations were most probably viewing the issue of food poisoning as important regardless of the food item, Seoul residents were consistently falling into this category with the highest probability. Some results confirm the common sense approach to the issue of food poisoning. For example, it was highly probable that respondents who viewed as risky eating raw fruits or vegetables that might contain soil particles also viewed the microbial vegetable contamination as important. In the case of fruit microbial contamination, a high probability of viewing this issue as important was associated with the preference of not eating food produced using conventional production practices (presumably applying a sizable quantity of synthetic chemicals). Interestingly, those who believed that increasing the consumption of fruits and vegetables reduced the risk of heart disease were highly likely to attach importance to microbial nut contamination.

Concluding comments

From the fruit, vegetable, and nut producer and distributor viewpoint, it seems important to recognize that consumers with a preference for healthy food, concerns about chemical use in food production, or the presence of natural contaminants in produce, e.g., soil particles, appear sensitive to the risk of food-born illness resulting from microbial contamination. Food exporters must apply utmost importance regarding this issue because about 70 percent of agricultural product needs are imported to South Korea [Produce Marketing Association 2009], or risk a loss of this potentially lucrative market. Results of this study indicate that there are opportunities to segment the market and establish sections of fresh produce meeting the demand of the health/safety-conscious consumer. Economic and demographic characteristics seem to offer little guidance in targeting a particular consumer group, but it appears that those older or with more education were less likely to view microbial contamination as a threat. The influence of education supports general observations that education helps to overcome the perception of risk stemming from eating food products with specific attributes. It is possible that consumer education efforts, although not necessarily through formal schooling, may help to overcome fears of microbial contamination, while teaching how to handle food to reduce the contamination threat. A concerted effort in the area of safe food handling would improve consumer knowledge about food safety and enhance skills in handling produce among Korean households.

Bibliography

Greene W. H. 2003: Econometric analysis. Prentice Hall, 1026 pp.

Hensher D.A., Rose J.M., Greene W.H. 2005: Applied choice analysis: a primer. Cambridge University Press, Cambridge, 742 pp.

Produce Marketing Association. 2009: International resources: global market profile: Republic of Korea (South). Available online at www.pma.com/cig/intl/southkorea.cfm. Accessed June 3, 2009.

U.S. Department of Agriculture. 2008: South Korea: Basic information – fruits, nuts, and vegetables. Available online at www.ers.usda.gov/Briefing/Southkorea/fruitsandvegs.htm. Accessed June 3.

U.S. Food and Drug Administration. 2006: FDA Announces Findings From Investigation of Foodborne E.Coli 0157:H7 Outbreak in Spinach. Accessed online at www.fda.gov/bbs/topics/NEWS/2006/NEW01474.html on May 27, 2009.

U.S. Food and Drug Administration. 2008: FDA Warns Consumers Nationwide Not to Eat Certain Types of Raw Red Tomatoes. Accessed online at www.fda.gov/bbs/topics/NEWS/2008/NEW01848.html on May 27, 2009.
WHO. 2003: WHO Fruit and Vegetable Promotion Initiative – report of the meeting, Geneva, 25-27 August 2003. Accessed online at http://www.who.int/hpr/NPH/fruit _and_vegetables/fruit_and_vegetable report.pdf on May 14, 2008.

Streszczenie

Celem pracy było zidentyfikowanie czynników wpływających na zwracanie uwagi przez konsumentów w Republice Korei na zatrucia pokarmowe spowodowane jedzeniem warzyw, owoców lub orzechów. Modele wyliczono na podstawie badań ankietowych przeprowadzonych wśród 1100 kobiet zamieszkujących w siedmiu wielkomiejskich obszarach Republik Korei. Wyniki pokazały prawdopodobieństwo z jakim występują zmiany opinii respondentów co do znaczenia m.in. cech demograficzno-ekonomicznych oraz preferencji dotyczących żywności i sposobu jej produkcji.

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