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Impact of Information Gathering Behavior and Residential Distance on Risk Preferences against Reputational Harm Caused by the Fukushima Disaster in Japan

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【abstract】

The massive earthquake that hit Japan on March 11, 2011, triggered an accident in the Fukushima No.1 nuclear power plant, adversely affecting the marine product processing industry by reputational harm. In order to find a solution, this paper examines the effects of information-gathering behavior and the distance from the power plant on the level of anxiety of processed marine products in the Miyagi prefecture, next to Fukushima prefecture. Ordered probit models with an instrumental variable were employed to estimate models without the endogeneity problem. The results indicate information-gathering behavior does not significantly affect the level of anxiety when considering the instrumental variables. On the other hand, the distance from the power plant was found to be correlated with such anxiety. Consequently, this study suggested that the farther the people lived from the plant, the higher was their tendency to avoid buying processed marine products made in the Miyagi prefecture, without gathering relevant information about the consumability of the products.

1. Introduction

1-1. Research Background

The accident that occurred at Tokyo Electric Power Company's (TEPCO) Fukushima No. 1 nuclear power plant on March 11, 2011, released radioactive material into the surrounding areas, predominantly in the eastern part of the Fukushima prefecture. Consequently, on March 21, 2011, the Japanese government issued shipping restrictions on agricultural, forestry, and fishery products from the Fukushima, Ibaraki,

Tochigi, and Gunma prefectures amid concerns of damage to people's health that could occur from ingesting such products from the region. Initially, the shipping restrictions were applied to 3 products but were later expanded to apply to 203 products in total from 15 prefectures (the Independent Investigation Commission on the Fukushima Nuclear Accident (2014), pp. 126-127). These shipping restrictions are gradually being relaxed as inspection systems have been established and the safety of the areas has been verified. Moreover, the fisheries operating around the affected area were ordered by the fisheries' unions to voluntarily refrain from catching fish until a safety confirmation was obtained. Consequently, only the marine products whose safety was verified have been distributed in markets. However, despite the safety inspection of products from the affected areas, in many cases, transaction volumes and prices remain low. This situation has prompted concerns that damages from groundless information are possibly being spread due to (1) excessive anxiety among consumers and distributors regarding possible radioactive contamination of products from the affected areas, and (2) miscommunication with the consumers (*e.g.* Kainou (2013) and Kudo and Nakayachi (2014)). Such continuous miscommunication could interfere with the affected area's revitalization since fishery is one of the basic industries in the Tohoku area (Abe (2014)). Therefore, this matter necessitates an immediate solution. However, in addition to fisheries, there are other entities, such as municipal organizations and consumers, who are involved with this issue. Communication, which is presumed to be the base of the reputational harm, is diversified in recent Japan, and this situation has made it difficult to handle all problems simultaneously. Consequently, there is an increasing demand for further studies in several related issues.

1-2. Previous studies

The term "reputational harm" is understood and used in several ways in Japan. Literally speaking, it means harmful result caused by wild rumors. However, Sekiya (2003) defined reputational harm as "(economical) harm caused by restrained consuming and/or sightseeing behavior, for the safety-verified products and/or places, because an incident, accident, environmental pollution, or disaster is covered extensively by the media." He pointed out that reputational harm in Japan is usually not caused by wild rumors, but tends to be generated based on some facts or issues that have happened in reality. The Dispute Reconciliation Committee for Nuclear Damage Compensation recognized the reputational harm caused by the nuclear plant accident as damage related to the accident and therefore subject to compensation. This is

because it led to the rejection of the market since people have been restrained from buying agricultural, forestry, and fishery products to avoid the risk of radioactive contamination (Dispute Reconciliation Committee for Nuclear Damage Compensation, Ministry of Education, Culture, Sports, Science and Technology (2011)).

Corresponding to this reputational harm, the relevant ministries and agencies (e.g. the Consumer Affairs Agency) have started disseminating important information about the food, such as, radioactive risks, verified safety, verification standards for radioactive substances, and system of shipping restriction, through their respective official websites.

The range of reputational harm is not limited to agricultural, forestry, and marine products, but other tangible products such as personal or real estates, and even intangible services provided by the tourism industry are also included (Dispute Reconciliation Committee for Nuclear Damage Compensation, Ministry of Education, Culture, Sports, Science and Technology (2011)). However, since consumers are primarily concerned about the quality standards of the food they consume, the media, and the government and related agencies have directed their initiatives towards information dissemination. Accordingly, this research focuses on the reputational harm of food, especially marine products, and the factors determining consumers' decisions[1].

1-3. Targeted factors

In a broad sense, the concrete reputational harm (e.g. avoiding buying food produced around the affected area) can be generated by "accumulation of consumers' active risk-avoiding behavior" (Kikkawa *et al.* (2001)). It is assumed that consumers worry about the risks of taking such food.

In particular, the risk that Japan experienced through the accident is the unpredictable "new risk" which can be experienced in the "risk society" filled with highly developed technology (Beck (1986), Azuma and Ito (Trans.) (1998)). Lau (1989) also categorized risks into three types, including "new risk" that is engendered by modern science to a certain level, and can neither be positively solved nor predicted by science. To add to the examples of "new risk," Mikami (2010) selected natural disasters and new kinds of virus beyond scientific prediction. Beck (1986) mentioned that people must rely on themselves to face the personalized risks in a global risk society. Based on this idea, Yanase (2012) indicated that the estimation of the levels of radioactivity present in the food is left up to the judgment of the individual consumer. Consequently, the problem of food and the risk of radiation are related to individual responsibility due

to lack of risk information, and not the problem of scientific technology or economic policies.

In societies where risks are personalized and left up to individual responsibility, people need to search for information in order to relieve anxiety due to ambiguity and information uncertainty, in the wake of natural or artificial disasters and crises (Hirschburg *et al.* (1986)). Traditionally, consumers get information through newspapers, television, and radio. Kikkawa and Ueno (2007) stated the importance of the impact of harmful reputation in Japan caused by mass media based on their research on fluctuations caused by avian influenza in the price of poultry. Additionally, a number of studies have been conducted on information-gathering behaviors related to the incident discussed in this research. For example, Sekiya *et al.* (2012) compiled the data about the information-gathering actions taken by people living around Tokyo when the 2011 Tohoku earthquake occurred. They specifically observed that people utilized social media as another information-gathering method (or also information-dissemination method at the same time), in addition to traditional mass media.

1-4. Research purpose

In particular, it appears that there are two types of concerns among consumers toward this new risk relevant to the accident in Fukushima: (1) anxiety regarding radioactivity, which is based on knowledge and information, and (2) an insidious sense of concern regarding radioactivity, which is not based on knowledge or information. The consumers having the latter type of concern seem to be particularly susceptible to rumors because they do not rely on knowledge and information. Besides, either can be increased or decreased by being more informed about the risks involved. A reverse causality that the anxiety toward processed marine products from the Miyagi prefecture affects information-gathering behavior is conceivable.

Moreover, with reference to the types of concerns discussed above, the distance of a residential area from the disaster area should be considered. Gu *et al.* (2012) examined this issue in terms of an area's distance from a given disaster risk site. Specifically, they performed empirical analysis of the relationship between land prices and distance from active geological fault lines. They determined that the change in risk perception that occurred in the wake of the Great Hanshin-Awaji Earthquake affected land prices according to the distance of the land from the active fault line. In the case of such a huge earthquake, it is logical to assume that land prices would increase in proportion to the distance from the active fault line, because its de facto risk is lower. In contrast,

it seems inherently logical that regional differences should not affect the degree of anxiety felt toward food products that may be radioactively contaminated (at least in the opinion of consumers, whether or not this is, in fact, the case). This is because irrespective of the consumer's area of residence, anyone can eat the products made in disaster area, thereby causing no difference in the degree of anxiety among people. On the other hand, it is also conceivable that recent people proactively obtain information from the Internet and the amount of concerns for radioactivity depends on the interests and proactiveness of individual consumers, instead of geographical distances. Even in this case, however, it can be expected that with increasing physical distance from the affected areas, the degree of vague anxiety also increases due to the proportional decrease in real knowledge and information based on actual visits and experience in the affected areas.

Therefore, this study examines the degree of anxiety towards marine products originating from Miyagi Prefecture, processed using raw materials obtained from places far from areas with possible radioactive contamination. The method includes conducting a survey followed by quantitative analysis of how these two points influence consumers: (1) behavior regarding collection of knowledge and information about radioactivity, and (2) the physical distance of their residence from the Fukushima nuclear power station.

2. Method

2-1. Data

The dataset used in the analysis was collected from a survey conducted in September 2013, using a questionnaire ("A Questionnaire on Health and the Environment") developed by the authors. The survey was conducted over the Internet using a stratified random sample of 420 men and women in their 20s through to their 60s, whose gender and age were proportional to estimates of the general population. The sample was taken from a collection of around 1,100,000 names registered with a research firm[2].

In Japan, the traditional paper-and-pencil questionnaires have been utilized in several study fields. However, since the Personal Information Protection Law came into effect in 2005, it has become difficult to send questionnaires directly by "snail mails" when researchers need to obtain data from residents in a specific area or all over Japan. Simultaneously, Japan has been experiencing a great increase in the population using the Internet, frequently mediated by not only computers but also smartphones.

Accordingly, studies of online populations have led to an increase in the use of online surveys (Andrews *et al.* (2003)). Even the history of online survey research is young and still evolving, with several papers using computerized questionnaires in various research fields. For instance, Yatsuzuka *et al.* (2012) researched the use of the domestic sanitary space's facility and use of hot water based on the results of a web questionnaire about domestic sanitary space. In addition, Oishi *et al.* (2014) utilized a web questionnaire and conducted a national research for general consumers in order to identify the latent needs for processed marine products produced in Miyagi prefecture. Wright (2005) mentioned (1) cost and (2) time as the advantages of online survey research compared to the traditional methods of survey. Moreover, Internet-based surveys enable researchers to obtain data from people living in a wide range of areas simultaneously. Therefore, the Internet-based survey is suited to this research aiming to investigate the data obtained from residents all over Japan.

This study focused on the Miyagi prefecture, next to Fukushima prefecture where the nuclear accident occurred. The survey asked respondents about their concerns about the effects of radiation on processed marine products made in Miyagi, even though such products are made from fish caught in waters far from the areas directly affected by the earthquake. The survey questionnaire used in this research is shown in Table 1.

The dependent variable here is WORRY. The responses to this question are summarized in Figure 1. Approximately 40% of the respondents answered either "Not worried at all" or "Somewhat not worried," while 35% responded either "Very worried" or "Somewhat worried." These results showed that the percentages of those who were worried and those who were not were quite similar.

The explanatory variables included the information gathered regarding radioactivity, distance of residence from the Fukushima power plant, and demographic attributes namely gender, age, marital status, and parental status. In this study, contrary to our analysis design which uses the information-gathering behavior as one of the explanatory variable, it was assumed that anxiety toward processed marine products from the Miyagi prefecture affects the information-gathering behavior related to radioactivity. To tackle with this problem called the endogeneity problem (explained in detail in 2-2), therefore, the respondents were asked if they research the ecolabels (environmental labels) of products after purchasing them. This ecolabel-research behavior is used in the estimation as the instrumental variable to make a model considering endogeneity.

The respondents were also asked if they researched and collected more information

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Table 1 Survey Questionnaire

	Variable name	Question	Scale Explanation
Dependent Variable	WORRY	How much are you worried about the effects of radiation on processed marine products made in Miyagi, even when such products are made from fish caught in waters far from areas directly affected by the earthquake?	Very worried =5, Somewhat worried=4, Neither=3, Somewhat not worried=2, Not worried at all=1
Independent Variable	INFOGATH	Have you researched and collected more information on radioactivity in the wake of the nuclear accident?	Yes = 1, No = 0
	DISTANCE	Where do you live? (Detailed address with town and district names)	Distance (100 km) from the Fukushima No. 1 Power Plant
	GENDER	What is your gender?	Male=1, Female=0
	AGE	What is your age?	Age of respondent
	MARRIED	Are you married?	Married=1, Not married=0
	CHILDREN	Do you have one or more children?	One or more children=1, No child=0
	ECOLABEL※	Have you researched and collected more information on ecolabels after you started buying products with ecolabels?	Yes = 1, No = 0

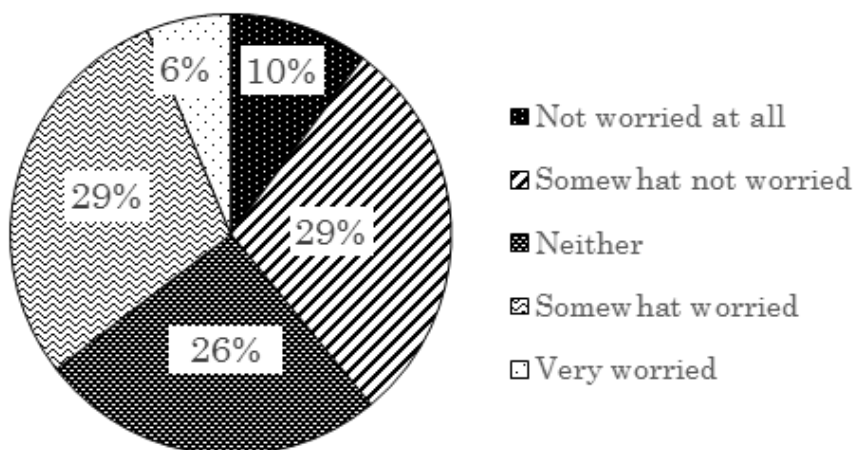※We used the variable ECOLABEL as an instrumental variable.

Figure 1 Concerns on Radioactivity in Processed Marine Products from Miyagi

on radioactivity in the wake of the nuclear accident. Around one-third of the respondents answered either "Yes." The average distance of the direct point-to-point path between these respondents' residence and the Fukushima power plant was 465 km (the closest = 43.9 km, and the farthest = 1,769.5 km).

Furthermore, in terms of family composition, 59% of the respondents were married,

Table 2 Descriptive Statistics

Variable name		Average	SD	Min	Max
Dependent Variable	WORRY	2.92	1.11	1	5
Independent Variable	INFOGATH	0.34	0.47	0	1
	DISTANCE (Unit: 100 km)	4.65	3.04	0.4	17.7
	GENDER	0.50	0.50	0	1
	AGE (Unit: Years old)	45.34	13.37	20	69
	MARRIED	0.59	0.49	0	1
	CHILDREN	0.55	0.50	0	1
	ECOLABEL※	0.14	0.34	0	1

※instrumental variable.

and around 55% had children. Finally, the survey asked a question pertaining to the instrumental variable: The respondents were asked if they proactively collect more information about the ecolabels of products, since the products they purchase have these labels. Around one tenth of the respondents answered "Yes." Table 2 shows the descriptive statistics of the variables in the analysis.

2-2. General aim of the analysis model

While analyzing the factors that determined consumers' sense of anxiety toward processed marine products from the Miyagi prefecture, a model was estimated to investigate the endogenous effect of anxiety on information-gathering behavior. A consecutive analysis was performed with two steps because it was also conceivable that a reverse causality existed in the relationship assumed in the study. In other words, anxiety toward processed marine products from the Miyagi prefecture affects the information-gathering behavior related to radioactivity. Such a reverse causation is called an endogeneity problem in the Econometrics, and the problem leads to violate non-stochastic assumption of regression. If the reverse effects are ignored when estimating the anxiety level of individuals, the estimation results would be biased because of the endogeneity in the model. We can expect to remove the endogeneity by using instrumental variable method. A suitable instrumental variable affects the explanatory variable but has no independent impact on the dependent variable. Therefore, by applying the instrumental variable regression to the explanatory variable, we can get rid of the impacts of a dependent variable on an explanatory variable. So,

we adopted method of instrumental variable in our study.

The endogenous problems often occur by a specific characteristic of observable data in the study field of social science, and there are several studies concerning this in econometrics and statistics. Recently, with the advance of coping strategies for the endogeneity, this problem has been reviewed and a number of papers utilizing the coping methods toward the problem has also increased in other study fields (Matsushima *et al.* (2013)). There are some examples of the empirical analysis considering the endogeneity bias. Nagai *et al.* (2009) analyzed the determinants for the types of land tenancy contracts in rural Java where the personal ties between landowners and tenants play an important role to potentially mitigate transaction costs. Additionally, Cho (2008) investigated parental investment in after-school programs for children in Korea using a tobit model with an instrumental variable to avoid the endogeneity problem. There are several approaches when formulating an estimation model in considering the endogeneity problem, and both researches above applied the IV (instrumental variable) probit/tobit models. In this research, IV probit models that can control the endogeneity problem are applied through a two-step estimation. When selecting an instrumental variable, the following two conditions are required (see, Wooldridge (2010), pp. 89-90): (1) the instrumental variable must be (strongly) correlated with the endogenous explanatory variables, and (2) the instrumental variables cannot be correlated with the error term in the explanatory equation.

In this research, the instrumental variable was formulated as a binary variable to denote if respondents who buy products with ecolabels collect more information about them. This is because the act of examining ecolabels may affect the tendency to gather information on the nuclear accident, but may not necessarily directly lead to anxiety toward processed marine products from the Miyagi prefecture.

With regard to the validity of using the act of examining ecolabels as an instrumental variable, the requirement (1) was satisfied in our model as mentioned later (i.e. the coefficient of the variable *ECOLABEL* was significant in 1st step estimation of Table 3). On the other hand, we cannot test the requirement (2) as mentioned by Wooldridge (2010), p.92 as follows: "Econometricians have been known to say that "it is not possible to test for identification." In the model with one endogenous variable and one instrument, we have just seen the sense in which this statement is true."

The analytical models formulated in this study are explained below.

2-3. Model without considering endogeneity

First, the standard ordered probit model shown in Equation (1) was developed, which can be used to estimate a model that does not consider endogeneity.

$$WORRY_i^* = \alpha + \beta INFOGATH_i + \gamma DISTANCE_i + \delta X_i + u_i \tag{1}$$

$$WORRY_i = \begin{cases} 1 & if & WORRY_i^* \leq \mu_1 \\ & 2 & if & \mu_1 < WORRY_i^* \leq \mu_2 \\ \vdots & \\ 5 & if & \mu_4 < WORRY_i^* \end{cases}$$

In this equation, $INFOGATH_i^*$ refers to the extent of information gathering, $DISTANCE_i$ is the distance of a respondent's area of residence from the disaster site, X_i denotes the explanatory variable vectors associated with the demographic attributes, $WORRY_i^*$ is the latent variable denoting anxiety, and $WORRY_i$ denotes the five-stage ordinal scale that can be observed from the data.

2-4. Model considering endogeneity

For the model that considers endogeneity, as the first step, the probit model was used to estimate the induction model associated with the extent of information gathering as a determinant, as shown in Equation (2) below.

$$INFOGATH_i^* = \alpha + \beta DISTANCE_i + \gamma X_i + \delta Z_i + \varepsilon_i \tag{2}$$

$$INFOGATH_i = \begin{cases} 0 & if \ INFOGATH_i^* < 0 \\ 1 & if \ 0 \leq INFOGATH_i^* \end{cases}$$

In this equation, $INFOGATH_i^*$ is the latent variable denoting the extent of information-gathering behavior. A binary variable can be observed from the data. Z_i (=$ECOLABEL$) is the instrumental variable (for more detailed explanation on instrumental variable models of ordered Probit, see Matsushima *et al.* (2016)).

Next, as the second step, the estimates were calculated by replacing $INFOGATH^*$ in Equation (1) with the linear predicted value obtained from Equation (2) that denotes the extent of information gathering. In this step, allowing the use of the predicted value, the standard error for the estimates was calculated by using the bootstrap method (500 times). STATA 13 software (Lightstone Corp., Japan) was used for our estimations.

3. Results

Table 3 shows the outcomes of this analysis[3]. First, the estimated outcomes from the model that did not consider endogeneity, indicated that anxiety levels were greater

among women, young people, and those who have children. Additionally, it was identified that the anxiety levels were greater for the people who were more proactive in gathering information and who lived farther away from the Fukushima power plant.

Second, considering the outcomes of the probit analysis that used information

Table 3 Estimated Outcomes

	Endogeneity-untreated Ordered Probit		Endogeneity-treated Ordered Probit			
			1st step		2nd step	
	WORRY [a]		INFOGATH [a]		WORRY [a]	
CONSTANT			-0.032			
			(0.306)			
INFOGATH	0.445	***			0.463	
	(0.112)				(0.495)	
DISTANCE	0.059	***	-0.070	***	0.059	***
	(0.017)		(0.023)		(0.019)	
GENDER	-0.253	**	-0.144		-0.246	**
	(0.105)		(0.133)		(0.112)	
AGE	-0.013	***	-0.006		-0.013	***
	(0.004)		(0.005)		(0.004)	
MARRIED	-0.016		0.069		-0.017	
	(0.145)		(0.187)		(0.146)	
CHILDREN	0.333	**	0.0607		0.327	**
	(0.152)		(0.194)		(0.147)	
ECOLABEL			0.935	***		
			(0.185)			
/cut1	-1.464				-1.097	
	(0.225)				(0.340)	
/cut2	-0.414				-0.060	
	(0.215)				(0.333)	
/cut3	0.271				0.612	
	(0.215)				(0.334)	
/cut4	1.510				1.817	
	(0.229)				(0.352)	
Obs.	420		420		420	
Log likelihood	-596.22		-248.79		-603.61	
Pseudo R²	0.036		0.074		0.024	
Wald chi² /LR chi²	44.13	***	39.82	***	31.00	***

Note: ***: Significant at 1%, **: Significant at 5%, *: Significant at 10%.

[a:] Dependent variable

gathering as the dependent variable in the first step with the model considering endogeneity, it was revealed that respondents who lived close to the power plant and those who examined ecolabels proactively collected information.

Third, the estimated results from the model used in the second step (the model that considered endogeneity) showed that the tendency to proactively gather information had no statistically prevailing effect on the sense of anxiety. For other variables, similar tendencies were found in the scenario where endogeneity was not considered. From these results, it is apparent that the impact of anxiety to drive people to gather information was reduced by some reversed cause and effect against this study's assumption, or was mitigated by upward bias in familiarity.

With respect to the outcomes from the analysis with the model that considered endogeneity, it was observed that first, in terms of gender, women were more worried about the issue than men were. This result is consistent with other previous studies such as Borghans *et al.* (2009) that shows that women tend to be more risk averse than men. It may be presumed that women are more worried about the food products as they are mothers (or mothers-to-be) and thus are often responsible for family meals. Next, in terms of age, younger people felt more anxious. This implied that young people who are yet to live a complete life and parents with young children were more worried about the long-term effects of consumption of products with possible radioactive contamination. The high levels of anxiety among parents with children may be attributed to the same reasons for the high levels of anxiety among women. Finally, the estimated outcomes from the first step showed that the distance factor reduced the tendency of proactive information gathering, while the outcomes from the second step indicated that the distance increased the levels of anxiety regarding processed marine products from the Miyagi prefecture.

4．Discussion and conclusion

In this study, the effects of (1) the extent of information gathering on radioactivity, and (2) the distance of a residential area from the Fukushima power plant, on the level of anxiety about processed marine products from the Miyagi prefecture were analyzed.

The outcomes of the analysis showed that first, when endogeneity was taken into account, the extent to which information was gathered did not affect the level of anxiety about the processed products. Second, the distance of a residential area from the power plant affected the extent to which information was gathered, and the level of anxiety

regarding the possible contamination of the products. The results imply that people who lived far from the power plant did not feel any immediate threat from radioactivity and therefore, do not proactively gather information. On the other hand, as distance of residence becomes farther, they feel more anxiety of radioactive contamination of processed marine products from the Miyagi prefecture.

In short, two major findings were obtained: (1) It is statistically confirmed that the increase in anxiety is based on only the distance from the power plant, and (2) It is likely that this anxiety is insidious, and not based on any knowledge or information about radioactivity.

Chiricos *et al.* (1997) clarified that the exposure to media, such as television and radio, significantly affects the level of fear toward crime. Their study mentioned that the effect of the exposure to media depends on the demographical status of the people exposed to it and whether the news is local or nationwide. It can, generally be said that being exposed to information is related to the level of fear. On the other hand, the construction of fear is manifold, and there are some possibilities that the levels can be decreased in accordance with the frequency of gathering information from new media, such as blogs, and other social networking services (SNS) (Kawabata (2014)). Kawabata (2014) indicates that people can actively gather information through the Internet by selective filtering, unlike passive information-gathering from television and radio. The results of this research indicate that there is no significant correlation between information-gathering behavior and the level of fear, as calculated by the estimation models considering the endogeneity bias, demonstrating the manifold construction of fear. Toda (1981) defined fear as an emotion raised in the situation where there are high levels of uncertainty of threats. Based on his indication, it can be possible to reduce the level of fear based on unarticulated anxiety caused by a lack of right information, by providing people with easily accessible and correct information.

To conclude, it was observed that anxiety arises from damages from groundless information; people who live far from the disaster area and who do not equip themselves with right information tend to have a high level of anxiety and thus, refrain from consuming processed marine products from the affected area. Therefore, the government and producers need to proactively disseminate information to effectively ease people's anxiety about the potential radioactive contamination of processed marine products.

Note

(1) There might be a possibility that a part of the marine products in the disaster area are radioactively contaminated. In such case, people's concerns for radioactivity should be regarded as those based not on "reputational harm" but on "actual harm." In this paper, we have to distinguish "reputational harm" from "actual harm" and focus on the former. Thus, we asked the respondents for our questionnaire survey about concerns for radioactivity as follows: "How much are you worried about the effects of radiation on processed marine products made in Miyagi, *even when such products are made from fish caught in waters far from areas directly affected by the earthquake*?"

(2) According to the Ministry of Internal Affairs and Communications (2012), Internet usage rates at the end of 2011 were 90% for 20–50-year-olds, 60% for those in their 60s, and over 42.6% for those in their 70s; the cutoff was 50%. As a result, the age bracket of 70+ was not surveyed in this study, as the percentage of Internet users in this age group in the selected sample was not representative of the actual percentage in the same age group in the general population.

(3) The variable ECOLABEL in this table is an instrumental variable to eliminate endogeneity in "Endogeneity-untreated Ordered Probit" model and the model structure we want to examine is expressed as "Endogeneity-untreated Ordered Probit" model. Thus, note that "Endogeneity-untreated Ordered Probit" model and the 2nd step of "Endogeneity-treated Ordered Probit" model do not include the variable ECOLABEL in explanatory variables. Just for information, we also estimated the model which adds the variable ECOLABEL to explanatory variables of "Endogeneity-untreated Ordered Probit" model. The result showed that the coefficient of ECOLABEL was not significant (the estimated value = 0.025, SD = 0.156, p value = 0.872). This result suggests that the variable ECOLABEL is not inappropriate as an instrumental variable, because if the coefficient of ECOLABEL is significant here, then it must be an explanatory variables in "Endogeneity-untreated Ordered Probit" and should not be used for an instrumental variable in "Endogeneity-treated Ordered Probit" model.

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