Effects of food safety and health risk information on demand for food in Taiwan

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Abstract

In recent years, there have been many reported cases of food contamination of foreign food products, both legally imported and illegally smuggled into Taiwan.   In addition, food safety issues in Taiwan have dramatically increased with regard to incidences of contaminated meat products as well as many reported cases of food contamination of foreign food products.   Outbreaks of food related diseases such as H5N1 avian influenza, Bovine Spongiform Encephalopathy (BSE), foot-and-mouth diseases (FMD), Escherichia coli (E. coli) and Salmonella have also frightened to consumers.   Potential impacts of these food safety issues on consumers' demand for the related food could be serious; however, we don't know how strong and how long they influence consumers' food demand.   In addition, their own-effects on the demand for contaminated food may involve potential cross-effects impacting the demand for other food.   This paper is aimed at providing such an economic analysis of the effects of food safety and health risk information on food demand in Taiwan.

Keywords: Taiwan, food safety, health risk, information index, demand system, structural change, habit formation

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1.   Introduction

Since its entry into the World Trade Organization (WTO), Taiwan's agricultural sector has faced strong competition from foreign imports of food products, especially from China, the United States, and South East Asian countries such as Vietnam and Thailand. In recent years, however, there have been many reported cases of food contamination of foreign food products, both legally imported and illegally smuggled into Taiwan. Food safety issues in Taiwan have dramatically increased with regard to incidences of contaminated meat products as well as many reported cases of food contamination of foreign food products. Contamination comes from several sources, e.g., pathogens, bacteria, fungi, viruses, parasites, and chemical toxins. Outbreaks of food related diseases such as H5N1 avian influenza, foot-and-mouth diseases (FMD), Bovine Spongiform Encephalopathy (BSE), Escherichia coli (E. coli) and Salmonella have also frightened consumers. Potential impacts of these food safety issues on consumers' demand for the related food could be serious; however, we don't know how strong and how long they influence consumers' food demand. In addition, their own-effects on the demand for contaminated food may involve potential cross- effects impacting the demand for other food. This paper is aimed at providing such an economic analysis of the effects of food safety and health risk information on demand for food in Taiwan.

There have been numerous studies attempting to estimate food demand in Taiwan; most of these studies estimated a relatively small group of food items, such as meats, fruits, and vegetables and most of them did not incorporate health information risk to explain the demand system. Even though some studies have investigated food safety and health risk issues in Taiwan, these studies did not examine any linkage between food safety or health risk information indices and the demand system estimation. To close some gaps in the related fields of study, the objective of this paper is to provide this critical assessment by constructing the food safety and health risk information indices for estimating both static and dynamic demand systems.

Food safety concerns have increased dramatically worldwide. Investigating impacts of food safety information reported in the public media on food demand has been heatedly discussed, see Burton and Young (1996), Robenstein and Thurman (1996), McKenzie and Thomsen (2001), and Piggott and Marsh (2004) for examples. To our best knowledge, the food safety information is never constructed in Taiwan and thus it will be

interesting to add it to the related field. In this paper we will first use the United News Data Bank to construct the information indices; specifically, we will use the method developed by Chern (2003) to quantify the Taiwanese consumers' food safety and health risk concerns or belief. For our study, we will use a set of key words in the search which include: "fat and cholesterol and (heart disease or arteriosclerosis)". The search will be done month by month for the period of 1980- 2012. We will also conduct a similar search for obesity and other food safety and health risk information using a set of key words related to food safety, calcium, diet and obesity, as necessary.

2.   Litereture Review

There has been numerous studies attempting to establish the link between diet and health risk, especially about "cholesterol", e.g., Levy and Heimbach (1990), Brown and Schrader (1990), Yen and Chern (1992) and Chern et al. (1995).   In these studies, they attempted to construct a cholesterol information index to investigate the effect of health risk information on related food, such as eggs and meats.   Thereafter, several other health risk indices were conducted accordingly, for example, Paudel et al. (2005) constructed low carbohydrate information index; Tonsor et al. (2010) constructed several indices related health, nutrition and diet.   In Taiwan, Lin et al. (2012) conducted a slightly different set of indices including obesity and cholesterol using publicized media articles and investigated their impacts on food demand.   In this paper, we will extend this approach to examining the effects of other food-related information on demand for selected food.

In addition, as discussed earlier, food safety concerns have increased dramatically worldwide.   Investigating impacts of food safety information reported in the public media on food demand has been heatedly discussed, see Burton and Young (1996), Robenstein and Thurman (1996), McKenzie and Thomsen (2001), and Piggott and Marsh (2004) for examples.   Piggott and Marsh (2004) constructed food safety information for meat and found that the average effect of the food safety events are relatively small, however, their corresponding responses are large but are short-lived to damage the meat demand in the United States.   To our best knowledge, the food safety information is never constructed in Taiwan and thus it will be interesting to add it to our proposal.

Functional form specification is another important aspect of empirical demand studies. There is no single "one-size-fits-all" functional form that is ideal for all applications (Pollak and Wales, 1992). Theory gives little guidance about what these parametric forms should be, but specification choices can affect results (Piggott, 2003). In the literature of model selection, several demand systems have been developed, including the Linear Expenditure System (Stone, 1954), the Translog Demand System (Christensen et al., 1975), the Almost Ideal Demand System (Deaton and Muellbauer, 1980b), Flexible Functional Form issues (Gallant, 1984), comparisons of alternative demand systems (Barten, 1993), the Nested PIGLOG Model (Piggott, 2003), and a rank four demand system (Lewbel, 2003). The newly developed R4/AIDS model surpasses the limitation of Gorman's (1981) theorem and nests the well- known AIDS and QAIDS models as its special cases. This higher rank demand system will be estimated and compared in this study.

3. Methodologies

3.1 Measurement of food safety and health risk concerns

In this paper, we propose to quantify the Taiwanese consumers' food safety and health risk concerns or belief. Several areas of food safety and health risk concerns will be investigated in this study, such as food safety, obesity, fat and cholesterol, and calcium. For empirical studies, one often makes an assumption that the health concern is affected by either knowledge or information. In the United States, surveys have been conducted to quantify the knowledge on the diet-health relationships. For example, the Diet and Health Knowledge Survey (DHKS) of the U.S. Department of Agriculture collected data on how well the surveyed households answered certain nutrition and health related questions in the questionnaire. These data have been used to analyze the impacts of health knowledge on food purchasing behavior (Variyam et al., 1996; Nayga, 1997). The Food and Drug Administration (FDA) has regularly conducted the health knowledge survey to monitor changes in the consumer's health knowledge and belief. One of the problems in using these survey data is that the ability to answer certain selected diet-health questions tends to be highly correlated with education. It is therefore very

difficult to sort out the causal relationships between the knowledge and health information generated from government programs in health and medical research as well as consumer education and outreach. Another problem is that these surveys tend to cover very generic diet-health questions, which do not provide specific measure of knowledge in a particular health risk concern such as fat and cholesterol or obesity. In any case, there is no comparable survey available in Taiwan.

It is expected that the consumer responses to any health concern about diet-health risk take place very slowly, but the consumer responses to food safety information are almost instant, because people do not adjust and change their dietary patterns abruptly and suddenly unless they face a life-threatening situation. Time-series data would be the best data source to capture such changes, compared with the cross-sectional data. One major problem in using time-series data, however, is how to construct an appropriate time series for related health knowledge or food safety information. Previous researchers have used a time-trend variable, but that has later been shown to produce misleading results (Chern et al., 1995). Time trend variable is almost always highly correlated with other explanatory variables in a time-series model, making it very difficult in attributing the impacts of time entirely to either health knowledge or food safety information.

Brown and Schrader (1990) made a seminal contribution in constructing a cholesterol information index based on the numbers of published articles in medical journals. Their index has been used in several other studies (Capps and Schmitz, 1991; Yen and Chern, 1992). By assuming that an article will have a constant effect as a source of information after it is published, the index, in essence, simply accumulates the numbers of articles over time. Therefore, it often performs as a time trend in a demand model.

Recently attempts have been made to create alternative indexes, following Brown and Schrader's approximation based on the numbers of articles published in medical journals or popular newspapers (Chern, 2003; Chern and Zuo, 1995; Kim and Chern, 1999). These researchers assume that after an article is published, its effectiveness as a source of consumer information diminishes over time.

For this paper we will first use the United News Data Bank to construct the information indices; in addition, other online databases will also be considered if they are available. Specifically, we will use the method developed by Chern (2003). Following Chern (2003), the health information index is defined as:

$$I_t = \sum_{i=0}^{n} w_i N_{t-i} \tag{1}$$

where I is the health information index, w is the weight, and N is the number of news articles, and n is the number of the lagged periods for which an article will remain as a useful source of information. The time $t = 0$ is used to denote the initial period when an article is published. Chern (2003) uses the following third degree polynomial weight function to create the weights:

$$w_i = \gamma_0 + \gamma_1 i + \gamma_2 i^2 + \gamma_3 i^3 \tag{2}$$

where i is the number of ith lagged period. Assume further that the maximum weight would occur in the period m. With certain regularity conditions, the weights can be derived analytically as a function of the two key parameters, n and m. For example, Chern and Zuo (2006) showed that equation (2) can be expressed as:

$$w_i = \frac{2a}{(n+1)b} + \frac{12m}{b} \cdot i + \frac{6(n+m+1)}{(n+1)b} \cdot i^2 + \frac{4}{(n+1)b} \cdot i^3 \tag{3}$$

where $a = (n+1)^2(n+1-3m)$ and $b = (n+2)[(n+1)^2 - m(2n+3)]$. Chern (2003) found that their fat and cholesterol information indexes as constructed within a reasonable range of n and m, performed fairly well in his empirical food demand model for the U.S. Using the cubic weighting scheme described here with the specific assumption of n and m such as $n = 24$ (that is the influence of an article will last for 24 months) and $m = 1$ (i.e., the maximum impact of a news article occurs during the first month), the fat and cholesterol information indexes can computed using the data series from United News Data Bank.

For our study, we will use a set of key words in the search which include: "fat and cholesterol and (heart disease or arteriosclerosis)". The search will be done month by month for the period of 1980- 2012. We will also conduct a similar search for obesity

and other food safety and health risk information using a set of key words related to food safety, calcium, diet and obesity, as necessary.

3.2 Demand modeling

A demand system can be constructed as large as possible, however, the larger the demand system, the more complicated the estimation. Since we are interested at investigating the effects of food safety and health risk information on food demand, selection of the food is important to make the estimation workable. As we have discussed earlier, food consumption structure has been changing because consumers have become more aware of health risk and food safety issues and thus demand for healthier food such as olive oil and low-fat milk has gradually increased. What food should be included in our demand system estimation should be determined beforehand. For this research, we will select several foods for the analyses, including but not limited to, meat (pork, poultry, and beef), aquatic products, eggs, fats and oils (e.g., olive oil), milk (low-fat and whole), vegetables, fruits, and rice. To our best knowledge, the proposed demand system consists of so many major food categories that could be the largest and the most thorough demand system for estimation.

Pollak and Wales (1992) conducted a study which included four important specifications in demand analysis. These four specifications are (1) choice of functional forms, (2) incorporation of demographic variables, (3) dynamic structure, and (4) stochastic structure. The integration of some or all of them into a demand analysis is crucial to understanding any consumer behavior. We have extensive research experience in estimating demand systems with respect to these specifications (Liu and Chern, 2002; 2004). The methods to be used in this project represent an extension from those we used previously. In addition, we seek further contributions in validating important empirical issues related to the application of the demand system estimation.

4. Empirical Results

Our preliminary results show that with an increasing income as well as the advancement and diversity of mass media in Taiwan, the public has become more concerned about food safety and health risks which are associated with dietary intakes. This study estimated an augmented Almost Ideal Demand System (AIDS) developed by Deaton and

Muellbauer (1980) with the incorporation of health information indexes and demographic variables to enrich this demand system for eight food groups in Taiwan. Annual time-series data from 1984 to 2008 were included for estimation. In addition to estimating and evaluating food demand elasticities, this study investigates how health information of obesity and cholesterol have affected the demand for oil, pork, chicken, aquatic products, beef, egg, vegetables and fruits in Taiwan. Our empirical results suggest that the AIDS model should seriously consider the serial correlation in estimation. In addition, we find that increasing health information appear to increase the demand for vegetables, pork, chicken, egg and oil, but to reduce the demand for aquatic products. It appears Taiwanese consumers have not entirely followed the path of changing food consumption pattern in response to diet/health concerns. In particular, the health concerns did not reduce the consumption of pork (as a red meat) and egg (high on cholesterol). The increasing rate of women in the labor force also has positive effects on the demand for fruits, beef and vegetable oil. We will attempt to work on more estimations and thus to find reasonable interpretation for our empirical results to encourage heated discussion in the meeting.

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