Analyzing the Impact of Food Safety Information on Food Demand in China

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Abstract

This study analyzed the impact of food safety information on food demand in urban China. The LA/AIDS model was estimated by using national province level food consumption data and quantities of articles about food safety event on public media from 2000 to 2008. The results of the study show that urban Chinese consumer food demand was influenced by food safety information from daily newspapers and GM labeling policy. This paper also indicates food price elasticities, expenditure elasticities by categories and the effect of food safety information.

JEL Classifications: D12, Q11

Keywords: food safety, food demand, Linear Approximated Almost Ideal Demand System(LA/AIDS), Genetically modified(GM), food consumption, price elasticity, expenditure elasticity

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Introduction

The issue of food safety has received an increased attention from policy makers and researchers as the number of foodborne events has increased and the globalization of the international economy has reduced the barriers facing the flow of food across borders. For example, United States import over 40% of its fruit, 15% of its vegetables, and 80% of its fish and seafood (Hoffmann and Hooker, 2009). In addition, the share of the total U.S. food imports from developing countries, with less food safety standards, has increased.

The food demand was influenced by many factors. Information on food safety from public media is one of them and food safety information available to consumers in the public media can be counted. Previous studies on food safety information have used aggregate data to estimate the impact of food safety information on food demand by categories, especially on meat and poultry demand.

Unlike United States where the number of food safety studies is abundant, in China, there is a lack of empirical studies dealing with the impact of food safety information on the consumption of food. The problem is even worse when put in the actual context where China's role in the global economy is apparent, not only for being a source for inexpensively produced goods but also for a rapidly growing consumer market due to increase in middle-class consumers with higher buying power.

For U.S. food companies, the Chinese middle-class consumers market looks very attractive as the sales of branded products, such as baked goods, soft drinks, fast food, and alcohol, are expected to grow from $150 billion in 2007 to $650 billion in 2017 (Kearney, 2007). However, this increase in buying power is accompanied by an increase in food safety awareness as the demand for high quality and safer food

increases. The objective of the model used in this research is to investigate if the public information on food safety impacts the food demand in urban China.

Literature on food Demand and Food Safety Information in China

After Brown's "Who Will Feed China"(Brown 1994), the issue of food demand in China attracted attentions from many researchers because of the big population, and lack of resource per capita. Most of those researches focus the food security (mostly the grain security) in China and its impact to the global food market. By using a two-stage LES-AIDS model and rural China household data Fan, Wailes et al. estimated the food price elasticities and expenditure elasticities, pointed the pressure of importing food(Fan, Wailes et al. 1995). Huang and Rozelle found a multidimensional impact for market development variable on food consumption behavior and suggest that previous estimates of China's income elasticity for purchased foodstuffs are biased(Huang and Rozelle 1998). China won't bring the global food market a disaster in 21st century(Huang, Rozelle et al. 1999) , and agricultural productivity growth helped China to pursue the goal of self-sufficiency especially in the grain sector(Brumer, Glauben et al. 2006).

Researches indicated the income elasticity of grain**.** Food grain has small positive income elasticity (Zhang, Mount et al. 2001), and with the economy developing and income increasing the income elasticity of grain became smaller and smaller(Liao and Chern 2007), and in the higher income group the income elasticity even became negative(Gale and Huang 2007).

Recently more and more researches focused on the demand of food quantity, and researchers started to analyze the demand of food quality. Their researches were about the structure of food demand, and consumers selected more high quality food when their income increased. With the increasing of income, consumers intend to consume more animal protein foods and demand more high quality food. Food product quality is relatively inelastic with respect to changes in market prices(Gould and Dong 2004).

By using Chinese urban household consumption data to compare four demand systems(AIDS, LA/AIDS, LES, and QES), Liu and Chern pointed the AIDS was the best and as household income increases, the Chinese urban inhabitants will consume more animal protein foods (Liu and Chern 2002). Consumers in China will consume more animal products, especially aquatic and poultry products(Ma, Rae et al. 2004).The expenditure elasticities of milk and most meat product were high and net substitution was found among most food products(Yen, Fang et al. 2004).

The empirical results of dynamic Almost Ideal Demand System (DAIDS) support the habit effects presence and got lower grain expenditure elasticity compared with the static AIDS models(Liao and Chern 2007). But the expenditure elasticity for grain was still high in rural China and income elasticities for animal products were the highest of all the groups(Jiang and Davis 2007). Consumers in China trend to demand greater quality, convenience, and safety in food(Gale and Huang 2007), and households in rural China tend to consume higher-quality food as income increases (Yu and Abler 2009).

Most researches related to food quality took unit value (price) as the main represent, but food quality was more complex rather than unit value, consumers' food selection were influenced by many factors. In the past decade, food safety concerns in China have dramatically increased with the economy developing. Food scandals happened (or been reported) in recent years increased consumers' risk perceptions of foods and decreased their trust in food safety. More and more consumers concerned about food safety, and their trust toward food in china is not very high, even the level of food safety is higher than before. And more and more information about food safety can be found in China. The primary influences of Consumers' preferences for safer produce are price differences and perceived risks(Eom 1994). Form the economics perspective the issue food safety caused by asymmetric information and incompletely information(Caswell and Mojduszda 1996). The impact of food safety information on meat demand in US is small compared with price effects(Piggott and Marsh 2004) . In Spain the consumption

meat products were impact by mass media information about BSE(Radwan, Gil et al. 2008). Based on a multidisciplinary perspective, an empirical results from a structural equation modeling analysis of Taiwan comprised modernization factors and cultural theory factors have all been supported(Chen 2008). More and more researchers concern about food safety in China, but most researches focus the consumer's willingness to pay for safety food or consumer's perception about food safety. The research about actual impact of food safety information is rare.

To fill the gap of the lack of empirical studies of the impact of food safety information on food consumption in China, this paper estimates the effect of information on foodborne events on the consumption of food in urban China, using a non-linear almost ideal demand system (NL-AIDS) model. Consumption of grains, vegetables, oils, meat, eggs, liquor, and aquatic products is estimated using province household annual data from 2000 to 2008.

Model

The Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980) is used to estimate a demand system for grains, vegetables, oils, meat, eggs, liquor, and aquatic products. AIDS model is consistent with the adding-up, homogeneity and symmetry restrictions of the demand theory. The AIDS model is a flexible model that allows consistent aggregation of micro-level demands up to a market demand function, and does not require additive preferences (Eales and Unnevehr, 1988). Following Deaton and Muellbauer (1980), the AIDS model is given by

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln(\frac{X}{P}), \tag{1}$$

where w_i is the budget share of the ith food product, p_j are prices of the food product, X is the total expenditure on all food products in the system, and P is a price index given by

$$\ln(P) = \alpha_0 + \sum_i \alpha_i \ln p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j \quad . \tag{2}$$

The aggregate annual time-series data were used in this research, and the Stone's (geometric) price index (P*) is used instead of P (Green and Alston 1990):

$$\ln P^* = \sum_i w_i \ln p_i \tag{3}$$

Conservation implies the following restrictions on the parameters in the nonlinear AIDS model:

$$\sum_i \alpha_i = 1, \quad \sum_i \beta_i = 0, \quad \sum_i \gamma_{ij} = 0 \tag{4}$$

Homogeneity is satisfied if and only if, for all *i*

$$\sum_i \gamma_{ij} = 0 \tag{5}$$

Symmetry is satisfied if

$$\gamma_{ij} = \gamma_{ji} \tag{6}$$

The food safety information and the regional variables are modeled as intercept shifter in the following way:

$$\alpha_i = \alpha_i^* + \theta_i RD + \sum_k \phi_{ik} FS_k \tag{7}$$

FS_k represents the number of news articles reporting food safety issues in (7):

$$k = \begin{cases} 1, FS_1 : \text{food safety articles on meat} \\ 2, FS_2 : \text{food safety articles on poultry} \\ 3, FS_3 : \text{food safety articles on vegetable} \\ 4, FS_4 : \text{food safety articles on GM food} \\ 5, FS_5 : \text{dummy variable of GM labeling} \end{cases}$$

RD is regional variable that equals one for Western China, two for central China, three for northeastern and four for Eastern China. This regional variable indicates those provinces difference not only in geography but also in the level of economy development.

Data

Per capita annual food purchases, consumption and expenditures of urban house hold by category from 2000 to 2008 are based the China Statistical Yearbooks from 2001 to 2009 complied by National Bureau of Statistics of China (NBSC), and published by China Statistics Press. Those yearbooks provided the food price indices by category of each year. The food categories in this research include grain, vegetables, oil, meat (pork, beef, mutton, and poultry), eggs, liquor, and aquatic products. The province household data of each year was selected to analysis in this research. The data include the price indices and expenditure and quantities of household food consumption in each province. From the yearbooks we got 30 provinces and 9 years' data so the sample size was 270.

Data about food safety information were taken from newspaper database of China National Knowledge Infrastructure (CNKI, http://www.cnki.net) by using the keywords related to food safety (BSE, bird flu, Hog cholera, blue ear disease, hoof-and-mouth disease, pesticide residue, GM, and etc). In this research we counted the numbers of food safety articles from 243 daily newspapers, the numbers were listed below. In 2004 the policy of GM oil labeling was implemented in China, so we add a dummy variable FS_5 which equals to zero from 2001 to 2003 and one, otherwise.

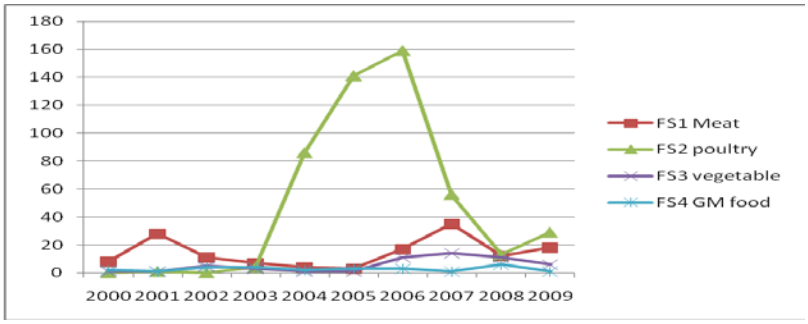

Fig 1 Articles on food safety in newspapers

Results and Discussion

To investigate whether food safety information and concerns have impacted food consumption, coefficients of LA/AIDS model was estimated with regional and food safety variables. Consider of the data used in this research was annual data the impacts of food safety variables were tested in current year. By the two steps estimation procedure, the Model1 (the LA/AIDS model with regional variable but without food safety variables) and Model2 (the LA/AIDS model with regional variable and food safety variables) were analyzed with annual province data. The estimated coefficients were listed in table2.

Table 1 Estimated coefficient for the Almost Ideal Model with and without Food Safety Variables

	Without food safety		With food safety	
	coefficient	Std. err	coefficient	Std. err
γ_{11}	-0.0398	0.0223	-0.0427	0.0282
$\boldsymbol{\gamma_{12}}$	**-0.0353***	0.0114	-0.0095	0.0137
$\boldsymbol{\gamma_{13}}$	-0.0331*	0.0108	-0.0419*	0.0140
$\boldsymbol{\gamma_{14}}$	0.0970	0.0222	0.0459	0.0373
$\boldsymbol{\gamma_{15}}$	-0.0350*	0.0106	-0.0235*	0.0142
$\boldsymbol{\gamma_{16}}$	-0.0536*	0.0188	-0.0263	0.0259
γ_{22}	-0.0094	0.0121	0.0107	0.0149
γ_{23}	-0.0011	0.0072	-0.0009	0.0088
$\boldsymbol{\gamma_{24}}$	0.0489*	0.0168	0.0145	0.0287
γ_{25}	-0.0063	0.0061	0.0005	0.0077
γ_{26}	-0.0081	0.0142	0.0010	0.0177
$\boldsymbol{\gamma_{33}}$	0.0326*	0.0102	0.0225*	0.0133
$\boldsymbol{\gamma_{34}}$	0.0289*	0.0132	0.0029	0.0225
$\boldsymbol{\gamma_{35}}$	-0.0179*	0.0066	-0.0067	0.0089
$\boldsymbol{\gamma_{36}}$	-0.0391*	0.0121	-0.0105	0.0172
$\boldsymbol{\gamma_{44}}$	-0.1085*	0.0428	-0.0436	0.0957
$\boldsymbol{\gamma_{45}}$	0.0279*	0.0121	0.0040	0.0206
$\boldsymbol{\gamma_{46}}$	0.0565*	0.0240	0.0233	0.0507
γ_{55}	-0.0003	0.0093	-0.0012	0.0123
γ_{56}	-0.0021	0.0110	0.0109	0.0163
γ_{66}	-0.0027	0.0294	-0.0146	0.0477
$\boldsymbol{\alpha_1}$	0.9339*	0.0431	1.1456*	0.0447
$\boldsymbol{\theta_1}$	-0.0032*	0.0014	0.0009	0.0012
$\boldsymbol{\beta_1}$	-0.1049*	0.0062	-0.1422*	0.0066
$\boldsymbol{\alpha_2}$	0.3506*	0.0383	0.5031*	0.0423

Table 1. (Continued)

	Without food safety		With food safety	
	coefficient	Std. err	coefficient	Std. err
θ_2	-0.0058*	0.0012	-0.0031*	0.0012
β_2	-0.0218*	0.0055	-0.0470*	0.0063
α_3	0.1632*	0.0229	0.2350*	0.0257
θ_3	-0.0038*	0.0007	-0.0026*	0.0007
β_3	-0.0128*	0.0033	-0.0245*	0.0038
α_4	-0.4005*	0.0840	-0.6448*	0.0978
θ_4	-0.0271*	0.0027	-0.0317*	0.0026
β_4	0.1131*	0.0120	0.1548*	0.0145
α_5	0.2935*	0.0203	0.3644*	0.0229
θ_5	0.0039*	0.0006	0.0052*	0.0006
β_5	-0.0354*	0.0029	-0.0474*	0.0034
α_6	0.3654*	0.0482	0.4787*	0.0573
θ_6	0.0067*	0.0015	0.0089*	0.0016
β_6	-0.0402*	0.0069	-0.0596*	0.0085
ϕ_{11}	-	-	0.0008*	0.0003
ϕ_{12}	-	-	0.0001	0.0001
ϕ_{13}	-	-	-0.0004	0.0007
ϕ_{14}	-	-	0.0075*	0.0019
ϕ_{15}	-	-	0.0247*	0.0080
ϕ_{21}	-	-	0.0001	0.0003
ϕ_{22}	-	-	0.0001	0.0000
ϕ_{23}	-	-	0.0011	0.0006
ϕ_{24}	-	-	0.0031	0.0018
ϕ_{25}	-	-	0.0081	0.0072
ϕ_{31}	-	-	0.0000	0.0002
ϕ_{32}	-	-	-0.0001*	0.0000
ϕ_{33}	-	-	0.0000	0.0004
ϕ_{34}	-	-	0.0015	0.0011
ϕ_{35}	-	-	0.0171*	0.0049
ϕ_{41}	-	-	-0.0004	0.0007
ϕ_{42}	-	-	-0.0002	0.0001
ϕ_{43}	-	-	-0.0013	0.0015
ϕ_{44}	-	-	-0.0071*	0.0043
ϕ_{45}	-	-	-0.0075	0.0184
ϕ_{51}	-	-	0.0002	0.0002
ϕ_{52}	-	-	0.0000	0.0000
ϕ_{53}	-	-	-0.0001	0.0004

Table 1. (Continued)

	Without food safety		With food safety	
	coefficient	Std. err	coefficient	Std. err
ϕ_{54}	-	-	0.0018	0.0010
ϕ_{55}	-	-	0.0104*	0.0045
ϕ_{61}	-	-	0.0003	0.0004
ϕ_{62}	-	-	0.0001	0.0001
ϕ_{63}	-	-	0.0005	0.0009
ϕ_{64}	-	-	0.0038	0.0026
ϕ_{65}	-	-	0.0009	0.0119

Note: a * denotes coefficients that are statistically significantly different from zero at the 5% level.

From the result of LA/AIDS model, some the estimated coefficients are predominately significant statistically significantly different from zero just as prior expectations. The constant components of the precommitted quantities (the α_is) are mostly nonnegative. The estimated coefficients of regional variables are statistically significantly different from zero indicate the household food consumption behavior differs across different region. Some estimated coefficients of food safety index are statistically significantly different from zero shows the food safety information on public media influence consumers food consumption behavior, but the coefficients are very small. Most of the estimated coefficients of FS5 (GM labeling policy) are statistically significantly different from zero shows this policy effected the consumers food select behavior.

Table2 reports estimates of the sample averages for the Marshallian price elasticities, expenditure elasticities. Elasticities are reported for all models shown in table 1, allowing a comparison whether food safety variables are included in the model effect price and expenditure elasticities. The estimated elasticities show most food demands are price inelastic, and income inelastic, except meat. The estimated elasticities in the model with food safety are different from those in the model without food safety. Most self price elasticities in the model with food safety are lower.

Table2 Estimated Price, Expenditure Elasticities

			grain	vegetable	oil	meat	egg	liquor
Without Food Safety	Marshallian price elasticity	grain	-0.6867	-0.0023	-0.0691	0.2628	-0.0211	-0.0793
		vegetable	-0.0857	-1.0128	0.0173	0.2285	0.0007	-0.0012
		oil	-0.2255	0.0350	-0.6176	0.2547	-0.1544	-0.3760
		meat	-0.0309	0.0284	0.0198	-1.1499	-0.1286	-0.2013
		egg	-0.0215	0.1635	-0.3362	0.3741	-0.6996	0.3176
		liquor	-0.2196	0.0791	-0.4728	0.5852	0.1450	-0.8227
	Expenditure Elasticity		0.4661	0.8739	0.8598	1.2843	-0.0517	0.3980
			grain	vegetable	oil	meat	egg	liquor
with Food Safety	Marshallian Price Elasticity	grain	-0.3196	0.3265	-0.0169	-0.3009	0.1562	0.2312
		vegetable	0.2763	-0.7969	0.0690	-0.1173	0.1069	0.1432
		oil	-0.1259	0.1294	-0.6811	-0.1656	0.0286	0.0199
		meat	-0.3674	-0.1652	-0.0982	-0.8222	-0.1653	-0.2229
		egg	1.0447	0.7435	0.1818	-0.9194	-0.4992	1.0311
		liquor	0.7126	0.4770	0.0845	-0.3096	0.5025	-0.7690
	Expenditure Elasticity		0.2762	0.7277	0.7323	1.3892	-0.4051	0.1080

Table 3 report the estimated expenditure shares share effect of food safety information. The estimated effects of the food safety information are noticeably small in comparison to price and expenditure effects. The food safety information variables have negative effect on meat consumption, but have positive effect on the consumption of grain, vegetables and liquor.

Table3 Estimated Food Safety Information Effect

	Grain	vegetable	oil	meat	Egg	liquor
FS1	0.0043	0.0004	0.0004	-0.0011	0.0062	0.0046
FS2	0.0004	0.0004	-0.0010*	-0.0005	-0.0004	0.0013
FS3	-0.0018	0.0062	-0.0002	-0.0033	-0.0041	0.0071
FS4	0.0382	0.0181	0.0168	-0.0178	0.0525	0.0564

Conclusions

The objective of this paper has been to assess consumers' reactions to food safety information provided by mass media. Specifically, this paper has focused on the effect of food safety information on the

demand for food in urban China. A better understanding the consumers' responses to food safety information could be important to both policy analysts and the food industry.

This research develops an empirical framework to investigate whether food safety information on meat, poultry, vegetables, and GM food has impacted food consumption in urban China over the last 8 years. The food safety information index has been constructed from the articles on food safety in the most popular Chinese daily newspaper.

Empirical study reveal coefficients measuring the food price elasticities, expenditure elasticities, and the effect from some food safety variables are jointly statistically significant from zero. As expected, all of the food safety effects are negative in the category of meat, some of the effects are negative in oil and eggs, and the effects are positive in the others. This result indicates the meat consumption in urban China is more sensitive to the related food safety information.

Our results slightly differ from previous studies on food demand in China. However, this study on the food demand effect of food safety information provides policy-makers and food industry new insights to understand the impacts of food safety event information on food consumption. In any case, further research is needed to investigate food safety information affecting food consumption behavior in China.

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