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Effects of Food Safety Information on Meat Demand: A Comparison of the United States and Canada

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Introduction

Food safety concerns have dramatically increased in the past decade following incidences of contaminated meat products and discovery of Bovine Spongiform Encephalopathy (BSE) in the U.S. and Canada. Foodborne diseases are very costly to society in terms of losses in public health. The U.S. Centers for Disease Control and Prevention (CDC) estimates 76 million people suffer foodborne illnesses each year in the United States, accounting for 325,000 hospitalizations and more than 5,000 deaths, with yearly cost of all foodborne diseases in the United States of $5 to $6 billion in direct medical expenses and lost productivity (U.S. Department of Health and Human Services).

In addition to the traditional economic factors of income level and prices, food safety concerns may have a potentially significant impact on consumers' meat preferences. Therefore, understanding the consumers' responses to food safety information is important to policy analysts and the meat industry. There have been a few studies on the impact of food safety information reported in the media and product recall information on food demand, such as Piggott and Marsh, Verbeke and Ward, Burton and Young, Dahlgran and Fairchild, Flake and Patterson, and Marsh, Schroeder and Mintert. Most of studies, however, use quarterly data or data back to 1990's. As medical research findings grow, however, consumer perceptions evolve. For example, there have been a number of positive developments associated with consumer health perceptions of beef. Those developments include widely publicized protein diets as well as new medical information that challenge links between beef and heart disease or cancer which were supported by many articles published between the 1980's and 1990's (Grier, 2002). Therefore, timely analysis of consumer perceptions is needed. In addition, the potential impacts of publicized food safety information on consumers' meat demand include own-effects on the demand for the contaminated meat as well as cross-effects impacting the demand for other meat products (Piggott and Marsh). Using a single-index for food safety information to investigate the impact of food safety on meat demand as done in most previous studies seems, therefore, limited. Moreover, given the occurrences of BSE in the U.S. and Canada, structural change due to BSE events needs to be investigated. Furthermore, since econometric literature indicates that the impact of communication on demand is generally a matter of months rather than quarters or years (Verbeke and Ward), monthly data is preferred in the empirical test.

The objective of this study is to compare both own- and cross-commodity impacts of publicized food safety information on U.S. and Canadian meat demand by setting up individual food safety indices for each meat product including beef, pork, and poultry using monthly data. As the U.S. and Canada have both experienced cases of BSE, U.S. and Canadian consumers' responses to BSE and food safety events are compared. This study provides valuable information about the consumer responses to food safety events in both the U.S. and Canada. Its new contribution is through use of recent and monthly data, construction of unique food safety indices and the ability to compare consumer responses in the two countries.

Theoretical Model

The Almost Ideal Demand System (AIDS) has been extensively used in modeling consumers' demand. However, if the share equations are expressed as linear functions of demand shifters in the AIDS model, it could result in estimated economic effects such as elasticities and consumer welfare that are not invariant to units of measurement of the prices and quantities of the goods in the model (Alston, Chalfant, and Piggott). To preserve the other desirable features of the AIDS model and also allow demand shifters to be incorporated, the Generalized Almost Ideal Demand System (GAIDS) is used (Alston, Chalfant, and Piggott).

The GAIDS expenditure function can be expressed as:

$$E(p,u) = p'c + E^{*}(p,u) \qquad (1)$$

where p denotes an N×1 vector of prices, c denotes a N×1 vector of pre-committed quantities, u is utility, and $E^{*}(p, u)$ is the expenditure function for supernumerary expenditures. Then the generalized expenditure function is decomposed into pre-committed expenditure $p'c$ and the supernumerary expenditure $E^{*}(p, u)$. The pre-committed consumption is to attain a minimal subsistence level and the supernumerary consumption is the remaining budget to be allocated among the competing meat products. The pre-committed quantities are independent of prices and expenditure, whereas the supernumerary ones are not.

By applying Shephard's Lemma, the *i*th quantity can be obtained as:

$$x_i = c_i + x_i^{*}(\mathbf{p}, E^{*}) \text{ for i=1,…,N.} \qquad (2)$$

where x_i is the quantity demand, c_i is the pre-committed demand, x_i^{*} is the supernumerary quantity demand of meat type i, $\mathbf{p}$ is an N-vector of prices, and E^{*} is supernumerary expenditure, $E^{*} = E - \sum_{i=1}^{N} c_i p_i$, where E is total expenditure on the N goods. Then the GAIDS model can be written as:

$$w_i = \frac{(p_i c_i)}{E} + (\frac{E^*}{E}) w_i^* (\mathbf{p}, E^*) \qquad (3)$$

where $w_i = \frac{p_i x_i}{E}$ is the expenditure share of meat type i; and $w_i^* = \frac{p_i x_i^*}{E^*}$ is

supernumerary expenditure share of meat type i. As proposed by Bollino, when the w_i* is assigned to be of the Almost Ideal model, the equation (3) can be expressed as

$$w_i = (\frac{p_i c_i}{E}) + (\frac{E^*}{E})(\alpha_i + \sum_{j=1}^{N} \gamma_{ij} \ln p_j + \beta_i \ln(\frac{E^*}{P})) \qquad (4)$$

and price index P is defined as

$$\ln P = \delta + \sum_{j=1}^{N} \alpha_j \ln p_j + \frac{1}{2} \sum_{j=1}^{N} \sum_{k=1}^{N} \gamma_{jk} \ln p_j \ln p_k .$$

As Alston, Chalfant, and Piggott discuss, the GAIDS model can be viewed as a generalization of the linear expenditure system in which the marginal budget shares are no longer constant. And incorporating demand shifters in GAIDS model can produce estimates that are invariant to changes in quantity units. Demand restrictions derived from economic theory such as homogeneity, adding up, and symmetry are satisfied by

$$\sum_{i=1}^{N} \alpha_i = 1, \sum_{i=1}^{N} \beta_i = 0, \sum_{i=1}^{N} \gamma_{ij} = 0, \text{ and } \gamma_{ij} = \gamma_{ji}$$

The precommitted demand quantity c_i is specified to incorporate non-price and non-income variables, which include a time trend, seasonal dummy variables, and BSE and food safety information index.

$$c_i = a_i + b_i t + \sum_{j=2}^{4} d_{ij} SD_j + \sum_{k=0}^{L} (\theta_{i,k} bf_{t-k} + \phi_{i,k} pk_{t-k} + \psi_{i,k} py_{t-k}) .$$

For i=1,…, N. (5)

where t is a time trend; SD_j are quarterly seasonal dummy variables; bf_{t-k} are beef food safety information indices; pk_{t-k} are pork food safety information indices; and py_{t-k} are poultry food safety indices for lag k period. Through such a set up, total food safety impacts on meat demand are decomposed into direct effects for pre-committed consumption and indirect expenditure effects for supernumerary consumption.

Data

Econometric literature indicates that the impact of communication on demand is generally a matter of months rather than quarters or years (Verbeke and Ward). Therefore, monthly data were used over the period January 1999 to December 2005, giving a total of 84 observations. Prices and disappearance of beef, pork and poultry were obtained from the United States Department of Agriculture (USDA), Economic Research Service (ERS) and Agricultural and Agri-Food Canada. Monthly per capita disappearance of beef, pork and poultry were derived by using the following formula: per capita disappearance of meat type i= (production +beginning stocks+imports-ending stocks-exports)/population, respectively.

Food safety indices were constructed based on newspaper articles from the most popular presses. Data for the newspaper articles were obtained by searching 30 top U.S. national and regional newspapers and 22 Canadian national and regional newspapers using the academic version of Lexus Nexus search tool. The Key words used for searching were food safety or contamination or product recall or salmonella or listeria or E. coli. or trichinae or staphylococcus or foodborne or abattoir hygiene or campylobacter or poisoning. And then the search was narrowed to focus on beef, pork, and poultry information separately by using additional terms, beef or hamburger, pork or ham, and chicken, turkey, or poultry, respectively. Each article was then individually examined for relevancy. Only negative information was counted for constructing food safety indices.

Model Estimation and Results

Lag Length for Food Safety Impacts

The models were estimated using iterated seemingly unrelated regression (ITSUR). The poultry equation was deleted due to singularity. Homogeneity, adding-up, and symmetry were imposed on the supernumerary expenditure share. To investigate whether food safety concerns have impacted meat demand contemporaneously or spread over more than one period, corrected likelihood ratio (LR) tests (Moschini, Moro, and Green) are conducted. The corrected likelihood ratio was calculated using the following formula:

$$LR^c = 2[\frac{MT - \frac{1}{2}(N_u + N_r) - \frac{1}{2}M(M+1)}{MT}](LL^u - LL^r)$$

Where M is the number of equations, T is the number of observations, N_u and N_r are number of parameters of the unrestricted and restricted model, respectively, and LL are maximum log-likelihood values for unrestricted and restricted models. The hypothesis test results of lagged length of food safety information indices are reported in table 1. Relative to the alternative hypothesis that the impacts of food safety information lasted one or two periods, the test rejected both the null hypotheses that food safety information had no effect on U.S. meat demand and that food safety information had only current period effects on U.S. meat demand. The results also reveal that the coefficients of two period lagged food safety variables were not jointly statistically significantly different from zero. Therefore, the model with one period lagged food safety information is preferred and the results suggest that food safety information has one period lagged impact on U.S. meat demand.

In contrast, the null hypothesis that food safety information has no effect on Canadian meat demand could not be rejected relative to the alternative hypothesis that food safety information has an impact on current, one lagged period, and two lagged period meat demand, respectively. These results suggest that food safety does not have a significant effect on Canadian meat demand. This may be because of the Canadian meat industry's promotion efforts or very positive image of Canadian meats for domestic consumers. Attempts to reduce the impact of negative information have been made by the Canadian meat industry in the form of generic advertising,funded by Canadian beef producers through a check-off program based on animal sold (Lomeli, Goddard, and Lerohl). These attempts may have helped combat the negative effects from food safety information. In addition, consumers may substitute other kind of meat products within same meat group for the meat related to food safety events and consequently do not change the total quantity of this kind of meat. For example, when there was a food safety concern with ground beef, consumers may switch to consume other beef products, say beef steaks, instead.

BSE Effects

To test if the occurrence of BSE caused structural change, a dummy variable was added to the estimated model and the maximum likelihood ratio test was conducted based on the preferred models. The test results are shown in table 2. The dummy variables are constructed in three ways: (a) a value of zero before the occurrence of BSE and one onwards, indicated as BSEt0, (b) a value of zero before and on the occurrence of BSE and one onwards, indicated as BSEt1, and (c) a value of zero before, on, and after one period of the occurrence of BSE and one onwards, indicated as BSEt2. The likelihood ratio for structural change test cannot reject the null that there was no structural change in both U. S. and Canadian meat demand.

In addition, the temporary change due to BSE was also tested by adding a dummy. Three situations are constructed as the dummy variables take on a value of one in (a) current and next one period, indicated BSE01, or (b) next two periods, BSE12, or (c) current and next two periods, BSE012, and zeros otherwise. The test cannot reject the null hypothesis that the coefficients on the BSE variables are zero in all three situations for both U.S and Canadian models[1]. This implies that both U.S. and Canadian consumers took BSE occurrence in the North America as isolated and they were confident about the governmental and industry's meat safety system to control the spread of BSE.

Preferred Model Estimation

Thus, the preferred models are the ones with one period lagged food safety variables and without BSE dummy for U.S. meat demand, and the one without both food safety and BSE variables for Canadian meat demand. The estimated coefficients are reported in table 3. In the U.S. model, the constant components of the pre-committed quantities of beef (a_b) and pork (a_p) are positive, indicating that consumers have some amount of pre-committed consumption independent of prices, income, and other demand shifters. Although the constant component of the pre-committed quantity of poultry (a_c) is negative, it is not significantly from zero. All meat consumption evidence shows some

[1] Similar tests were also conducted for other models and had similar results as the ones from the preferred models.

seasonal changes as one of three seasonal dummy coefficients is significantly different from zero. In addition, pork consumption shows a negative time trend.

Most parameters relating to current food safety variables are not significantly different from zero. A notable exception is $\varphi_{b,1}$ denoting a significant positive spill over effect on pork consumption when there were beef food safety incidences. All one period lagged food safety coefficients related to pork are negative, revealing that consumers reduced their pork consumption in the following month when there were food safety incidences on no matter what kind of meat. It is important to note, the estimates are for the period 1999-2005. This is a relatively recent period and represents the period after implementation of major changes in food safety control and regulation for the meat industry. The results suggest consumer confidence is relatively high. In addition, the insignificant own-food safety effects on beef and poultry may be attributed to the following reasons: (1) the majority of food safety issues on beef are related to ground beef and when they happened, consumers may stop eating ground beef and start consuming other cuts of beef. Consequently, the total beef consumption might not change; (2) consumers are exposed to more positive research and scientific/medical findings on beef and poultry. For example, medical research has shown that beef is a source of dietary iron, beef fat inhibits proliferation of mammary tumors, etc; and poultry is viewed as a low-fat source of animal protein. These positive health perceptions counteract the negative of some occasional food safety issues. And when there were food safety accidents, consumers would find out the related companies and their products and switch to other companies. The significant negative own- and cross- effects on pork consumption reveal that the pork industry may be vulnerable to food safety issues.

In Canadian meat demand model, the constant components of the pre-committed quantities of beef (a_b) and poultry (a_c) are positive and significant from zero while that of pork (a_p) is negative but not significant from zero. Pork and poultry demands showed some seasonality while beef did not. Poultry consumption shows a positive time trend.

Table 4 presents estimates of the average for the Marshallian and Hicksian price elasticities and expenditure elasticities calculated at every data point. All Marshallian and Hicksian own-price elasticities of demand are negative for both U.S. and Canadian meat demand. Compared with U.S. demand, Canadian meat has less elastic beef demand but more elastic pork and poultry demand. In addition, the Canadian poultry Marshallian demand is price elastic. Moreover, Canadian beef and pork are more income elastic while poultry is less income elastic.

The food safety elasticities are estimated using following formula:

$$\varepsilon_{i,fs_t} = \frac{\partial \ln x_{i,t}}{\partial \ln fs_t} = (\frac{\partial \ln c_{i,t}}{\partial \ln fs_t})(\frac{c_{i,t}}{x_{i,t}}) + (\frac{\partial \ln x^*_{i,t}}{\partial \ln E^*_t})(\frac{\partial \ln E^*_t}{\partial \ln fs_t})(\frac{x^*_{i,t}}{x_{i,t}}) \qquad (6)$$

where *fs* is food safety index variable, i.e., beef, pork, and poultry food safety variables. The first part of the formula is the direct elasticity for the *i*th meat with food safety information weighted by the share of quantity; this part measures the percentage change in per-committed quantity of the *i*th meat in response to a 1% increase in the food safety index fs_t. The second part of the equation is the indirect elasticity weighted by the share of quantity and consists of a supernumerary expenditure effect, $(\frac{\partial \ln x^*_{i,t}}{\partial \ln E^*_t}) = (1 + \beta_i / w^*_{i,t})$, and a reallocation effect of pre-committed expenditure $(\frac{\partial \ln E^*_t}{\partial \ln fs_t}) = (\frac{fs_t}{E^*_t})(-\sum_{j=1}^{N} p_{j,t}\lambda_{j,k})$ with $\lambda_{j,k}$ denoting the food safety parameters, i.e., $\theta_{j,k}$, $\varphi_{j,k}$, and $\psi_{j,k}$. The sum of the direct and indirect elasticity is the total elasticity. The estimated direct, indirect, and total economic effects of both current and lagged food safety information are reported in table 5.

The estimated direct effects are very small for both current and lagged food safety variables. Considering the preferred model with lagged food safety variables, we focus on the effects of lagged food safety information. Except for beef, all meat own-direct effects are negative. Positive own-direct effect of the beef food safety index implies that some strategies had been taken to confront decreased sales in difficult situations and counteract the negative effects from the food safety concerns. The own-direct elasticity on pork indicates that there would be a 0.0377% decline in the precommitted quantity of beef in response to a 1% increase in the pork food safety index. The own-direct elasticity on poultry indicates that there would be a 0.0046% decline in the pre-committed quantity of poultry in response to a 1% increase in the poultry food safety index, which is much smaller than the own-direct effect of pork. Except for the cross effects of pork on beef which is positive, all cross-direct effects of food safety information are negative, suggesting that meat consumption would be decreased when there were food safety issues in the meat industry, no matter what kind of meat.

The indirect effect is made up of two components, the supernumerary and re-allocation effects, as described in equation (6). Marginal changes in food safety information for meat *i* trigger a reallocation from pre-committed expenditure to supernumerary expenditure, which then induces a supernumerary expenditure effect on supernumerary quantities. Beef food safety information has negative indirect effects on all kinds of meat, suggesting that when there were food safety events on beef, all meat supernumerary quantities decreased. All other indirect elasticities are positive.

The total own-pork food safety elasticities are negative, while the total own-beef and –poultry food safety elasticities are positive. Negative direct elasticities for pork dominate its positive indirect elasticities and pork has a negative total elasticity. Although poultry also has a negative direct elasticity, positive indirect elasticities outweigh the negative direct elasticity and give a positive total elasticity. In contrast, beef has both positive direct and indirect elasticities and consequently a positive total elasticities. And both negative and positive cross-effects occur in the total effects.

Conclusions

This article compares how food safety information regarding to beef, pork, and poultry has impacted meat consumption in the U.S. and Canada in recent years (1999-2005) by using monthly data. The results suggest that food safety information including BSE has had little effect on Canadian meat demand. This implies that Canadian consumers have a high degree of confidence in the domestic meat industry in the face of adverse food safety events. In contrast, food safety information has had an impact on U.S. meat demand and the impacts were determined to have one month lag. U.S. pork consumption seems more vulnerable than other meat consumption. As pork has relatively few negative food safety issues reported in the U.S, this result is unexpected and thus subject to further investigation. Both countries' meat demand has positive pre-committed quantities, indicating their meat demands are impacted by factors other than price and income, like seasonal factors, time trends, and food safety information. This result suggests that the separation of meat demand into pre-committed and supernumerary consumption is necessary.

The direct negative food safety (lagged) elasticities on pre-committed pork and poultry quantities indicate that publicized food safety information has a negative effect on U.S. pork and poultry demand. In contrast, beef demand has remained relatively unaffected by food safety issues. However, it also implies that further work to disaggregate beef into ground beef and other beef products may be warranted. Most negative cross-demand food safety elasticities reveal spillover adverse effects on to other meats pre-committed quantities, but the magnitudes are very small.

The results for the U.S. meat demand in this study differ from those of Piggott and Marsh because of the study period. In addition to strengthened industry and governmental food safety controls, this was a period of high protein demand based on new “fad” diets. Consumers’ responses to food safety issues evolve over time, and, in the area of food safety, Canadian consumers differ from US consumers. The results do suggest that the monthly time period for analysis is appropriate and we provide an updated analysis suitably with monthly data. For policy-makers and meat industry, this research provides some useful input to understand the impacts of food safety events on meat consumption.

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Table 1. Corrected Maximum Likelihood Tests of Lag Length for Food Safety Effects

	H0: No Effect	H0: Lag=0	H0: Lag=1
		The U.S.	
Ha: Lag=0	16.2431		
Ha: Lag=1	52.7040*	35.7942*	
Ha: Lag=2	56.0209*	35.4791*	4.8463
		Canada	
Ha: Lag=0	5.1255		
Ha: Lag=1	13.4773	8.2463	
Ha: Lag=2	17.9692	12.7402	4.6265
df	9	18	27
$\chi^2_{0.05}$	16.919	28.8693	40.1133

Table 2. Maximum Likelihood Ratio Tests for BSE Effects.

	The U.S.	Canada
	H0: No BSE (with one period lagged food safety)	H0: No BSE (without food safety)
Ha: BSEt0	2.0494	2.3512
Ha: BSEt1	3.0148	3.1926
Ha: BSEt2	0.2345	1.8108
Ha: BSE01	1.6493	0.0829
Ha: BSE12	2.4715	7.5199
Ha: BSE012	4.6008	3.4701
df	3	3
$\chi^2_{0.05}$	7.8147	7.8147

Table 3. Estimated Coefficients for the GAIDS Model

	U.S. Model with One Period Lagged Food Safety Variables			Canadian Model Without Food Safety Variables		
	Estimates	Standard Errors	t-values	Estimates	Standard Errors	t-values
γ_{bb}	-0.2288	0.2726	-0.84	0.2114	0.1525	1.3900
γ_{bp}	0.0725	0.2072	0.35	-0.1376	0.2791	-0.4900
γ_{bc}	0.1562	0.3304	0.47	-0.0738	0.2601	-0.2800
γ_{pp}	-0.6088	0.6152	-0.99	0.2383	0.1809	1.3200
γ_{pc}	0.5362	0.5922	0.91	-0.1008	0.2270	-0.4400
γ_{cc}	-0.6925	0.5401	-1.28	0.1746	0.4589	0.3800
α_b	0.0974	0.3414	0.29	0.5080	1223	0.0000
α_p	-0.7177	0.4583	-1.57	0.8256	4698	0.0000
α_c	1.6202	0.4696	3.45	-0.3337	5921	0.0000
δ	1.6096	0.4859	3.31	9085.8750	1124E+5	0.0000
a_b	6.0933	1.3333	4.57	2.0199	2.3347	0.8700
d_{b2}	0.2887	0.2484	1.16	-1.0208	0.8332	-1.2300
d_{b3}	0.5786	0.2475	2.34	-0.7339	0.7755	-0.9500
d_{b4}	-0.2217	0.2197	-1.01	-0.5493	0.4140	-1.3300
b_b	-0.0070	0.0057	-1.22	0.0091	0.0114	0.8000
$\theta_{b,0}$	0.0014	0.0068	0.20			
$\varphi_{b,0}$	0.1281	0.0535	2.40			
$\psi_{b,0}$	0.0061	0.0138	0.44			
$\theta_{b,1}$	0.0032	0.0114	0.28			
$\varphi_{b,1}$	-0.2415	0.0619	-3.90			
$\psi_{b,1}$	-0.0097	0.0173	-0.56			
a_p	6.9914	1.6558	4.22	5.5712	3.2229	1.7300
d_{p2}	-0.1536	0.1671	-0.92	-2.0398	0.9735	-2.1000
d_{p3}	0.0614	0.1553	0.40	-1.8429	0.9001	-2.0500
d_{p4}	0.3283	0.1461	2.25	-0.2728	0.4337	-0.6300
b_p	-0.0120	0.0041	-2.94	-0.0092	0.0107	-0.8600
$\theta_{p,0}$	0.0012	0.0050	0.25			
$\varphi_{p,0}$	0.0164	0.0346	0.47			
$\psi_{p,0}$	-0.0060	0.0094	-0.63			
$\theta_{p,1}$	0.0016	0.0062	0.26			
$\varphi_{p,1}$	-0.1645	0.0403	-4.08			
$\psi_{p,1}$	-0.0008	0.0113	-0.07			
a_c	-0.4646	5.9357	-0.08	-1.5002	7.9794	-0.1900
d_{c2}	0.1681	0.2707	0.62	-0.1477	0.1992	-0.7400
d_{c3}	0.5984	0.2987	2.00	0.2035	0.2026	1.0000
d_{c4}	0.0543	0.2476	0.22	0.5329	0.1860	2.8700
b_c	-0.0072	0.0070	-1.03	0.0294	0.0069	4.2800
$\theta_{c,0}$	0.0057	0.0056	1.02			
$\varphi_{c,0}$	0.0957	0.0657	1.46			
$\psi_{c,0}$	0.0157	0.0157	1.00			

$\theta_{c,1}$	-0.0009	0.0137	-0.07			
$\varphi_{c,1}$	-0.2243	0.0538	-4.17			
$\psi_{c,1}$	-0.0068	0.0193	-0.36			
β_b	0.1513	0.1566	0.97	0.3631	0.1168	3.11
β_p	0.3681	0.1997	1.84	-0.3063	0.0971	-3.15

Table 4. Estimated Price and Expenditure Elasticities

	The U.S		Canada	
	Mean	Std Dev	Mean	Std Dev
		Marshallian Price Elasticities		
ebb	-0.7992	0.0839	-0.4846	0.0562
ebp	-0.1759	0.0893	-1.4323	0.1876
ebc	0.7325	0.1243	-0.4745	0.1009
epb	-0.1085	0.0710	-0.9017	0.1717
epp	-0.4461	0.2157	-0.7320	0.1955
epc	0.0773	0.0261	0.0892	0.0706
ecb	0.2166	0.2627	0.2771	0.1098
ecp	-0.4897	0.4072	-1.3998	0.2057
ecc	-0.5561	0.0574	-1.0109	0.1101
		Expenditure Elasticities		
ebm	1.0520	0.0759	1.3027	0.0599
epm	0.8976	0.3222	1.5744	0.3069
ecm	1.0300	0.4112	0.2550	0.2854
		Hickisian Price Elasticities		
hebb	-0.3137	0.0574	-0.0537	0.0206
hebp	0.1116	0.0874	-1.0388	0.1421
hebc	1.0115	0.1424	0.0039	0.1281
hepb	0.3086	0.0993	-0.3723	0.0820
hepp	-0.2041	0.1342	-0.2636	0.1147
hepc	0.3157	0.1070	0.6658	0.1372
hecb	0.6914	0.0830	0.3567	0.0459
hecp	-0.2068	0.2894	-1.3251	0.2093
hecc	-0.3137	0.0574	-0.9102	0.1640

Table 5. U.S. Food Safety Elasticities

	Current Food Safety Information				Lagged Food Safety Information			
				Direct Effects				
	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
bb	0.0015	0.0018	0.0002	0.0131	0.0037	0.0044	0.0004	0.0311
bp	0.0194	0.0237	0	0.1061	-0.0378	0.0505	-0.2995	0
bc	0.0047	0.0040	0	0.0207	-0.0077	0.0066	-0.0381	0
pb	0.0021	0.0026	0.0002	0.0198	0.0028	0.0034	0.0002	0.0249
pp	0.0037	0.0048	0	0.0237	-0.0377	0.0511	-0.2841	0
pc	-0.0066	0.0054	-0.0287	0	-0.0009	0.0007	-0.0039	0
cb	0.0057	0.0070	0.0006	0.0505	-0.0009	0.0011	-0.0080	-9.3E-05
cp	0.0125	0.0158	0	0.0771	-0.0305	0.0418	0.2513	0
cc	0.0104	0.0087	0	0.0455	-0.0046	0.0039	-0.0211	0
				Indirect Effects				
bb	-0.0030	0.0040	-0.0302	-0.0003	-0.0023	0.0027	-0.0195	-0.0003
bp	-0.0136	0.0173	-0.0967	0	0.0392	0.0559	0	0.3355
bc	-0.0033	0.0028	-0.0163	0	0.0053	0.0047	0	0.0266
pb	-0.0014	0.0047	-0.0100	0.0348	-0.0015	0.0026	-0.0164	5
pp	-0.0103	0.0338	-0.2504	0.1136	0.0122	0.1151	-0.6256	0.2788
pc	-0.0019	0.0052	-0.0214	0.0318	0.0036	0.0073	-0.0357	0.0224
cb	-0.0029	0.0035	-0.0199	-0.0001	-0.0024	0.0032	-0.0208	-6.4E-05
cp	-0.0150	0.0234	-0.1334	0	0.0291	0.0342	0	0.1741
cc	-0.0034	0.0037	-0.0213	0	0.0049	0.0043	0	0.0212
				Total Effects				
bb	-0.0014	0.0022	-0.0172	-0.0001	0.0013	0.0017	0.0002	0.0117
bp	0.0058	0.0084	0	0.0487	0.0014	0.0078	-0.0131	0.0401
bc	0.0015	0.0014	0	0.0087	-0.0024	0.0021	-0.0115	0
pb	0.0007	0.0062	-0.0046	0.0546	0.0013	0.0020	-0.0031	0.0085
pp	-0.0066	0.0312	-0.2267	0.1166	-0.0255	0.1194	-0.7115	0.1189
pc	-0.0085	0.0089	-0.0501	0.0254	0.0027	0.0070	-0.0365	0.0190
cb	0.0028	0.0050	-3.8E-05	0.0437	-0.0033	0.0043	-0.0287	-0.0002
cp	-0.0024	0.0104	-0.0654	0.0089	-0.0013	0.0240	-0.1269	0.0429
cc	0.0071	0.0060	0	0.0381	0.0002	0.0025	-0.0094	0.0085