An Analysis of Food Safety Events on Consumers' Confidence and Consumers Attitude towards Preparedness of U.S. Food System

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Abstract

Every year hundreds of food recalls are made due to contamination. The main focus of this paper is to examine the effects of specific food events on consumers' confidence in food safety as well as their preparedness regarding the United States food system. The food events studied in this are major food-borne illnesses outbreaks and recalls that have occurred since May 2008. The three events chosen included: the salmonella outbreak in jalapeno and Serrano peppers occurring in 2008, the salmonella outbreak in peanut butter occurring in 2009, and the E.coli outbreak in Nestle cookie dough occurring in 2009. An ordered probit model was used to measure the effects that these specific foodborne illnesses had on consumers' confidence. The results revealed that the effect of the jalapeno and Serrano peppers and peanut butter significantly and negatively impact consumers' confidence. The Nestle recall had a negative impact on confidence but was not significant.

Introduction

Every year there are hundreds of recalls made for food products because of foodborne illnesses. The impact of these recalls genuinely affects the citizens of the United States. Many consumers expect the government and such agencies as the FDA, USDA, and CDC to protect them from contaminated food products and regulate companies to ensure the food we consume is safe. However, when a recall is made and is on a huge scale, consumers' confidence in the U.S. food supply is negatively affected (Bharad, etc. 2010). Several food safety events occurred during the period of this study. These events had a major impact on the food industry and consumers. The most prominent events discussed in this paper are the jalapeno and Serrano peppers salmonella outbreak (JSP), the PCA peanut salmonella outbreak (PCA) and the Nestle cookie dough E. coli outbreak (Nestle).

The JSP event occurred in 2008, and was initially linked to certain raw tomatoes according to the FDA. However, on July 17th, the FDA notified consumers that tomatoes currently on the market were safe to eat and that they should stop eating jalapeno and Serrano peppers. On July 21st, the FDA officially linked the salmonella outbreak to raw Mexican jalapeno and Serrano peppers which were obtained and distributed in Texas but grown in Mexico. On August 28, 2008, FDA ended the recall on the peppers.

The PCA event occurred in 2009. On January 17, 2009, the FDA announced they had traced the source of a salmonella outbreak to a plant in Blakely, GA owned by PCA and warned people to stop eating commercially prepared or manufactured peanut-butter-containing products and institutionally served products. On March 23, 2009, FDA asked Irvington, N.J.-based Company, Westco Fruit & Co, Inc. to voluntarily recall all of its products containing peanuts from PCA. The salmonella outbreak continued from January to beginning of April 2009 and resulted in one of the largest food safety recalls ever in the history of the U.S. (Wittenberger and Dohlman, 2010).

In June 2009, the FDA and CDC warned consumers that the company, Nestle, cookie dough product was linked to an E. coli outbreak. On June 29, 2009, the FDA and CDC announced that a culture of a sample of prepackaged Nestle Toll House refrigerated cookie dough tested positive for E. coli. Nestle issued a voluntary recall and on August 18, 2009, they began to send shipments of the product back to stores.

This paper is an extension of a working paper presented by Bharad, et al., (2010) and examines the impact of the JSP, PCA, and Nestle food safety events on consumers' confidence. The Bharad et al., (2010) study looked at the effect of a media tracking index (MTI), as well as certain social and demographic variables, on consumers' confidence in U.S. food safety using ordered probit model. They found that MTI was significant and negative, suggesting that a larger MTI value decreases consumer confidence in food safety as measured by the ordered probit's index function (Bharad, et al., 2010). The more coverage the media gives a food safety event; the generally more negative the news will reduce consumers' confidence as indicated by an increase in the MTI. The MTI measures the effect of media across all events due to food safety, negative and positive and does not account for specific events. By

analyzing the specific events previously mentioned, additional information is captured. Specifically, it can be determine how big of an impact the specified event had on confidence.

Literature Review

According to Ajzen and Fishbein (1980) information plays a vital role in altering consumers' beliefs, attitudes, and choices. The notion that the media frames the way people think about certain issues, and in doing so, influences the public's attitudes about said issues is referred to as the agenda setting effect (McCombs and Shaw 1972; Kinsey et al. 2009). Studies have been conducted to estimate the impact of negative TV coverage and advertising on consumption habits (Verbeke and Ward 2001). Currently, less than two percent of the U.S. population is engaged in agricultural production, and the average consumer has little knowledge of agriculture and food production systems. As a result, consumers often rely on mass media for relevant information about food safety (Kalaitzandonakes et al. 2004). It has been argued that the mass media can play an important role in building or undermining consumer confidence in the safety of foods, particularly because consumers have limited ability to assess food safety prior to consumption (Verbeke et al. 1999).

Media coverage of food safety issues has primarily been studied in relation to specific food incidents and food product (Verbeke et al. 1999; Jonge et al. 2010). Jonge et al. addressed how daily media reporting about the totality of food safety events may accumulate to affect consumer confidence in the safety of food. This was accomplished by monitoring actual newspaper coverage about food safety issues in parallel to evidence about consumer recalls of the food safety incidents (Jonge et al. 2010). These studies demonstrated that information processing strategies substantially mediated the relationship between local news media and the public's perception of food safety, with elaborative processing being more influential than active reflection in people's learning from the news media (Kenneth et al. 2006).

Data and Methodology

As stated in Bharad's, et al. 2010 paper, the MTI was constructed from article counts associated with food safety events from selected newspapers and/or television programs in the United States. The reach of the media intensity is difficult to capture solely by using article counts as media exposure varies

by media type and the nature of the event (Bharad, et al., 2010). Therefore, a media index was constructed to address these shortcomings. The media index incorporates the respondents' use of selected media types and normalizes article/ transcript counts across media types (Bharad, et al., 2010). The formula used for normalizing media counts is,

$$Z_{kt} = X_{kt} - Min(X_k)/Max\ (X_k) - Min\ (X_k) \qquad (1)$$

where Z_{kt} is the standardized score for media source k during week t, X_{kt} is the article/ transcript count for media source k during week t, and $Min(X_k)$ and $Max(X_k)$ are the minimum and maximum counts for the k^{th} media source over the sample period (Kinsey et al. 2009). The X's are the article or transcript counts of news stories containing at least one of the following keywords: *food safety, food defense, food terrorism, agricultural terrorism or agterrorism, food poisoning, food contamination, food borne illnesses, food-borne diseases,* and *food recall*. The media sources included for keyword searches were: *national and local newspapers, network and cable TV, radio, news magazines,* and *the internet*.

The next step in construction of the media tracking index involves aggregation of standardized scores using the following formula:

$$MTI_t = \Sigma\ w_k Z_{kt}, \quad (2)$$

where the MTI is the media tracking index value for week t and w_k is the weight assigned to the k^{th} media source where $\Sigma w_k = 1$ and $0 \leq w_k \leq 1$. Each respondent in the survey was asked to indicate which of the selected media outlets they considered their primary source of news. Frequency counts from these questions were used as estimates for the weights in equation 2.

In addition to analyzing the effect of the MTI, this paper also analyzed the effects of the specific food safety events previously discussed. The criteria for choosing these events included considerable media coverage of the identified event and a distinct spike in the MTI (insert MTI graph) during the time period of the event. Also, the specific start and end date of the specified event must be identifiable. To identify the start and end date, we use the date that the FDA first warned the consumers of possible

dangers or issued a voluntary recall to companies until the date that FDA notified the consumers that it was safe to eat the food product or notified companies it was ok to ship products.

To analyze the effects of the JSP, PCA, and Nestle recalls on consumers' confidence a set of dummy variables were created for the time period of the recall/foodborne illness outbreak. The measurement of time is done in weeks according to the survey conducted

The survey design was patterned after earlier surveys conducted by The Food Industry Center at the University of Minnesota, with funding from the National Center for Food Protection and Defense (Stinson et al. 2008). The survey asked questions about consumers' attitudes towards terrorism in general and about food defense and food safety, after defining the difference to the respondents. The survey was administered via the internet with respondents selected from Taylor Nelson Sofres' TNS national online panel of more than two million U.S. consumers (Bharad et al., 2010). Respondents were contacted by TNS and invited to come to a website to complete a survey. The sample of respondents is selected in such a way that it comprises a nationally representative cross section of consumers by geographic region, income, household size, and age of respondent (Bharad et al., 2010). A six point likert scale was used to indicate the strength of positive and negative attitudes for each question (Bharad et al., 2010). This paper uses consumer survey data collected over 132 weeks, from May 2008 to November 2010. According to the survey, the first day of the week started on Monday of May 5, 2008 and ended on Sunday of May 11, 2008.

To create the dummy variables for each event, the day in which the initial recall/ foodborne illness outbreak occurred was identified and the corresponding week was included until the day in the week the event ended. Therefore, the set of dummy variables consists of 1(the event occurred during the specified week) and 0 (the event did not occur during the specified week). The first food safety event was the jalapeno and Serrano Peppers recall which lasted from weeks 11 to 17, which were all coded as one. The peanut butter recall lasted from weeks 37 to 48 and the Nestle cookie dough recall lasted from weeks 61 to 68 which were coded as one. The dummy variable and the MTI were included in an ordered probit

model as independent variables to determine the effect on consumers' confidence. It is assumed that the dummy variables JSP, PCA, and Nestle will have a negative effect on consumers' confidence.

The dependent variables, CFSTC and CFSTP, were created using the two primary indicators of consumer's confidence identified by the Kinsey et al., 2009 study. The first measures consumer's current confidence in the safety of U.S. food system, and the second measures their belief regarding how better prepared the food system is regarding food safety relative to a year ago (Bharad, et al., 2010). This was accomplished using factor analysis separate attitudinal questions in the survey into two sets of questions (see appendix). All the questions included in these two sets use a likert scale that ranges from 1 to 6. The first set of questions measures level of concern about food safety, or inversely their confidence in the safety of food (1 being Not At All Concerned to 6 being Extremely Concerned). In order to measure the consumer confidence, the scale for these four questions is reversed (1 being Extremely Concerned to 6 being Not At All Concerned). Responses for these four questions are aggregated to obtain a new aggregated variable (CFSTC) to measure respondents' confidence in the safety of our food, and it is scaled from 1 to 7. The second set of questions obtained from factor analysis measures respondents' attitudes regarding how prepared we are for food safety/defense events compared to a year ago. Responses for the questions in the second set were aggregated together to obtain a new aggregated variable (CFSTP) to measure respondents' attitudes regarding how prepared we are for food safety/defense events compared to one year ago, and it is scaled from 2 to 12.

Since the dependent variables are ordinal, an ordered probit model is used for the analysis. The ordinal regression model is commonly presented as a latent variable model with a structural equation specified as, $y_i^* = x_i\beta + \varepsilon_i$, where y_i^* is a latent variable ranging from $-\infty$ to ∞, x_i is a vector of independent variables, β is a vector of coefficients to be estimated and ε_i is the error term. The vector x_i contains the variable MTI, and the event specific dummy variables defined as JSP = 1 if the event occurred during the specified time period and JSP = 0 if the event did not occur during the specified time period; PCA = 1 if the event occurred during the specified time period and PCA = 0 if the event did not occur during the specified time period; and Nestle = 1 if the event occurred during the specified time

period and Nestle = 0 if the event did not occur during the specified time period. This model is derived from a measurement model in which y_i^* is mapped to an observed variable y which is thought of as providing incomplete information about an underlying y_i^* according to the measurement equation (Long, 1997). The y_i^* cannot be observed, however we can observe the categories of response:

$$y_i^* = \begin{cases} 1 & if\ y_i^* \leq 1 \\ 2 & if\ 1 < y_i^* \leq \mu_1 \\ 3 & if\ \mu_1 < y_i^* \leq \mu_2 \\ & \vdots \\ 7 & if\ \mu_6 \leq y_i^*, \end{cases}$$

where the μ's are unknown " thresholds" that determines the ordinal intervals of the scale, and all other variables are as previously defined (Harrison, et al., 2002). Ordered probit assumes that ε_i is normally distributed with a mean of zero, but sets σ^2 equal to one (Harrison, et al., 2002). This restriction is necessary because all values of y_i^* are assumed to be censored in the ordered probit model (Long, 1997).

This paper differs in several ways from the Bharad et al. 2010 study. First the socio-demographic variables and media sources variables are not included in the models. However, the MTI is, as well as the dummy variables, JSP, PCA, and Nestle. The primary interest is to analyze the effects of specific events on consumers' confidence. Following the Bharad et al., 2010 study, it is expected that the MTI will have a negative effect on consumers' confidence. It is also expected that the dummy variables created for the JSP, PCA, and Nestle events will have negative effects on consumers' confidence. Because media reports of food safety usually increases during recalls and foodborne illness outbreaks, consumer confidence is expected to be negatively affected during the time period of the specified events. In addition, including the dummy variables for the specified events will also control for factors other than media which may affect consumers' confidence.

Results and Discussion

There were two models analyzed. The first model included only the MTI and the results are shown in Table 1. As expected and supported by the results found in Bharad et al., 2010 study, MTI was

found to negatively affect consumers' confidence and it was significant. Therefore, if there is an increase in the media coverage, consumers' confidence in the U.S. food safety will decline.

The second model analyzed included the MTI and the three event specific dummy variables for the specified food recall/ foodborne illness events. The results are shown in Table 2. Again, the MTI is found to be negative and significant. Two of the three dummy variables were significant and all of them had the expected negative sign. The variable JSP was significant and had a negative impact on consumers' confidence during the time of the outbreak. The variable PCA was found to be significant and also had a negative impact on consumers' confidence during this time period. The variables JSP and PCA carried the expected signs and were significant. However, the Nestle even though negative, was insignificant.

There is little previous literature including Bharad et al. 2010, or theory to support these results, therefore there might be several factors affecting these results. Jalapeno and Serrano peppers and peanut butter are widely consumed and added as ingredients in other products, therefore the impact of these outbreaks would affect more consumers. Length of the outbreak and how it is handled might also affect the results. The peanut butter salmonella outbreak was the lengthiest event analyzed and pinpointing the initial cause of the outbreak took longer. However, the Nestle cookie dough E. coli outbreak was the shortest, and Nestle and FDA responded quickly by determining the product responsible and issuing recalls of all contaminated products.

Marginal effects were also estimated for the two models and the results are shown in Tables 5 and 6. The lower categories for CFSTC have a positive sign for the marginal effects, while the higher categories have negative signs. The marginal effects for MTI imply that increase in media coverage of the food safety events decreases the probability that a subject's response will fall in the higher categories for the dependent variable. This is consistent with the finding from Bharad et al. 2010 paper that MTI negatively impacts consumer confidence in food safety. The marginal effects for JSP and PCA indicate that during the period of the event the probability of the consumer being low in confidence increases relative to the period when there is no event.

A log likelihood ratio test was performed to test model specification. The test compares the restricted model against the unrestricted model by determining the significance of the restrictions. If the test statistic exceeds the critical value, then the restricted (null) model is rejected in favor of the unrestricted (alternative) model. One of the assumptions of the test is that the models are nested and they can be transformed by imposing certain linear restrictions. A log likelihood ratio test was run using STATA comparing the two models previously discussed. The results were that the restricted model containing only MTI was rejected in favor of the unrestricted model containing MTI and JSP, PCA and Nestle. These results were significant with a chi squared of 9.11 and p-value of 0.0279. Therefore, including the dummies better specifies the model and offers additional information about the effect of specific events on consumers' confidence.

The same two models were analyzed with the CFSTP as the dependent variable. The results shown in Tables 3 and 4 were similar to the models with CFSTC. In the model with only MTI, it was found to be negative and significant. Therefore, as the MTI increase, it will have a negative impact on consumers' belief on U.S. preparedness of the food system regarding food safety (Bharad et al., 2010). In the model including the dummy variables, both the jalapeno and Serrano peppers salmonella outbreak and the peanut butter salmonella outbreak were negative and significant. The Nestle E. coli outbreak was negative, however it was insignificant.

A likelihood ratio test was run to determine model specification for the preparedness model. The results were that the restricted model with only MTI was rejected in favor of the unrestricted model including the dummy variables. The chi squared was 39.41 and the p-value was 0.00.

The marginal effects for the MTI imply that increase in media coverage of food safety events decreases the probabilities that a subject's response falls in the higher categories for the dependent variable. This is consistent with the finding that the MTI negatively impacts consumers' attitude towards preparedness of our food system in dealing with the food safety/defense events (Bharad et al., 2010).

For the events JSP and PCA the probability of a person believing that our food system is better prepared to deal with the food safety/defense events decreases during the event period relative to the period when there is no event.

Conclusion

The results showed that specific food safety events have a negative impact on consumers' confidence. By conducting a log likelihood ratio test, it revealed that the model including the dummy variables was a better specified model and added additional information about how specific events affected confidence. Because of data limitations, more recent food recalls/ foodborne illnesses outbreaks could not be included such as the egg salmonella outbreaks in 2010. It would be of interest to analyze the effects of these events. Also, it would be of interest to analyze the effect of specific positive events such as the Obama food safety bill on confidence. Further studies including this information in the model would allow for greater analysis of the media and specific events on consumers' confidence. This study shows that it is possible to model specific events and capture information that is not reflected solely with the MTI.

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Table 1. Ordered Probit Model with MTI for Consumer Confidence

Variable name	Variable	Coefficient	Standard Error	Z	P> z
MTI	Media Tracking Index	-0.1735978***	0.0614941	-2.82	0.005
Ordered Probit Thresholds					
/cut1		-0.8562649	0.0111289		
/cut2		-0.2218749	0.0102395		
/cut3		0.4210616	0.0104032		
/cut4		1.06421	0.0117859		
/cut5		1.687299	0.0154721		
/cut6		2.26564	0.0239006		
Log likelihood = -40683.058					
Number of obs = 23869					
LR chi2(1) = 7.98					
Prob> chi2 = 0.0047					
Pseudo R2 = 0.0001					

*significant at .10 level, **significant at .05 level, ***significant at .01 level

Table 2. Ordered Probit Model with Event Specific Variables for Consumer Confidence

Variable name	Variable	Coefficient	Standard Error	Z	P> z
MTI	Media Tracking Index	-0.1329274**	0.0656085	-2.03	0.043
JSP	Jalapeno /Serrano Peppers	-0.0653907**	0.0302537	-2.16	0.031
PCA	Peanut Butter	-0.0505877**	0.0250822	-2.02	0.044
Nestle	Nestle Cookie Dough	-0.0362879	0.0285761	-1.27	0.204
Ordered Probit Thresholds					
/cut1		-0.8625693	0.0114959		
/cut2		-0.2279872	0.0106252		
/cut3		0.4150554	0.010776		
/cut4		1.058272	0.0121121		
/cut5		1.681424	0.0157184		
/cut6		2.259788	0.0240585		
Log likelihood = -40678.5					
Number of obs = 23869					
LR chi2(4) = 17.09					
Prob> chi2 = 0.0019					
Pseudo R2 = 0.0002					

*significance at .10 level, **significance at .05 level, ***significance at .01 level

Table 3. Ordered Probit Model with MTI for Consumers Attitude towards Preparedness

Variable name	Variable	Coefficient	Standard Error	Z	P> z
MTI	Media Tracking Index	-0.2952232***	0.0603823	-4.89	0
Ordered Probit Thresholds					
/cut1		-1.22819	0.012294		
/cut2		-0.9444245	0.0113005		
/cut3		-0.5398364	0.0104758		
/cut4		-0.1919109	0.0101588		
/cut5		0.3238868	0.0102364		
/cut6		0.7311801	0.0108074		
/cut7		1.313258	0.0128496		
/cut8		1.663211	0.0152958		
/cut9		2.093299	0.0207211		
/cut10		2.281872	0.02449		

Log likelihood = -51022.25
Number of obs = 23869
LR chi2(1) = 23.92
Prob> chi2 = 0
Pseudo R2 = 0.0002

*significance at .10 level, **significance at .05 level, ***significance at .01 level

Table 4. Ordered Probit Model with Event Specific Variables for Consumers Attitude towards Preparedness

Variable name	Variable	Coefficient	Standard Error	Z	P> z
MTI	Media Tracking Index	-0.1741233***	0.0644355	-2.7	0.007
JSP	Jalapeno Serrano Peppers	-0.1038701***	0.0296593	-3.5	0
PCA	Peanut Butter	-0.1355679***	0.0246259	-5.51	0
Nestle	Nestle Cookie Dough	-0.024295	0.0280337	-0.87	0.386
Ordered Probit Thresholds					
/cut1		-1.236422	0.0126312		
/cut2		-0.9523954	0.0116603		
/cut3		-0.5473672	0.0108495		
/cut4		-0.1990587	0.010531		
/cut5		0.3172822	0.0105954		
/cut6		0.7249153	0.0111492		
/cut7		1.307256	0.013142		
/cut8		1.657292	0.0155427		
/cut9		2.087577	0.0209055		
/cut10		2.276264	0.0246493		

Log likelihood = -51002.498
Number of obs = 23869
LR chi2(4) = 63.33
Prob> chi2 = 0
Pseudo R2 = 0.0006

*significance at .10 level, **significance at .05 level, ***significance at .01 level

Table 5. Marginal Effects for MTI for Consumer Confidence

Variable Name	Category1	Category2	Category3	Category4	Category5	Category6	Category7
MTI	0.0487124	0.01911	-0.0049133	-0.024323	-0.0223887	-0.0110847	-0.0051127

Table 6. Marginal Effects for Event Specific Variables for Consumer Confidence

Variable	Category1	Category2	Category3	Category4	Category5	Category6	Category7
MTI	0.0372948	0.0146384	-0.0037653	-0.0186282	-0.0171427	-0.0084848	-0.0039124
JSP	0.0187926	0.0068925	-0.0023049	-0.0093063	-0.0082722	-0.0040007	-0.001801
PCA	0.0144386	0.0054031	-0.001682	-0.0071694	-0.0064364	-0.0031336	-0.0014204
Nestle	0.010317	0.0039041	-0.0011657	-0.0051303	-0.0046317	-0.0022634	-0.0010299

Table 7. Marginal Effects for MTI for Consumers Attitude towards Preparedness

Variable	Category2	Category3	Category4	Category5	Category6	Category7	Category8	Category9	Category10	Category11	Category12
MTI	0.0574216	0.0200795	0.0258979	0.0128358	-0.0055888	-0.0224606	-0.0403755	-0.0197011	-0.0157352	-0.004228	-0.0081455

Table 4. Marginal Effects for Event Specific Variables for Consumers Attitude towards Preparedness

Variable	Category2	Category3	Category4	Category5	Category6	Category7	Category8	Category9	Category10	Category11	Category12
MTI	0.0338202	0.0118524	0.015298	0.007584	-0.0033062	-0.0132685	-0.0238221	-0.0116116	-0.0092693	-0.002489	-0.004788
JSP	0.0213105	0.0070841	0.0087957	0.0039517	-0.002909	-0.0083391	-0.014123	-0.0066484	-0.0051868	-0.0013678	-0.002568
PCA	0.0281101	0.0092406	0.011381	0.0050033	-0.0040321	-0.0109792	-0.0183947	-0.0086034	-0.006684	-0.0017569	-0.0032847
Nestle	0.0047795	0.0016553	0.0021181	0.0010281	-0.0005122	-0.0018755	-0.0033207	-0.0016054	-0.0012746	-0.0003408	-0.0006518

Appendix

Consumer confidence questions used in ordered probit model:

- How concerned are you about the safety of the food that you buy?
- How concerned are you about a terrorist attack on the food system?
- How serious do you think the impact of a terrorist event regarding a common food product would be on your household?
- How concerned are you about food defense?

Consumer Preparedness questions used in ordered probit model:

- In thinking about food safety, that is the natural or accidental contamination of food, do you think the U.S. food supply is safer than it was a year ago?
- In thinking about food defense, do you think the United States is better prepared for a terrorist attack on the food supply than it was a year ago?