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Consumer Confidence in the Food System, Media Coverage and Stock Prices for the Food Industry

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Abstract

Ongoing food safety incidents have generated a national interest in the significant costs that food recalls impose on stakeholders. This paper examines the impact of media coverage of food safety events on consumer confidence in food safety, and measures the response of stock prices of food companies to changes in consumer confidence. Results show that increases in media coverage have a negative impact on consumer confidence, and that decreases in the levels of consumer confidence regarding food safety have a negative impact on a stock price index for a basket of food companies. These findings suggest that financial performance of food companies is generally and negatively affected by food safety events, even though the event may be company and/or category-specific in nature.

Keywords: Food safety, media coverage, consumer confidence, stock prices.

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Introduction

As Fischler (2001) states, there is a real paradox in advanced societies because while their consumers have today the highest levels of security when they buy food, their fear about what they eat has never been so important. Historically, the U.S. food supply has been considered among the safest in the world, however a series of recent outbreaks and food recalls has eroded consumer trust, and underscore important challenges faced by food industry and government authorities. Some of the most serious incidents, such as the tomato/jalapeno peppers and the peanut butter salmonella outbreaks in 2009, were linked to illness and deaths. Due to their severity and frequency, these events were covered extensively by national media and raised concerns among consumers, industry leaders and policy makers. Previous studies have found evidence of changes in public opinion triggered by the media's focus on particular issues (Jarrell and Peltzman 1985; Hoffer, Pruitt, and Reilly 1988; Bromiley and Marcus 1989; Pruitt and Peterson 1986; Thomsen and McKenzie 2001; Salin and Hooker 2001). Because most consumers acquire their information about food safety issues from mass media, they are also more likely to be influenced by news stories.

Besides the obvious negative impacts of food safety incidents on public health, these events also have financial consequences for implicated firms as well as peripheral effects on the entire food industry. This is not a trivial issue given that the U.S. food industry contributes about 20 percent to U.S. Gross National Product, employs about 14 million individuals, and provides an additional four million jobs in related industries (CFSAN 2010).

Changes in stock prices are associated with the announcement of an economic event. If the event is positive (negative) news about firms, stock prices will increase (decrease), so stock prices reflect the new available information in the market, which is referred to as the efficient market hypothesis (EMH) - for a review of the efficient market hypothesis see chapter 11 of Bodie, Kane, and Marcus (2008). However, the linkages between consumer confidence and the performance of capital markets are a recurrent topic in the finance literature. In this context, it is important to be aware of the so-called herd mentality which occurs during periods of marketing turbulence in which investors become influenced by the crowd's emotional state, which causes them to react and decide irrationally in buying or selling stocks. More specifically, often investors tend to "flock together" and make decisions based on what the rest of the crowd is doing. Sometimes the media tends to perpetuate this style of investing, where sensational headlines often exaggerate the reality of the current market conditions. This investment behavior can cause over-reactions in the markets, in where pieces of good or bad news can cause investors to become overly optimistic or pessimistic, respectively (For a general review of the herding literature, see Devenow and Welch, 1996. Also, for a good discussion on popular theories explaining why institutional investors might trade together, see Wermer 1999).

Even though the literature regarding events that affect stock prices is extensive, we are not aware of a study that empirically assesses how changes in consumer confidence in food safety and media coverage of food safety/defense events affect a stock price index for a basket of food companies. The purpose of this study is to first measure the media "agenda-setting" effect associated with food safety events on consumer confidence in the safety of the food system. Following estimation of media effects on consumer confidence, two different components

affecting consumer confidence in food safety are estimated. The first component measures the "agenda-setting" effect on consumer confidence, and the other component measures unexplained factors that affect consumer confidence. Finally, dynamic OLS (DOLS) is used to estimate the effects of changes in these confidence measures on stock price indices for selected food companies. Our results show clearly that increases in media coverage of food safety events do indeed erode consumer confidence in the safety of food system. We also find a positive, although limited, relationship between consumer confidence in food safety and a stock price index for a basket of food companies.

The remainder of the paper is organized as follows: Sections two and three discuss previous literature on linkages between media coverage, consumer confidence and stock prices and presents the methodology used to construct the stock indices and the theoretical framework. Section four presents the econometric procedures. Sections five and six discuss the empirical results and conclusions respectively.

Literature Review and Theoretical Framework

For the construction of the theoretical framework of this study, concepts from mass communication and finance literature are utilized. In the examination of the relationship between mass media coverage and consumer confidence, it is necessary to understand the role information plays in altering consumers' beliefs, attitudes and choices (Ajzen and Fishbein 1980). According to the "agenda-setting" effect literature, mass media can influence the way people think about certain issues by the media's choice of what stories to consider newsworthy and how much prominence and space are given to them (McCombs and Shaw 1972; Thompson 1995). In addition, the agenda-setting effect will depend on an issue's "obtrusiveness" – that is, the degree to which an individual has direct personal experience and/or knowledge about an issue. The less direct experience and/or knowledge an individual has about a particular issue, the more likely the individual will rely on media for information. Consequently, it is more likely that the individual will be influenced by the agenda-setting effect (Zucker 1978). Because only a small share of the U.S. population is directly involved in food production and food safety protocols, these issues are believed to be relatively unobtrusive. Hence, consumers are expected to acquire most of their information and knowledge about food safety incidents from the news media. Anecdotal evidence suggest that there is a tendency of the news mass media to report negative news stories, which are more likely to capture an audience's attention. Finally, previous research has shown that highly publicized food safety incidents affect consumer perceptions, leading to changes in food purchasing patterns (Buzby 2001).Based on these premises, this study presents the following hypothesis:

> ***Hypothesis 1:*** *Increased media coverage of food safety and defense events will have a negative effect on consumer confidence in food safety.*

Food safety incidents can pose high financial costs to industries and their shareholders. This is because costs associated with food recalls or food safety incidents are borne by the implicated company and the costs represent unanticipated effects on corporate earnings. In particular, the firms will incur direct costs that include lost sales, money spent on advertising to compensate for reputation damage, plant closures and clean-up, and expenses related to recovering, disposing of, or reconditioning contaminated products already placed on the market. Other costs will arise

from the potential loss of future sales associated with a decline in long term consumer confidence. Bad publicity resulting from these events can lead to long term reductions in product demand, and may erode prior investments in reputation and brand equity for the implicated firms. This is a result of highly publicized food recalls that lead to lasting changes in consumers' perceptions about food safety and their food purchasing patterns. Moreover, litigation associated with product liability can also increase costs substantially, especially when there are numerous illnesses and deaths associated with the incident. At the international level, implicated multinational firms are likely to see their exports reduced or banned due to food safety concerns by the importing countries. In summary, all these costs will have negative impacts on the profitability of the affected firms, and investors may anticipate reductions in future dividends to be paid to the shareholders and fear potential negative spillovers across other food firms. Thus, more concerned consumers lead to losses in brand equity and sales, increased costs and greater financial risks, which will reduce the financial returns of those who invested in those firms. The relationship between higher profitability and higher stocks prices has been widely investigated by the finance literature, and many studies have shown that there are some easily observed variables that predict market returns. Fama and French (1988) show that returns on the aggregate stock market are likely to be higher given a high dividend/price ratio. In another study, Campbell and Shiller (1988) find that earnings yield can predict market returns, while Kein and Stambaugh (1986) find that the spread between yields of high grade and low grade corporate bonds help predicts market returns. Yet these results are not to invalidate the EMH, these results show that is not the predictability of risk-adjusted abnormal returns that predicts market returns, but the predictability of the risk premium (Bodie, Kane, and Marcus 2008). Fama and French (1993) used a 3-factor CAPM and find that stocks with higher betas on firm size or book to market ratios have higher average returns and suggest that these are risk premiums associated with each of these factors which may be proxies for other important determinants of risk. In the context of this study, it may be that consumer confidence is associated with some level of risk premium; therefore, we presume that consumer confidence about food products has some effect on firms' stock prices due to the connection between consumer confidence and firms' profitability.

Hypothesis 2: *Positive changes in consumer confidence in the safety of the food system have a positive effect on a stock price index for a basket of food companies.*

There are also a growing number of empirical studies that have investigated the stock market's reaction to product recall announcements for several industries. According to Jarrell and Peltzman (1985), negative abnormal returns associated with recalls can act as a deterrent to a manager knowingly producing substandard products. This is particularly important for the food industry given the direct linkages between food products and public health. Earlier studies have looked at the automobile sector and analyzed the impact of automotive recalls on producers' stock returns. Jarrell and Peltzman (1985) find evidence that automotive recalls are associated with significant and negative abnormal stock returns, while other studies have found statistically insignificant or modest negative returns that proved to be too small to be a sufficient deterrent (Bromiley and Marcus 1989; Hoffer, Pruitt and Reilly 1988). In a seminal study Pruitt and Peterson (1986) examined nonautomotive recalls, and identified significant negative abnormal returns associated with recall announcements. Other empirical studies have evaluated the reaction of the stock market to food products recalls. In terms of sales responses to recalls, Thomsen, Shiptsova and Hamm (2006) found that sales of frankfurter brands declined following

a recall for a food-borne pathogen (*Listeria mnocytogenes*). The same study showed that sales approached the prerecall levels four to five months later. Other studies find significant shareholder losses and increases in volatility when a food company is implicated in a recall involving serious food safety hazards (Thomsem and McKenzie 2001; Salin and Hooker 2001), while others show only a limited impact (Wang et al. 2002). Using the event study approach, McKenzie, Thomsen and Dixon (2004) analyzed the negative reaction of agricultural commodity prices to market-related events.

The finance literature has also explored the time-series relationships between economic news, consumer sentiment, and stock markets with mixed results (Jansen and Nahuis 2003; Lemmon and Portniaguina 2006). Other empirical studies find evidence of stock prices responding to the economic news stories and their content (Pearce and Roley 1985; Dasgupta et al. 2006; Tetlock 2007). Finally Orlitzky, Schmidt and Rynes (2003) conducted a meta-analysis, based on thirty years of research, and concluded that reputation appears to be an important mediator of the relationship between social and financial performance.

The present study differs from past research by examining simultaneously the impact of national and local media coverage of food safety and defense events on consumer confidence in food safety, and the change in stock prices for basket of food companies due to changes in consumer confidence. Finally, the variables accounting for consumer confidence and media coverage are two novel indices that, by design, are national in scope. Because these indices capture the overall consumer sentiment relatively to the safety of the food system, and the national media coverage of any food safety event, this study aggregates stock prices of the overall food industry in a single index rather than analyzing only company-specific events.

Continuous Food Safety Tracking Index (Consumer. Confidence)

To measure the consumer confidence in food safety in the United States, the present study used a continuous food safety tracking index (Consumer.Confidence) developed by the authors in a previous study (Kinsey et al. 2009). This index is constructed based on information from a consumer survey administered by The Food Industry Center with the funding from the National Center for Food Protection and Defense, a Homeland Security Center of Excellence. The survey design follows the same methodology used in computation of the Consumer Sentiment Index from the University of Michigan (Curtain 1973). The two primary components of the Consumer Sentiment index tracks how consumers feel about the general economy and their position in it. One component measures consumers' perception of their current states of well-being and the other component measures their opinions about the future of the economy and their own well-being. In this study, our index focuses on the consumer's confidence in the safety of the U.S. food system, and the surveys asked questions about consumers' attitudes towards food safety and food defense, where food safety was defined as an event (e.g., a food recall) associated with the accidental contamination of a food and food defense defined as an event associated with the deliberate contamination of a food (e.g., a food terrorist event). A six-point Likert scale was used to indicate the strength of positive or negative attitudes for each question used to construct the index. After some debate, the researchers decided to use all six possible responses in the analysis, which resulted in each data point registering the strength of, and change in, consumers' concern for each question. Furthermore, the Consumer.Confidence survey was administered via

the Internet with respondents selected from Taylor Nelson Sofres' (TNS) national on-line panel of more than two million U. S. consumers. Respondents were contacted by TNS and invited to visit a website to complete a survey. In return for their participation, panelists receive points which accumulate and can later be redeemed for prizes. Overall, the sample was selected so that it comprised a nationally representative cross-section of consumers by geographic region, income, market size, household size, and age of respondents. Emails were sent to 175 different primary grocery shoppers each week, 80 percent of which were women. Therefore, this sample over-represents women and in the first 40 weeks is skewed towards an older population with a mean age of 52.6. With the exception of more women, the sample became fully representative over time, and the results of this paper represent the first 87 weeks of data collection.

Results from factor analysis separated attitudinal questions from the previously discussed Consumer.Confidence survey into a set of questions that indicated the respondent's attitude toward food safety and food defense. The questions measures respondents' current level of concern about food safety, or inversely their confidence in the safety of our food. The Consumer.Confidence index is calculated using the following formula:

$$(1) \quad Consumer.Confidence_t = \frac{\sum_{i=1,2}(F_{it} - U_{it} + 100)}{Base} \times 100,$$

where the subscript t denotes the week of the survey and the subscript i denotes one of two questions from the survey used to measure the respondents' confidence in the safety of the food system. F_{it} is the percentage of respondents checking the favorable three boxes for question i during week t, and U_{it} is the percentage of respondents checking the unfavorable three boxes for question i during week t. The selected "*Base*" is the average of the numerator over the first five weeks of the study, which was consider a relatively calm period without any major event. The index is constructed so that larger values imply higher "confidence" in food safety, and an index value of 100 indicates that consumer confidence is equal to the level of confidence over the first five weeks of the study period.

Media Tracking Index (Media.Tracking)

A food safety media tracking index was constructed during the same period as the Consumer.Confidence. The previously cited studies pertaining to media's effect on consumer attitudes measured media exposure based on article counts for specific food safety events from selected newspapers and/or television news programs. A shortcoming of this approach is that the "reach" of media intensity is not fully reflected by article counts from these media outlets. For instance, some media sources reach a larger audience than other sources and some people rely more heavily on television than newspapers or radio for information. Moreover, the amount of media exposure attributed to each media source varies by media type and the nature of a particular event. This study addresses these shortcomings by constructing a media index that incorporates the Consumer.Confidence respondent's use of selected media types and by normalizing article/transcript counts across media types. Media types are normalized using the following formula:

$$(2) \quad Z_{kt} = \frac{x_{kt} - Min(x_k)}{Max(x_k) - Min(x_k)},$$

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 *kth* media source over the sample period (Arundel and Hollanders 2002). The x's represent article or television transcript counts of news stories containing at least one of the following keywords: *food safety, food defense, food terrorism, agricultural terrorism* or *agriterrorism, food poisoning, food contamination, food-borne illnesses, food-borne diseases,* and *food recall*. Five media sources included in the keyword searches were: (1)*national and local newspapers; (2) network and cable TV; (3) radio; (4) news magazines*; and (5) *the internet.*

The second step in constructing the media tracking index involves aggregating standardized scores (Z_{kt}) for all five media sources using the following formula:

$$(3)\quad \text{Media.Tracking}_t = \sum_{k=1}^{5} w_k Z_{kt},$$

where Media.Tracking_t is the media tracking index value for week *t* and w_k is the weight assigned to the *kth* media source where $\sum_{j=1}^{5} w_k = 1$ and $0 \leq w_k \leq 1$. The weights for each media source were used to estimate the reach of the selected news sources and were estimated using data from the previously described Consumer.Confidence survey. Each subject from the survey was asked to indicate which of the selected media outlets they considered their primary source of news. Frequency counts for each category across all respondents were calculated for each week during the survey. The frequency counts were then averaged across all 87 weeks in the survey and these values were used as estimates for the w_k*'s* in the media tracking index. The responses revealed the following distribution of media outlets considered primary source of news; (1) television (56%); (2) internet (28%); newspapers (15%); magazines (0.6%); and radio (0.4%).

For a more intuitive interpretation of these two indices, Figure 1 shows the evolution of both indices (Media.Tracking and Consumer.Confidence) throughout the entire period of analysis. The figure also highlights major food safety events that took place during these 87 weeks. More specifically, the period of analysis begins on May 5 – May 11 of 2008 and ends on

Dec 8 – Jan 3 of 2010. A simple look at the Media.Tracking confirms the effectiveness of this index in capturing media coverage in the sense that the spikes registered coincide with the major food safety events. Furthermore, the graph also reveals that, in most cases, increases in the Media.Tracking are followed by decreases in Consumer.Confidence. In other words, higher media coverage of food safety events seems to erode the consumer confidence in food safety.

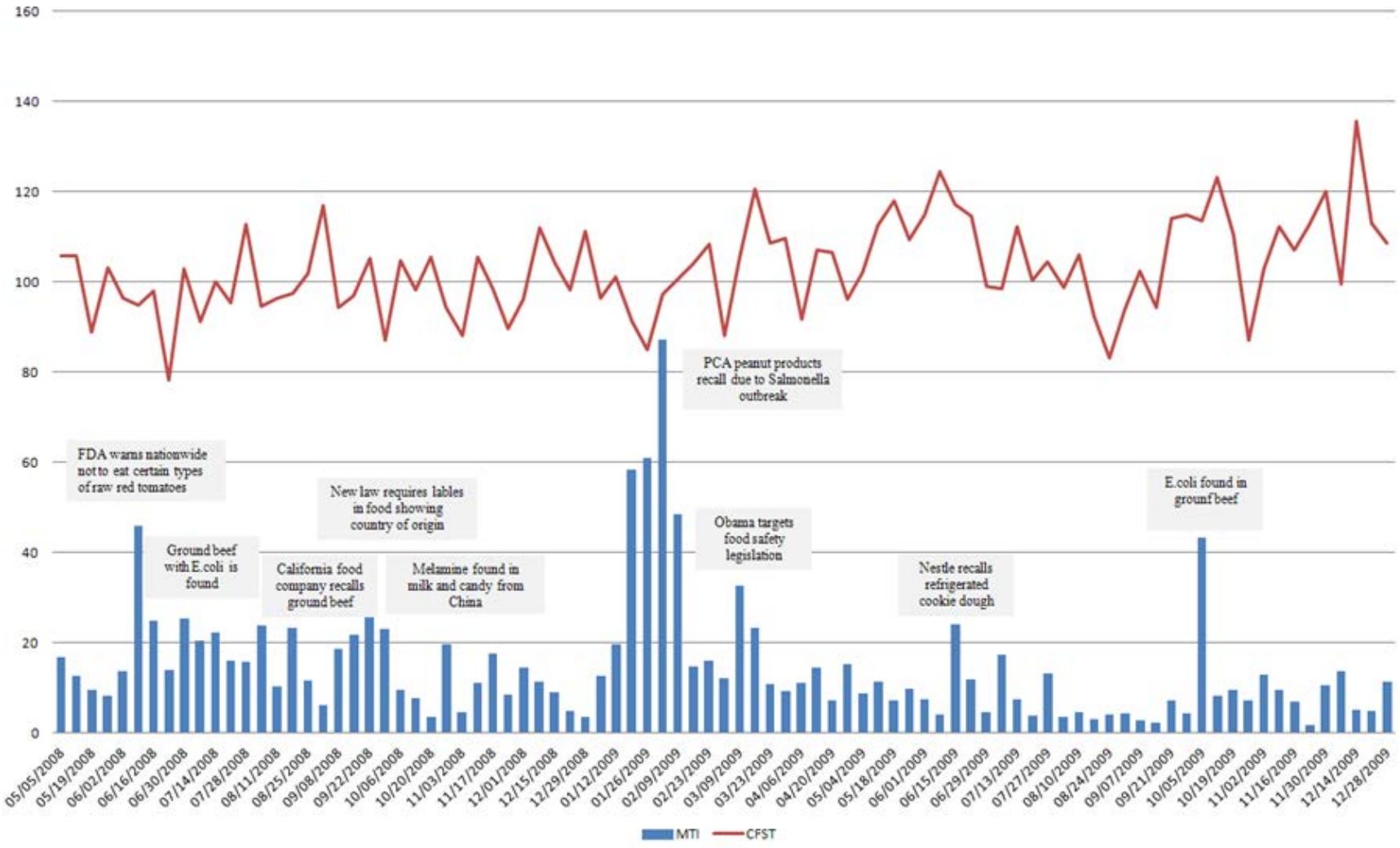

Figure 1. Media.Tracking, Consumer.Confidence and major food safety events (05/05/2008 to 01/03/2010).

Food Industry Stock Price Index (Food.Stock.Price)

The most widely followed stock market indices in the U.S. are the Standard and Poor's (S&P500) and the Dow Jones Industrial Average (DOW). Stock price indices are also commonly used to summarize the historical performance of particular economic sectors. For the present analysis a market-capitalization weighted stock price index for selected U.S. food and beverage companies is constructed by replicating the methodology used in the S&P500. The construction of this index involves two steps. First, following the Industry Classification Benchmark (ICB) definitions of food and beverage producers used by the NYSE, 39 firms are initially selected. Based on data availability at The Center for Research in Security Price's Daily Stock Price dataset, only 31 of the initial 39 firms were included in the Food Industry Stock Price Index (Food.Stock.Price). As shown in Table 1, the index is comprised of 29 food companies and 2 beverage companies (For a complete list of the selected companies see Appendix one).

Table 1. Selected Constituents of Food Companies Stock Index

Industry	Supersector	Sector	Subsector	Number of Companies Selected
Consumer Goods	Food & Beverage	Food Producers	Soft Drinks	29
Consumer Goods	Food & Beverage	Beverages	Food Products	2

The second step consists of calculating and summing the market value of all index constituents. That is, a firm's security price is multiplied by the number of outstanding shares. Next, the final value of the Food.Stock.Price is calculated by dividing the total sum of all firms' market value by a *Divisor*. These operations are expressed by the following formula:

$$(4)\quad \text{Food.Stock.Price}_{it} = \frac{\sum_{i=1}^{n} P_{it} S_{it}}{Divisor},$$

where P_{it} is the closing stock price of firm *i* on day *t*, and S_{it} is the number of outstanding shares of firm *i* on day *t*. All the data for individual firms were obtained from Compustat database, and the selected value of the *Divisor* is the sum of all market values registered in the first day of the sample period. This method takes into account the size of each firm in the index and weights each security accordingly. The $\text{Food.Stock.Price}_{it}$ is initially calculated daily (i.e., the t subscript denotes daily values) and then averaged over the same weekly periods used in the Consumer.Confidence and Media.Tracking indices. The subscript *s* will denote weekly values of the Food.Stock.Price, Consumer.Confidence, and Media.Tracking indices in all subsequent sections of the paper.

Previous literature has shown that market reaction may differ with firm-level characteristics. The most frequently investigated firm characteristic is the size of the company (van Beurden and Goessling, 2008), and Salin and Hooker (2001) confirmed that stock prices react differently to food safety incidents depending on the size of the affected firm. To explore these differences, three additional indices are computed based on the size of the firms in the index. A firm is categorized as large if it is a component of the S&P 500 index (Food.Stock.Price.500), medium

if it is a component of the S&P 1500 index but not of the S&P 500 index (Food.Stock.Price.1500), and small otherwise (Food.Stock.Price.Small). It is important to point out that dividend payments are not included in the index, thus these issues should be regarded as a measure of price appreciation rather than of true investment return. It is reasonable to leave the dividends out of the index because of their constant and predictable nature. Consequently, any changes in the index will account strictly for changes in the stock prices. Finally, the period of analysis descriptive statistics of all variables are shown in Table 2.

Table 2. Descriptive Statistics of All Variables

Variable	Number of observations	Mean	Standard Deviation	Minimum	Maximum
Media.Tracking	87	15.03	13.97	1.68	87.34
Consumer.Confident	87	103.05	10.23	78.37	135.64
Food.Stock.Price	87	83.42	8.87	66.36	99.22
Food.Stock.Price.500	87	84.28	8.34	67.18	98.87
Food.Stock.Price.1500	87	85.70	11.64	62.65	105.25
Food.Stock.Price.Small	87	63.46	17.41	36.57	100.52
S&P500	87	1028.57	184.16	695.19	1412.84

Econometric Methods

To undertake the empirical analysis, the time series properties of all variables need to be examined first. A visual inspection to their individual plots suggests that some variables may be trending, and may not be stationary. An examination of autocorrelation functions (ACF) and the partial autocorrelation functions (PACF) was also carried out to provide further evidence that some series may not be stationary in levels and may contain unit roots. That is, their variances and covariances are not finite or independent over time. As econometric theory suggest, when variables are nonstationary the standard ordinary least squares (OLS) model cannot be applied and there might be a spurious regression[1] (Granger and Newbold, 1974). The stationarity is also investigated by conducting the Augmented Dickey-Fuller test (ADF), the Phillips and Perron (1988) (PP), the Kwiatkowski et al. (1992) (KPSS), and the modified Dickey-Fuller (DFGLS) unit root tests.

The first regression analysis proposed in equation (5) is a simple OLS that estimates both the coefficient of the media impact on consumer confidence and the error term. The model is specified as follows:

$$(5)\quad \text{Consumer.Confidence}_t = \theta + \sum_{i=0}^{n} \pi_i \, Media.Tracking_{t-i} + \varepsilon_t,$$

[1] Spurious regressions are normally characterized by having a high R^2 and statistically significant t-statistics; however, their results have no economic meaning

where Consumer.Confidence$_s$ is the computed weekly index value for consumer confidence in food safety. The lagged values for the weekly values of Media.Tracking are included in the right hand side of equation (5) to account for possible lagged effects of media coverage on the weekly index of consumer confidence. The estimated value of π_1 represents the component of consumer confidence influenced by media (Media.Consumer.Confidence), while the estimated error term represents the component of consumer confidence explained by other factors (Other.Consumer.Confidence). That is, Other.Consumer.Confidence represents factors that affect the variation of Consumer.Confidence, but not explained by the media index. These factors may include differences in demographic characteristics of survey respondents, as well as, variations in individual core beliefs and behavioral characteristics of respondents, and of course, random error.

In a second regression, the DOLS method developed by Saikkonen (1991) and Stock and Watson (1993) is used to estimate the impact of the Consumer.Confidence, Media.Consumer.Confidence and Other.Consumer.Confidence variables on the four different stock price indices. This modeling procedure is selected for several reasons. First, evidence from Monte Carlo simulations shows that DOLS estimators are superior to a number of alternative estimators of long-run parameters, including those proposed by Engle and Granger (1987), Johansen (1988) and Phillips and Hansen (1990). In addition, DOLS allows for estimation of parameters for variables that exhibit different orders of integration, and allows for possible simultaneity bias among the regressors. The model also guarantees valid estimates even in the presence of endogenous independent variables. Finally, DOLS is asymptotically equivalent to Johansen's maximum likelihood estimator, but it tends to perform well with small samples. The DOLS procedure allows for regressing any $I(1)$ variable on other $I(1)$ variables, or on $I(0)$ variables and on the leads and lags of the first differences of any $I(1)$ variables. The final equation of DOLS model is presented in the following section of the paper, and its final specification is based on results from unit root tests for each series.

Results

The results from unit root tests indicate that Media.Tracking, Consumer.Confidence, Media.Consumer.Confidence and Other.Consumer.Confidence variables are stationary variables, while all the stock price indices are integrated of order one[2]. Since Media.Tracking and Consumer.Confidence are both stationary series, we use OLS with robust standard errors to test the effect of media coverage on consumer confidence. Based on the results from the Akaike's information criterion (AIC), the Schwarz's Bayesian criterion (SBIC), and the Hannan and Quinn information criterion (HQIC), up to two week lags for Media.Tracking are included in the estimation to account for dynamic effects of media coverage on Consumer.Confidence. The results in table 3 confirm hypothesis 1 and show how increases in media coverage on food safety recalls have a negative and significant contemporaneous effect on consumer confidence. However, lagged effects do not appear to improve the overall predictive power of the model, reduce the statistical significant to 10 percent, and do not lead to any notable changes in the results. Therefore, and in order to preserve degrees of freedom, subsequent use of the OLS models is confined to the model without lags. According to the results in Table 3, an increase in

[2] All unit root tests were conducted with and without a time trend term, and with different lags structure. However, no qualitative differences were found

the Media.Tracking value of two standard deviations above the mean (an increase of 27.94 points) causes consumer confidence to decrease by 4.6 points. This decrease is non-trivial in the sense that represents a 4.5 percent decrease relative to the mean value of the Consumer.Confidence index.

Table 3. OLS regression of consumer confidence on media coverage.

	Dependent Variables		
Independent Variables	Consumer. Confidence$_t$	Consumer. Confidence$_t$	Consumer. Confidence$_t$
Media.Tracking$_t$	-0.163**	-0.163*	-0.162*
	(0.065)	(0.094)	(0.095)
Media.Tracking$_{t-1}$	-	0.000	0.011
		(0.096)	(0.126)
Media.Tracking$_{t-2}$	-	-	-0.020
			(0.099)
N	87	86	85
R^2	0.049	0.050	0.050

Note: Robust standard errors of estimated coefficients in parenthesis. Asterisks indicate significance at the 10 percent (*), 5 percent (**), and 1 percent (***) level respectively. Values in parenthesis are p-values.

In order to test hypothesis 2, DOLS is now used to estimate the linkage between consumers' confidence in the safety of the food system (i.e. Consumer.Confidence) and stock price indices. First, and as shown in equation (6), all stock price indices are regressed on Consumer.Confidence and the S&P500. The second model (equation 7) uses predicted values of Media.Consumer.Confidence and Other.Consumer.Confidence and error estimates in the first OLS model (equation 5), and the S&P500 as explanatory variables in the stock price model. The DOLS models are as follows:

$$\text{Food.Stock.Price}_{it} = \beta_0 + \beta_1 \text{Consumer.Confidence}_t + \beta_2 \text{SP500}_t + \quad (6)\ \sum_{k=-n}^{k=n} \beta_3 \Delta SP500_{t-k} + \omega_t$$

$$\text{Food.Stock.Price}_{it} = \alpha_0 + \alpha_1 \text{Media.Consumer.Confidence}_t + \quad (7)\ \alpha_2 \text{Other.Consumer.Confidence}_t + \alpha_3 \text{SP500}_t + \sum_{k=-n}^{k=n} \alpha_4 \Delta SP500_{t-k} + \xi_t,$$

where β_1, β_2, α_1, α_2 and α_3 represent the long-run linkages (in time series terms), β_3 and α_4 are coefficients of weekly leads (n) and lags (-n) of the first differences of the *I*(1) regressors, and are treated as nuisance parameters to adjust for possible endogeneity, autocorrelation, and nonnormal residuals. Given the theory of efficient markets, all currently available information should be quickly reflected in stock prices, the DOLS regressions are modeled with one order leads and lags. Finally, both equations (6) and (7) are estimated with the Food.Stock.Price, F

Food.Stock.Price.500, Food.Stock.Price.1500, and Food.Stock.Price.Small as dependent variables in order to account for different firm sizes.

Table 4 shows the results from the estimation of equation 6. Overall market performance has a very significant and positive effect on the stock prices of the basket of food firms – regardless of the firm sizes. For example, in model I, an increase of one unit in the S&P500 index increases the FSP by 0.047 units. Moreover, an increase of one standard deviation in the market value of the S&P500 relative to its mean, which is an 18% increase, increases the market value of the portfolio of the firms included in the FSP index in model I by 0.85%. In model II, given the same increase in the market value of the S&P500, the market value of the portfolio of firms included in the FSP500 increases by 0.77%. In model III, given the same increase in the market value of the S&P500, the market value of the portfolio of firms included in the FSP1500 increases by 1.00%. And, in model IV, given the same increase in the market value of the S&P500, the market value of the portfolio of firms included in the FSP1500 increases by 1.66%. Thus, the coefficient on the S&P500 suggests that the portfolios of food firms are sensitive to the changes in the proxy for the macroeconomic factor.

On the other hand, changes in consumer confidence in food safety has a positive and significant effect on stock prices for all firm sizes with the exception of smaller firms. Interestingly, the significance is of five percent for the general index (Food.Stock.Price), increases to one percent in the case of the largest food firms (Food.Stock.Price.500), and decreases to 10 percent with the medium sized firms (Food.Stock.Price.1500).

Table 4. DOLS regression of stock price indices on consumer-investor confidence.

	Dependent Variables			
Independent Variables	(I) Food.Stock. $Price_t$	(II) Food.Stock. $Price500_t$	(III) Food.Stock. $Price.1500_t$	(IV) Food.Stock. $Price.Small_t$
$S\&P500_t$	0.047***	0.043***	0.060***	0.092***
	(0.001)	(0.002)	(0.003)	(0.004)
$Consumer.Confidence_t$	0.058**	0.101***	0.090*	0.078
	(0.026)	(0.036)	(0.053)	(0.062)
N	84	84	84	84
R^2	0.92	0.85	0.84	0.88

Note: Robust standard errors of estimated coefficients in parenthesis. Asterisks indicate significance at the 10 percent (*), 5 percent (**), and 1 percent (***) level respectively. Values in parenthesis are p-values.

These results merit a more detailed discussion, especially in terms of their magnitude. Given the results in Table 4, for model I a decrease in Consumer.Confidence of two standard deviations below the mean (a decrease of 20.46 points) causes a decrease of 1.19 points in the Food.Stock.Price general index. For model II, the same decrease in Consumer.Confidence causes a decrease of 2.07 points (a larger negative effect) in the Food.Stock.Price500 index. This decrease is economically more significant and represents 2.4 percent decrease in the stock price relative to the mean value of the stock price index for large firms. For model III, the decrease in Consumer.Confidence causes a decrease of 1.84 in the Food.Stock.Price1500 index. This

increase is also economically significant and represents 2.2 percent decrease in stock price relative to the mean value of the stock price index for small firms. Thus, reductions in consumer confidence have negative effects on the profitability of food companies of various sizes. Finally, between 84 and 92 of the total variance is explained by the proposed models. In summary, these results lend support to hypothesis 2, which states that there is a positive relationship between how consumers feel about the safety of the food system and the stock price indices comprised of food companies.

The next step involves decomposing the Consumer.Confidence into explained and unexplained by the media components and the estimation of the DOLS model in equation 7. The results in Table 5 show that the component of consumer-investor confidence not influenced by media has a positive and significant impact on overall and larger food companies' stock prices (Food.Stock.Price and Food.Stock.Price.500) at the five percent level. Furthermore, the component of consumer confidence that is shaped by media coverage has a positive and significant effect only for the Food.Stock.Price.500 at the 10 percent level. Once again, the overall market conditions have a very significant and positive effect in the stock prices of all four baskets of food companies and the between 79 and 84 percent of the variance is explained by the different models.

Table 5. DOLS regression stock price indices on media component of consumer-investor confidence and on the other factors affecting consumer-investor confidence.

	Dependent Variables			
	(I)	(II)	(III)	(IV)
Independent Variables	Food.Stock. Price$_t$	Food.Stock. Price.500$_t$	Food.Stock. Price.1500$_t$	Food.Stock. Price.Small$_t$
S&P500$_t$	0.047***	0.042***	0.059***	0.092***
	(0.001)	(0.002)	(0.003)	(0.005)
Media.Consumer.Confidence$_t$	0.101	0.241*	0.220	0.085
	(0.090)	(0.124)	(0.205)	(0.065)
Other.Consumer.Confidence$_t$	0.056**	0.094**	0.084	-0.076
	(0.027)	(0.037)	(0.056)	(0.243)
n	84	84	84	84
R^2	0.92	0.85	0.84	0.79

Note: Robust standard errors of estimated coefficients in parenthesis. Asterisks indicate significance at the 10 percent (*), 5 percent (**), and 1 percent (***) level respectively. Values in parenthesis are p-values. .

In both regressions, large and statistically significant changes in the consumer confidenceare more evident for larger food producers. This results seem counterintuitive given that larger firms are likely to be more diversified (i.e. holding of nonfood assets), and thus more protected against food safety incidents. Such differences may be the result of smaller firms having lower analyst following or high dispersion of analyst forecasts (Gurun and Butle 2012).

Conclusions and Policy Implications

The empirical results of this paper present strong evidence that media does influence perceptions and beliefs of consumers/investors, thus confirming hypothesis 1. Moreover, these findings indicate the presence of a media "agenda-setting" effect associated with food safety events on consumer confidence in the safety of the food system. Another important contribution of this study is the evidence showing that, as stated inHypothesis 2, consumer confidence (represented by the Consumer.Confidence index) has a positive and significant effect on the stock prices of the selected food companies, with the exception of the smaller firms. Finally, and after the estimation of the two consumer confidence components (one related to media coverage and the second one explained by other factors), it was found that stock prices of the food industry react positively to changes in the latter. In addition, only a marginally significant positive effect was found for the media component and the stock prices of larger food producers. In summary, the empirical results of this study indicate that there is a clear direct effect of media coverage on consumer confidence, and a consistent relationship between consumer confidence and stock prices of the selected firms. Nevertheless, only a weak indirect effect of media coverage on the stock price indices was found. Interestingly, the stock prices of larger firms are most affected by the consumer confidence and its media component (Media. Consumer.Confidence).

In terms of managerial implications, the findings of this study also shed some light on how food companies should weigh the costs and benefits associated with the adoption of additional food safety protocols. With investments in safer production practices, firms may mitigate the risks of a significant drop in stock values. Additionally, vertical integration and/or enhanced traceability may be a strategy to ensure quality and food safety. However, firms may not have the economic incentives to invest in safer production practices because the benefits only accrue in the event of an outbreak. Based on evidence in this study, it may be best for the U.S. food companies to cooperate as sector and with government agencies to prevent individual food safety events that may get extensive coverage from the media and affect the entire industry. Such joint efforts could avert declines in the consumer confidence in the food system and the consequent negative impacts on the firms' wealth. Despite stricter safety standards some events are simply accidental or unavoidable, and in those cases food companies may minimize some of the negative effects through timely public announcements and advertising campaigns after the recall. This may reduce the amount of negative media coverage on the issue and its impact on consumer confidence, which in turn may mitigate negative effects on stock prices. At the policy level, estimating the impacts of food safety incidents on food industry's wealth provides policy makers with additional information on whether or not the costs from these incidents surpass the benefits of regulating and implementing stricter and safer food production practices.

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Appendix

Table A1. List of Food and Beverage Companies in the Stock Indices

Name of Company	Size classification
Archer Daniels Midland Co	S&P 500
ConAgra Foods Inc.	S&P 500
Campbell Soup Company	S&P 500
Dean Foods Company	S&P 500
General Mills, Inc.	S&P 500
H.J. Heinz Company	S&P 500
The Hershey Company	S&P 500
Hormel Foods Corporation	S&P 500
J. M. Smucker Company	S&P 500
Kellogg Company	S&P 500
Kraft Foods Inc.	S&P 500
Tyson Foods Inc.	S&P 500
The Coca-Cola Company	S&P 500
PepsiCo, Inc	S&P 500
Sarah Lee Corp.	S&P 500
Smithfield Foods Inc.	S&P 1500
Tootsie Roll Industries Inc.	S&P 1500
TreeHouse Foods, Inc.	S&P 1500
Ralcorp Holding Inc.	S&P 1500
NBTY, Inc.	S&P 1500
Corn Products International Inc.	S&P 1500
Darling International Inc.	S&P 1500
Flowers Food Inc.	S&P 1500
Schiff Nutrition International, Inc.	SMALL
Nu Skin Enterprises Inc.	SMALL
Omega Protein Corporation	SMALL
Medifast, Inc.	SMALL
B&G Foods, Inc.	SMALL
Bunge Limited	SMALL
Chiquita Brands International Inc.	SMALL
Del Monte Foods Company	SMALL

Source: NYSE

Table A2. List of Variables Used in the Regression Analyses

Acronym	Description
Consumer.Confidence	Continuous food safety tracking index. Used to measure consumer confidence in the food safety.
Media.Consumer.Confidence	Consumer confidence influenced by national media coverage on food safety and food defense events.
Other.Consumer.Confidence	Consumer confidence influenced by other factors other than national media coverage on food safety and food defense events.
Media.Tracking	Media tracking index. Used to measure national media coverage of food safety and food defense events.
S&P500	Standard and Poor's 500. Used to control for general economic and market conditions.
Food.Stock.Price	Food Industry Stock Price Index. Used to measure the performance of this particular economic sector and it includes all selected firms.
Food.Stock.Price.500	Food Industry Stock Price Index 500. It includes all firms in the FISI that are a component of the S&P500, and thus considered large.
Food.Stock.Price.1500	Food Industry Stock Price Index 1500. It includes all firms in the FISI that are a component of the S&P1500 but not the S&P 500.
Food.Stock.Price.Small	Food Industry Stock Price Index small. It includes all firms in the FISI that are not a component of the S&P1500 or the S&P 500.