Stock Market Reaction to Food Recalls

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Paper presented at
Smoothing the Way for International Trade: The Politics of Food Safety
The First Annual Meeting of the National Alliance of Food Safety
Georgetown University, Washington D.C.
October 12-13, 1999

Abstract

Many authors have discussed the potential industry costs of food recalls yet only limited empirical analyses of these costs have been conducted. This paper uses stock market reactions to four recent recalls as an indicator of industry costs. A partial event analysis technique is used to demonstrate the unique impact of recalls separate of any general market trends. These recalls (Odwalla, two IBP events, and Sara Lee) vary by product, company size (and scope), and severity. A discussion of the crisis management strategies conducted by the three companies is included. Detailed information regarding the response of stock prices to recalls is useful in two related ways. First, such data can be used to discuss potential firm and industry-level benefits of adopting particular food safety interventions. Second, it is interesting to compare the market reaction to different recalls to determine if the size and scope (relative to the firms' product range) and severity (in terms of the number of illnesses and deaths associated with the product prior to recall) influence the magnitude of the reaction. Early indications suggest that though share price levels recoup initial losses reasonably quickly a measure of price variability takes longer to recover.

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Foodborne illness imposes significant costs on various stakeholders be they consumers, industry, or the public sector (see table 1). Many authors have discussed the potential industry costs of food contamination incidents that lead to product recalls, but only limited empirical analyses of the various elements of these costs has been conducted to date. This paper investigates the stock market reaction to four recent recalls by using a partial event analysis technique.

Detailed information regarding the response of stock prices to recalls is useful in several ways. First, such data can be used to discuss potential firm and industry-level benefits of adopting a particular food safety intervention. The intervention could be the selection of a particular piece of equipment or the broad adoption of an industry quality assurance or management system. Second, it is interesting to compare the market reaction to different recalls to determine if the size and scope (relative to the firms' product range) and severity (in terms of the number of illnesses or deaths associated with the product prior to recall) influence the magnitude of the reaction. Further, do these measures affect the ability of the share price to recover from the initial decline (in both level and some measure of variability). Finally, in making such comparisons across recalls it is interesting to consider the effectiveness of the various crisis management strategies adopted by firms.

Another important dimension to the costs of food recalls is the burden on consumers. Two main techniques have been used in prior economic analyses to assess consumer responses to food safety information: survey work (Baker; Misra), and demand systems estimation (Henneberry, Piewthongngam, and Qiang; Richards and Patterson). Survey results for hypothetical products and purchasing scenarios have been analyzed using contingent valuation (Misra, Huang, and Ott) and conjoint analysis (Baker). Misra, Huang, and Ott surveyed Georgia consumers in 1989 about preferences for testing and certification that fresh produce is free of pesticides. They found that consumers desire such certification but are unwilling to pay large premiums. Baker used a study of consumer preferences for attributes of apples in relation to pesticide residues and lifetime cancer risk as the basis for identifying market segments, which is useful information for those interested in successfully marketing safer produce.

The econometric work of Henneberry, Piewthongngam, and Qiang analyzed consumer demand for several fresh fruits and vegetables from 1970 to 1992 and assessed the effects on demand of net negative publicity regarding chemical residues on foods. They found that risk information has not had a significant influence on consumption of most of the items studied. Richards and Patterson present similar econometric work, with the addition of separate explanatory variables to characterize the "good news" from the "bad news" publicity. Their analysis of a recent contamination incident initially linked to California strawberries revealed that

adverse information can substantially reduce grower profits, while positive information can partially offset negative effects. This finding suggests that managers might be able to mitigate damage among consumers through public announcements.

All of this research on consumers' reaction to news reports of food safety incidents was at the market level focusing on commodity groups rather than a particular company or brand. The present event study, in contrast, measures reactions linked to specific firms, and the market in question is not consumer purchases of the food, but shareholders' investments in common stock.

Another difference between this study and prior work is that the recalls are due microbiological rather than pesticide contamination. Microbiological contamination (arising from bacteria, viruses, or parasites) presents an immediate health concern for consumers, rather than the long-run chronic health effects that may result from exposure to pesticide residues. Such contamination causes brief illness, severe sickness, or death, with the most severe effects expected among older, very young, or immuno-compromised consumers. Presumably, microbiological risks cause different consumer reactions than the life-time risks associated with pesticides.

The main contribution of this study is that it is the first quantitative investigation of firm-specific repercussions of actual incidents of microbiological contamination of foods. The results provide conclusions about how financial markets value food safety. The *Wall Street Journal* reported that the Hudson Foods incident, a recall of 25 million pounds of ground beef in August, 1997, "...sensitized Wall Street to food safety issues..." (Gibson and Kilman). This paper tests that claim by examining shareholders' reaction to other food recalls before and after this date, in an event study of stock returns. To the extent that the goal of management is to enhance shareholders' wealth, it is important for researchers to consider the reputation of a firm among its owners as well as among its customers. Differences in the reaction of the two audiences, owners and customers, may suggest different management responses to food safety issues. The trust-building measures that are appropriate for the general public, such as general media publicity, may not satisfy stockholders, or may not be needed at all.

Contamination Incidents

Product contamination incidents of varying severity affected Sara Lee Corp., IBP Inc., and Odwalla, Inc., between 1996 and 1998. Sara Lee Corp., is a multi-division firm employing some 139,000 people over 40 countries and is ranked number 4 on the 1999 *Fortune* Global 500 list for the food industry. Sara-Lee Foods division processes packaged meats by its subsidiary Bil-Mar Foods. IBP Inc. is a large U.S. meat packing and processing company that produces meats mainly in commodity form for further processing or export. IBP is number 8 on the 1999 *Fortune* Global 500 list for the food industry and number 2 on the 'Top 100' of meat and poultry companies, Sara Lee Packaged Meats is number 5 (*Meat and Poultry*, July 1999). Odwalla, Inc.

is a small manufacturer (1998 net sales of $59 million) and distributor of fresh fruit juices and natural foods that trades heavily on its image as a provider of highly nutritious products.

In 1996, Odwalla apple juice was contaminated with *Escherichia (E.) coli* O157:H7 bacteria. One death and 66 illnesses were linked with the incident. Odwalla recalled its products after learning of the problem on October 30, 1996. Direct costs from the recall and related claims were 12.4% of sales in fiscal 1997, and 2.1% of sales in fiscal 1998 (year ending August 30; U.S. Securities and Exchange Commission 10-K report) Legal proceedings account for some of the costs. Seventeen personal injury claims were settled and covered by insurance; 5 claims are still pending; and a plea agreement pursuant to a Federal grand jury investigation in July 1998 required a substantial payment.

IBP, Inc. recalled ground beef after contamination with *E. coli* O157:H7 bacteria was discovered, on two occasions. No illnesses were reported in connection with these recalls. The quantities affected were 282,128 pounds recalled on April 29, 1998 and 556,226 pounds recalled on November 4, 1998. Each of the IBP recalls is treated as an independent event in the analysis below.

Sara Lee Corporation recalled 15 million pounds of hot dogs and deli meat products on December 22, 1998 because of contamination with *Listeria*. The contamination was linked with 21 deaths and more than 100 illnesses in 21 states. The company recorded a $76 million charge for the costs of the recall, compared with $10.15 billion in net sales and $660 million in net income for the 6-month period in which the recall occurred (U.S. Securities and Exchange Commission 10-Q report). The charge is the company's estimate of costs of return and destruction of products from retail and distribution, destruction of inventory at the plant, and liability.

Event Study Methodology

An event study uses financial market data to measure the impact of a specific episode on the value of a firm (MacKinlay). First, the "normal return" of the stock is estimated by comparing the returns on a company's stock to a broad index of the market over time. Then any "abnormal return" during the period of interest can be attributed to the event.

The normal performance of the stock is represented with the market model. This statistical model relates the return on a particular security to the return on a broad-based market portfolio. The maintained hypothesis of the model is that returns on an asset are linearly related to returns on a broad portfolio of assets in the market. The specification is a simple linear regression. We use two different market portfolios as explanatory variables in two separate market models. The general market portfolio is represented by the S&P 500 composite index.

Another version of the market model uses the S&P index for the food industry to represent the market portfolio.

As a single-variable linear regression, the market model omits many variables likely to explain stock returns. An alternative way to represent normal performance of the stock is a factor model, which is also linear but has multiple explanatory variables. The factor model specification used in this study includes both the S&P 500 composite index and the S&P food industry index. The addition of the industry-specific index is thought to increase explanatory power of the model.

Data

Daily closing stock prices for the three firms and Standard and Poors (S&P) 500 and S&P 500 - Food indices were collected from Datastream™. This database reports prices for every weekday regardless of whether the market was open or closed for a public holiday. To correct for repeated observations, such days were deleted. Volume and daily high/low prices were taken from the finace.yahoo.com website. Both data sources include adjustments for stock splits.

The event dates correspond to the press release days for the four recalls. These 'voluntary' dates follow significant company analysis and review perhaps initiated by the detection of bacteria in random samples (e.g., the IBP cases). Further, public health agencies may be involved when the product has entered the final consumer market place and foodborne illnesses need to be traced to their source. In either case the stock market may be better informed than consumers prior to the press release resulting in reductions in share prices prior to the event days.

The volatility of daily returns (the day-to-day difference in the daily closing share price) on each stock in the period before the incidents are shown in table 2. Odwalla and Sara Lee experienced more variability in daily returns than IBP, as measured by the coefficient of variation. Two pre-event estimation periods of 120 and 250 days prior to the incident date were selected, following MacKinlay). For the second IBP event, the longer of these two windows overlapped with the first event. To prevent any dilution of the impact this estimation period was not considered.

Normal Return Models

The estimated parameters of the three models are the constant, which represents average return on the stock during the estimation period, and the coefficients on market indexes, which represent the sensitivity of an individual security to the market. Estimated parameters for the models of normal stock performance are shown in table 3. The overall explanatory power of the

models is quite low. R^2 does not exceed 0.3822, and in 16 of the 24 regressions, the R^2 is less than 0.10. This result is typical of event studies. The implication is that the movements in stock prices for an individual firm are not well explained by the market. In general, R^2 increased from the use of the two-factor model compared with the general market model, but the increases were modest. This result supports the findings of other researchers that the simple market model is usually an adequate specification for the normal return model in event studies (MacCauley; Cable and Holland). The choice of the market index used in the simple market model appeared to matter. In all but 3 cases, R^2 is higher in the model with the S&P composite for food companies as the portfolio of reference, compared with the models using the S&P 500.

The coefficient estimates (table 3) represent the share of the movement in returns of the stock that is accounted for by movements in the market. The coefficients are statistically significant in most cases. Returns on Sara Lee Corp. shares are closely related to the food industry index, with coefficients between 0.80 and 1. Returns for IBP, Inc. are much less tied to either market index than those for Sara Lee, and surprisingly, the food index has less correlation to IBP returns that does a general market portfolio. Returns on Odwalla stock moved faster than the market indexes in the shorter-run model, as indicated by the coefficients greater than one. This result underscores the volatility in Odwalla share prices even prior to the recall. The estimated constants in the normal return models equal zero to two digits rounding, indicating that investors cannot expect positive short-run returns over the market from holding these companies' stocks.

Abnormal Returns Associated with Food Recalls

Once the base model for stock market returns has been developed, the parameters are used to estimate abnormal returns that occur immediately after the event. Abnormal returns are estimated as a disturbance term calculated on an out of sample basis (MacKinlay). They are the difference between the market model's predicted return and the actual return. An abnormal return is calculated for each observation within a particular post-event window. Event windows used are 10 days, 20 days, 30 days, and 40 days. Abnormal returns (in percent) across the event window period are cumulated and presented in table 4. The estimated cumulative abnormal returns have the expected negative sign, but only a few are statistically different from zero.

For Odwalla, negative returns are greater than 30% and statistically significant only immediately after the event. The volatility in Odwalla stock prices before the event is large, so that it is difficult to obtain statistical power with any forecasts based on the normal return model. The daily returns during the immediate post-event period were close to market on many days, but two days of very large negative returns (-0.20 and -0.10) contribute to the large cumulative negative return.

The first IBP recall was associated with the strong evidence of declining stock market reactions to food recalls. IBP's second recall, which was larger than the first in terms of quantity of product, was not accompanied by statistically significant abnormal returns in any event window. The lack of apparent reaction could result from increased volatility and resulting statistical difficulties with forecasts. Or, the lack of reaction could suggest that the stock market has "learned" from IBP's initial recall that the management reacts well and that there are little long-term expected effects on IBP's financial health from the food contamination. The fact that the bacterial contamination in the ground beef was identified before reaching consumers could have bolstered investors' confidence in IBP's management of food safety risks.

Sara Lee Corp. stock exhibited significant abnormal returns only in the model that included the S&P 500 market portfolio, and only for the 20-day window.

The preceding analysis of abnormal returns focused on changes in the levels of returns. Riskiness of returns is also important to shareholders and business managers. Statistical analysis of the volatility of returns before and after the events provides preliminary evidence that returns are more volatile after the recall. The volatility differences appear to persist longer than the abnormal returns. The reader should note that these statistical measures do not control for variability associated with the market overall, or for other factors in the company's business environment.

We present three measures that relate to volatility. The first, the standard deviation of daily returns, is the standard measure of stock price risk. In addition, we computed a daily price spread and normalized it on the daily opening stock price to represent intra-day price movements. Volume traded is also shown, although volume is associated with movement in the market, it is not always connected with price variation. These measures are computed for 50, 100, and 150 days before and after the recall. The daily spread and volume measures are averaged over the 50, 100, and 150 day periods. It should be noted that the 150 days before IBP's second recall overlaps with the first IBP recall.

Sara Lee Corp. shares were more volatile after the recall, according to both the standard deviation and the daily intra-day spread measure. The differences in volatility were statistically significant in all periods up to 150 days following the food recall. Volatility for IBP was not greater immediately after the recall, but was higher in the periods 100 days and 150 days following the recall. IBP's second recall was not associated with an increase in volatility; in fact there was a discernable decrease in volatility for the 50 days following the recall compared with 50 days prior to the recall. Odwalla stock was a more volatile investment than the other firms examined, both before and after the recall. Standard deviation of returns was larger after the recall, in all three time periods. Intra-day price spreads were only larger in the period immediately after the recall.

Limitations of the Analysis

The final phase in a typical event study is to aggregate abnormal returns across many firms experiencing the same event, in order to draw general conclusions about the market reaction. Aggregation across firms is impossible for this study, because of the relatively small number of food contamination events that have occurred for publicly traded companies, compared with sample sizes in the hundreds for event studies typically conducted in finance. Further, the paper's focus on the impact on firm reputation required these four recalls to be treated as separate events. Aggregation would also be difficult across heterogeneous types of firms, each experiencing recalls of different levels. One could also anticipate problems with event clustering, as recall periods for firms would overlap in time, and the need to account for potential contagion of food contamination problems at one firm into investors' expectations regarding similar firms.

Discussion and Conclusions

This event study suggests that financial markets reacted in a limited way to certain food recalls. This event study of stock market reaction to food contamination events suggest that returns to shareholders are negatively affected. Negative repercussions did not last very long after the events; with only one lasting at least 40 days. The negative effects were strongest immediately after the event and for the smallest firm in the study. Based on four recalls of differing scope and severity, there appears to be little or no relationship between the stock price reaction and the severity of the recall.

Research that assesses the effects of food contamination on consumer demand suggests that publicity is a potentially effective crisis management technique that a firm could use to repair its reputation with the general public. This paper highlights a different approach by considering the effects of food contamination incidents on the firm's image in the stock market. Managers must be the judge of which audience most concerns them. The reaction by different audiences only matters to the extent that managers' behavior with respect to the relationship differs. A manager might work on the relationship with the stock market through annual reports, press releases designed for the analyst community, or personal communications with financial reporters, analysts and shareholders. These are different tools than the general media, the Internet, and advertising that are more oriented toward consumers.

Whether or not the managers' efforts to affect stock market reaction are different than managers' efforts to maintain consumer confidence after food contamination incidents, this study illustrates that there clearly are differences in research approaches. Share price data are a readily-available way to isolate firm-specific effects of a given contamination event. The econometric methodology is straightforward, but gave mixed results. The authors encourage further analysis of this exciting topic. Extensions to this general research area may arise from considering

additional recalls. Also it would be interesting to attempt to gauge stock market analysts' reactions during a large recall, perhaps using a survey by companies such as First Call™. Scanner data may allow a more detailed analysis of consumers' reactions at the product level. In particular the data can be used to determine the presence of positive or negative 'spillovers' to similar products following a competitors' recall or other branded (non recalled) products of the affected company..

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Table 1. Taxonomy of Social Costs from Foodborne Illness.

Allocation of Costs	Cost Center
Costs to individuals	Income and productivity losses
	Pain and suffering
	Leisure time losses
	Averting behavior costs
	Risk aversion costs
	Travel costs
	Child care costs
	Medical costs
Industry costs	Product recall
	Plant closures and clean-up
	Product liability costs
	Reduced product demand
Public health costs	Outbreak investigation
	Disease surveillance
	Clean-up costs

Source: Roberts (1989).

Table 2. Statistics on returns, 250 days before event.

	Sara Lee	IBP	Odwalla
		percent	
Minimum	-0.0570	-0.0462	-0.1111
Maximum	0.0499	0.0484	0.1882
Average	0.0001	-0.0003	0.0002
Standard deviation	0.0171	0.0139	0.0397
Coefficient of variation	133.5884	-49.2860	192.6640

Table 3. Parameters of normal return models, estimated for 120 days and 250 days prior to event.

	S&P 500		S&P Food			
	Parameter	Standard error	Parameter	Standard error	Constant	R^2
Sara Lee--120 days						
Market portfolio	0.4139**	0.1068	-	-	-0.0004	0.1129
Food industry	-	-	0.7958**	0.1016	-0.0001	0.3422
Factor model	-0.2403*	0.1333	0.9895**	0.1472	-0.0000	0.3600
Sara Lee--250 days						
Market portfolio	0.5049**	0.0784	-	-	-0.0004	0.1433
Food industry	-	-	0.8527**	0.0704	-0.0002	0.3715
Factor model	-0.2039**	0.0985	1.0101**	0.1034	-0.0000	0.3822
IBP 1--120 days						
Market portfolio	0.3148**	0.1278	-	-	-0.0010	0.0489
Food industry	-	-	0.4250**	0.1235	-0.0039	0.0912
Factor model	-0.0416	0.1972	0.4568**	0.1950	-0.0009	0.0915
IBP 1--250 days						
Market portfolio	0.2393**	0.0888	-	-	-0.0006	0.0367
Food industry	-	-	0.2616**	0.0746	-0.0005	0.0473
Factor model	0.0139	0.1566	0.2500	0.1509	-0.0005	0.0473
IBP 2--120 days						
Market portfolio	0.5903**	0.1443	-	-	0.0028	0.1242
Food industry	-	-	0.3336**	0.1645	0.0029	0.0337
Factor model	0.8062**	0.2145	-0.3157	0.2328	0.0028	0.1378
Odwalla--120 days						
Market portfolio	1.8008**	0.5529	-	-	-0.0017	0.0825
Food industry	-	-	1.9728**	0.5863	-0.0028	0.0876
Factor model	0.9560	0.8048	1.2314	0.8557	-0.0026	0.0984
Odwalla--250 days						
Market portfolio	1.0652**	0.3456	-	-	-0.0006	0.0369
Food industry	-	-	0.8922**	0.3331	-0.0005	0.0281
Factor model	0.8454	0.5288	0.2788	0.5074	-0.0004	0.0381

* statistically significant at the 90% level. ** statistically significant at the 95% level.

Table 4. Cumulative Abnormal Returns from Food Contamination, for Various Post-event Windows.

	10-day	20-day	30-day	40-day
	---------- percent ----------			
Sara Lee--120 days				
Market portfolio	-0.0495	-0.1356	-0.1286	-0.0557
Food industry	-0.0425	-0.0783	-0.0594	-0.0107
Factor model	-0.0339	-0.0620	-0.0393	0.0019
Sara Lee--250 days				
Market portfolio	-0.0544	-0.1381*	-0.1322	-0.0587
Food industry	-0.0428	-0.0735	-0.0532	-0.0053
Factor model	-0.0359	-0.0609	-0.0380	0.0033
IBP 1--120 days				
Market portfolio	-0.0524	-0.0858	-0.0428	-0.1084
Food industry	-0.0681*	-0.1093**	-0.0732	-0.1339*
Factor model	-0.0690*	-0.1114**	-0.0757	-0.1359*
IBP 1--250 days				
Market portfolio	-0.0546	-0.0939	-0.0538	-0.1224
Food industry	-0.0630	-0.1080*	-0.0713	-0.1359
Factor model	-0.0627	-0.1073*	-0.0705	-0.1353
IBP 2--120 days				
Market portfolio	-0.0957	-0.1257	-0.0504	-0.0982
Food industry	-0.0855	-0.0945	-0.0135	-0.0394
Factor model	-0.0968	-0.1374	-0.0701	-0.1194
Odwalla--120 days				
Market portfolio	-0.3470**	-0.1101	-0.1334	-0.2729
Food industry	-0.3536**	-0.0925	-0.0554	-0.2027
Factor model	-0.3601**	-0.1161	-0.0940	-0.2422
Odwalla--250 days				
Market portfolio	-0.3298**	-0.0785	-0.1285	-0.2646
Food industry	-0.3286**	-0.0630	-0.0962	-0.2364
Factor model	-0.3331**	-0.0805	-0.1222	-0.2611

* statistically significant at the 90% level. **statistically significant at the 95% level.

Table 5. Volatility of stock prices before and after food recalls.

		Days prior to event			Days after event		
		50	100	150	50	100	150
SLE	std. deviation of returns (%)	0.018	0.021	0.019	0.022*	0.024*	0.022**
	avg. intra-day spread (%)	2.504	2.909	2.619	3.107**	3.273**	3.022**
	avg. daily volume (shares)	897,208	1,024,761	941,803	2,710,278	2,758,982	2,478,807
IBP1	std. deviation of returns (%)	0.012	0.013	0.013	0.010	0.025**	0.024**
	avg. intra-day spread (%)	1.764	1.783	1.842	1.548	2.223**	2.426**
	avg. daily volume (shares)	198,924	215,653	249,786	230,854	298,003	354,063
IBP2	std. deviation of returns (%)	0.029	0.028	0.024	0.019	0.022	0.025
	avg. intra-day spread (%)	3.289	2.684	2.356	2.604**	2.927	3.117**
	avg. daily volume (shares)	516,256	390,948	338,859	500,902	413,354	379,711
ODW	std. deviation of returns (%)	0.037	0.041	0.043	0.071**	0.054*	0.050**
	avg. intra-day spread (%)	5.069	5.437	5.424	7.283**	6.040	5.990
	avg. daily volume (shares)	24,192	26,777	33,456	188,104	110,988	84,153

Average intra-day spread is daily high price minus daily low price, as a percent of opening price.
* statistically significant at the 90% level. **statistically significant at the 95% level.