Consumer Reaction to Food-Safety Concerns: The Role of Supplier Behavior

Sayed H. (Mehdi) Saghaian

This study examines the role of supplier attitudes and behavior on consumer response to a food-safety incident. The objective is to investigate consumers' reactions to how the news of a food-safety scare is handled, reflected in price changes in the immediate neighborhood of the news.

Public concern for food safety has increased during the past two decades due to the increased incidence of food-safety scares worldwide. Food-safety scares can have short-run and long-run impacts on consumer preferences because of their health and well-being implications, leading to huge costs to the food industry. Such costs stem from product recalls and foregone sales as well as quality-assurance provision and promotion measures, and are directly linked to the impact of a food-safety incident on consumers' trust in suppliers. The reliability of suppliers and a perceived discrepancy between different suppliers' reliability may explain the impact of a food-safety incident on consumers and their loss of confidence or trust (Bocker and Hanf 2000).

In general, when it comes to food safety and reliability, consumers differentiate among product brands and origins, and trust in suppliers and retailers plays a major role in their purchasing decisions. This is in part due to the fact that consumers are unaware of unsafe food, a priori, and rely on suppliers' credibility and reputations; any news of a food-safety scare involving a particular supplier impacts consumers' perceptions and judgments regarding the reliability of that supplier. A survey of German consumers by Becker et al. (1996) showed "trust/safety" was one of the main factors influencing the choice of a particular meat-product retailer. In an experimental study, Bocker (2002) tested the hypothesis that consumer reaction to a food-safety scare could be explained by differentiation between suppliers with respect to reliability. In this study, we focus on the Japanese beef market and examine supplier attitudes and behavior by considering the impact of the Bovine Spongiform Encephalopathy (BSE) discovery on Japanese consumers' purchasing decisions.

Beef was not the primary source of animal protein in the Japanese diet until recently. As Japanese social structures changed and real per-capita income increased, consumers gradually accepted beef, and its consumption grew faster than any other meat. Annual per-capita consumption increased from 4.12kg in 1986 to 7.7kg in 1996. Japanese beef consumption hit 542,800 metric tons in April–September 2000. This consumption was up 3.2% from the same period in 1999, as reported by Japan's Ministry of Agriculture, Forestry, and Fisheries. For the time frame of this study (1994:04 to 2002:12), the Japanese beef market mainly comprised four types: two domestic types (wagyu and dairy) and two imported types (U.S. and Australia). Japan was the largest beef-importing country in the world in terms of value and second (behind the U.S.) in terms of volume.

The Japanese beef industry faced the BSE crisis in September of 2001. The BSE discovery in Japan resulted in considerable economic damage to Japanese beef producers as well as to food service industries, in part due to the actions of Japanese beef industry and government officials that impacted consumer confidence and trust (McCluskey et al. 2004). In widely published remarks, Japanese meat industry officials responding to the BSE discovery originally differentiated beef suppliers by country of origin, indicating that imported (American and Australian) beef was the most likely source of BSE in Japan, (Zielenziger 2001; Jin and Koo 2003; McCluskey et al. 2004). However, after a two-week delay in publicly announcing the first confirmed case, the government's assurances of healthy domestic animals were contradicted by a second case a month later, prompting more anxiety among consumers (McCluskey et al. 2004). This study investigates the impact of the beef-safety scare and the initial differentiation of suppliers on consumers' response to the scare. The retail-level Japanese beef prices in the immediate neighborhood of the event are utilized for this purpose. The question is whether supplier differentiation and the handling of the beef-safety scare affected consumer trust and purchase decisions after the beef-safety incident.

Saghaian is assistant professor, Department of Agricultural Economics, University of Kentucky, Lexington.

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The Model and Data

Prices of four beef types identified by type and origin—U.S., Australian, Japanese wagyu, and Japanese dairy beef—were evaluated. The monthly time-series retail-price data employed by Peterson and Chen (2005) were used. The assumption is that the impact of the BSE scare on consumers is reflected in the prices because in the short-run supply is rigid and demand shocks are translated into price shocks. The sample contained 105 observations from April 1994 to December 2002. Retail prices were national monthly averages for beef obtained from Agriculture and Livestock Industries Corporations (ALIC) data. These prices were the weighted prices of four cuts (chuck, loin, round, and flank) reported by ALIC based on Nikkei Point-of-Sales.

The methodological approach used in this study included Johansen's cointegration tests along with a VEC model, directed acyclic graphs, and historical decomposition.[1] VAR/VEC models have the advantage of describing the reaction to scares dynamically and cointegration binds the series into a long-run relationship. Historical decomposition provides a visual explanation of the impact of the beef-safety shock on the price series in the neighborhood of the event. The first step is to test if the series are stationary by using the Augmented Dickey-Fuller (ADF) test. The ADF test can under-reject when sudden shocks are the cause of structure breaks in series with deterministic trends, and prior to ADF, tests for structure breaks in the series are recommended (Sanjuan and Dawson 2003).

Johansen's co-integration test is performed to determine whether the series are co-integrated and, if so, the co-integrating rank, r, using the likelihood ratio (Holden and Perman 1994). If the series are integrated and co-integrated, then a VEC Model is appropriate to characterize the multivariate relationships among the variables in the series (Engle and Granger 1987; Enders 1995). The VEC model uses both short-term dynamics as well as long-term information; it has a co-integrating equation which captures the long-run relationship among the variables due to the presence of co-integration. The covariance matrix of the VEC model is used to investigate the causal relationship among the variables using directed acyclic graphs (Bessler and Akleman 1998). Finally, historical decompositions break down the quantity series into historical shocks in each series to determine their responses in a neighborhood (time interval) of the BSE event.

[1] For a detailed explanation of the model see Saghaian, Maynard, and Reed (2007).

Results

The results of the unit-root test were estimated by OLS and are presented in Table 1. The second column of the table shows that the null hypothesis of zero first-order autocorrelation cannot be rejected at the five-percent level of significance except for U.S. and dairy quantities, given the MacKinnon critical value. The right-most column of Table 1 gives the results of the ADF test for the first-difference transformation of the series. The null hypothesis was rejected for all variables after first-differencing.

Table 2 presents the results of co-integration tests for the price series. As indicated by these results, the null hypothesis that $r = 0$, $r \leq 1$, and $r \leq 2$ was rejected at the five-percent level. However, the null hypothesis that the co-integrating rank of the system was at most 3 could not be rejected at the five-percent level. Thus there exists a long-run stationary relationship among the price series—specifically, the beef price series were part of the cointegration space—so the VEC model was appropriate in order to determine the directed graphs and causal patterns.

The residual correlation matrix of the estimated VEC models provided the contemporaneous innovations that showed how errors among the endogenous variables were related. The strongest correlation existed between the Japanese wagyu and dairy prices (0.674). The results showed that residuals associated with the two import origins were more strongly correlated to residuals from Japanese wagyu beef than from Japanese dairy beef. There was little correlation in residuals for U.S. and Australian

Table 1. Augmented Dickey-Fuller (ADF)[a] Test Results.

Variable	Test results for variables in levels	Test results for variables after first-differencing
U.S. beef price	2.64	9.47*
AUS beef price	2.39	11.60*
Japan wagyu beef price	2.13	11.11*
Japan dairy beef price	1.64	13.05*

* 1% significance level.
[a] Test statistics are in absolute value and compared to MacKinnon one-sided p-value.
Source: Saghaian, Maynard, and Reed (2007).

Table 2. Johansen Cointegration Test Results.

Null hypothesis[a]	Trace statistics	5% critical value	Eigenvalue
$r = 0$*	206.18	125.62	0.54
$r \leq 1$*	128.64	95.75	0.42
$r \leq 2$*	74.64	69.82	0.29
$r \leq 3$	41.05	47.85	0.17

[a] r is the cointegrating rank, MacKinnon-Haug-Michelis p-value.
* 5% significance level.
Source: Saghaian et al. (2007).

beef prices (0.067). A formal test of contemporaneous causal structures was performed using TETRAD IV software to generate the causal patterns and structure of the series on innovations from the endogenous variables in the system (Spirtes et al. 1999), and the historical decomposition results for the endogenous variables from the BSE shock over a 12-month horizon were generated.

Figure 1 presents the impact of the 2001 BSE discovery on beef prices. The solid line is the actual price including the impact of the food scare, and the dashed line is its forecast without any shock. The response of domestically produced beef prices in Japan after the BSE shock contrasts with the pattern for imported beef prices in the early months. As discussed earlier, Japanese meat-industry representatives initially announced domestically produced beef to be safe and blamed imported beef as the source of the BSE scare, influencing Japanese consumers' trust in the U.S. and Australian beef supplies. In response, as shown by the results, imported beef prices fell immediately in reaction to the BSE discovery, but Japanese domestically produced wagyu and dairy beef prices actually rose after the BSE outbreak, which shows that consumers switched to meats considered to be free of a BSE threat. This indicates Japanese consumers reacted to the differentiation between suppliers in terms of riskiness, increasing their confidence in the domestically produced beef; Japanese consumers' beef-purchase decisions were impacted by the perception of risk and reliability of beef suppliers. Customers did not abandon all beef, but differentiated beef by perceived riskiness of the source. A survey of German customers by Bocker and Hanf (2000) showed that in the case of BSE in Germany, consumers similarly shifted from one supplier to another by switching to local butcheries that they trusted for safer products.

Immediately after the BSE discovery, U.S. beef import prices fell the most dramatically and saw the widest difference between the actual and forecasted prices. U.S. beef prices rebounded after the first two months, suggesting an increased consumer confi-

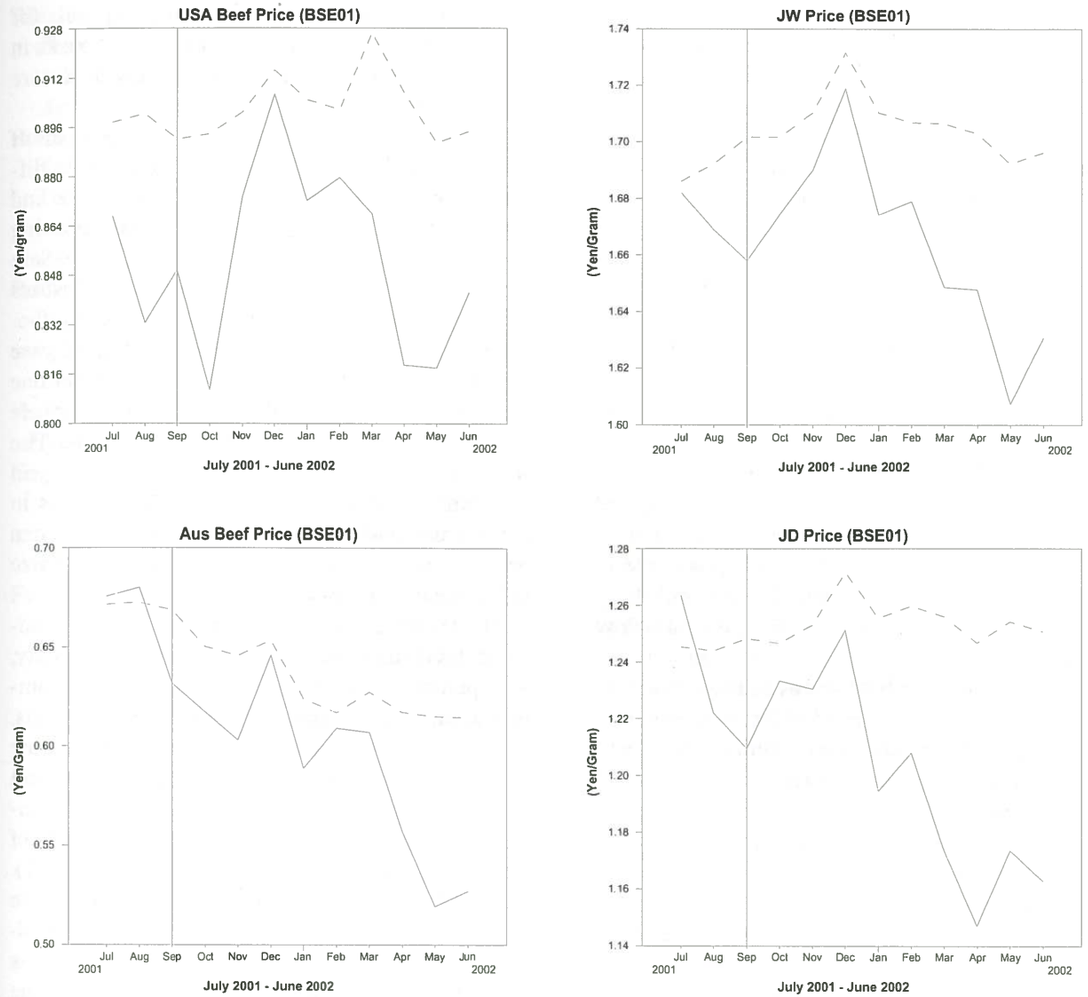

Figure 1: The Impact of BSE on Beef Prices in Japan (in log-form).

Source: Saghaian, Maynard, and Reed (2007).

dence, but they took another quick dive with the second announcement of the BSE discovery, reaching their lowest point in May (an eight-percent drop relative to no-BSE), approximately seven months after the outbreak. Australian beef prices followed a similar pattern to U.S. prices except there was no dramatic drop during the first month. They also reached their lowest point in May, a ten-percent drop because of BSE.

With the second announcement of BSE discovery and the perceived discrepancy in the news and between suppliers, all beef prices were adversely impacted, indicating erosion of consumer trust and confidence in the whole beef industry. Japanese wagyu and dairy prices remained rather close to what was projected before the outbreak, but by December those prices began to fall absolutely and relative to what they would have been without an outbreak. Wagyu prices reached a low point in May at 5.1 percent below the no-BSE case, and dairy prices reached a low in April at 7.8 percent below the no-BSE case.

Overall, domestic beef prices fell less than imported prices, which suggests that Japanese consumers still had more confidence in domestic beef production despite the BSE outbreak, a sign of brand loyalty. These insights into consumer behavior can help supply-chain managers and practitioners in the food industry to understand and develop appropriate strategic responses. The changing purchasing patterns for consumers of meat products faced with food-safety concerns and the supplier attitudes and behavior with respect to reliability and quality of the information provided have strategic implications.

Conclusion

The distinctive price responses to the food-safety scare suggest that Japanese consumers paid attention to what was reported regarding the origin and type of contaminated beef products, as well as the source and type of contamination. The discrepancy and inconsistency of the initial BSE report impacted Japanese consumers' perceptions and purchase decisions and their trust in different supply sources. In response to the crisis, the Japanese government launched an aggressive marketing campaign promoting the safety of Japanese beef (Fox and Peterson 2002). Overall, consumer concerns and the public and private costs of the beef-safety incident led to increased attention to strategic options for prevention and management of beef-safety risks in order to reassure consumers, attempting to restore lost markets.

Producers and retailers need to be cognizant of the length and extent of consumer reactions to different food-safety scares. Proactive accurate and quality information provision in the food-marketing systems can reduce the impacts of a food scare. Safe food seems to be largely a public good, so industries have an interest in developing protocols together to provide greater safety assurances. A BSE case or salmonella outbreak can impact everyone; one incidence of "bad strawberries" hurts the whole strawberry industry and even related fruits. The food industry must continue to invest heavily in procedures that will reduce food-safety scares in these areas and in information systems that can provide on-time accurate information to minimize the impacts of food-safety shocks.

Beef producers and retailers can promote branded beef with emphasis on variety, safety, reliability, and quality to differentiate themselves from competitors and gain competitive advantage over rivals. Beef quality-assurance schemes now incorporate proactive measures such as information provision to minimize consumers' perception of risk associated with search, experience, and credence of beef attributes (Fearne, Hornibrook, and Dedman 2001). McCluskey et al. (2004) provide arguments for the need for monitoring and validation to build credibility among consumers for credence attributes such as labeled BSE testing and traceability throughout the production process. Quality labeling is now more widely applied than ever before in Japan in order to gain consumer confidence. Food-safety scares are likely to continue shocking commodity prices in the future, but it is hoped that more information and tracking systems will be developed to reduce the shock effects. Furthermore, the more food producers educate their consumers and differentiate their products, the less likely consumers' reactions to food scare will hurt the food industry when shocks do occur.

References

Becker, T., E. Benner, and K. Glitsch, K. 1996. "Wandel des Verbraucherverhatens bei Fleisch." *Agrarwirtschaft* 45:267–277.

Bessler, D. A. and D. G. Akleman. 1998. "Farm Prices, Retail Prices and Directed Graphs: Results for Pork and Beef." *American Journal of Agricultural Economics* 80:1144–1149.

Bocker, A. 2002. "Consumer Response to a Food Safety Incident: Exploring the Role of Supplier Differentiation in an Experimental Study." *European Review of Agricultural Economics*, 29(1): 29–50.

Bocker, A. and C.-H. Hanf. 2000. "Confidence Lost—Partially—Regained: Consumers' Response to Food Scares." *Journal of Economic Behavior and Organization* 43:471–485.

Enders, W. 1995. *Applied Econometric Time Series*. New York: John Wiley & Sons, Inc..

Engle, R. E. and C. W. J. Granger. 1987. "Cointegration and Error Correction: Representation, Estimation, and Testing." *Econometrica* 55: 251–276.

Fearne, A., S. Hornibrook, and S. Dedman. 2001. "The Management of Perceived Risk in the Food Supply Chain: A Comparative Study of Retailer-Led Beef Quality Assurance Schemes in Germany and Italy." Research Paper TN255AH. University of London.

Fox, J. A. and H. H. Peterson. 2002. "Bovine Spongiform Encephalopathy (BSE): Risk and Implications for the United States." Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, St. Louis, MO, April, 22–23.

Holden, D. and R. Perman. 1994. "Unit Root and Cointegration for the Economist." In *Cointegration for the Applied Economist*, ed. B. B. Rao. St. Martin's Press: New York.

Jin, H. J., C. Sun, and W. W. Koo. 2003. "The Effect of the BSE Outbreak in Japan on Consumers' Preferences." *European Review of Agricultural Economics* 30(2):173–192.

McCluskey, J. J., K. M. Grimsrud, H. Ouchi, and T. I. Wahl. 2004. "BSE in Japan: Consumers' Perceptions and Willingness to Pay for Tested Beef." Research Paper, TWP-111.Pullman: Washington State University.

Peterson, H. H. and Y. J. Chen. 2005. "The Impact of BSE on Japanese Retail Meat Demand." *Agribusiness* 21(3):313–327.

Saghaian, S. H., L. J. Maynard, and M. R. Reed. 2007. "The Effect of *E. Coli* 0157:H7, FMD and BSE on Japanese Retail Beef Prices: A Historical Decomposition." *Agribusiness* 23(1):131–147.

Sanjuan, A. I. and P. J. Dawson. 2003. "Price Transmission, BSE and Structure Breaks in the UK Meat Sector." *European Review of Agricultural Economics* 30(2):155–172.

Spirtes, P., R. Scheines, C. Meek, T. Richardson, C. Glymour, A. Boomsam, and H. Hoijtink. 1999. TETRAD II-Version 3.1 *Tools for Causal Modeling*. Pittsburgh: Carnegie Mellon University.

Zielenziger, M. 2001. "Second Mad Cow Discovery Cripples Beef Sales in Japan." *The Honolulu Advertiser* November 22.