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Dairy-borne Disease Outbreak and Milk Demand: A Study Using Outbreak Surveillance Data

Yuqing Zheng and Harry M. Kaiser

We utilize the outbreak surveillance data from the Centers for Disease Control and Prevention (CDC) to examine whether consumer demand is impacted by the outbreak of food-borne disease. An additional person sickened due to the ingestion of tainted cheese products at home is found to decrease per capita milk demand in New York State by 0.13 percent (or 0.07 pound), while milk- and ice cream-borne disease outbreaks, occurring at home or in public places, are found to have no impact on fluid milk demand. Our results imply the existence of word-of-mouth effects, which cannot be tested by the popular information/media index approach used to measure food-borne disease outbreaks. We also find that a 7 percent increase in generic advertising expenditures or a 10 percent increase in expenditures on non-advertising marketing activities can offset the negative influence of one ill person in cheese-borne disease outbreaks at home, while holding other demand factors constant.

Key Words: Centers for Disease Control and Prevention, dairy-borne disease outbreak (DBDO), fluid milk demand, food-borne disease outbreak (FBDO), outbreak surveillance data

Food-borne disease outbreak (FBDO) is defined as "the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food" by the Centers for Disease Control and Prevention (CDC). A recent example is peanut butter tainted with *Salmonella* bacteria that sickened 453 people and may have killed five people in the United States (Larkin 2009). There is a rich literature on the impacts of FBDOs on demand and prices of associated foods [see Park, Jin, and Bessler (2008) for animal disease outbreaks in Korea; Pendell et al. (2007) for foot-and-mouth disease outbreaks in Kansas; and Mazzocchi (2006) for milk contamination, bovine spongiform encephalopathy (BSE), and *Escherichia coli* scares in the United States]. A FBDO can negatively affect demand and prices of associated foods by attracting mass media coverage and therefore causing food scares. Accordingly, the most commonly used quantitative measure of FBDOs in the literature of food scares is an information index (i.e., a media index) that counts the number of related newspaper articles (or TV reports). Two BSE-related examples are the media coverage index used by Verbeke and Ward (2001) and the food publicity index constructed by Lloyd et al. (2001, 2006). Other strategies for modeling demand response to a food scare include a dummy variable approach (Iraizoz, Bardaji, and Manuel 2005) and a stochastic parameter approach (Mazzocchi 2006).

In this paper, we propose using an alternative to the information index approach. Unlike the aforementioned studies, we investigate the impact of FBDOs by utilizing the outbreak surveillance data from the CDC. We are motivated to do so for several reasons. First, for many diseases, physicians, other health care workers, and clinical laboratories are requested or required by state and local health departments to report cases to the local health department (CDC Annual Report 2005, p. 37). Therefore, detailed data on FBDOs by state, month, vehicle, and location (i.e., outbreak sur-

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veillance data) are made available but remain mainly neglected in the literature of food scares.

Second, to the best of our knowledge, whether or not FBDOs affect food demand by word of mouth has not been addressed. Among the FBDOs reported to the CDC, some small-scale ones, particularly those occurring at private homes, are unlikely to be reported in the mass media. For example, it was reported to the CDC that in February 2006, two persons in New York State were sickened after consuming unpasteurized milk at home, with the confirmed etiology being *Campylobacter*. Such small-scale FBDOs do not appear in the media.[1] The impact of FBDOs on food demand tend to be manifested by scaring people who are associated with the affected person, i.e., through word-of-mouth. The outbreak surveillance data make it possible to test for such word-of-mouth effects.

Finally, an information index is not a direct measure of the scale of FBDOs. A large information index mainly reflects high news coverage of the underlying FBDO and a high possibility that consumers will be aware of this FBDO. Although FBDOs on a larger scale will more likely result in more news coverage, an information index does not inform exactly how many people were sickened in a FBDO, such as the 453 people in the peanut butter example. On the other hand, it might be the scale of FBDOs that pulls the trigger of a consumption halt on the associated food. One can imagine that a consumer will probably respond more fully to learning once of a FBDO that sickens 453 people than to seeing reports in a number of different newspapers of a FBDO that sickens only twenty people. The outbreak surveillance data report how many people were sickened, providing a direct and quantitative measure of the scale/severity of FBDOs.

Given the perceived importance of public information regarding FBDOs on food demand, we examine the impact of dairy-borne disease outbreaks (DBDOs) on retail fluid milk demand in New York State (NYS). Food scares in the dairy sector have received much less attention than BSE has. Searching the economics literature database *EconLit* results in only a handful of studies regarding food scares in the dairy sector, e.g., Mazzocchi (2006), Foster and Just (1989), and Smith, van Ravenswaay, and Thompson (1988). Unlike the one-to-one relationship between BSE and beef demand, fluid milk demand might be affected by disease outbreaks that are related to other dairy products, i.e., cheese and ice cream. Our model accommodates this. In the next section, we estimate a fluid-milk retail demand equation, augmented with the CDC's outbreak surveillance data. Our hypothesis is that DBDOs have a negative impact on milk demand. To better isolate the word-of-mouth effect, we distinguish disease outbreaks occurring at home from those occurring at public places such as schools and restaurants. Following that, we present and discuss empirical results. The final section presents our conclusions.

Introduction of DBDOs into NYS's Retail Demand for Fluid Milk

Following Dong, Schmit, and Kaiser (2007) and Zheng and Kaiser (2009), we specify NYS's retail demand for fluid milk in the following double-log form:

$$\begin{aligned}\ln Q_{it} &= \beta_0 + \beta_1 \ln Q_{i,t-1} + \beta_2 Milk_Home_t \\ &+ \beta_3 Milk_Public_t + \beta_4 Cheese_Home_t \\ &+ \beta_5 Cheese_Public_t + \beta_6 IC_Home_t \\ &+ \beta_7 IC_Public_t + \sum_{j=8}^{24} \beta_j X_{ijt} + u_{it}\end{aligned} \tag{1}$$

In (1), i indexes the five NYS regional market areas—Albany, Buffalo, New York City, Rochester, and Syracuse—and t (= 1, ..., 68) indexes quarters for 1990 through 2006.[2] Q is per capita retail demand for fluid milk. *Milk_Home* (*Cheese_Home*) denotes the number of persons in NYS who have become ill as a result of the ingestion of fluid milk (cheese products) at home. *Milk_Public* denotes the number of persons who become ill as a result of the ingestion of fluid milk at a public place. Those public places include: school,

[1] Using LexisNexis Academic and Google News, we could not find any news coverage on this FBDO.

[2] Quarterly data were the most disaggregate data we could obtain. We acknowledge that the use of quarterly data may obscure some short-run effects. For example, if a person's consumption of milk decreases in January due to scares of milk contamination, but increases in February for some reason, his/her quarterly milk consumption may remain unchanged from the previous quarter. The effect of the food scare, in this instance, is therefore obscured.

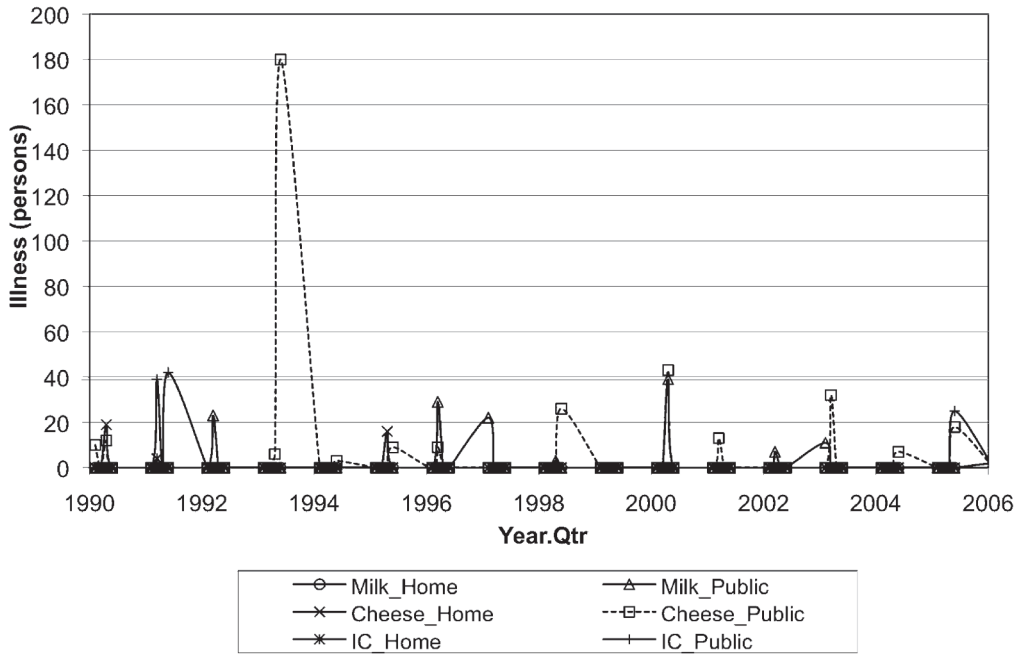

Figure 1. Dairy-borne Disease Outbreaks in New York State, 1990–2006

restaurant, medical center, hotel, conference center, fair, banquet facility, prison or jail, and wedding reception. The variables *Cheese_Public*, *IC_Home*, and *IC_Public* bear similar meanings, with IC denoting ice cream. The six variables measure the scale of DBDOs in NYS and were obtained from the outbreak surveillance data from the CDC. A plot of these variables by quarter is presented in Figure 1. Note that those DBDOs at home had no news coverage, while those at public places might have had news coverage (e.g., the spike in the fourth quarter of 1993 for cheese).[3] There are a total of 745 persons with illness related to DBDOs in NYS during our data period. As indicated by Figure 1, cheese-related disease outbreaks accounted for the majority of them.

The inclusion of the lagged dependent variable accounts for the autocorrelation within our time-series data, as suggested by the Durbin–Watson statistic, as well as the capture of habit formation by consumers. Since previous studies on demand for fluid milk (e.g., Zheng and Kaiser 2009, Dong, Schmit, and Kaiser 2007, Vande Kamp and Kaiser 1999) find that expenditures on generic milk advertising and non-advertising marketing activities had a small but statistically significant positive impact on NYS milk demand, we include goodwill from generic fluid milk advertising and expenditures on non-advertising marketing efforts (mainly sales promotions, public relations, and sponsorship) to account for this. We include a variable of competing beverage advertising expenditures to account for a possible spillover effect of advertising, i.e., the negative impact of competing beverage advertising on milk demand. Three demographic variables, which are the percent of population that is Hispanic, the percent of population that is Asian/American Indian, and the percent of population between five and nineteen years of age, are included, since Hispanics in NYS were found to drink more milk than other racial groups (Dong, Schmit, and Kaiser 2007), and Asians tend to drink less milk. When children get older, they tend to drink more soft drinks and other beverages and less

[3] Our argument is that since those DBDOs at home had no news coverage at all, their impact on milk demand, if there is any, should be largely attributed to the word-of-mouth effect. However, those DBDOs at public places can affect milk demand through media coverage and/or through the word-of-mouth effect. This is because DBDOs at public places might have news coverage. Therefore, if the estimated parameters for those DBDOs at home are statistically significant, they can be interpreted as word-of-mouth effects. However, the interpretation of a statistically significant parameter for those DBDOs at public places is more complicated.

Table 1. Variable Definitions and Sources

Variable	Definition and Source	Unit
Q	Quarterly retail demand for fluid milk. Source: Division of Dairy Industry Services and Producer Security (DIS), NYS Department of Agriculture and Markets	lbs/person
Milk_Home	Number of persons (in NYS) who become ill as a result of the ingestion of fluid milk at home. Source: outbreak surveillance data from the CDC. (The following five variables were obtained from the same source.)	person
Milk_Public	Number of persons who become ill as a result of the ingestion of fluid milk at a public place (i.e., school, restaurant, medical center, hotel, conference center, fair, banquet, prison, and wedding reception)	person
Cheese_Home	Number of persons who become ill, as a result of the ingestion of cheese product at home	person
Cheese_Public	Number of persons who become ill, as a result of the ingestion of cheese product at a public place	person
IC_Home	Number of persons who become ill, as a result of the ingestion of ice cream at home	person
IC_Public	Number of persons who become ill, as a result of the ingestion of ice cream at a public place	person
P	Quarterly retail price for whole fluid milk, deflated by nonalcoholic beverage consumer price index. Source: Survey of Retail Milk Prices for Selected Markets in NYS, DIS	$/half gallon
Inc	Per capita disposable income, deflated by the CPI for all items in NYS. Source: U.S. Bureau of Economic Analysis (BEA)	$1,000
Adv	Generic fluid-milk advertising expenditures, deflated by the media cost index (MCI). Source: Lowe World Wide, Inc., DMI, ADADC Milk for Health on the Niagara Frontier, and Rochester Health Foundation	$1,000
Nadv	Fluid milk's non-advertising marketing expenditures, deflated by the CPI for all items in the United States. Source: same as those for *Adv*	$1,000
CompetAdv	Advertising expenditures for juice, soft drinks, bottled water, soy beverages, and coffee/tea, deflated by the MCI. Source: Lowe World Wide, Inc. and DMI	$1,000
Hispanic	Percent of population that is Hispanic. Source: County Population Datasets, U.S. Census Bureau	%
Asian	Percent of population that is Asian/American Indian. Source: County Population Datasets, U.S. Census Bureau	%
Age0519	Percent of population between five and nineteen years of age. Source: County Population Datasets, U.S. Census Bureau	%
FAFH	Per capita food-away-from-home expenditures in the Northeast, deflated by the CPI for all items in the Northeast. Source: Consumer Expenditure Survey, U.S. Bureau of Labor Statistics	$1,000
ALB, BUF, NYC, ROC, and *SYR*	Regional dummies for Albany, Buffalo, New York City (base), Rochester, and Syracuse	0/1
Qtr1-4	Quarterly dummies; Qtr4 is the base	0/1
Trend	Time trend; 1990.Qtr1 = 1 and 2006.Qtr4 = 68	

milk. The inclusion of the percent of population between five and nineteen years of age captures such a potential diverting effect. The use of per capita food-away-from-home expenditures in the Northeast informs us how the increasing trend of dining out affected consumers' demand for fluid milk. Many restaurants do not have much variety in fluid milk products, which may have a negative impact on milk consumption as the trend in dining away from home increases. Given that Kinnucan et al. (2001) find a decreasing trend in U.S. per capita milk consumption, we included a trend variable to see if such a decreasing pattern holds for NYS.

Overall, the X vector in (1) includes: retail price for fluid milk; per capita personal disposable income; goodwill from generic fluid milk advertising; expenditures on non-advertising marketing efforts; regional and quarterly dummies; a time trend; and controls for spillover effects from competing beverage advertising, racial and age effects, and the dining-out effect.

All of the continuous variables in the vector X are in logarithms, and all the monetary variables are in 2005 constant dollars. Parameters $\beta_0 - \beta_{24}$

are to be estimated, and u is the error term. The full variable definitions and sources are shown in Table 1, while further detail regarding the data can be found in Zheng and Kaiser (2009).

We define the goodwill of generic advertising as follows to account for possible carryover effects up to two quarters:

$$(2)\quad Adv_{it}^{*} = \ln Adv_{it} + \exp(-10-2\gamma)\ln Adv_{i,t-1} + \exp(-20-2\gamma)\ln Adv_{i,t-2}$$

where: *Adv* are generic expenditures on advertising, and γ is a lag-weight parameter to be estimated. Such specification in effect assigns a lag weight of one, $\exp(-10-2\gamma)$, and $\exp(-20-2\gamma)$ for advertising in the most recent three quarters. The three lag weights result from a quadratic exponential lag function with proper endpoint restrictions (Cox 1992, Dong, Schmit, and Kaiser 2007, Zheng and Kaiser 2009). Therefore, the short-term advertising elasticity is expressed as $[1+\exp(-10-2\gamma)+\exp(-20-2\gamma)]$ multiplied by the estimated coefficient for the goodwill of generic advertising. The corresponding standard error is obtained using the Delta method (Greene 1993).

Estimation Results

Non-DBDO Parameter Estimates

To account for price endogeneity, we instrument the milk price with one supply side variable—the farm price for milk—and a few other exogenous variables in (1), including income, advertising expenditures for competing beverages, and Northeast per capita food-away-from-home expenditures. The price and retail demand equations are estimated with the full information maximum likelihood method. With the regional dummies controlling for differences among the five markets, this is a fixed-effects model. Estimated parameters are reported in Table 2.

The model yields a high adjusted R^2 of 0.91. The estimated parameter on the lagged dependent variable is 0.652 and is statistically significant at the 5 percent level (default level). The estimated parameters on price and income are found to be not statistically significant. The percentage of the population between five and nineteen years of age is found to be negatively related to milk demand, with the estimated parameter being statistically

Table 2. Maximum-Likelihood Estimates for NYS Fluid-Milk Retail Demand, 1990-2006

Variables	Parameter	Estimate	Std error
Intercept(NYC)	β_0	-0.032	1.192
Q_{t-1}	β_1	0.652**	0.041
Milk_Home	β_2	-0.0108	0.0097
Milk_Public	β_3	-0.00001	0.0003
Cheese_Home	β_4	-0.0013*	0.0008
Cheese_Public	β_5	0.00004	0.0001
IC_Home	β_6	-0.0032	0.0059
IC_Public	β_7	0.0005	0.0004
P	β_8	-0.037	0.033
Inc	β_9	0.075	0.080
Adv	$\beta_{10}[1+\exp(-10-2\gamma)+\exp(-20-2\gamma)]$	0.019**	0.008
Nadv	β_{11}	0.013**	0.007
CompetAdv	β_{12}	-0.016	0.025
Hispanic	β_{13}	0.043	0.045
Asian	β_{14}	-0.018	0.050
Age0519	β_{15}	-0.544**	0.168
FAFH	β_{16}	-0.021	0.035
ALB	β_{17}	0.238*	0.136
BUF	β_{18}	0.222*	0.125
ROC	β_{19}	0.195*	0.116
SYR	β_{20}	0.274**	0.135
Qtr1	β_{21}	-0.064**	0.016
Qtr2	β_{22}	-0.078**	0.017
Qtr3	β_{23}	-0.055**	0.014
Trend	β_{24}	-0.056**	0.014
Lag-weight parameter	γ	-4.858**	0.559
Adjusted R^2		0.91	
degree of freedom		314	

*** and * denote that estimates are statistically significant at the 5% and the 10% levels, respectively.*

significant. All the control dummies for the regional and quarterly differences have estimated parameters that are at least statistically significant at the 10 percent level, indicating that New York City has less demand for fluid milk than four other NYS regions, and that the fourth quarter has the greatest demand for fluid milk during the year. We also find that the consumption trend in NYS fluid milk is downward. Zheng and Kaiser (2009) also estimated NYS retail demand for fluid milk for 1986 through 2005. This current study differs from that study mainly in two respects. First, we updated that study's data through 2006. To be able to use the outbreak surveillance data, which are available for years starting from 1990, we estimate the demand model for 1990 through 2006. Second, this study includes those six additional variables that represent DBDOs. Overall, the above estimated parameters are largely consistent with those found by Zheng and Kaiser (2009).

The lag-weight parameter is found to be statistically significant. As discussed at the end of the second section, the coefficient for the generic advertising is reported in Table 2 in the form of $\beta_{10}[1+\exp(-10-2\gamma) + \exp(-20-2\gamma)]$. The estimated value for this term is 0.019, which is statistically significant. The estimated parameter for non-advertising marketing activities is 0.013, which is statistically significant as well. Note that both the above values are short-term elasticities. That is, we find that in the short run, a 1 percent increase in generic advertising expenditures increased NYS (per capita) milk demand by 0.019 percent (holding other demand factors constant); and a 1 percent increase in expenditures on non-advertising marketing activities increased NYS milk demand by 0.013 percent. Both short-term marketing elasticities are larger than those reported by Zheng and Kaiser (2009) due to different data ranges and model specifications. However, generic advertising was more effective than non-advertising marketing activities in enhancing demand. Note that dividing the above two short-term elasticities by $(1-\beta_1)$ yields the long-term advertising and non-advertising marketing elasticities at 0.054 and 0.038, respectively.

Negative versus Positive Promotion

The focus of this paper lies in the parameter estimates for the six DBDOs. We expected those parameters to be negative due to food scares. We find that all the six estimated parameters are very small. However, only the parameter for cheese-borne disease outbreaks at home (β_4) is statistically significant at the 10 percent level (marginally significant), while all the other five parameters are statistically insignificant. The interpretation of the value of β_4, -0.0013, is that an additional person sickened due to the ingestion of cheese products at home will decrease milk demand by 0.13 percent. In other words, an additional person sickened due to the ingestion of cheese products at home will decrease milk demand by 0.07 pound given that the average milk demand is 55 pounds in NYS.

Since we have estimated both impacts of positive promotion (advertising and non-advertising marketing activities) and negative promotion (DBDOs), we can obtain some interesting results by a comparison of these. Dividing the percentage change in milk demand after one person falls ill from consuming cheese products at home (0.13 percent) by the percentage change in milk demand due to a 1 percent increase in generic advertising (0.019 percent) yields a ratio of seven. This ratio indicates that a 7 percent increase in generic advertising expenditures (about an increase of $50,000) can offset the negative influence of one ill person in cheese-borne disease outbreaks at home. Similarly, the results imply that a 10 percent increase in expenditures on non-advertising marketing activities (about an increase of $20,000) can offset the negative influence of one ill person in cheese-borne disease outbreaks at home. Verbeke and Ward (2001) find that fresh meat advertising is found to have only a minor impact compared with negative press. Our comparison of negative and positive promotions also indicates that the negative impact of DBDOs can be fairly large.

Other Specifications

We also estimate two alternative specifications of the model. Since there may be multi-state disease outbreaks, which are not reflected in the CDC data, we construct a variable that represents the number of persons in any of the neighboring states of NYS—i.e., Connecticut, New Jersey, Massachusetts, Pennsylvania, and Vermont—who have become ill as a result of the ingestion of fluid milk at home. Five other variables—which bear similar specification to *Milk_Public*, *Cheese_Home*,

Cheese_Public, *IC_Home*, and *IC_Public*—are constructed for the neighboring states as well. We re-estimate equation (1) with the above six additional variables included and find none of the parameters for the additional variables are statistically significant. Other results remain fairly robust, with β_4 (the parameter for *Cheese_Home*) turning significant at 5 percent and β_{11} (the parameter for non-advertising marketing activities) turning significant only at 10 percent in this case.

Another specification stems from the consideration that disease outbreaks related to unpasteurized and pasteurized dairy products might have different impacts on demand since unpasteurized and pasteurized dairy products are segmented. Our data suggest that only two DBDOs (there are about 50 DBDOs in total) are related to unpasteurized dairy products: one related to unpasteurized fluid milk consumed at home and the other related to unpasteurized fluid milk consumed at a public place. We first re-estimate equation (1) with the inclusion of dummy variables that control for unpasteurized milk and find the estimated parameters for the added dummies are not statistically significant. We also re-estimate equation (1) by replacing the classification of "home versus public" with "unpasteurized versus pasteurized" for milk. Again, results change little from Table 2.

Conclusion

The dairy industry is very important for states like California, Wisconsin, and New York. Unlike the meat industry (mainly the beef industry), whether and how the dairy industry is affected by FBDOs has received little attention beyond the case of heptachlor milk contamination in 1982 in Oahu, Hawaii. This paper adds to our limited understanding on DBDOs' impact by examining the impact of DBDOs on NYS fluid milk demand. Recent data are used. In addition, we propose an alternative approach to the predominant information index approach used in the literature to quantify FBDOs. We argue that the outbreak surveillance data from the CDC make it feasible to test for the word-of-mouth effects due to FBDOs and examine whether consumers respond to the scale of FBDOs directly, i.e., the number of ill persons. Our main finding is that the number of ill persons in cheese-borne disease outbreaks at home negatively affected milk demand, while milk- and ice cream-borne disease outbreaks at home and at public places, and cheese-borne disease outbreaks at public places did not affect milk demand. Our finding implies the existence of the word-of-mouth effects.

We find that an additional person sickened due to the ingestion of cheese products at home decreased (per capita) milk demand by 0.13 percent. Such an estimate can be interpreted as an upper limit of the effect of DBDO because of the limitation in the outbreak surveillance data. As documented by the CDC *Annual Report* (2005, p. 4), the number of reported cases of diseases under surveillance is underestimated partly because many ill persons do not seek medical care, with the result that some cases never reach the reporting systems. Therefore, our estimate of 0.13 percent needs to be interpreted with the above caveat in mind. Nevertheless, the outbreak surveillance data turn out to be the best data available for measuring the scale of DBDOs in NYS.

Finally, we provide an interesting comparison of positive promotion versus negative promotion. We find that a 7 percent increase in generic advertising expenditures or a 10 percent increase in expenditures on non-advertising marketing activities can offset the negative influence of one ill person in cheese-borne disease outbreaks at home, while holding other demand factors constant. In times of DBDOs, such numbers may be of great interest to program managers of the dairy checkoff funds, who might opt for advertising or non-advertising marketing to counteract the negative influence of DBDOs. It would also be interesting to see if advertising or non-advertising marketing activities in times of disease outbreak have a more- or less-profound impact on demand than those conducted in the absence of disease outbreaks do. If advertising is found to be less effective in times of disease outbreak, the timing of advertising to coincide with no-disease periods seems to enhance profit for the associated producers. We tried to obtain some insight from allowing the interaction of promotion and disease outbreaks. However, the parameter for such interactions is not statistically significant. Other researchers can include such interaction effects in their research related to promotion and disease impact on demand.

References

Centers for Disease Control and Prevention. 2005. "Bacterial Foodborne and Diarrheal Disease National Case Surveillance." Annual Report, 2005. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Cox, T. 1992. "A Rotterdam Model Incorporating Advertising Effects: The Case of Canadian Fats and Oils." In H.W. Kinnucan, S.R. Thompson, and Chang, eds., *Commodity Advertising and Promotion* (pp. 139–164). Ames, IA: Iowa State Press.

Dong, D., T.M. Schmit, and H.M. Kaiser. 2007. "Optimal Media Allocation of Generic Fluid Milk Advertising Expenditures: The Case of New York State." *Agricultural and Resource Economics Review* 36(2): 253–266.

Foster, W., and R.E. Just. 1989. "Measuring Welfare Effects of Product Contamination with Consumer Uncertainty." *Journal of Environmental Economics and Management* 17(3): 266–283.

Greene, W.H. 1993. *Econometric Analysis*. Upper Saddle River, NJ: Prentice Hall, pp. 297–299.

Iraizoz, B., I. Bardaji, and R. Manuel. 2005. "The Spanish Beef Sector in the 1990s: Impact of the BSE Crisis on Efficiency and Profitability." *Applied Economics* 37(4): 473–484.

Kinnucan, H.W., Y. Miao, H. Xiao, and H.M. Kaiser. 2001. "Effects of Advertising on U.S. Non-Alcoholic Beverage Demand: Evidence from A Two-Stage Rotterdam Model." In M.R. Baye and J.P. Nelson, eds., *Advances in Applied Microeconomics*. Elsevier Science, Amsterdam, pp. 1–30.

Larkin, C. 2009. "Tainted Peanut Butter May Have Killed 5, Sickened 453." Bloomberg, January 16. Retrieved from http://www.bloomberg.com.

Lloyd, T., S. McCorriston, C.W. Morgan, and A.J. Rayner. 2001. "The Impact of Food Scares on Price Adjustment in the UK Beef Market." *Agricultural Economics* 25(2-3): 347–357.

Lloyd, T., S. McCorriston, C.W. Morgan, and A.J. Rayner. 2006. "Food Scares, Market Power and Price Transmission: The UK BSE Crisis." *European Review of Agricultural Economics* 33(2): 119–147.

Mazzocchi, M. 2006. "No News is Good News: Stochastic Parameters versus Media Coverage Indices in Demand Models after Food Scares." *American Journal of Agricultural Economics* 88(3): 727–741.

Park, M., Y.H. Jin, and D.A. Bessler. 2008. "The Impacts of Animal Disease Crises on the Korean Meat Market." *Agricultural Economics* 39(2): 183–195.

Pendell, D.L., J. Leatherman, T.C. Schroeder, and G.S. Alward. 2007. "The Economic Impacts of a Foot-and-Mouth Disease Outbreak: A Regional Analysis." *Journal of Agricultural and Applied Economics* 39(special issue): 19–33.

Smith, M.E., E.O. van Ravenswaay, and S.R. Thompson. 1988. "Sales Loss Determination in Food Contamination Incidents: An Application to Milk Bans in Hawaii." *American Journal of Agricultural Economics* 70(3): 513–520.

Vande Kamp, P.R., and H.M. Kaiser. 1999. "Irreversibility in Advertising-Demand Response Functions: An Application to Milk." *American Journal of Agricultural Economics* 81(2): 385–396.

Verbeke, W., and R.W. Ward. 2001. "A Fresh Meat Almost Ideal Demand System Incorporating Negative TV Press and Advertising Impact." *Agricultural Economics* 25(2-3): 359–374.

Zheng, Y., and H.M. Kaiser. 2009. "Evaluating the Effectiveness of Generic Advertising versus Non-advertising Marketing Activities on New York State Milk Markets." *Agribusiness: an International Journal* 25(3): 351–368.