You Know It's Going to Be a Bad Day When a 60 Minutes Camera Crew Is Waiting for You at Work - A Case Study of Chicken Contamination Publicity

by

Dean G. Fairchild and Roger A. Dahlgran

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Adverse publicity about food contamination can depress demand, causing lost producer revenue. TV and print news coverage of bacterial contamination of chicken in the US is incorporated into an inverse demand for chicken which is estimated using 1982 to 1991 data. A beta binomial audience-exposure distribution is used to estimate net reach and average frequency of exposure to contamination publicity. It was found that for each unit of increase in weekly publicity frequency, prices were depressed by 1.2 percent, leading to a $760 million retail loss to the chicken industry. This amounts to less than one-quarter of one percent of revenue over the ten years studied.

Introduction

For several years, food demand analysis has focused on linkages between health inform tion and red meat consumption. Researchers in this area have generally hypothesized that over long time period the public dissemination of scientific evidence linking red meat consumption t high blood cholesterol levels and also linking high blood cholesterol levels to heart disease ha caused the demand for beef to decrease while the demand for chicken increased.(Chavas, 198: Dahlgran, 1987; Moschini and Meilke, 1984 and 1989; Wohlgenant, 1986; Eales and Uhnnevel 1988; Chalfant and Alston, 1988) The *ceteris parabus* manifestation of these demand changes i the decline in the 1970s and 1980s of per capita red meat consumption and the accompanying ir crease in poultry meat and fish consumption. Time plays a critical role in this research because 1 the suspected linkage is between current consumption and long-run health, 2) the linkage wa confirmed gradually, and 3) the information was diffused over a time horizon of several years. 1 these extended effects exist, then should not warnings of immediate dangers associated with con sumption of specific food items cause immediate declines in the consumption of those food items?

News coverage of chicken meat contaminated by potentially fatal bacteria provide a set ting to investigate this question. This news coverage was precipitated in March of 1987 by the CBS news show 60 Minutes which aired an investigative report entitled "One in Every Three." The essence of this report was that one third of all chicken reaching consumers was contaminated with salmonella bacteria. After this report, coverage mushroomed as newspapers picked up the

*The authors are doctoral student, Department of Food and Resource Economics, University of Florida, Gainesville, FL 32611-0240 and Associate Professor, Department of Agricultural and Resource Economics, University of Arizona, Tucson AZ 85721-0023.

theme of the 60 Minutes story and ran stories of their own. Newspaper reports appeared in the Wall Street Journal, the Des Moines Register, the Providence (RI) Journal, Supermarket News and the Atlanta Constitution. 60 Minutes rebroadcast their original story in September of 1987 and Consumer Reports and Consumer Research also picked up the message.

The danger of salmonella and the closely-related campylobacter bacteria is that they cause food poisoning in humans. In addition to the considerable discomfort of the symptoms, food poisoning can be fatal to the elderly or to people with immune system deficiencies. Untreated cases can lead to a debilitating form of arthritis. In 1987, approximately 1,000 deaths and 36,000 hospitalizations resulted from 1.9 million reported cases of salmonella poisoning.

A possible link between chicken contamination news and chicken demand is the focus of this study. This study is related to research on meat demand structure change in the following way. Consider hypotheses A that concerns about the health effects of red meat consumption increased the demand for chicken and B that adverse health information about salmonella contamination decreased the demand for chicken. Common forces drive both hypotheses, namely the arrival of new information regarding the healthfulness of consuming specific food items. Therefore if hypothesis A is credible, then so is hypothesis B. Furthermore, information applicable to each hypothesis would have been disseminating through the populace at the same time so the demand effects would be, to some extent, offsetting. Issues of timing and risk, summarized in table 1, differentiate these two types of studies. Specific differences are the juxtaposition between consumption and the timing and risk of health consequences, the timing of the accumulation of scientific evidence about the health consequences of consumption, and the process by which the scientific evidence becomes diffused as the consuming public's general knowledge.

In many respects, poultry contamination publicity is a typical food safety scare. The literature on similar scares includes herbicide contamination of cranberries (Brown, 1969), kepone contamination of Virginia seafood (Swartz and Strand, 1981), heptachlor contamination of milk in Hawaii (Smith, van Ravenswaay, and Thompson, 1989), and Alar contamination of apples (Buxton 1989; and van Ravenswaay and Hoehn, 1991). However, the poultry contamination scare may be unique because of its national scope and because of the heightened awareness of food and product safety during the mid to late 1980s brought about by several accidental product-tainting

Table 1. Conceptual differences between meat demand structure change studies and food contamination publicity studies.

Features	Meat Demand Structure Change Studies	Food Contamination Publicity Studies
Relationship	current cons/long-term health	current cons/immediate health
Discovery	linkage confirmed gradually	linkage already known
Information diffusion	gradually over several years	publicity pulses

tract, whereby growers can adjust output only at the time of contract negotiation and the negotia tion cycle is considerably longer than the production cycle. Finally, chicken cold-storage capacit is a small fraction of weekly production so that inventory-holding is relatively minor. Given thes features and our commitment to short observation intervals, the model must allow chicken price to adjust to production so that an inverse demand specification of (1) is more is more appropriat than the demand specification shown. Thurman (1986, 1987) and Kenyon also present evidenc that chicken quantities should be treated as predetermined.

Data Considerations

Publicly available US data from 1982 through 1991 will be used for the price, quantity an income variables in the demand model. The USDA Agricultural Marketing Service (AMS) esti mates wholesale prices and quantities based on plant inspections. The Economic Research Serv ice (ERS) uses AMS data to derive monthly and quarterly estimates of retail and wholesale price and quantities. Weekly wholesale data came from *Poultry Market Statistics*, published by th AMS while monthly and quarterly wholesale data came from *US Egg and Poultry Situation Sta tistics*, published by the ERS. Weekly retail chicken prices were not available so the wholesal price of boneless-skinless chicken breasts was chosen as a proxy for the retail chicken price. The wholesale boneless-skinless chicken breast price includes processing margins, and is more highl correlated with the retail broiler price in the monthly and quarterly data than any other wholesal price. Quantity was measured as pounds of per capita live chicken disappearance, rather than pounds of per capita consumption because weekly consumption data were not available while weekly data on slaughter quantity and average weight were.

Weekly price and quantity data did not correspond perfectly because the AMS reportec the boneless-skinless chicken breast price for Monday-beginning weeks from 1982-91 and re ported quantity for Wednesday-ending weeks from 1982-87. The quantity data were interpolated to a Monday-beginning week so that the price and quantity observation periods would corre spond. Also weeks containing holidays tend to skew chicken slaughter downward, creating arti ficial seasonality. Assuming evenly distributed poultry slaughter among the six working days in each week gives a simple adjustment for weeks with one holiday, multiply quantity by 6/5.

Monthly and quarterly data on the consumer price index for food items (CPI-F) and population are available but weekly observations required interpolating the monthly data. Non- seasonally adjusted average weekly earnings (Bureau of Economic Analysis, US Department of Commerce) was used as the measure of income in the model.

To quantify the temporal distribution of chicken contamination publicity a media schedule was constructed. The steps in constructing this schedule were 1) a keyword search, 2) prelimi- nary story list, 3) final story list and 4) audience quantification.

Keyword searches gathered media stories from available newspaper, magazine and televi- sion news indices. Newspaper and magazine indices were used as a source for print news stories. *Television News Index* and *Journal Graphics* provided television stories. Manual and computer- aided searches by root keywords yielded a preliminary story list consisting of all matches to: broil-

ers, campylobacter, chicken food contamination, eggs, food poisoning, food safety, meat inspections, livestock, meat poisoning, poultry, and salmonella. The final list came from the elimination of stories not dealing with poultry contamination or food safety. The final list included over 400 news stories and their publication dates from 1982 through 1991. Audience estimates came from several sources. Standard Rate and Data Service (SRDS) provides audited circulation estimates for newspapers and magazines. Nielsen, Simmons Market Research Bureau (SMRB), and a host of other firms estimate TV viewing.

Three exposure measures, gross impressions, net reach, and average frequency were constructed from these raw data. First, multiplying total circulation (audience) for each print (broadcast) vehicle by the number of stories featured each week gives total gross impressions

$$GI_t = \sum_{i=1}^{m} AUD_{it} \, STO_{it} \tag{2}$$

where AUD_{it} represents viewership or circulation of media vehicle i and m represents media vehicles which carry news stories about chicken contamination during period t.

Gross impressions over counts message exposure because it ignores audience overlaps. For example, a consumer could read a story in the morning paper, hear a news story on the radio while driving to work and see a third story on the evening news. This counts as three gross impressions although only one consumer has been reached. In this vein, advertising and psychological research posits that the frequency of exposure and the number of different people exposed (net reach) may be more important than gross impressions in determining the impact of a message. The beta binomial distribution technique, responds to the overlap problem by summarizing the net reach and frequency of the media schedule. The beta binomial method (Greene 1982; Leckenby and Wedding 1981) starts by estimating the average reach of a story for all m vehicles in the publicity schedule:

$$r_{1t} = (GI_t/POP_t)/ \sum_{i=1}^{m} STO_{it} \tag{3a}$$

Next, the average reach of two stories in each vehicle is estimated as

$$r_{2t} = \left\{ \sum_{i=1}^{m} \binom{STO_{it}}{2} r_{2it} + \sum_{i=1}^{m} \sum_{j=1}^{k} STO_{it} \, STO_{it} \, r_{jit} \right\} / \binom{N}{2} \tag{3b}$$

where r_{jit} represents the net audience of vehicles i and j (i not equal to j) and N represents the number of contamination stories that occurred during period t. Simmons Market Research Bureau (1982-89) estimates r_{ijt}, the overlap between vehicle pairs, and r_{2it}, overlap between two different issues of the same vehicle. Overlap data were generally not available for regional magazines and small newspapers. Composite audience duplication figures simplified estimation of (3b) for such periods.

For each period, the non-exposure parameter β and the exposure parameter α for the beta binomial distribution are estimated as

$$\alpha_t = r_{1t} (r_{2t} - r_{1t}) / (2 r_{1t} - r_{2t} - r^2_{1t})$$

$$\beta_t = \alpha_t (1 - r_{1t}) / r_{1t}$$

With these two parameters, the beta binomial distribution can be expanded to compute probability of an individual's exposure to x_t of the N_t chicken contamination stories which c curred during period t as

$$P(x_t \mid \alpha_t, \beta_t, N_t) = \binom{N_t}{x_t} \frac{\alpha_t (\alpha_t + 1)(\alpha_t + 2) \dots (\alpha_t + x_t - 1) \beta_t (\beta_t + 1)(\beta_t + 2) \dots (\beta_t + N_t - x_t - 1)}{(\alpha_t + \beta_t)(\alpha_t + \beta_t + 1) (\alpha_t + \beta_t + 2) \dots (\alpha_t + \beta_t + N_t - 1)}$$

One minus the probability of zero exposures yields net reach -- the percentage of different peop in the population exposed at least once. Gross impressions divided by net reach equals averag frequency, the third measure of media impact.

Formulas (2) through (5) were used to estimate gross impressions, net reach and fre quency for each week, month and quarter from 1982 through 1991. The average frequency c media coverage is ultimately used a the measure of media coverage in our empirical analysis.

Other measures of media exposure were also constructed. These include a simple articl count for the time period, a dummy variable indicating more than 1,000,000 impressions durin the time period, and a dummy variable indicating a story during the time period. Content analy sis which separates articles according to different themes is another media measure but was no used because the classification of media stories entails an element of subjectivity.

Empirical Model and Results

Regression analysis is used to test the hypothesis that media coverage of chicken contami- nation had no effect on the demand for chicken. The empirical model begins with a logarithmic- linear specification of (1) which is transformed to its price dependent form in accordance with the arguments about the fixity of chicken supplies. A partial price-adjustment model

$$\ln P_t - \ln P_{t-1} = \lambda (\ln P^*_t - \ln P_{t-1})$$

is incorporated to allow for non-instantaneous price adjustment. Finally, the theory of inverse demands gives the result that the income flexibility of demand should be unity (Houck). Hence, the resulting model fit to the data is

$$\ln RP_t = \mu + (1-\lambda) \ln RP_{t-1} + \phi \ln QPC_t + \sum_{i=1}^{N} \delta_i D_{it} + \gamma_1 MEDIA_t + \gamma_2 MEDIA_{t-1} + \theta T_t + \varepsilon_t \quad (6)$$

where RP_t is the per pound price of boneless-skinless chicken breasts relative to per capita weekly earnings, QPC_t is the live weight young chicken slaughter per non-institutionalized civilian, D_{it} is a seasonal dummy variable $MEDIA_t$ is the media variable, and T_t is a linear time trend with the first period of 1982 set to one. Different MEDIA variables, including gross impressions, average frequency, net reach and a story count, were specified but average reach calculated from the beta

binomial audience estimation procedure are ultimately used. The dummy variables account for seasonal demand variations and indicate four-week periods in the weekly model, months in the monthly model and quarters in the quarterly model.

Our *a priori* expectations are that β, the price flexibility of demand, should be negative. If news coverage of chicken contamination had a negative influence on chicken demand, one or both of γ_1 and γ_2 should be negative and indicate the time profile of media influence. These slopes estimate the percentage change in price associated with a unit change in the average frequency of exposure. Table 2 shows OLS chicken demand parameter estimates for weekly, monthly and quarterly data intervals.

The results reported in table 2 indicate that the lagged dependent variable, current production, seasonal dummies and the trend variable are all significant. The media variables are generally less significant, reaching the five percent level of significance only in the weekly model. One criteria for choosing a best model from among the three estimated is to examine implied price

Table 2.   Ordinary least squares regression estimates of chicken demand parameters.

| Parameter	509 weeks		120 months		40 quarters	
α	-.474	(.000)	-.006	(.986)	3.673	(.031)
λ	.893	(.000)	.860	(.000)	.550	(.000)
β	-.162	(.008)	-.487	(.001)	-2.299	(.000)
γ_1	.001	(.853)	.008	(.538)	-.017	(.593)
γ_2	-.012	(.034)	-.019	(.143)	.015	(.643)
δ_1	.053	(.000)	.158	(.000)	.139	(.000)
δ_2	.042	(.001)	.096	(.000)	.290	(.001)
δ_3	.043	(.001)	.100	(.000)	.169	(.001)
δ_4	.040	(.002)	.152	(.000)		
δ_5	.068	(.000)	.181	(.000)		
δ_6	.055	(.000)	.133	(.000)		
δ_7	.041	(.004)	.074	(.007)		
δ_8	.050	(.000)	.118	(.000)		
δ_9	.049	(.000)	.131	(.000)		
δ_{10}	.035	(.012)	.049	(.07)		
δ_{11}	.039	(.003)	.067	(.025)		
δ_{12}	.025	(.049)				
θ	9.7E-5	(.073)	.002	(.007)	.023	(.001)
R^2	.885		.864		.763	
Regression F	222.36	(.000)	48.31	(.000)	12.51	(.000)
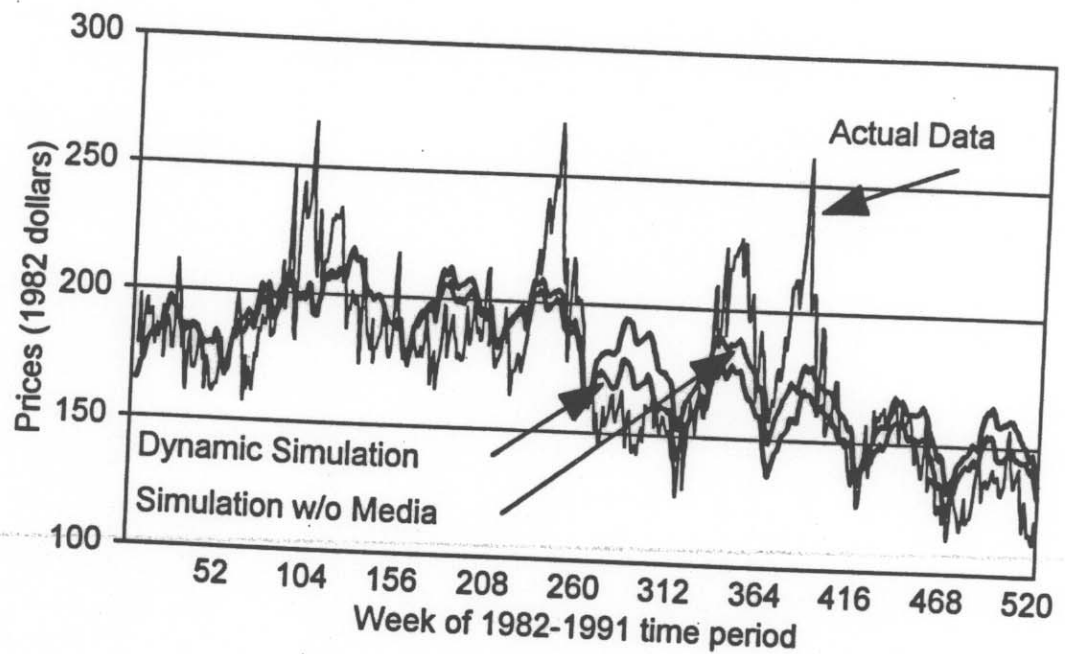
Figure 3. Simulation of weekly model with and without media events.

tory-holding wherein chicken is bought when it is cheap, and frozen or cooked for consumption in subsequent weeks. This storage is easily imagined over weekly data intervals but not over a quarterly data interval.

Second, chicken contamination new stories did influence the demand for chicken, but the losses created were small relative to the total revenues generated. Chicken contamination news stories appear to have reduced retail chicken sales by approximately $716 million over the ten year period modeled. Wholesale losses to producers over the same ten year period were $190 million. Despite the size of these losses, they are small relative to total wholesale and retail sales. During 1987, the year of maximum new coverage, the losses are approximately 0.7% of retail sales and 0.46% of wholesale sales. For the entire period of 1982-1991 losses associated with the salmonella contamination news stories amounted to less than one fourth of one percent of sales revenues.

Several factors may be responsible for the relatively small effect of chicken contamination publicity. First, because proper cooking and handling substantially reduces the risk of disease from contaminated poultry, response to contamination publicity is probably less intense than other food safety incidents such as Alar-contaminated apples. Second, the highest weekly average frequency of stories was near two. Advertising research suggests that a minimum of three exposures is needed to change purchasing behavior so coverage of chicken contamination may not have reached the frequency threshold required for a meaningful behavior change. Third, this publicity occurred during a period of ongoing consumer switching from beef to chicken consumption and the contamination reported was not enough to substantially disrupt this changeover.

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So, is it going to be a bad day if a 60 Minutes camera crew is waiting for you when you show up at work? The answer appears to be yes, especially if the national media pick up on the theme of the 60 Minutes story. However, these results indicate that you should make the most of your notoriety because consumers will soon move on to other issues and your 15 seconds of fame will be over.

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