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THE EFFECT OF MEDIA INFORMATION REGARDING *SALMONELLA* ON THE DEMAND FOR SHELL EGGS AND PASTEURIZED EGG PRODUCTS

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De 1985 à 1991, 380 foyers de Salmonella enteritidis ont été signalés au Centre de contrôle et de prévention des maladies (CDCPA) d'Atlanta, en Géorgie. Quatre-vingt dix pour cent de ces foyers sont apparus au niveau de services de restauration collective alors que seulement 10% concernaient la vente au détail. Les oeufs en coquille de calibre A étaient responsables des foyers dans 82% (137) des cas pour lesquels un vecteur alimentaire a été mis en évidence (167 foyers sur 380). Aucun des foyers n'a été occasionné par des ovoproduits pasteurisés. La structure de la consommation d'oeufs en coquille et d'ovoproduits a aussi été modifiée au cours du temps, la consommation d'oeufs en coquille par tête allant en diminuant tandis que la consommation d'ovoproduits augmentait.

Afin d'évaluer l'effet d'une information médiatique négative concernant Salmonella enteritidis sur la structure de la consommation d'oeufs, trois indices ont été élaborés à partir d'articles de vulgarisation de 1985 à 1995 : 1) les articles liant spécifiquement Salmonella enteritidis provenant de la consommation d'oeufs à la coque aux foyers de contamination humaine; 2) les articles faisant de Salmonella sp. une cause de maladie d'origine alimentaire; 3) les articles donnant une information générale sur les problèmes de sécurité alimentaire. Des données mensuelles sur les prix, les quantités et sur d'autres facteurs déterminant la demande ont été utilisés dans cette analyse. Les résultats initiaux ont montré que l'indice d'information spécifique sur Salmonella provenant de la consommation d'oeufs en coquille était le seul indice qui mettait en évidence une relation avec la baisse de la consommation de ces oeufs ($p<10$). Une information médiatique négative liant Salmonella enteritidis aux oeufs résultait en un recul dans la demande d'oeufs en coquille. Dans le même temps, la demande devenait aussi plus inélastique. Les futures orientations impliquent la proposition d'un système d'équations de la demande visant à évaluer l'effet d'une information médiatique négative portant simultanément sur la structure de la consommation des oeufs en coquille et sur celle des ovoproduits pasteurisés.

INTRODUCTION

Salmonella sp. is among the ten most common foodborne diseases in humans, with U.S. outbreaks (exclusive of isolated cases) being reported at an average annual rate of 4,500 cases (Centers for Disease Control (CDC) Morbidity and Mortality Weekly Reports; MacDonald and Griffin, 1986). Further, there has been a recent upward trend in the *Salmonella sp.* isolation rate reported to the Centers for Disease Control (CDC) in Atlanta, Georgia (CDC, 1987a; CDC 1987b; St. Louis, et al., 1988; Hargrett-Bean et al., 1989).

The symptoms in humans develop within 48 hours after ingesting food contaminated with *Salmonellae.* Symptoms vary from abdominal pain, vomiting, diarrhea, fever and chills to death with the highest risk group consisting of the very young, the immune-compromised or the elderly.

For many years, microbiological studies have implicated contaminated poultry and eggs with foodborne salmonellosis. However, only relatively recently has the consuming public become conscious of this risk. Since early 1988, an increasing number of newspaper articles and television programs have publicized the dangers of salmonellosis and the link with table egg consumption. An important question remains: to what extent has the perceived risk of *Salmonella* affected individual consumption decisions and aggregate demand for eggs?

This paper discusses an econometric method to measure the impact of foodborne disease perceptions on market demand. The economic theory employed is simple. If consumers think there is a greater risk of salmonellosis from consuming eggs, then they will substitute away from this product. Thus, for any given egg price, the quantity of eggs demanded will decline. This action in the aggregate will cause the demand schedule for eggs to shift back and hence, prices will fall. The size of the price fall (for a given supply schedule) is a measure of the importance consumers attach to salmonellosis risk. In cases of *Salmonella* sp. outbreaks where regulatory actions are taken (for example, in the case of *Salmonella enteritidis*, diversion of shell eggs to the breaking market or less frequently, recall or ban of contaminated products), it is also likely that the supply of eggs will decrease. The objectives of this paper are: (1) to identify when exogenous changes in risk perception occur and, (2) to determine the demand response induced by the changes in risk perception.

DATA AND ESTIMATION METHODS

The main empirical problems in implementing the econometric model are: (1) identifying when changes in consumers' risk perceptions occur, and (2) measuring the extent to which a consumption change is abnormal taking into account non-disease determinants of shell egg demand.

In order to identify when changes in risk perception might occur, publicized outbreaks of salmonellosis and press releases addressing food safety issues were reviewed in conjunction with *Salmonella* sp. surveillance updates in the

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CDC's Morbidity and Mortality Weekly Report. Only those releases indexed in the National Newspaper Index (indexes Wall Street Journal, Washington Post, L.A. Times, Christian Science Monitor among others) and the New York Times Index were used, as they were likely to have a wider circulation.

Classification of these press releases required differentiating between news reports detailing specific outbreaks versus adverse publicity related to the *Salmonella* problem in general. Press releases were thus categorized into 3 groups: (1) those dealing with outbreaks caused by *Salmonella* sp., food vehicle was not egg-related or was of an unknown source; (2) adverse publicity related to the *Salmonella* problem and food safety of a more general nature; (3) adverse publicity related specifically to Salmonellae in eggs (egg-associated outbreak reports due to *Salmonella* sp. included).

The second problem was addressed by specifying an econometric model of the normal demand relationship for shell eggs. The effect of adverse information on shell egg consumption, given the other determinants of demand, were then analyzed in a multiple regression model that incorporates distributed lag structures and seasonal effects.

Commercially produced eggs are sold either in the shell egg market or the breaker egg market. Per capita shell egg consumption was the variable of choice because it seemed more representative of the typical consumer demand for eggs, as breaker eggs are more often sold to food processors.

Monthly data on per capita shell egg consumption, retail prices of eggs, per capita personal consumption expenditure, and dummy variables pertaining to the different levels of information regarding Salmonellae were collected for January 1985 through December 1989.

Initial attempts to model egg demand revealed that the dummy variable related to Group 1 *Salmonella* information (those dealing with outbreaks caused by *Salmonella*, food vehicle is not egg-related or of an unknown source) was not significant, so a composite dummy variable consisting of the other two classifications was created and retained.

The final demand function for shell eggs was then specified as:

$$Q_t = f(P_t, Y_t, DS_t, P_t{*}DS_t, T1_t, T2_t)$$

where Q_t is per capita shell egg consumption; P_t is retail price (nominal) of Grade A large shell eggs; Y_t is per capita personal consumption expenditures in real terms (PCE) POPN); DS_t is the dummy variable associated with adverse information; and $T1_t$, $T2_t$ are dummy variables used to capture time trend in the retail price of eggs.

Due to an apparent trend in retail prices and the possibility of simultaneity, a two-stage least squares estimation procedure was employed. The identified instrumental variable was the average number of layers on all farms. With this method, the predetermined variable is used as a regressor to obtain a predicted value for price of eggs. The predicted price is then incorporated into the demand equation in place of retail price.

The final estimated demand equation (standard errors in parentheses) was:

$$\begin{array}{lccccccc} Q_t = & 21.266 & - 0.085P & + 0.030(P_tDS_t) & + 1.244Y_t & - 2.637DS_t & - 0.744DT1_t & - 1.198DT2_t \\ & (7.576) & (0.022) & (0.020) & (2.446) & (1.666) & (0.222) & (0.369) \end{array}$$

RESULTS AND DISCUSSION

The results of the analysis of the demand for shell eggs given adverse information on salmonellosis are presented in Table I. The coefficient for the dummy variable associated with adverse information on salmonellosis, DS_t (-2.637) is almost significant at the 0.05 significance level, as is the price-dummy interaction ($P_t{*}DS_t$) coefficient (0.030). These coefficients respectively suggest that adverse information shifts shell egg demand back and further makes demand less elastic. Thus, while shell egg demand is less responsive to price changes with the adverse information than prior to the information, there is also a decline in the quantity demanded at every price level when adverse information is present.

Table I
Econometric estimates of per capita consumption of Grade A shell eggs with adverse information on Salmonella.

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T STATISTIC
Intercept	21.266	7.576	2.807
Price P_t	-0.085	0.022	-3.879
Price-Information Interaction ($P_t{*}DS_t$)	0.030	0.020	1.519
Income Y_t	1.244	2.446	0.509
Information DS_t	-2.637	1.666	-1.583
$DT1_t$	-0.744	0.222	-3.345
$DT2_t$	-1.193	0.369	-3.244

Table II compares price and income elasticities at each extreme and at the midpoint of the time series. It is of interest to note that the own-price elasticity is slightly larger toward the end of the series. This is coincident with the fact that publicity on salmonellosis risk in eggs began to gain momentum in mid-1988. While it may be tempting to infer that there is a relation between the increasing own-price elasticity and the increasing publicity, any association is more likely attributable to the specified linear functional form. One would expect that over the very short run, demand for eggs will be fairly inelastic and that the income variable would have an insignificant effect on demand since eggs are generally viewed as an inexpensive source of protein. However, the positive income elasticities

seem consistent with eggs being a normal good and that it is quite difficult to find substitutes for eggs. It is worth noting that the income elasticity seems to have remained fairly constant through time further supporting the notion that eggs have few close substitutes.

The lack of statistical significance when testing the coefficients of the variables related to adverse information on salmonellosis could be a direct consequence of the use of monthly data in the estimation. Studies have shown that adverse information effects on consumer demand are largest immediately following the episode, tapering off and disappearing within two to three weeks following the episode in question (Foster and Just, 1989; Swartz and Strand, 1981; Smith, van Ravenswaay and Thompson, 1988). Use of weekly consumption and price data is more likely to capture the episodic effect on demand and possibly its decay and thus provide a better understanding of the effect of changing risk perceptions on consumer demand.

Future endeavors are to incorporate pasteurized egg consumption in the analysis in a system of demand equations and evaluate the effect of adverse information on both shell and pasteurized egg consumption.

Table II
Estimated price and income elasticities at extremes and midpoint of the time series.

	PRICE ELASTICITY	INCOME ELASTICITY
START OF SERIES	-0.362	0.207
MIDDLE OF SERIES	-0.274	0.223
END OF SERIES	-0.566	0.223

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