

Chapter 9

FINANCIAL MARKET REACTION TO THE FAST FOOD HAMBURGER HEALTH SCARE OF 1993

9.1. Introduction

In 1993 a bacteria epidemic killed several children in the Pacific Northwest. The bacteria was a virulent strain of *E. coli* and was traced to undercooked hamburgers at Jack-in-the-Box restaurants. The outbreak was the largest and most serious for *E. coli* with a total of 400 confirmed or probable instances. Ultimately the tainted hamburgers forced 125 people to be admitted to a hospital and led to kidney failure in 29 people.

Jack-in-the-Box, whose corporate name was Foodmaker, did not handle the public relations crisis very well in the first few days of the crisis. It took several days before the company addressed the public and removed all meat from its restaurants. However, Jack-in-the-Box did respond with a quality assurance program to ensure the safety of food at each point in the distribution system from meat supplies to the cooking process. The process now mandates that if a supplier's products test positive for harmful *E. coli* on more than one occasion that supplier is dropped. Today, restaurant management tests the cooking system and cooks sample products. There are weekly inspections and each beef patty is checked by a company certified employee before it is removed from the grill.

Public health officials are worried about virulent strains of *E. coli* including *E. coli* 0157:M7 because they may appear anywhere, from the municipal water supply to apple cider, and in rare meat. Outbreaks in meat are particularly difficult to avoid because cattle are a major reservoir of the bacterium. *E. coli* 0157:M7 is more virulent than other forms of *E. coli* because it clings to cell walls in the human bowel and produces a toxin that causes bleeding. Doctors do not have an effective treatment plan for *E. coli* 0157:M7 and are baffled by the spectrum of symptoms. Most commonly a problem is detected in otherwise

healthy children that present with kidney disease including hemolytic-uremia syndrome or thrombocytopenic purpura.

Hamburgers pose the greatest risk because the grinding and mixing of the meat provides a large surface area for the growth of the bacteria. Steaks and ribs are less susceptible due to the heating of the exterior even in "rare" preparations.

As a result of the Jack-in-the-Box outbreak and because of increasing awareness of the health hazards of *E. coli* 0157:M7, the U.S. government adopted new inspection programs for the monitoring and testing of meat and poultry from slaughter to consumption. New standards were adopted for salmonella bacteria; all meat processes were required to test for *E. coli* 0157:M7; each plant must now identify the critical points for inspection and these must be approved by the Department of Agriculture on a can by can basis. Most importantly the Food and Drug Administration has increased the federal minimum cooking temperature for ground beef from 140 degrees to 155 degrees.¹

While Jack-in-the-Box was able to respond fairly rapidly to the public relations nightmare it was not quick enough to control the damage to its reputation. Over the two years following the outbreak, Jack-in-the-Box lost 30 percent of its stock market value and had its debt reclassified to junk bond status by Moody's investor rating services. Foodmaker was reported to have lost at least \$138 million over two years. Fortunately for Foodmaker this financial disaster was subsequently reversed as Foodmaker stood behind its franchises and used a public relations campaign to humanize its fast-food chain by resurrecting the "Jack" icon including an ad in which Jack dynamited company headquarters. At this time Foodmaker's annual sales were approximately \$129 billion with two-thirds of the revenue coming from the Jack-in-the-Box outlets. Reported sales losses were, in fact, much too low.

In this chapter I use historical sales data to estimate a demand model for hamburgers sold in the fast-food market. I use this model to compare Jack-in-the-Box actual and forecasted sales for the two-year period following the *E. coli* outbreak. My conclusion is that Jack-in-the-Box sustained much greater losses and at levels that were consistent with investor expectations that the losses would be permanent.

In section 9.2, I discuss the data sources used in this analysis. In section 9.3, I present my econometric model of hamburger demand and contrast it to two other approaches for forecasting demand, one based on sales revenues of Jack-in-the-Box directly while the second based on a market share approach. The final section presents estimates of lost sales and my conclusions.

¹McDonald's corporation has always cooked its burgers to a temperature of at least 157 degrees while Jack-in-the-Box was much closer to the then-permissible standard of 140 degrees according to federal reports.

9.2. Data Sources

The data for this study were derived from four sources: (1) Jack-in-the-Box sales for several regions from 1987 through 1994 obtained through Restaurant Trends, (2) national income product accounts by year and quarter, (3) consumer price index and unemployment data by region and quarter from the Bureau of Labor Statistics; and (4) earnings, population, and employment data by year and region from the Bureau of Economic Analysis.

9.2.1. Restaurant Trends Data

The Restaurant Trends data represent surveys of Quick Service Restaurants (QSR) in major regions of the United States. Data were obtained for ten cities: Los Angeles, Sacramento, San Diego, San Francisco, St. Louis, San Antonio, Phoenix, Dallas, Houston, and Seattle. (The sales for these cities represent approximately 80 percent of reported domestic and international sales.) The data provide revenues and number of stores on a quarterly basis for the period 1987 through 1994. The econometric analysis is based on 240 observations (ten regions, six years, and four quarters). The estimation period is based on the period from 1987 through 1992 and excludes 1993 and 1994 so that a lost-sales calculation can be made using predicted and actual sales. The QSR reports provide information on the major hamburger chains including Burger King, McDonald's, Wendy's, Arby's, Carl Junior's, Jack-in-the-Box, Hardy's, and Whataburger.

9.2.2. Bureau of Economic Analysis

Data were obtained on the ten primary cities for the years 1987–1996 from the Regional Economic Information System of the Bureau of Economic Analysis (BEA). The BEA data provide measures of population, per-capita income, earnings at retail establishments, earnings at eating and drinking establishments, total employees, and employment at retail establishments.

9.2.3. National Income and Product Accounts

Data were obtained from the National Income Products Accounts, including real gross domestic product, real personal consumption expenditure, real personal consumption expenditure on food, real personal consumption expenditure on services, national population levels, real disposable personal income, and the price index for personal consumption expenditures on food. Data were obtained on a quarterly basis from 1987 through 1996.

9.2.4. Bureau of Labor Statistics

From the Bureau of Labor Statistics, I collected CPI data for all urban consumers and unemployment statistics by region. Data were collected on

a monthly basis and converted to a quarterly basis for the years 1987 through 1996.²

9.3. Econometric Models

In order to model the historical sales at Jack-in-the-Box, I utilize a time-series cross-section structure with quarterly observations. The use of the ten primary regions, six years (1987–1992), and four quarters per year, results in 240 observations. The regression models I specify in this section consider: (1) revenues, (2) number of stores, and (3) revenues per store (average unit volumes). A variable glossary is provided in Table 9.1.

Table 9.1. Variable Glossary

r2–r10	Region dummy variables
q2–q4	Quarter dummy variables
perfran	Percentage of stores that are franchised
trend	time trend
lrpci	log of real per-capita income
lur	log of unemployment rate
lrrev	log of real sales revenue per capita
lrauv	log of real sales revenue per store
lrsto	log of stores per capita

When modeling revenues, I use real sales per capita, *i.e.*, I adjust the quarterly sales for changes in the price level and express the result on a per-capita basis. All adjustments are done using the values of the factors at specific regions and time periods. When modeling average unit volumes, the sales per store are expressed in real terms. When modeling the number of stores, I divide the number of stores by the regional population. The latter variable is the reciprocal of the number of individuals in the population per store and corrects for possible heteroscedasticity.³

²Where specific regional information was not available, the values for nearby regions were substituted.

³The time-series cross-section form of the data allowed generalized least squares estimation. The optimal weighting (estimated ratio of within and between variances) was 0.95 so that a fixed-effects approach was adopted. The models were estimated in log-linear form. The estimation period is from 1987 through 1992 and represents the pre-outbreak period.

9.3.1. Revenue per Capita

To explain the real sales per capita of Jack-in-the-Box stores in a quarter, I use nine region-specific dummy indicator variables (the fixed effects), three quarterly dummies (to control for seasonality), the percentage of franchised stores in the region, a trend term, real per-capita income, and the unemployment rate. Based upon the 240 historical observations, the R -squared is over 97 percent. A significant trend effect was determined implying a 3.5 percent annual increase in real per-capita sales for the period 1987–1993. Increases in real per-capita income increase sales, while increases in unemployment decrease sales. The percentage of franchised stores apparently does not affect the real per-capita sales level. Some seasonality is demonstrated with lower sales in January through March. Finally, the fixed effects were very precisely determined. The estimated regression model is given in Table 9.2.

9.3.2. Average Unit Volume

Table 9.3 considers real average unit volume. Average unit volume is defined as revenue divided by the number of stores. The results are similar to those described in Table 9.2, with approximately 87 percent of the variation explained.

There are some notable differences. In this model, the trend in average unit volumes is slightly negative over the period. Additionally, the percentage of stores that are franchised in an area leads to higher per-store revenue. Regional sales are otherwise higher in regions with a higher percentage of franchises.

9.3.3. Stores per Capita

The qualitative results for per-capita stores were not dissimilar to those obtained in the average unit volume regression (Table 9.4). Not surprisingly, there was no quarterly store effect.

There was a positive trend effect measured at a 4.4 percent per year growth in store placements per capita. Areas with higher real per-capita income or lower unemployment rates also revealed a greater penetration in stores. The R -squared for this model was 96 percent.

9.4. Simulations and Conclusions

The estimated models were used to forecast “but-for” sales in the post-1993 period. The purpose of the “but-for” simulation is to predict sales levels as if the E. coli outbreak had not occurred. The estimated lost sales for the 1993–1994 period inclusive is \$267 million, or approximately 16.6 percent of historical actual Jack-in-the-Box sales.

Actual sales for 1993 and 1994 were \$1.6099 billion, while predicted sales were \$1.8771 billion. Models based on average unit volume and number of

Table 9.2. Revenue per Capita

Dependent Variable: lrrev		
Independent Variable	Estimated Coefficient	t-Statistic
(1)	-18.662	-20.34
r2	0.138	6.91
r3	0.099	5.40
r4	-0.261	-3.22
r5	-0.728	-23.51
r6	-0.506	-7.99
r7	0.209	7.63
r8	-0.050	-2.01
r9	-0.265	-9.28
r10	-0.623	-17.12
q2	0.087	7.74
q3	0.114	9.30
q4	0.149	11.56
perfran	0.007	0.11
trend	0.034	9.48
lrpci	2.073	10.01
lur	-0.128	-4.20
Observations		240
Corrected R-squared		0.978
Mean of Dependent Variable		-5.417

stores provided identical results (when combined) given the logarithmic transformation of the dependent variables.

9.4.1. Market Share Logit Model

To corroborate these estimates I estimated a multinomial logit market share model. The market share model is based on the ratio of the market share of each chain's sales to that of a normalizing alternative. I use sales at McDonald's stores as the normalizing alternative. While this can be done without loss of generality (*i.e.*, predicted market shares would be identical using another normalizing alternative), the interpretation of the coefficients for the explanatory factors is affected by this choice. The dependent variables in these regressions

Table 9.3. Average Unit Volume

Dependent Variable: lrauv		
Independent Variable	Estimated Coefficient	t-Statistic
(1)	-4.765	-6.48
r2	0.109	6.76
r3	0.053	3.58
r4	-0.241	-3.70
r5	-0.069	-2.81
r6	-0.148	-2.91
r7	0.045	2.06
r8	-0.173	-8.56
r9	-0.110	-4.79
r10	-0.135	-4.64
q2	0.090	9.95
q3	0.118	12.01
q4	0.161	15.52
perfran	0.201	3.79
trend	-0.009	-3.32
lrpci	1.244	7.50
lur	-0.126	-5.15
Observations		240
Corrected R-squared		0.883
Mean of Dependent Variable		0.507

are the difference in the log average unit volume of a particular chain and log average unit volume at McDonald's. Explanatory factors include alternative specific constants, a time trend, real per-capita income, and unemployment. The market share model is estimated using four regression equations (one less than the number of alternatives). Here, I assumed that there are five major alternatives in the market share model (Jack-in-the-Box, Burger King, Wendy's, Carl Junior's, and McDonald's).

In order to simulate the market share model, I constructed a variable to measure the total revenue for the five hamburger chains used in the market share equations. To model real per-capita sales at the five hamburger chains, I used a constant term, time trend, the ratio of employment in the retail sector to total

Table 9.4. Stores per Capita

Dependent Variable: lrsto		
Independent Variable	Estimated Coefficient	<i>t</i> -Statistic
(1)	-13.897	-14.69
r2	0.029	1.44
r3	0.046	2.45
r4	-0.020	-0.25
r5	-0.658	-20.62
r6	-0.358	-5.48
r7	0.164	5.80
r8	0.122	4.70
r9	-0.155	-5.28
r10	-0.488	-13.00
q2	-0.002	-0.23
q3	-0.004	-0.32
q4	-0.011	-0.85
perfran	-0.194	-2.85
trend	0.044	11.78
lrpci	0.828	3.88
lur	-0.002	-0.07
Observations		240
Corrected <i>R</i> -squared		0.962
Mean of Dependent Variable		-5.924

population, and the real earnings at retail establishments divided by employment at retail establishments (a measure of per-capita earnings for workers at retail establishments). The estimated regression model showed that real sales per capita for the five hamburger chains increased both as the retail sector grew in real terms and with increases in the payments to those working in the retail segment. The *R*-squared for this regression is approximately 65 percent. Given the similarity in findings to the revenue per-capita models, the regression results are omitted.

Using the results of the market share equations and the total revenue per-capita equation at the five chains, it was possible to forecast the post-1993 sales period. The sales simulation proceeds under two scenarios. In the first

scenario, I assume that the actual revenues for the five hamburger chains for 1993–1994 were identical to their historical levels. My assumption here is that any loss in sales at Jack-in-the-Box would simply shift to another competitor but that total sales would not be affected. This assumption should be correct provided that the degree of substitution among the major hamburger chains is closer than that between Jack-in-the-Box and non-hamburger substitutes.

Under this zero-sum scenario, in which Jack-in-the-Box sales will go to another hamburger competitor, I calculate that the lost sales for 1993 and 1994 would be \$282 million for the ten regions. This estimate is similar to the estimate of lost sales using the revenue per-capita model.

9.4.2. Conclusions

As Foodmaker's annual sales circa 1993 were \$1.29 billion with two-thirds of the revenue derived from hamburger sales, annual hamburger revenues were approximately 859 million dollars. If investors concluded that the lost earnings were permanent, the stock price would fall in proportion to the decline in earnings due to the E. coli scare. As stock prices lost some 30 percent of their value, an estimate of lost earnings consistent with the stock decline would be \$258 million per annum. The econometric estimates show that lost sales were closer to \$133.5 million per annum (\$267m for two years). This figure is nearly double that reported in the trade news. The decline in stock prices does not necessarily reflect irrational expectations of investors. Investors correctly perceived the news to be much worse than that reported in the press. However, the initial stock price decline appears to have been too large to be explained by the financial consequences of the E. coli outbreak, even if investors believed the effects to be permanent. As revenues subsequently stabilized and returned to normal levels, the financial market revised stock prices accordingly and returned them to levels consistent with long run trends.