

The Effect of Mad Cow (BSE) Scare on Beef Demand and Sales Loss: The Case of İzmir

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Abstract: This paper investigates the effect of the BSE scare on beef consumption due to the intense media coverage. Using monthly data, a beef demand model for January 1995-February 1997 period is estimated for İzmir Province. Beef sales dropped immediately after the media coverage on BSE in April 1996 and continued through June 1996 when the intense media coverage stopped. The econometric model reveals that beef sales in İzmir would have been 36.4% higher if the BSE crisis never occurred. The annual individual willingness to pay is \$0.5224 per year to avoid consuming BSE contaminated meat.

Key Words: Health risk, demand model, mad cow (BSE), consumer surplus, sale loss

Delî Dana Korkusunun Dana Eti Tüketimi ve Satış Kaybı Üzerine Etkisi: İzmir Örneđi

Özet: Bu çalışma yoğun yazılı basın haberlerinin yolaçtığı delî dana (BSE) korkusunun sığır eti tüketimine etkisini araştırmaktadır. Ocak 1995 ile şubat 1997 arasındaki aylık verileri kullanmak suretiyle İzmir için bir talep modeli tahmin edilmiştir. Sığır eti satışları, delî dana haberlerinin medyada yer almaya başladığı 1996 nisanında aniden düşmüş ve bu düşüş medya haberlerinin sona erdiği 1996 haziranına kadar devam etmiştir. Ekonometrik model, eđer delî dana krizi yaşanmasaydı sığır eti et satışlarının % 36,4 daha fazla olacağını göstermiştir. Ayrıca, tüketicilerin delî dana bulaşığı olmayan ete yılda kişi başına 0,5224 ABD doları ödemeyi kabul ettiği belirlenmiştir.

Anahtar Sözcükler: Sağlık riski, talep modeli, delî dana, tüketici rantı, satış kaybı

Introduction

Consumer concerns about the safety of food have been high particularly during the past decade. These concerns appear to be due to new information that consumers perceived the potential risks about food borne diseases and presence of chemicals in foods (1-5).

Concern about food safety issues has increased the importance of consumer protection and policies aimed to improve the safety of food. Food safety issues are related to food contamination resulting from the use of agrochemical in pest control and growth regulation such as pesticides, hormones, antibiotics, and animal feed that routinely remain in the marketed product and represent a health risk.

The economic rationale for the need to protect consumers from food contamination is related to externality and information asymmetry. The problem of

externality is due to the condition that the producers are not paying for health costs imposed on consumers. Similarly, the problem of information asymmetry puts consumers in an unfavorable position since they cannot assess the presence or absence of health risks, unless they are assured about the safety of the food supply. Laws, regulations and policies for consumer protection are important tools to improve efficiencies in the market.

The debate related to health risks about the transmission of Bovine Spongiform Encephalopathy (BSE- 'mad cow disease') started in Britain in the early 1990s. European concern about the disease emerged within weeks of the release in London of a 16-volume report on the 15-year-old crisis in the United Kingdom (6). The report provides evidence and supporting papers of the inquiry into the emergence and identification of BSE and its variant Creutzfeldt-Jakob Disease (vCJD) in humans.

Panic over the transmission of the disease has spread across Europe and received wide publicity. The announcement of outbreaks appears to cause the consumption of beef to decline and the meat industry was seriously affected after the publicity about the presence of a health risk in meat.

There was intense media coverage in Turkey about the risk of BSE and its possible transmission to humans in March 1996 after exports of live and processed bovine animals slaughtered in the UK, which are liable to enter the animal feed or human food chain, were prohibited (European Commission Decision 96/293/EC). The relevant media coverage continued intensively from April through June 1996, declined significantly after June 1996 and ceased afterwards.

Meat is a common ingredient in Turkish cookery. In fact monthly per capita beef consumption in Turkey and İzmir is about 0.395 and 0.493 kg, respectively (7,8). Therefore a decrease in meat consumption can cause considerable sales losses for producers. The objective of the paper is to estimate the impact of the BSE crisis on the demand for beef and to calculate sales losses for the case of İzmir. More specifically the paper aims to answer the following research questions:

How did the consumers react to the BSE media coverage?

What is the average consumer willingness to pay to avoid health risks of consuming BSE contaminated meat?

The findings of the study have significant implications for the government and food industry. When information about food contamination is released, consumers react and change demand, thus causing a loss in sales. Understanding how consumers react to the food safety incidents provides guidance to policy makers in responding to consumer fears in similar health scare events. The food industry also benefits from such knowledge in developing strategies to prepare for similar incidents. An estimate of the economic consequence of a food scare event provides important evidence for the food industry in quantifying the revenue losses associated with the controversy.

Another finding from this study is an estimate of consumer willingness to pay to avoid BSE contaminated meat. This piece of information is valuable for policy makers in evaluating policy alternatives concerning improvements in the safety of the meat supply.

Determining consumer demand for food safety and understanding how consumers react to food contamination incidents is important for government policy makers. The government agencies are responsible for regulating the use and application of agrochemical in food production. It is therefore important for the government agencies to understand the consumer benefits of imposing regulations to assure safety in the food supply.

Materials and Methods

The research analyzes how health-risk information about food affects food purchases over time by systematically identifying measures on the presence or absence of risk information in the market by incorporating these variables into an econometric demand model. To investigate the impact of health scare on purchases, we explore the demand effects in the İzmir metropolitan area, the third largest city in Turkey. One major reason that we chose İzmir is the availability of the most comprehensive monthly data on retail purchases of meat and retail price of meat and its substitutes.

The data consist of monthly observations of beef consumption, population, retail price of beef, retail price of chicken, retail price of lamb and consumer price index for food products and the number of articles on the presence of health risk of BSE contaminated meat in the market. The available data set consists of observations in January 1995 through April 1997.

Monthly data on total beef consumption is not available for the January 1995-April 1997 period. We therefore have to use the monthly figures of beef carcass weights produced in İzmir's largest beef production and packaging plant as a proxy for beef consumption in the İzmir metropolitan area, which consistently provides about 60-70% of the total beef supply of İzmir (9). Discussion with the experts and comparing the available consumption data (January 1996 through April 1997) with reported carcass weights revealed that on average 52% of total carcass is marketed and consumed (mean percentage of carcass weight available for consumption is 0.52 with a standard deviation of 0.02)*. The variable representing per capita consumer income was obtained annually and then converted to monthly data by interpolating.

* The data set is available from the authors on request.

The model of consumption choice in this study is based on the expected utility model. This framework is useful in the food-safety context since consumption decisions are made in the presence of uncertainty.

Assume that the consumer's preferences are separable. That is, preferences can be partitioned into groups such that the preferences within each group can be described independently on the quantities in other groups. Following this assumption, food will be defined as a separate group.

Assume that the representative consumer consumes q (meat) and y (all other foods) during a lifetime. Among all food items, assume that only meat contain substances that are harmful to human well being if consumed.

The lifetime expected utility of the consumer is

$$EU_t = U_t(q_t, y_t) + p(h)U_{fa}(q_f, y_f) + (1 - p(h))U_{fb}(q_f, y_f)$$

where $EU_t(\cdot)$ is the expected utility of the consumer in the current period and $U_{fa}(\cdot)$ is the utility associated with poor health and $U_{fb}(\cdot)$ is the utility associated with good health in the future. q_t and y_t are consumption of meat and all other goods in the present period. q_f and y_f are consumption of meat and all other food in the future period. $p(h)$ is the consumer's perceived probability of occurrence of future health problem, after consuming q_t and y_t in the present period. Note that we assume that the past and present consumption is always irrelevant to the current period's utility, i.e. the health effects are always delayed to the future period. We also assume that there are no marginal health risks associated with future consumption.

The optimization problem of the consumer is to maximize the lifetime utility function subject to the lifetime budget constraint. The lifetime budget constraint is

$$m = pq + zy$$

where m is consumer's lifetime disposable real income, p is the deflated retail price of meat, z is the deflated retail price of all other foods, q is the quantity of meat consumed over the lifetime and y is the quantity of all other foods consumed over the lifetime. Note that p and z are assumed to be constant over a lifetime. Therefore, the per-period budget constraint is proportional to the lifetime budget constraint.

The first order conditions from the maximization problem at time t , the demand function for meat and all other foods are

$$q_t = q_t(p_t, z_t, m_t, p_t) \quad y_t = q_t(p_t, z_t, m_t, p_t)$$

To summarize, the demand for meat is a function of its own price, the price of its substitutes, income and perceived health risk of consuming contaminated meat.

There are several approaches in the economics literature on how risk information affects individual's perception of risk (10). One is that the individuals believe all the information received and behave according to the information. Following the assumption that people take risk information at face value and believe the reported information on health risks, it is expected that meat consumption will be affected following reports on information on the presence of health risk due to BSE contaminated meat. The theoretical background proposes the following hypotheses:

1. Beef consumption dropped during the intense media coverage on health risks due to BSE contaminated meat.
2. Beef consumption returned to the pre-announcement levels once the intense media coverage on the BSE contaminated meat ceased.
3. Consumers are willing to pay for policies that aims to eliminate health risks of BSE contaminated meat.

The dependent variable of the econometric beef demand model is per capita meat consumption in İzmir, which is calculated as total beef carcass weight produced in İzmir's largest beef production and packaging plant per population of the İzmir metropolitan area. The independent variables are, deflated price of meat in İzmir, deflated prices of substitutes of meat (lamb meat and chicken meat), deflated per capita consumer income in İzmir and the dummy variables that measure the presence or absence of health risk information in the media. The variables used in the econometric variables are reported in Table 1.

In estimating a demand equation for beef in a regional market such as İzmir, the supply and demand relationships at the national market and at the regional market should jointly be examined using a system of equations. This is justified by the assumption that price and quantity are determined simultaneously in the national market, the supply of beef to the regional is perfectly elastic and that the price at the regional level is affected by shifts in demand at the national level. The

Table 1. Variables used in the econometric model.

Variable	Explanation
Y_t	Per capita meat consumption in İzmir at time t (kg).
P_t	Retail price of meat in İzmir (deflated by the CPI for food products) at time t (TL/kg).
PL_t	Retail price of lamb meat in İzmir (deflated by the CPI for food products) at time t (TL/kg).
PC_t	Retail price of chicken meat in İzmir (deflated by the CPI for food products) at time t (TL/kg).
Inc	Per capita consumer income in İzmir (deflated by the CPI for food products) at time t (TL/month).
$D1_t$	Dummy variable that measures the presence or absence of intense media coverage about BSE. The variable takes the value of 1 for the three months after the first intense media coverage of BSE and 0 otherwise
$D2_t$	Dummy variable that measures the absence of intense media coverage after the BSE controversy. The variable takes the value of 1 for the months after the intense media coverage of BSE finished (July 1997 and onwards) and 0 for all other months

econometric model for beef demand at the regional level should therefore take into account the impact of demand shifts at the national level.*

When a regressor is contemporaneously correlated with the disturbance term, estimates are biased and inconsistent. For example, in the beef demand equation for İzmir, estimating the consumer demand for beef in İzmir market by a single equation may introduce simultaneity bias and the simultaneity bias should be tested by the specification test developed by Hausman (11). One way to deal with this problem is to find an instrument for the regressor. That is, a variable that is correlated with the regressor but not the disturbance term. Good instruments are hard to find, however. One method to deal with the problem is to use the instrumental variable method, where an instrument for the price variable is included in the demand model. In this study, an instrument for the price variable is determined by using the projected values of the price variables using a time-series model.

The estimate of the revenue loss from the BSE scare is the difference between the estimated actual sales and sales that would have occurred if the BSE event has not taken place. This gives an estimate of the revenue loss to beef retailers in İzmir Province. In estimating the change

in sales, estimated actual sales rather than the observed values of the sales were used. The reason to use this approach is to minimize the errors in sales loss estimates (12,13).

The welfare measure used in this study is the change in consumer's surplus due to a shift in an individual's beef demand associated with health risk information. The share of beef expenditures in an individual's budget can be considered small. Following Willig (14), the Marshallian demand should approximate the Hicksian welfare measures. Therefore, observing the change in consumer surplus with and without the risk information will give the individual's willingness to pay to avoid BSE contaminated beef. This willingness to pay estimate reflects the individual's total welfare changes from the BSE scare and total willingness to pay to avoid health risk from BSE contaminated beef.

The underlying assumption in the econometric model in this study is that the supply of beef to the İzmir Province is perfectly elastic at the national price plus a fixed transportation cost. Therefore, the quantity demanded is hypothesized to vary with changes in risk information at a given price. This implies that change in risk information causes a shift in the demand curve and thus reduces the quantity of beef that the individual

* For the specification of the econometric model, see (9). The econometric model developed in (9) suggests that the health risk information can cause a downward shift in beef demand in İzmir Province and all other regions. Since we assume that the national demand is the horizontal sum of the regional demands, health risk information should cause a downward shift at the national level and thus affecting national and regional prices. Estimating the consumer demand for meat in the İzmir Province by a single equation may introduce simultaneity bias if the price variable in İzmir beef demand is correlated with the error term in this equation.

consumes. The change in individual welfare comes from consuming fewer meat to avoid health risks associated with the consumption of BSE contaminated beef.

Results

The first step in estimating the demand model is to detect whether there is simultaneity bias in using a single equation to specify the demand equation. To test for simultaneity bias, the test developed by Hausman is used to compare the asymptotic covariance matrix for the demand equation with and without an instrument for the price variable. In the Hausman test, the null hypothesis that there is no simultaneity was not rejected (Hausman statistics = 3.34; $X^2(7) = 12.02$ for 10%). Therefore, retail beef market of İzmir was represented by only one equation, which was estimated by ordinary least squares.

The results of the econometric model (Table 2) suggest that beef has price elasticity with absolute value greater than 1, implying that the consumers can easily substitute for alternative products. Two alternative products for beef were investigated in the demand equation. Although the estimator of chicken price in the equation was found negative, opposed to the expectation, the zero hypothesis of "no effect" was not rejected through t-test at $\alpha = 0.10$, which means chicken price has no effect on beef consumption or is not an alternative product for beef. The results suggest that consumers in

İzmir treat lamb meat as a substitute for beef and chicken is not considered a substitute for beef. The econometric model also states that consumers are extremely sensitive to income changes.

The model proposes that beef demand declined promptly and swiftly right after the first announcements on the possibility of the presence of BSE contaminated beef in the market. The drop in beef consumption continued all through the period during which there was intense media coverage on BSE. The demand recovered promptly after June 1996, right after the intense media coverage ceased and the coverage on the BSE scare was not as intense as before.

The results indicate that the intense negative media coverage of the BSE scare caused a sales loss of approximately 36.4% during the April, May and June 1996 period. The model reveals a sales loss of 1,143,551,580,870 Turkish Liras (6,181,360 US Dollars in 1996 prices) to the beef producers (Table 3).

The change in consumer surplus associated with risk information can be estimated using the estimated demand curve. The annual change in consumer surplus associated with the information on the presence of health risk due to the BSE scare can be interpreted as the consumer's annual willingness to pay to avoid health risks due to consuming BSE-contaminated beef. The demand equation reveals that the change in consumer surplus is 7201 TL in April, 7260 TL in May and 9701 TL in June, 1996

Table 2. Equation for beef demand in İzmir Province (January 1995-February 1997)
(Dependent variable: $\ln(Y_t)$).

VARIABLE	COEFFICIENT	ST-ERROR	t-VALUE
Constant	-8.7049	9.568112	-0.90978
$\ln(\text{Inc})$	9.99641***	5.373737	1.860234
$\ln(\text{Pt})$	-1.57959**	0.735583	-2.1474
$\ln(\text{PLt})$	2.175022*	0.739031	2.943073
$\ln(\text{PCt})$	-0.24385	0.492898	-0.49472
D1t	-0.45282**	0.17826	-2.54024
D2t	0.231423	0.217079	1.066078
AR(1)	0.330054	0.283334	1.164896
$R^2 = 0.67$	F=4.826757*	Breusch-Godfrey Serial	Correlation LM (F) = 0.042649

* significant at $\alpha = 0.01$

** significant at $\alpha = 0.05$

*** significant at $\alpha = 0.10$

Table 3. Estimates of total beef sales in İzmir Region with and without the effect of the BSE scare for the April 1996-June 1996 period.

Period	Projected Per Capita Beef Consumption with the Risk Information (kg)	Projected Per Capita Beef Consumption without the Risk Information (kg)	Difference in Per Capita Consumption (kg)	Population	Retail price of Beef in 1997 (TL)	Sales Loss (TL)
April 1996	0.152	0.239	0.087	3,233,271	1,000,000	281,576,618,672
May 1996	0.218	0.343	0.125	3,241,031	1,000,000	404,914,318,748
June 1996	0.245	0.386	0.141	3,248,809	1,000,000	457,060,643,450
Total						1,143,551,580,870

1 US \$ = 185000 TL and total loss in beef sales in US dollars is 6,181,360 US \$

(\$0.0389, \$0.0392, \$0.0524 respectively). This means, on average, the İzmir consumers are willing to pay \$0.0435 monthly to avoid health risks due to consuming BSE contaminated beef (on average, the annual individual willingness to pay is $\$0.0435 \times 12 = \0.5224).

Discussion

The econometric model revealed that beef demand in İzmir market promptly and swiftly fell right after the first media coverage on the probable presence of BSE contaminated beef, which is consistent with the findings of Verbeke and Ward's (15) study showing that television publicity had a particularly negative effect on beef expenditures. Smed and Jensen's study (16) also identifies news with temporary impacts and news with permanent impact on consumers' food demand behavior and consumers were found to adjust quite rapidly to both temporary and permanent news and to be more influenced by the impact of more severe news. The beef sales in İzmir Province would have been 36.4% higher if the BSE crisis had never occurred. This implies that a drop in beef sales of almost \$6 million was realized in İzmir Province during April, May and June 1996. Pickelsimer and Wahl (17) declared that 45 % of French consumers have altered their consumption of beef with the impact of BSE crisis. The French consumers were found to have substituted lamb, pork, poultry and horse meat for beef while the İzmir consumers prefer lamb to beef. The consumers in İzmir are willing to pay a certain, even little, amount of money to avoid health risk due to BSE contaminated beef. Smith et al. (18) stated that

although the reduction in price, the passage of time, and yet more government control measures may have all contributed to some partial recovery in sales, the margins of beef have been eroded and the image of beef as a generic product has suffered significantly.

The results of the study imply that the benefits of food safety polices aimed to conduct tests and assurance programs to avoid health risks are significant. The costs of such policies should be weighed against the estimated benefits for optimum amount of food safety improvement practices.

Implications for Further Research

The findings of the study suggest that the BSE scare affected beef demand in İzmir. The research should be duplicated to other markets to test whether the BSE incident has the same effect across the nation.

Another point that needs to be investigated further is to explain the reasons why the beef consumption returned to pre-announcement levels once the intense media coverage ceased after June 1996. This result might be due to the fact that the government about the safety of the food supply assured consumers. Another possibility might be that the consumers pay attention to the immediate media coverage and tend to forget when the coverage ceases. More research is needed to elaborate more on the consumer behavior and investigate the reasons why the consumption of beef returned to pre-announcement levels.

If the consumer's perceived risks of consuming and experiencing health effects associated with BSE

contaminated beef were known, it would have been possible to calculate the implicit willingness to pay to avoid risk of a one in a million risk of death. The results then would have been comparable with the value of life studies. Research is needed to explore the Turkish

consumer's perceived possibility of experiencing health risks due to BSE contaminated beef. It would therefore be possible to derive to an estimate of willingness to pay to avoid perceived mortality risks.

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