Changes in Consumers' Meat Demand during the Dioxin Scandal in Germany: The Role of the Media and Consumer Attitudes

Veränderungen der Fleischnachfrage durch den Dioxin Skandal: Die Rolle der Medien und Verbrauchereinstellungen

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Summary

This study investigates household's demand responses to the German dioxin scandal in 2011 based on GfK Consumer Scan panel data focusing on the effect of media coverage and consumption habits. In contrast to pork demand, the media had a significant negative effect on the propensity to purchase poultry as well as the quantity purchased. We found evidence that strong habit persistence compensated the negative influence of household media exposure. This indicates the importance of considering also other factors (e.g. risk perception), to explain changes in consumers' meat demand during food scandals.
Keywords: demand analysis, media effect, habits, food scandal

Zusammenfassung

Dieser Beitrag untersucht die Fleischnachfrage von Haushalten in Deutschland während des Dioxinskandals 2011. Die auf wöchentlichen Daten des GfK-Haushaltspanels basierenden Analysen zeigen einen signifikant negativen Effekt der Medienberichterstattung auf die Geflügelfleischnachfrage jedoch nicht auf die Schweinefleischnachfrage. Langfristig werden diese Effekte aber durch das Gewohnheitsverhalten der Haushalte kompensiert was die Bedeutung von Konsumenteneinstellungen (Risikowahrnehmung etc.) bei Lebensmittelskandalen hervorhebt.

Schlagworte: Nachfrageanalyse, Medieneinfluss, Lebensmittelskandal, Konsumgewohnheiten

1. Introduction

In the last decades European consumers have repeatedly experienced severe food scandals like the foot and mouth disease or the BSE scandal. Scandals are usually unforeseen and temporary events having severe economic impacts especially on consumption patterns of consumers. In December 2010 too high dioxin contents in the feed for poultry, pigs, and laying hens were discovered in Germany. The source of contamination was the illicit use of technical fatty acids in the production process of nearly 3,000 tons of feed by a feed mill in northern Germany. In January 2011 high dioxin contents were discovered in pork and poultry in different federal states in Germany (AGE, 2011). This so called dioxin scandal triggered an intensive media coverage and public debate over institutional deficiencies in the food and animal feed production in Germany. Several studies investigated the extent of economic consequences as well as the relevant determinants for consumers' behavior in the context of food scandals. The general tenor is that food scandals have severe economic impacts and the media coverage (BURTON and YOUNG 1996) as well as behavioral and attitudinal factors (DING et al., 2011, 2013; LOBB et al., 2007) can play an important role in the disclosure of such scandals affecting consumers demand patterns. However, it became evident that the reaction of consumers in the course of a food scandal differs greatly and the specific reasons have not been sufficiently understood. The objective of this paper is to contribute to the better understanding of consumer behavior in the course of food scandals. Possible changes in demand during the dioxin scandal are quantified and the impact of relevant determinants considered hereof. Our hypothesis is that consumers react to the scandal by reducing or stopping their meat purchases. We assume that negative effects on demand behavior are mainly driven by media coverage. Further, we expect that consumption habits persist and counteract to reductions in demand.

2. Theoretical approach

2.1 Consumer behavior

Underlying determinants of purchases or consumption can be manifold (KOTLER and BLIEMEL, 1995). Besides socioeconomics such as age, gender, presence of children, income and education, also other

psychological and social constructs are important. These include individual perceptions, attitudes, emotions, motives, knowledge, values, information, knowledge and aspects of personal lifestyle and personality (TROMMSDORFF and TEICHERT, 2011). In the case of a food scandal, consumers are able to react by changing their purchase behavior. Since a multitude of food products are permanently available and accessible, products affected can be substituted by others. However, each consumer will respond differently depending on the extent of the individual perceived risk and the feeling of insecurity. Both are also determined by information gathered at the time of the crisis through media and the social environment.

Individual perceived risk is different from objective risk as consumers cannot gather and discriminate all the required information about the risky event which impedes them in making rational choices (SIMON et al., 2002). The level of risk perception can influence consumers demand behavior and interacts with various factors. Especially during food scandals the media can amplify the risk among consumers by sensationalising the food safety incident (ROWE et al., 2000). However the influence of the media coverage on risk perception and consequently the intention to purchase depends on the consumer trust in this information source (LOBB et al., 2007). Further, consumers' response to a food risk depends on consumers' desire, expressed through its habits, to adapt to that risk event. During food scandals consumption habits can influence the level of risk perception as they can act as risk relievers. In particular, habit persistence can offset the negative influence of the media and explain the reason for marginal or no demand changes during food scandals (DING et al., 2011). This will be further investigated in this study.

2.2 Media effect

We follow previous literature in constructing a media index which is based on the frequency of the media coverage (e.g. number of newspaper articles) as an adequate indicator for the journalistic attention as well as for the consumer awareness of a specific topic in a certain time period (DURANT et al., 1998). All media articles about the dioxin scandal are used and no differentiation is made between positive and negative articles to avoid any subjective classification (MAZZOCCHI, 2006). In the literature media indices of absolute or cumulative numbers

of articles have been widely used (BURTON and YOUNG 1996). Few studies, however, have explicitly modeled the diminishing marginal effects of media information. We follow the approach of CHERN and ZUO (1995) in constructing our media index as it accounts for carryover effects and forgetting using polynomial lag distributions to stimulate non-linear diminishing marginal effects of media information. Further we take differences in the potential media influence levels into account by computing weekly weights of different media (TV, print, online) in accordance to their actual reach level (SCHMIT and KAISER 2003). The Food Scandal Index (FSI) can be expressed as follows:

$$FSI_{i,t} = \sum_{k=0}^{n} W_k M_{t-k} \qquad\qquad (1)$$

where M_{t-k} is the number of relevant media articles published within a given period $(t-k)$, n is the number of lagged periods and W_k is the weight assigned to lagged period k. W_k is computed using a 3rd degree polynomial to overcome the restrictions of symmetric weights:

$$W_k = x_0 + x_1 k + x_2 k^2 + x_3 k^3 \qquad\qquad (2)$$

Here k is the number of lagged periods, and x_0, x_1, x_2, x_3 are parameters. The values of these coefficients have to be determined based on the subsequent criteria: (1) the maximum weight lies between the current period (k=0) and the last lagged period (k=n); (2) the minimum weight occurs at k = (n+1) and (3) is set to zero ($W_{n+1} = 0$); (4) the sum of weights over the current and lagged period i have to be equal to one.
Incorporating these criteria in equation (2) results in:

$$W_k = 2a/((n + 1)b) + (12m/b)k$$
$$-(6(n + 1 + m)/((n + 1)b))k^2 + (4/((n + 1)b))k^3 \qquad (3)$$

where $a = (n+1)^2(n+1-3m)$ and $b = (n+2)[(n+1)^2 - m(2n+3)]$. In these terms n is the number of total lag periods and m is the lag period with the maximum weight. The term $(n+1-3m)$ needs to be positive.

3. Data and descriptive statistics

3.1 Media index

For the Food Scandal Index we selected the newspapers, online news and TV news with the highest reach level in Germany during the time period the dioxin scandal occurred. We obtained the relevant articles utilising the LexisNexis Academic Search tool and official news archives.

A total of 352 relevant articles were published over the first 19 calendar weeks of 2011. For this period of observation we analyse possible short and medium-term effects of the dioxin scandal on household behavior. The specification of the adequate FSI is based on the Bayesian information criterion (BIC) to determine the appropriate lag length n and maximum lag weight m. The development of the media coverage and the FSI during the dioxin scandal is depicted in figure 1.
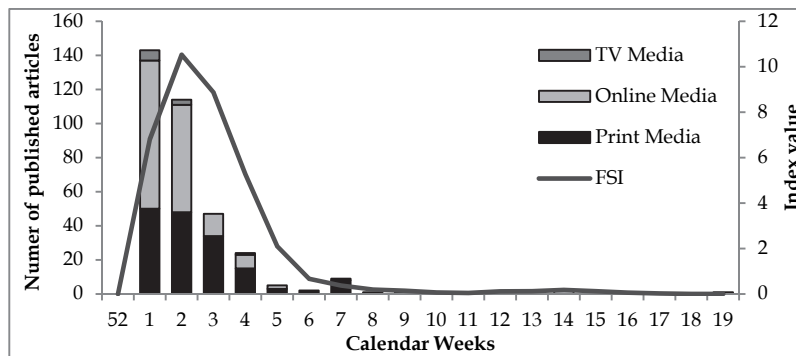

Fig. 1: Media coverage and the FSI during the dioxin scandal in 2011
Source: OWN CALCULATION based on LexisNexis and news archives

3.2 Household Scanner Data

The analysis of consumer behavior during the dioxin scandal is based on a sample of the GfK Consumer Scan panel dataset on food purchases of German households covering the years 2010 and 2011 (104 calendar weeks) with a total number of 16,023 households. For each shopping trip detailed information about individual household's purchases by species (pork, poultry, beef), type of cut is collected, including the transaction date, amount purchased and expenditure, and retail outlet. In addition, the dataset comprises socio-demographic information about the households.

The data has been aggregated to weekly observations and a constant data pool[2] of households has been created in order to permit the comparison of identical households over the whole period consisting of

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[2] We included households who reported purchases in more than 75% of the 104 weeks of observation and showed no gaps in purchase reporting of more than 3 consecutive weeks.

6,199 households and a total of 636,376 observations. To examine the changes in consumers demand for poultry and pork we computed the changes in demand for both products on identical calendar weeks in 2010 and 2011 (see figure 2). Overall the consumption level of poultry and pork meat declined by about 41% and 32% respectively. The largest decline in demand can be observed during the first three calendar weeks which fall in line with 86% of the total media coverage.
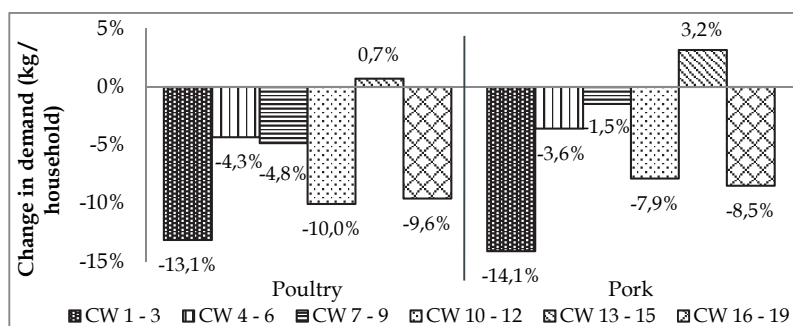

Fig. 2: Changes in households demand for pork and poultry from 2010 to 2011
Source: OWN CALCULATION based on GfK data.

Because exact product prices are not reported in the GfK Consumer Scan panel, only unit values can be calculated, having well-known shortcomings as they capture quality differences which can lead to biased estimation results. Therefore, we compute quality adjusted prices by estimating hedonic price functions (COX and WOHLGENANT, 1986) for pork and poultry. Because quality characteristics are unobservable, variables which influence the consumer's choice of quality such as socio-demographic variables and the retail outlets are used as proxies for household preferences.

4. Method

Since our data has a large share of zero consumption values for both of the investigated product categories we base our analysis on a dynamic Tobit model. We estimated a dynamic correlated random effects Tobit model that considers the complex structure of the panel which is important when analyzing consumer demand during food scandals (for further details see RIEGER and KUHLGATZ, 2015):

$$x_{i,t}^* = \alpha + \beta\, FSI_{i,t} + \boldsymbol{p}_{i,t}\, \gamma + \boldsymbol{h}_{i,t}\, \mu + \lambda_1\, x_{i,t-1} + \lambda_2\, x_i^{PY} + \boldsymbol{d}_i \eta + + u_i + e_{i,t}$$
$$u_i \sim N(0, \sigma_u^2),\ e_{i,t} \sim N(0, \sigma_e^2)$$

$$x_{i,t} = x_{i,t}^* \quad if \ x_{i,t}^* > 0 \qquad x_{i,t} = 0 \quad if \ x_{i,t}^* \leq 0$$

where x is the amount of goods consumed, x^* is a latent variable representing the consumer's propensity to buy a product given their preference structure, **p** is a vector of prices consisting of the prices of the investigated products as well as a price for beef products. *FSI* is the media index defined in eq. (1) and **h** is a vector of household characteristics. Indices i = 1,…,N and t = 0,…,T denote the household and week. As consumer behavior for the investigated product is likely to be influenced by consumption habits (DING et al. 2011), we include a lagged dependent variable, which takes values of the quantity demanded in the previous period x_{t-1} (short-term habitual adjustments), as well as a time-invariant variable x^{PY} (long-term consumption habits), which indicates the quantity consumed by the household in 2010. u_i is an unobserved household specific effect that is modeled as a random effect (RE) and $e_{i,t}$ is the idiosyncratic error term. To overcome the restrictive assumption of independence between the random effect and the explanatory variables, we employ the correlated RE model proposed by CHAMBERLAIN (1984), which relaxes this assumption by including a set of variables $\mathbf{d}_i$ that represent the linear projection of the unobserved effects onto the time-variant explanatory variables. Parameter estimates can be further divided into (1) the effect on the probability of quitting consumption, and (2) the effect on the magnitude of consumption (MCDONALD and MOFFITT, 1980) which is of great relevance to our research objective.

5. Results and discussion

Table 1 presents the estimates of the correlated random effect Tobit model for the marginal effects on the probability of quitting demand and on the magnitude of demand changes for poultry and pork respectively. The results for the FSI support our hypothesis that media coverage exerted a significant negative influence on households' probability of consuming poultry as well as on the quantity consumed.

A one-unit increase in the FSI reduced the probability of purchase for poultry by 0.2%, whereas the weekly quantity purchased decline by 0.002 kg which is quite low even though the media effect in the second calendar week could be 10 times higher (see Table 1).

Tab. 1: CRE Tobit model estimates for poultry and pork

	Marginal effects	
Demand for Poultry	**Purchase probability**	**Quantity purchased**
Food Scandal Index (FSI$_{i,t}$)	-0.002***	-0.002***
Short-term habits (x$_{i,t-1}$)	-0.022***	-0.030***
Long-term habits (x$_i$^{py})	0.470***	0.659***
Price of poultry	-0.041***	-0.057***
Price of beef	0.000	0.000
Wald χ²	7485.42 ***	
Demand for Pork	**Purchase probability**	**Quantity purchased**
Food Scandal Index (FSI$_{i,t}$)	-0.001	-0.001
Short-term habits (x$_{i,t-1}$)	-0.015***	-0.021***
Long-term habits (x$_i$^{py})	0.400***	0.586***
Price of pork	-0.031***	-0.046***
Price of beef	-0.001	-0.002
Wald χ²	9998.82***	
Notes: ***, ** and * denote significance at 1%, 5% and 10% level. N=116,261. Control variables cover education level, household net income, household composition and place of residence. Results are available from the authors upon request.		

Source: OWN CALCULATIONS based on GfK data

For pork demand the FSI had a negative but not significant effect. However, in regard to pork chop, which is the most important pork product, RIEGER and KUHLGATZ (2015) showed a highly significant effect by media coverage during the dioxin scandal. This indicates that the demand of most of the other pork products were not affected by the scandal and compensated the significant media's effect on pork chops demand. A plausible reason for the marginal adjustment in household consumption behavior is the fact that the dioxin scandal already started in December 2010 where high dioxin contents in eggs were verified. This could have desensitized consumers and reduced the shock effect when the dioxin scandal extended to pork and chicken meat. Evidence of consumer desensitisation by reoccurring food scandals is confirmed by DING et al. (2013) where a series of recurring BSE incidences in Canada was investigated. Other plausible reasons for the marginal adjustment could be strategies on the supply side, for instance sales promotion or price formation. Those are not covered in the model due to data limitations. The results further suggest that consumptions habits are important factors in explaining household's meat demand response during the Dioxin scandal which is also in line with our hypothesis. The significant negative effect of the short-term consumptions habits (x$_{i,t-1}$) on the magnitude and the purchasing propensity indicates that

consumers prefer a variation of different kinds of food over the weeks. The long-term consumptions habits, measured by the household's average consumption level of 2010 (x_i^{py}), had a strong positive significant influence for both products giving evidence of habit persistence in the long-term. We find evidence that the strong effect of habit persistence appears to have acted as a risk reliever and compensated the influence of media coverage resulting in the minor adjustments in the demand for both products (DING et al., 2011). The price estimates for poultry and pork carry expected negative signs. Beef, which was not affected by the dioxin scandal, did not act as substitute in either poultry or pork demand.

6. Conclusion

This paper aims to explain household's meat demand responses during the German dioxin scandal in 2011. A correlated random effect Tobit model was applied for analyzing pork and poultry demand. To account for the impact of media coverage, a media index was constructed. Although strong habit persistence regarding the household's purchase of pork and poultry were identified, a negative yet minor impact of the media index on the propensity to buy as well as the purchased quantity could have been observed. However, a significant impact of the media index was only detected for poultry demand. In regard to pork, we assume that only specific products, e.g. pork chops, were affected by media coverage, and thus, compensated by the overall effect of the product aggregate. The research presented in this article indicates the importance of considering more individual factors of consumers, e.g. attitudes and perceptions, to explain changes in demand behavior during food scandals.

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