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ANALYZING CONSUMER DEMAND DURING A FOOD SCANDAL: THE CASE OF DIOXIN CONTAMINATED FEED IN GERMANY AND THE MEDIA

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This study investigates the effect of media coverage on the consumer demand for pork chops and chicken filet in the course of the German dioxin scandal in 2011. A media index is constructed to account for the dynamics of the media coverage for the first nineteen calendar weeks in 2011. The response of the German households is estimated with a dynamic correlated random effect Tobit model based on weekly panel data provided by the GfK and data on media coverage provided by Lexis Nexis. Our dataset contains detailed information on purchasing transactions and socio-economic characteristics of the consumer households. The empirical results show that unobserved heterogeneity is important to consider when analyzing the determinants of demand in times of a scandal. For both meat products, media had a significant negative effect on the propensity to consume as well as the quantity purchased.

Keywords: Dynamic correlated random effects Tobit model, consumer demand, media, food scandal, panel data

JEL codes: L15, Y90

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1. Introduction

In the last decade Germany and other European countries have repeatedly experienced severe food scandals like the foot and mouth disease, the BSE scandal (bovine spongiform encephalopathy) or the contamination of vegetables with E.coli (EHEC scandal). These scandals are usually unforeseen events with specific characteristics having substantial impacts on the consumption patterns of consumers. To investigate possible effects of a food scandal and corresponding determinants on consumer behavior, an initial definition of such an event is necessary. Kepplinger et al. (2002) stresses that, almost every scandal is based on a nuisance but not every nuisance results in a scandal. To clearly identify the occurrence of a (food) scandal, three essential criteria can be distinguished. First, there has to be a nuisance which the consumers perceive as a threat for food safety and system reliability regarding production and control systems in the food chain. Second, the origin of the mentioned nuisance is on the supply side during the production, processing or marketing stage. Third a food scandal is a concrete crisis-laden event with clear time and spatial limits (Linzmaier 2007). The nuisance is then communicated to the consumers mainly by the media, which denunciate it in the public. The actual dimension of the food scandal can depend considerably on the intensity of the media coverage (Kepplinger 2001).

Several studies investigating possible explanatory variables for consumers' behavior in the context of food safety and food scandals were published in the last decades (Chern and Zuo 1995; Burton and Young 1996; Wildner 2002; Verbeke and Ward 2001; Piggot and Marsh 2004). The general results of these studies are that the media coverage can play an important role regarding the disclosure of food scandals affecting consumers demand patterns. In a consumer demand function information may be used as an explanatory variable in addition to neoclassical economic factors like income and prices. The information variable can influence consumers' demand for foods which are potentially fraught with risk (Smith et al. 1988; Chern and Zuo 1995; Smed 2012). The extent of consumers' reactions in case of a food scandal can also depend on the type of food affected. If the corresponding product is a widely-used staple food the possible reaction of the consumers is found to be stronger (Kutsch 1992). An example would be meat products where consumers have a comparably high mistrust resulting in an increased receptiveness for information through the media during a scandal (Alvensleben 1992). Various studies showed that especially for demand shifts of meat products, factors such as out-of-home consumption, the trend to convenience products or the effects of the media coverage during food scandals can be more important than classical variables like income or price (Wildner 2001, Piggot and Wright 1992; Verbeke and Ward 2001).

In this study a specific incident in Germany will be investigated where feed for meat production has been contaminated with dioxin. Here, the nuisance is the discovery of too high dioxin contents in the feed for poultry, pigs, dairy cows and laying hens in Germany in December 2010. The contamination of the feed had their origin on the supply side. A feed producer from northern Germany illicitly used technical fatty acids in the production process of nearly 3,000 tons of feed which lead to the high dioxin contents. In January 2011 high dioxin contents have also been discovered in pork and poultry in different federal states in Germany (Agra-Europe 2011). This triggered an intensive media coverage pertained to chicken meat and pork, which will be investigated later more in detail. This nuisance on the supply side has clear crisis-laden characteristics as well as time and spatial limits and fits therefore in our definition of a food scandal.

The purpose of this study is to quantify possible changes in consumers' meat demand and the determinants during the dioxin scandal. For our analysis we selected pork chops and chicken filet, as they are among the most frequently bought products within the affected meat types. The main objective is to ascertain the extent to which the shift in pork chops and chicken filet demand can be attributed to media coverage during the dioxin scandal. Our main hypothesis is that the information the consumers received through the media caused a certain level of insecurity among them resulting in a reduced demand for these products during this food scandal.

Previous analysis on the influence of media coverage on consumer behavior during food scandals focused on older scandals such as the BSE incident (Boecker and Mahlau 1999; Burton and Young 1996; Wildner 2002). We want to contribute to the literature by examining a recent food scandal to account for possible changes of the consumers' information behavior, which could have changed since the BSE scandal. Besides, the dioxin scandal hasn't been investigated in this context in the literature so far.

To the best of our knowledge, this is the first analysis examining food demand in times of a food scandal that takes into account the effect of unobserved characteristics of households. Previous studies on food scandals used cross-section datasets or econometric approaches, with which it is not possible to account for the influence of unobserved heterogeneity on the purchasing decision of households (Verbeke and Ward 2001; Wildner 2002; Burton and Young 1996; Richards and Patterson 1999). Given that such factors, and particularly unobservable individual risk perception, are a key factor in understanding consumer behavior in times of a food scandal, our econometric approach fills an important research gap.

While previous studies focus either on the differences in the potential influence level of newspapers or on the decay effect of information (Chern and Zuo 1995; Rickertsen et al. 1995; Verbeke and Ward 2001, Smed and Jensen 2005), this study takes both of these effects into account.

The data employed stem from the GfK Consumer Scan panel which comprises detailed information on each transaction (e.g. quantity bought, expenditures) as well as the corresponding household's socio-demographic characteristics (number of household members, children, age etc.). This allows analyzing the possible dynamic effects of media coverage on the households demand on a weekly basis taking into account various socio-demographic criteria.

This study is structured as follows. In the subsequent section the theoretical framework is described. A presentation of the media index employed in our study follows in section 3. In the fourth section the econometric methods are discussed. In the following section the data used in our study will be characterized. Empirical results regarding the GfK data and the media index are presented in section 6. In the seventh section the estimation results are discussed. Section 8 summarizes and concludes.

2. Theoretical framework

This study follows the branch of literature suggesting that the individual experience from consuming goods (x) depends on the perceptions of the quality (q) of the goods, including food safety perceptions (e.g. Chang and Kinnuncan 1991). Perceptions are influenced by the product information received (I), which furthermore are influenced by the media coverage about the product (me). We assume that the main buyer of the household is a rational individual that maximizes the expected utility (U) of the household members under a budget constraint:

$$\max_{x} U = U(x(q(I(me)); h) \qquad s.t. \qquad B \geq p \cdot x \qquad (1)$$

Where h are household specific characteristics that influence the process of utility generation from the consumption of x, B represents the budget available and p indicates a price vector.

The consumer cannot determine food safety of a product before consumption. In times of food scandals, recognized media reports (me) on the product x are therefore likely to be a major source of information for the purchasing decision (Smith et al. 1988; Burton and Young 1996; Boecker and Mahlau 1999). As stated by Foster and Just (1989) we expect the likelihood of purchasing the potentially contaminated product to decline if the consumer's perception of the safety for this product also declines. Thus our hypothesis is that consumers will avoid products that are mentioned in the media together with food scandals, since they might expect a certain health safety risk. Since

media coverage is a very general indicator of food safety, consumers may also use other heuristics to find products that they assume to be safe.

Purchaser's perceptions on product *x* may also be influenced by the amount of the same product consumed in previous periods (Blanciforti et al. 1986). This influence could be positive, indicating habitual behavior, or negative, e.g. because of a preference for product variety. Given that in our dataset demand is observed on a weekly basis, we expect that the food immediately consumed a week before has a negative sign, indicating a wish for dietary diversity on the short run.[1] Recognizing the above considerations about the different influences on the purchasing decision, equation (1) can be rewritten for every household *i* at a given time *t* as:

$$\max_{x_{it}} U_{it} = U_{it}(x_{it}(q_{it}(I_{it}(me_t), x_{it-1}); h_{it}) \qquad s.t. \qquad B_{it} \geq p_{it} \cdot x_{it} \tag{2}$$

Previous studies on food scandals have estimated reduced form versions of equation (2) for relatively aggregated product groups by employing the almost ideal demand system approach (AIDS; see e.g. Verbeke and Ward 2001; Burton and Young 1996; Richards and Patterson 1999). The advantage of the AIDS is that it allows the estimation of broad product groups in a way that some restrictions derived from utility theory can be easily imposed.

There are two reasons why we do not apply the AIDS model for our study. Firstly, unobserved heterogeneity of the households is not taken into account in AIDS models. As it is argued previously and seen in equation (2), the individual household response is important to consider when analyzing food scandals. The individual consumption responses to the media would therefore not be adequately captured when applying the AIDS model to household panel data, and this can result in considerable estimation bias.

Secondly, in our specific dataset we analyze high-frequency (weekly) data of disaggregated product groups. As stated by Dahlgran and Fairchild (2002) the consideration of high-frequency data is necessary if the media coverage about a food scandal wears out rapidly (e.g. few weeks), as it has been the case in the dioxin scandal (see section 5). In order to reveal the media's short-term demand impact, adequately disaggregated time periods have to be investigated. Thus we focus on weekly data to capture the potential short-run dynamic effects of the media coverage on consumer demand.

[1] Habitual consumption behavior can be seen as a characteristic of household heterogeneity, i.e. as part of vector h. In the econometric model, we capture consumption habits as a variable indicating the average consumption of the whole previous year.

At this detailed data level, a quite high proportion of zero-consumption values occurs. In this setting the use of a standard AIDS model would be invalid. Taking zero values not adequately into account is an important drawback, since scandal-sensitive households are likely to quit consumption in times of a scandal. While extended versions of the AIDS exist, these either come at the cost of non-fulfillment of the adding-up restriction (Shonkwiler and Yen 1999), thus limiting the theoretical benefits of an application of the AIDS, or are based on highly advanced Bayesian techniques. Given that both of these approaches do not account for unobserved heterogeneity while our focus is on the influence of media on individual household's decision to purchase few affected key products, we see more merit in following a panel data approach tailored to this problem than employing a general demand systems.

3. Media effect

To measure the possible effect of media coverage (me_t in equation (2)) on meat demand during the dioxin scandal, a media index is constructed. One possibility is to use the number of newspaper articles published over time, which mention the scandal (Burton and Young 1996; Richards and Patterson 1999). The frequency of the media coverage can be a good 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, Görke et al. 2000). In previous studies many types of indices have been developed and used in food demand analysis ranging from dummy or shock variables (Tansel 1993; Arnade et al. 2009), to indices using the absolute (Smith et al. 1988) or cumulative numbers of articles (Brown and Schader 1990; Chang and Kinnucan 1991; Piggot and Marsh 2004) or both (Burton and Young 1996).

Studies further differentiate the effect of positive and negative articles (Chang and Kinnucan 1991; Verbeke and Ward 2001; Smith et al. 1988, Weinberger and Dillon 1980; Liu et al. 1998). However Smith et al. (1988) suggest that positive and negative articles should be added together, because the negative attitude towards a product in a scandal is reinforced by all types of publicity. Also Mazzocchi (2006) states, that the discrimination between positive and negative articles is highly subjective. This can also be true for the dioxin scandal, because the possible negative effects have a long latency period, which will not cause the same impact on young then on old people. Thus, in our study all articles about the dioxin scandal will be used.

To account for processes of forgetting, the decay of information the consumers receive from the media can also be included in a media index. This has been done by Rickertsen et al. (1995),

Verbeke and Ward (2001) and Chern and Zuo (1995) by computing weights for the lagged effects of media coverage.

In this study we follow the approach of Chern and Zuo (1995) who adjusted the cumulative media index used by Brown and Schader (1990) by considering the decay effect of information. They assumed that published articles, as a source of consumer information, have a finite duration and a lag distribution which accounts for the diminishing effects of information.

The Food Scandal Index (FSI) based on this method can be expressed as follows:

$$FSI_t = \sum_{k=0}^{n} W_k NM_{t-k} \quad (3)$$

NM_{t-k} is the number of relevant articles published within the period ($t - k$), n is the total number of lagged periods and W_k is the weight assigned to the lagged period k. Thus by considering the total lag period and a weight function, not only the carryover effects but the decay effect of information is taken into account. To compute W_k, Chern and Zuo (1995) use a third degree polynomial weight function, to overcome the restrictions of symmetric weights:

$$W_k = x_0 + x_1^k + x_2^{k^2} + x_3^{k^3} \quad (4)$$

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. Following Chern and Zuo (1995) based on these four restrictions the third degree polynomial weight function can be rewritten as:

$$W_k = \frac{2a}{(n+1)b} + \left(\frac{12m}{b}\right)k - \left(\frac{6(n+1+m)}{(n+1)b}\right)k^2 + \left(\frac{4}{(n+1)b}\right)k^3 \quad (5)$$

where

$$a = (n+1)^2\,(n+1-3m)$$

$$b = (n+2)\,((n+1)^2 - m(2n+3))$$

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) need to be positive which requires $m \leq (n+1)/3$ to avoid negative weights. In general n and m can take any finite numbers.

One possible shortcoming of this index is that it does not account for differences in the potential influence level of the newspapers. Schmit and Kaiser (2003) and Smed and Jensen (2005) took this into account in their media index by weighting the articles subject to the readership. This seems reasonable because it can be expected that an article from a newspapers with a high readership and popularity has a higher probability to be read as well as a higher potential influence on the public opinion. We follow this approach by computing additional weights for the weekly aggregates of the newspaper articles in accordance to the distribution level of the respective newspaper[2]. Thus we do not only take into account the carryover and decay effects of information but also possible differences in information input levels from the articles according to the respective newspaper.

4. Econometric methods

A reduced form of the economic model of equation (2) is formulated to estimate the significance of the mentioned determinants. Since our data has a large share of zero consumption values for both of the investigated products, econometric models that assume a continuous relationship between the dependent and the explanatory variables such as OLS will yield biased results. We therefore employ a limited dependent variable method, namely a dynamic Tobit model, which is defined as follows:

$$x_{i,t}^{*} = \alpha + \beta\, FSI_{i,t} + \boldsymbol{p}_{i,t}\,\gamma + \boldsymbol{h}_{i,t}\,\mu + \lambda\, x_{i,t-1} + \varepsilon_{i,t} \qquad (6)$$

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

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

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, $\boldsymbol{p}$ is a vector of prices consisting of the prices of the investigated products as well as a price index for beef products[3], *FSI* is the media index defined in eq. (3) and used to measures me of eq. (2), and $\boldsymbol{h}$ is a vector of household characteristics. Indices $i = 1,\ldots,N$ and $t = 0,\ldots,T$ denote the household and week. Since consumer behavior for the investigated product is likely to be influenced by consumption habits, we include a lagged dependent variable, which takes values of the quantity demanded in the previous period $x_{i,t-1}$.

[2] The newspapers' distribution level January to May 2011were selected and the total average calculated. Then the discrepancy of every newspaper's distribution level from this average has been computed and accordingly normalized. The resulting weights have been multiplied with the weekly aggregated articles from every newspaper, before computing the total sum of weekly articles over all newspapers.

[3] As beef has not been contaminated with dioxin, we included the Laspeyres price index for all beef products purchased by the household in order to account for possible substitution effects during the period of the scandal.

Equation (6) is a pooled Tobit model, which fails to account for unobserved heterogeneity between different consumers. In this respect it is similar to the approaches used in the previous literature on food scandals (Verbeke and Ward 2001; Wildner 2002; Burton and Young 1996; Richards and Patterson 1999). Given that typical research question in food scandal analyses are on consumer perceptions, it seems far more important to distinguish household-specific effects rather than to derive theory consistent elasticity estimates averaged over all households. We therefore opted for estimating a random effects Tobit model that considers the complex structure of the panel.[4] In doing so, heterogeneity between households is considered by the decomposition of the residual $\varepsilon_{i,t} = u_i + e_{i,t}$, where u_i is an unobserved household specific effect that is modelled as randomly N-distributed with zero mean and variance σ_u^2 among the observations but remaining same over time, and $e_{i,t}$ is the idiosyncratic error term.

The restrictive assumption of independence between the random effect and the right hand side variables is a known drawback of the standard RE model. We therefore follow Mundlak's (1978) and include mean variables of each time variant variable. This introduces a way for the RE to correlate with the average of these variables, thus lifting the often unrealistic assumption of no correlation between unobserved individual characteristics and observed variables.

The initial condition problem is inherent to dynamic RE models with a lagged dependent variable, i.e. in dynamic models the initial conditions of the first time period observed (t=0) can in general not be treated as exogenous. In order to tackle this problem, we include a time invariant variable in the regression that holds the value of the first t=0 period of the dependent variable, as it is suggested by Wooldridge (2005). The specification that is finally employed in the later analysis is

$$x_{i,t}^{*} = \alpha + \beta\, FSI_{i,t} + \boldsymbol{p}_{i,t}\,\gamma + \boldsymbol{h}_{i,t}\,\mu + \lambda\, x_{i,t-1} + \bar{m}_i\,\eta + \vartheta\, x_{i,t0} + u_i + e_{i,t} \qquad (7)$$

$$u_i \sim N(0, \sigma_u^2),\ e_{i,t} \sim N(0, \sigma_e^2)$$

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

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

[4] Another possibility to account for unobserved heterogeneity is to treat unobserved differences between the households as estimable fixed effects. This approach is however not suitable in the given context because of two reasons. Firstly, unconditional fixed effects estimates are typically biased in a limited dependent variable model. Secondly, time-invariant variables cannot be included in the model as the individual fixed effect would capture their influence on the dependent variable. Given that we are interested in the effect of such socioeconomic variables and that their inclusion allows a more efficient estimation approach compared to a model with N fixed effects, we consider the application of an RE model as preferable.

Where $x_{i,t0}$ includes the initial condition of $x_{i,t}$, and $\bar{m}_i$ is the 'Mundlak device,' a vector of variables, each having the mean value of a time-variant explanatory variable within the model. The estimation is conducted in Stata 13, using the inbuilt xttobit command with manually generated variables of the Mundlak device.

Exact product prices are not reported in the GfK Consumer Scan panel. One commonly used practice is to calculate unit values as a proximate for prices, which can be derived by dividing the sum of (weekly) expenditures by their corresponding quantities (Deaton 1989). A well-known shortcoming of this method is that unit values may also capture quality differences, spatial variations (e.g. transportation costs, seasonal variation etc.) and pricing strategies of different retail outlets, which can lead to biased estimation results (Cox and Wohlgenant 1986).

Given that there are large differences in the unit values within the considered product groups, this might indicate high quality differences. Moreover, both of the investigated products have been purchased in various retail outlets. Therefore we take an approach developed by Cox and Wohlgenant (1986), which has been used in many studies to adjust the prices for quality differences (e.g. Park and Capps, 1997; Gao et al. 2006; Zheng and Henneberry 2010). The quality adjusted price can be computed from the difference between the unit value and the expected price, given its specific quality characteristics. Because the quality characteristics are unobservable, variables which influence the consumer's choice of quality such as socio-demographic variables (income, region, household size, education level, age of main buyer, number and age of children) and the retail outlets[5] are used as proxies for household preferences.

The expected price is calculated by estimating hedonic price functions for every product (pork chops, chicken filet) using a correlated random effect model:

$$p_{iht} = a_i + \sum_s \beta_{1_{is}} S_{sht} + \sum_r \beta_{2_{ir}} R_{rht} + \bar{m}_{ih}\eta + u_{ih} + e_{iht} \qquad (8)$$

where p_{iht} is the calculated product price i for the household h in period t; β_1 and β_2 are the parameters to be estimated, S_{sht} represents the socio-demographic variables and R_{rht} the different retail outlets influencing the quality choice of the consumers. As it is suggested by Mundlak (1978), we model the correlation between the variables on the right hand side and unobserved heterogeneity as $\bar{m}_{ih}$, a vector of variables, each having the mean value of the time-variant explanatory variables within the model. u_{ih} and e_{iht} denote the household-specific and idiosyncratic regression residuals

[5] To account for the pricing strategies of different retail outlets, the households' expenditure shares for the according retail outlets were integrated in to the hedonic price regression.

representing non-quality-related price variations. a_i is the intercept indicating the average price of the product.

The quality adjusted price is then given as:

$$p^*_{iht} = a_i + \bar{m}_{ih}\eta + u_{ih} + e_{iht} \quad (9)$$

The inclusion of the Mundlak device ($\bar{m}_{ih}\eta$) in this equation is not without the risk of introducing socio-economic bias, as it is a systematic component of the individual unobserved household effect. Strictly speaking, equation (9) is only valid if one assumes that all quality-relevant variables have been accounted for in the observable characteristics, so that the conditioning of the RE on observed time-variant characteristics only captures non-quality relevant influences on the unit value. On the other hand, if the term $\bar{m}_{ih}\eta$ is not included in the calculation of the quality-adjusted price, one would implicitly assume that the Mundlak device consists only of quality-relevant characteristics. Since we cannot measure the fraction of quality-relevant information in the Mundlak device but think that many socioeconomic relevant variables are included among the observed variables, we pursue a path of reporting the results for prices computed using equation (9), but also conducted a sensitivity analysis, in which we checked the changes of estimates if the term $\bar{m}_{ih}\eta$ is excluded. Both ways of dealing with quality adjusted prices reveal very similar results, so that using equation (9) seems to not introduce any significant bias.[6]

Given that our data is on a highly disaggregated product level and observed at short time intervals, there is a considerable proportion of observations for which the quantity is zero and unit values cannot be computed. For periods in which a household does not purchase the product, we therefore use the value of the average price faced by the household ($\alpha_i + \bar{m}_{ih}\eta + u_{ih}$).

5. Data

The analysis of consumer behavior during the dioxin scandal is based on the GfK Consumer Scan panel dataset on food purchases of German households. Our sample covers the years 2010 and 2011 with a total number of 16,023 households. For every shopping trip detailed information on each transaction is collected including the date of purchase, the amount bought and the corresponding expenditures, the type of the store, as well as whether the food is conventionally or organically produced. In addition, the dataset comprises annual socio-demographic information like net income, household size, number and age of children, education level, profession and the place of residence

[6] For the sake of brevity, the results of the sensitivity analysis are not reported, but they are available upon request by the authors.

(federal state level). However, this household panel does not cover purchases of public authorities, tourists, large-scale consumers as well as the restaurant and catering sector (Schroeck 2012).

Our sample contains information about the households' meat purchases between 2010 and 2011, because only meat products and the feed for meat production have been contaminated in the dioxin scandal. The products are, registered by type of meat (pork, poultry, beef, other meat types.) and by type of meat product (18 pork products, 13 beef products, 4 poultry products, and 5 mixed pork and beef products).

This dataset is highly qualified for the analysis of the extent and the possible determinants of demand shifts for meat products, because it has a large sample size with a registration of daily purchases of 16,023 household and furthermore directly links the purchase information to various socio-demographic variables. However, some editing of the GfK dataset was necessary for our analysis because many households leave the panel each year and are replaced by similar households. The data has been aggregated to weekly observations and a constant data pool of households has been created in order to permit the comparison of identical households over the whole period. To estimate the model with reasonable precision the constant data pool has been selected by the following criteria: First a household has to do shopping in at least 75% of the total weeks and second the household is not allowed to skip shopping for more than 3 weeks in a row. The resulting sample consists of 7,376 households and 693,594 observations over 104 calendar weeks.

In our analysis we focus on pork and poultry to investigate possible changes in consumer demand. One conventional meat product for each type of meat has been selected according to the total amount bought and the purchase frequency[7]. As a result pork chops and chicken filet will be used in the following analysis.

For the Food Scandal Index adequate data need to be gathered. In our study, the articles about the dioxin scandal in a certain time period will be investigated. We selected five different newspapers in accordance to their distribution level[8] in 2011 where the dioxin scandal occurred. We use the newspapers with the highest distribution levels in Germany (see table 1), because we expect them to adequately represent the general intensity and trend of media coverage during the scandal.

[7] The organic meat products are excluded, due to its minor share (0.42%) in total meat purchased between 2010 and 2011. Furthermore the low purchase frequency of organic meat could cause problems in our analysis because it will be done on weekly basis.

[8] The distribution level includes the absolute amount of sold newspapers as well as distributed free copies (IVW 2001)

To obtain the relevant articles for FAZ, Die Welt and the TAZ, we used the Lexis Nexis Academic Search tool[9] with various key word combinations (e. g. "Dioxin Fleisch" (Dioxin meat); "Dioxin Schwein" (Dioxin pig), "Dioxin Hähnchen" (Dioxin chicken) etc.[10]). The articles from BILD-Zeitung and the Süddeutsche Zeitung had to be gathered from their official archives due to their unavailability in Lexis Nexis.

In total 165 articles have been published over 19 calendar weeks. A few authors further use formal criteria of the articles such as the size of the article in square centimeters (cm^2), date of publication, the name of the newspaper, the size of the headline or the use of pictures to account for possible differences in the influence level of the articles (Boeckler and Mahlau 1999; Hagenhoff 2003). In our study only the date of publication and the name of the newspaper can be considered, because the Lexis Nexis search results are displayed in a default view with standardized letter and article sizes as well as without pictures. The published articles of all newspapers have been aggregated on a weekly basis and represent the database for the Food Scandal Index. As it can be seen in figure 1 the media coverage was distributed over nineteen calendar weeks with the highest intensity in the first three calendar weeks.

6. Data preparation

This section describes how the abovementioned methods were applied to the GfK dataset. It is shown how the Food Scandal Index is calculated. Then the potential determinants of demand changes are presented.

6.1 Implications for the consumer behavior during the dioxin scandal

Media coverage about the dioxin scandal started in the first calendar week of 2011. We select an observation period until the 19th calendar week because the main purpose of this study is to analyze possible short and medium-term effects of the dioxin scandal. Furthermore in the 20th calendar week of 2011 the so-called EHEC scandal was first mentioned in the German media. This has been a comparatively long and intensive scandal where people died due to an infection with E.coli-bacteria from vegetables. We expect a high shock effect of this scandal for the German consumers in the 20th calendar week, which could bias the analysis of the effects of the dioxin scandal. To work with a dataset that has appropriate variation in the dependent variable to get stable results, we

[9] www.nexis-lexis.com provides more detailed discussions of aspects of the search tool.
[10] The full list of key word combinations is not reported but available from the authors upon request.

consider households who at least consumed the corresponding product once within our observation period in the respective year to capture potential dynamic demand changes.

In figure 2 the average consumption per household from 2010 to 2011 on a weekly basis is illustrated, characterized by high fluctuations due to the disaggregated time periods used. To further examine the changes in consumers demand for pork shops and chicken filet in our observation period, we computed the percentage changes in demand for the selected products from 2010 to 2011 according to the identical calendar weeks in the corresponding year (see figure 3). Overall, the consumption of pork chops and chicken filet declined for the period under consideration by about -50.56% and -41.03% respectively in 2011.The differences in demand for pork chops is highest in the first three calendar weeks, where also 86.26% of the total media coverage occurred, with continuous variation afterwards. For chicken filet a relatively large decline in demand can be observed until the 12th calendar weeks with only marginal demand differences in the following calendar weeks.

6.2 Food scandal index (FSI)

In addition to these variables the media coverage can have an influence on the consumption behavior during the dioxin scandal. Following the previous literature suggesting experimentation with various combinations the maximum lag length *n* and the maximum lag weight *m*, we found that in general the trends of the FSI remained quite stable. In a study of Hassouneh al. (2009) who investigated the effects of media coverage during the BSE scandal a maximum lag length of 6 months is used. This is based on the findings of Clarke (1976) who investigated cumulative advertising effects on sales. Using this lag length for the BSE scandal seems feasible due to its exceptional length and intensity. In this study a maximum lag length of 6 weeks is selected because the dioxin scandal has been comparatively short with much less intensity than the BSE scandal. Furthermore we assume that the information behavior of the consumers could have changed since 1976 as well as the BSE scandal. Another reason that makes it difficult to define the appropriate lag length is that other events in the media that occur during the period can highly influence the processes of forgetting of consumers. We defined the maximum lag weight for the second calendar week (m = 1) because the media coverage had its peak in the first and the second calendar week. Furthermore we expect a shock effect for the consumers when the dioxin scandal was first mentioned. Based on this assumption we computed the values for the food scandal index for n = 6 and m = 1. The results are illustrated in figure 4.

6.3 Descriptive statistics

Table 2 provides information on the sample demographic distribution (mean and standard deviation of net income[11], education level, place of residence, household size etc.), average product prices and demand for our observation period (calendar week 1 -19 in 2011). These variables could potentially influence the consumers demand behavior and will be included as independent variables in our estimations. In total we observe 2,545 pork chops consuming households and 3,824 chicken filet consumers in our observation period in 2011. The average consumption per household for pork chops is 1.894 kg and 1.719 kg for chicken filet with the respective average prices of 5.862 Euros and 10.697 Euros per kilogram for our observation period. Most households from our sample are located in the Midwest (30.1% of pork chops consumers and 32.5% of chicken filet consumers) and the South (27.7% and 30.3%) of Germany. The majority of both consumer groups are characterized by a lower education level (57.0% and 51.2%). Furthermore a large share of the households has no children (80.7% and 67.8%) and consists only of two persons (52.9% and 43.8%). The main buyers of both consumer groups are to a large extent between 50 and 69 years old (46.0% and 42.8%). The net income varies between the households with a high share of low net income (38.7% and 34.0%) and a low share of medium net income (12.8% and 17.3%).

7. Estimation results

Table 3 shows the estimation result of the correlated random effects (CRE) Tobit model. The first column indicates the various variables that are included in the CRE Tobit to explain the meat demand, while the second, third and fourth rows in each table include the estimated coefficient, standard error and p-value of each of those variables. The last part of the table shows overall test statistics of the model. The Chi^2 statistic shows that the explanatory variables are jointly significant. Furthermore, for both products σ_u is highly significant at 1% level, and the Mundlak device also has significant components in it. This confirms that it is important to take the panel structure into account, and indicates that previous studies on food scandals, by pooling the data, might be biased.

The variable of main interest in our study is the Food Scandal Index ($FSI_{i,t}$) representing the possible effects of the media coverage on consumption behavior during the dioxin scandal. The $FSI_{i,t}$ has a negative and significant influence at 1% level on the demand for pork chops and chicken filet. This supports our hypothesis that consumers reduce the demand for products which are

[11] The net income is calculated as the equivalent household disposable income by weighting the households according to the OECD square root scale.

mentioned in the media together with food scandals, since they might expect a certain health safety risk.

According to the estimation results the product price had a highly significant and negative effect on the demand for pork chops and chicken filet. The price for beef products had no significant influence on the demand for pork chops and chicken filet. Thus beef products, which have not been contaminated with dioxin, did not serve as substitutes during the time period the dioxin scandal occurred. Furthermore there is no significant substitution effect between pork chops and chicken filet.

The results have also shown that the consumptions habits of the households influenced the demand for both products significantly during the dioxin scandal. The significant negative effect of the short-term consumptions habits ($x_{i,t-1}$) for pork chops and chicken filet indicates that the demand for those products in the former period reduced the respective demand in the given period. This is in line with the hypothesis that consumers prefer a variation of different kinds of food over the weeks.

Other variables that significantly influence the demand for both products during the time period the dioxin scandal occurred are various socio-demographic characteristics like the children's age, the household size, as well as the place of residence[12]. Furthermore the main buyer's age significantly influenced the demand for chicken filet during the given time period. Households located in Eastern Germany increased their demand for pork chops significantly whereas households with young children (between 6 – 14 years) demanded significantly less during the given time period. The demand for chicken filets decreased significantly for households located in the south as well as for households with very young children (children < 6 years). In addition the estimation results suggest that households with main buyers older than 70 years reduced their demand significantly during the time period the dioxin scandal occurred.

The estimated coefficients from the CR Tobit model reported in Table 3 provide only information about the direction of the independent variables' effect on the dependent variable. To add value to these results, we further computed the decomposed marginal effects suggested by McDonald and Moffitt (1980). In particular, we report the probability to purchase as well as the magnitude of the purchased amount, given that one has a non-zero purchase decision. The calculation of the marginal effects of the independent variables on both the probability of being participant in the according market and on the consumption decision are meaningful because the effect size of the coefficients

[12] It has to be kept in mind that these variables are time-invariant, so that their correlation with the random effect cannot be modeled, and their interpretation relies on the assumption that they are uncorrelated with the individual's RE.

can be differentiated. The resulting marginal effect for pork chops demand and chicken filet are shown in table 4 and table 5 respectively. The column headed by "Probability" indicates the marginal effect of the independent variables on the probability, with sub-columns showing the marginal effect, its standard error and p-value. The column with the heading "Quantity purchased (kg)" indicates their marginal effect on the expected quantity of the product purchase conditional on that the purchases are positive, with sub-columns showing the marginal effect in kg as well as its standard error and p-value.

The $FSI_{i,t}$ has a negative and significant influence on the probability of participating in the market for both the chicken filet and pork chops equations however with a relatively low effect size. For the average household the probability of participating in the pork chop and the chicken filet market decreases by 0.5 and 0.6 percentage points per unit of the $FSI_{i,t}$ respectively at a given calendar week. The reduction of the quantity demanded for the average household was slightly higher for pork chops with 9 grams per unit of the $FSI_{i,t}$ compared to chicken filet with 7 grams.

The negative and significant effect of the products price is by far the most important aspect for both quantity and probability of purchases for pork chops and chicken filet. For pork chops the probability to buy this product decreases by 4.6 percentage points for an increase in the price by one euro whereas the according probability to enter the chicken filet market decreases by 3.2 percentage points. With regard to the conditional expected value, the price also had a higher negative effect on the quantity demanded for pork chops compared to chicken filet. For pork chops and chicken filet an increase of one euro resulted in a decreased demand of 84 grams and 35 grams respectively.

8. Summary and conclusions

The present study analyzed consumer demand patterns in the course of the German dioxin scandal in in the first nineteen calendar weeks of 2011 based on panel data provided by the GfK. This scandal triggered an intensive media coverage pertained to poultry meat and pork. We selected the dioxin incident which is a comparably recent food scandal to account for possible changes of the consumers' information behavior over time. A methodological focus was set on the consideration of unobserved heterogeneity of consumers, which was not addressed in previous studies but is presumably of high importance for the demand decision during the period of a scandal.

A dynamic correlated random effects Tobit model is employed to analyze the impact of the media coverage on consumption behavior during the dioxin scandal. The potential influence of unobserved household characteristics on meat consumption is modeled as a household-specific random effect

(RE). The correlated random effects (CRE) approach employed here is proposed by Mundlak (1978) and circumvents the strict and typically unrealistic assumption of no correlation between the RE and observed variables, which is inherent in standard RE models. Since consumption habits may play a significant role, we estimate a dynamic model that accounts for the demand of previous periods. Furthermore, a large fraction of the data consists of zero purchase values, so the application of linear models would result in considerable bias. To avoid biased results, we employ a non-linear dynamic CRE Tobit model for the pork chops and chicken filet demand. In order to follow this approach, it is not possible to employ the almost ideal demand system (AIDS), which is commonly used in the previous literature on food scandals. We argue that the drawbacks of a general inability to account for unobserved heterogeneity in the AIDS approach clearly outweigh its theoretical benefits. This is particularly true due to the fact that adding-up plays a relatively unimportant role when food categories are investigated that play a minor role in the overall household budget, and that the large fraction of zero consumption values introduces an econometric bias in those versions of the AIDS models that are typically employed. The effect of media coverage is measured using a media index that takes into account the different influence levels of the German newspapers as well as decay effects of information.

The hypothesis that the media coverage during the dioxin scandal had an influence on the declining consumer demand for pork chops and chicken filet is supported by the empirical findings. Media coverage had a negative significant effect on both the probability of the households to participate in the pork chops and chicken filet market and the quantity purchased of the participating households. However the effect size of the media index has been relatively low. The small effect of the media coverage on both the participation probability and the changes in the quantity demanded could be interpreted in different ways. One possible reason is the fact that the dioxin scandal already started in December 2010 where high dioxin contents in eggs have been verified. This could have desensitized the consumers and reduced the extent of the shock effect when the dioxin scandal extended to pork and poultry meat. The consumers could have already informed themselves to a certain extent about the possible adverse health effects which are relatively low compared to other food scandals in the past. Thus the dioxin scandal with relatively short period of media coverage and negligible adverse health effects was not able to change the consumption behavior to a large extent. As stated by Dahlgran and Fairchild (2002) it can be expected the demand response to food scandals with immediate adverse health effects like the contamination of vegetables with E.coli bacteria (German EHEC scandal) or Alar-contaminated apples are more intense and may generate a higher shock effect for consumers.

This work can be extended in a number of ways. First, other meat products are going to be analyzed, which belong to meat types that are unaffected of the dioxin scandal, e.g. beef. Second, other pork and poultry products could be included to identify possible differences in the influence level of the media coverage on the corresponding demand. This would show to what extent consumers differentiate in their demand decision by food safety reasons.

The results about the influence of this short-term food scandal on consumer demand could provide important implications for policy makers as well as the meat industry. The better understanding of consumer behavior and the according determinants during food scandals might improve the development of adequate and uniform crisis and risk management strategies due to a better understanding of consumer behavior and the according determinants during food scandals.

Appendix

Tables

Table1: Characterization of the selected newspapers

Newspaper	Distribution level (Ø January - May 2011)	Published articles
BILD - Zeitung	12,155,728	14
Sueddeutsche Zeitung	1,739,271	45
Frankfurter Allgemeine Zeitung (FAZ)	1,521,740	21
Die Welt	1,069,776	37
Die Tageszeitung (TAZ)	224,392	48
Sum ∑		165

Source: own calculation based on data of Lexis Nexis and the according news archives.

Table 2: Sample means of pork chops, chicken filet demand, prices and household composition

Variable	Description	2011 (CW 1 - 19) Pork chops consumer		2011 (CW 1 - 19) Chicken filet consumer	
Number of households		n = 2545		n = 3824	
Consumption per household		**Mean**	**SD**	**Mean**	**SD**
Pork chops	kg/household	1.894	(2.020)	-	
Chicken filet	kg/household	-	-	1.719	(2.003)
Price					
Price pork chops	(€/kilogram)	5.862	(0.919)	-	
Price chicken filet	(€/kilogram)	-		10.697	(1.201)
Place of residence (dummy variables)					
East	1 = Brandenburg, Mecklenburg-West Pomerania, Saxony, Saxony-Anhalt	0.275	(0.446)	0.209	(0.407)
Midwest	1 = Berlin, Hesse, North Rhine-Westphalia	0.301	(0.458)	0.325	(0.469)
South	1 = Baden-Wuerttemberg, Bavaria, Saarland	0.277	(0.447)	0.303	(0.460)
North	1 = Bremen, Hamburg, Lower Saxony, Schleswig-Holstein	0.147	(0.355)	0.162	(0.369)
Education level (dummy variables)					
High eductation level	1 = university degree, state examination	0.221	(0.422)	0.263	(0.440)
Medium education level	1 = a-levels with/without professional education	0.209	(0.414)	0.225	(0.416)
Low education level	1 = secondary school with/without professional education	0.570	(0.497)	0.512	(0.499)
Household Composition (dummy variables)					
No children	1 = no children	0.807	(0.400)	0.678	(0.467)
Children < 6 years	1 = children 0 - 6 years	0.058	(0.238)	0.099	(0.299)
Children 6 - 14 yeras	1 = children 6 - 14 years	0.084	(0.284)	0.151	(0.358)
Adolescent 15 - 19 years	1 = adolescent 15 - 19 years	0.051	(0.221)	0.072	(0.258)
Household size 1 person	1 = One person	0.201	(0.365)	0.156	(0.362)
Household size 2 persons	1 = Two persons	0.529	(0.497)	0.438	(0.496)
Household size 3 persons	1 = Three persons	0.136	(0.350)	0.189	(0.391)
Household size ≥ 4 persons	1 = Four persons or more	0.134	(0.348)	0.217	(0.412)
Age of main buyer (dummy variables)					
Age < 30 years	1 = main buyer younger 30 years	0.060	(0.096)	0.026	(0.158)
Age 30 - 49 years	1 = main buyer between 30 and 49 years	0.225	(0.425)	0.390	(0.488)
Age 50 - 69 years	1 = main buyer between 50 and 69 years	0.460	(0.499)	0.428	(0.494)
Age > 70 years	1 = main buyer older than 70 years	0.255	(0.443)	0.156	(0.362)
Net income (dummy variables)					
Very high net income	1 = income 3.500 - 4.000 €/month or more	0.244	(0.429)	0.195	(0.396)
High net income	1 = income 2.500 - 3.499 €/month	0.241	(0.428)	0.292	(0.455)
Medium net income	1 = income 1.500 - 2.499 €/month	0.128	(0.334)	0.173	(0.378)
Low net income	1 = income 999 - 1.499 €/month	0.387	(0.487)	0.340	(0.339)

Source: own calculation based on data of the GfK

Table 3: Non-linear dynamic CRE Tobit model estimates

Demand pork chops				**Demand chicken filet**			
	Coef.	Std. Err.	P>z		Coef.	Std. Err.	P>z
Food Scandal Index ($FSI_{i,t}$)	**-0.051*** **	0.013	0.000	Food Scandal Index ($FSI_{i,t}$)	**-0.035*** **	0.008	0.000
Short-term consumption habits ($x_{i,t-1}$)	**-0.089** **	0.041	0.027	Short-term consumption habits ($x_{i,t-1}$)	0.007	0.024	0.780
Price pork chops	**-0.491*** **	0.025	0.000	Price chicken filet	**-0.186*** **	0.009	0.000
Price beef	-0.001	0.002	0.461	Price index beef	0.001	0.001	0.291
North	0.018	0.048	0.705	North	0.004	0.025	0.866
South	-0.024	0.040	0.552	South	**-0.055*** **	0.021	0.009
East	**0.072***	0.041	0.077	East	-0.032	0.024	0.192
Medium eductation level	0.022	0.038	0.560	Medium eductation level	0.030	0.021	0.156
High education level	0.019	0.040	0.637	High education level	-0.020	0.022	0.345
Children < 6 years	-0.145	0.094	0.122	Children < 6 years	**-0.096** **	0.040	0.017
Adolescent 6 - 14 years	**-0.169** **	0.082	0.038	Adolescent 6 - 14 years	-0.008	0.036	0.832
Adolescent 15 - 19 years	-0.056	0.086	0.514	Adolescent 15 - 19 years	**0.070***	0.039	0.070
Age 30 - 49 years	0.159	0.173	0.357	Age 30 - 49 years	-0.014	0.055	0.801
Age 50 - 69 years	0.233	0.175	0.183	Age 50 - 69 years	-0.091	0.056	0.102
Age > 70 years	0.182	0.177	0.303	Age > 70 years	**-0.132** **	0.059	0.024
Household size 2 person	**0.109** **	0.049	0.024	Household size 2 person	**0.076*** **	0.028	0.006
Household size 3 persons	**0.197*** **	0.069	0.005	Household size 3 persons	**0.160*** **	0.037	0.000
Household size $\geq$ 4 persons	**0.228*** **	0.085	0.008	Household size $\geq$ 4 persons	**0.218*** **	0.042	0.000
Medium income	-0.049	0.042	0.244	Medium income	**0.035**	0.025	0.157
High income	-0.045	0.051	0.376	High income	0.032	0.028	0.266
Very High income	-0.086	0.067	0.202	Very High income	0.037	0.034	0.279
Pork chops_t0 ($x_{i,t0}$)	**1.007*** **	0.079	0.000	Chicken filet_t0 ($x_{i,t0}$)	**1.259*** **	0.058	0.000
Price chicken filet	-0.058	0.040	0.151	Price pork chops	-0.004	0.032	0.893
Constant (α)	**-2.557*** **	0.308	0.000	Constant (α)	**-1.982*** **	0.152	0.000
Mundlak_Price pork chops	**0.563*** **	0.032	0.000	Mundlak_Price chicken filet	**0.224*** **	0.012	0.000
Mundlak_Price beef	0.000	0.002	0.886	Mundlak_Price beef	0.000	0.001	0.707
Mundlak_Price chicken filet	0.013	0.044	0.777	Mundlak_Price pork chops	0.015	0.035	0.666
σ_u	0.223	0.032	0.000	σ_u	0.283	0.010	0.000
σ_e	1.905	0.023	0.000	σ_e	1.177	0.010	0.000
Number of observations	48355			Number of observations	72656		
Number of households	2545			Number of households	3824		
Log likelihood	-20723.263			Log likelihood	-33016.493		
Wald chi^2	610.67***			Wald chi^2	1215.18***		

Notes: ***, ** and * denote siginificance at 1%, 5% and 10% level, respectively.

Source: own estimations based on data of the GfK, Lexis Nexis and the according news archives

Table 4: Average Marginal effects, pork chops

	Probability			**Quantity purchased (kg)**		
	Marginal effect	Std. Err.	P>z	Marginal effect	Std. Err.	P>z
Food Scandal Index ($FSI_{i,t}$)	**-0.005*** **	0.001	0.000	**-0.009*** **	0.002	0.000
Short-term consumption habits ($x_{i,t-1}$)	**-0.008** **	0.004	0.027	**-0.015** **	0.007	0.027
Price pork chops	**-0.046*** **	0.002	0.000	**-0.084*** **	0.004	0.000
Price beef	-0.000	0.000	0.461	0.000	0.000	0.461
North	0.002	0.005	0.706	0.003	0.008	0.706
South	-0.002	0.004	0.550	-0.004	0.007	0.551
East	**0.007***	0.004	0.080	**0.012***	0.007	0.078
Medium eductation level	0.002	0.004	0.561	0.004	0.007	0.560
High education level	0.002	0.004	0.638	0.003	0.007	0.637
Children < 6 years	-0.013	0.008	0.106	-0.024	0.015	0.115
Adolescent 6 - 14 years	**-0.015** **	0.007	0.030	**-0.028** **	0.013	0.035
Adolescent 15 - 19 years	-0.005	0.008	0.507	-0.010	0.014	0.511
Age 30 - 49 years	0.015	0.017	0.370	0.028	0.030	0.363
Age 50 - 69 years	0.022	0.017	0.185	0.040	0.030	0.184
Age > 70 years	0.018	0.018	0.316	0.032	0.031	0.309
Household size 2 person	**0.010** **	0.005	0.023	**0.018** **	0.008	0.024
Household size 3 persons	**0.019*** **	0.007	0.007	**0.034*** **	0.012	0.005
Household size $\geq$ 4 persons	**0.023** **	0.009	0.011	**0.040*** **	0.015	0.009
Medium income	-0.005	0.004	0.243	-0.008	0.007	0.243
High income	-0.004	0.005	0.373	-0.008	0.009	0.375
Very High income	-0.008	0.006	0.192	-0.015	0.011	0.198
Pork chops_t0 ($x_{i,t0}$)	**0.094*** **	0.007	0.000	**0.172*** **	0.013	0.000
Price chicken filet	-0.005	0.004	0.151	-0.010	0.007	0.151
Mundlak_Price pork chops	**0.053*** **	0.003	0.000	**0.096*** **	0.005	0.000
Mundlak_Price beef	0.000	0.000	0.886	0.002	0.008	0.777
Mundlak_Price chicken filet	0.001	0.004	0.777	0.000	0.000	0.886

Notes: ***, ** and * denote siginificance at 1%, 5% and 10% level, respectively.

Source: own estimations based on data of the GfK, Lexis Nexis and the according news archives

Table 5: Average Marginal effects, chicken filet

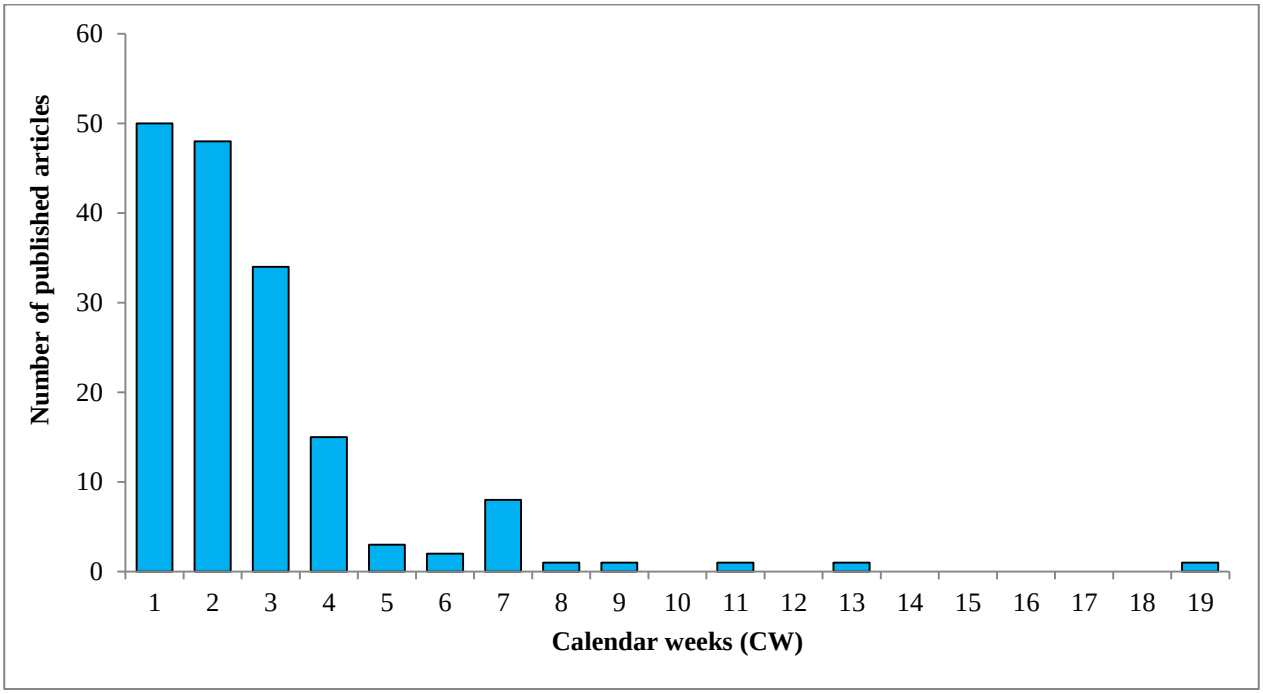
	Probability			**Quantity purchased (kg)**		
	Marginal effect	Std. Err.	P>z	Marginal effect	Std. Err.	P>z
Food Scandal Index ($FSI_{i,t}$)	**-0.006*** **	0.001	0.000	**-0.007*** **	0.001	0.000
Short-term consumption habits ($x_{i,t-1}$)	0.001	0.004	0.780	0.001	0.005	0.780
Price chicken filet	**-0.032*** **	0.002	0.000	**-0.035*** **	0.002	0.000
Price index beef	0.000	0.000	0.291	0.000	0.000	0.291
North	0.001	0.004	0.866	0.001	0.005	0.866
South	**-0.009*** **	0.004	0.009	**-0.010*** **	0.004	0.009
East	-0.006	0.004	0.189	-0.006	0.004	0.190
Medium eductation level	0.005	0.004	0.159	0.006	0.004	0.157
High education level	-0.004	0.004	0.343	-0.004	0.004	0.344
Children < 6 years	**-0.016** **	0.007	0.014	**-0.017** **	0.007	0.015
Adolescent 6 - 14 years	-0.001	0.006	0.831	-0.001	0.007	0.831
Adolescent 15 - 19 years	**0.013***	0.007	0.078	**0.013***	0.007	0.074
Age 30 - 49 years	-0.002	0.010	0.800	-0.003	0.010	0.800
Age 50 - 69 years	-0.016	0.010	0.100	-0.017	0.010	0.101
Age > 70 years	**-0.022** **	0.010	0.018	**-0.024** **	0.010	0.021
Household size 2 person	**0.013*** **	0.005	0.006	**0.014*** **	0.005	0.006
Household size 3 persons	**0.029*** **	0.007	0.000	**0.031*** **	0.007	0.000
Household size $\geq$ 4 persons	**0.041*** **	0.008	0.000	**0.041*** **	0.008	0.000
Medium income	0.006	0.004	0.159	0.007	0.005	0.158
High income	0.006	0.005	0.269	0.006	0.005	0.268
Very High income	0.007	0.006	0.284	0.007	0.006	0.282
Chicken filet_t0 ($x_{i,t0}$)	**0.223*** **	0.010	0.000	**0.234*** **	0.011	0.000
Price pork chops	-0.001	0.006	0.893	-0.001	0.006	0.893
Mundlak_Price chicken filet	**0.039*** **	0.002	0.000	**0.041*** **	0.002	0.000
Mundlak_Price beef	0.000	0.000	0.707	0.000	0.000	0.707
Mundlak_Price pork chops	0.003	0.006	0.666	0.003	0.007	0.666

Notes: ***, ** and * denote siginificance at 1%, 5% and 10% level, respectively.

Source: own estimations based on data of the GfK, Lexis Nexis and the according news archives

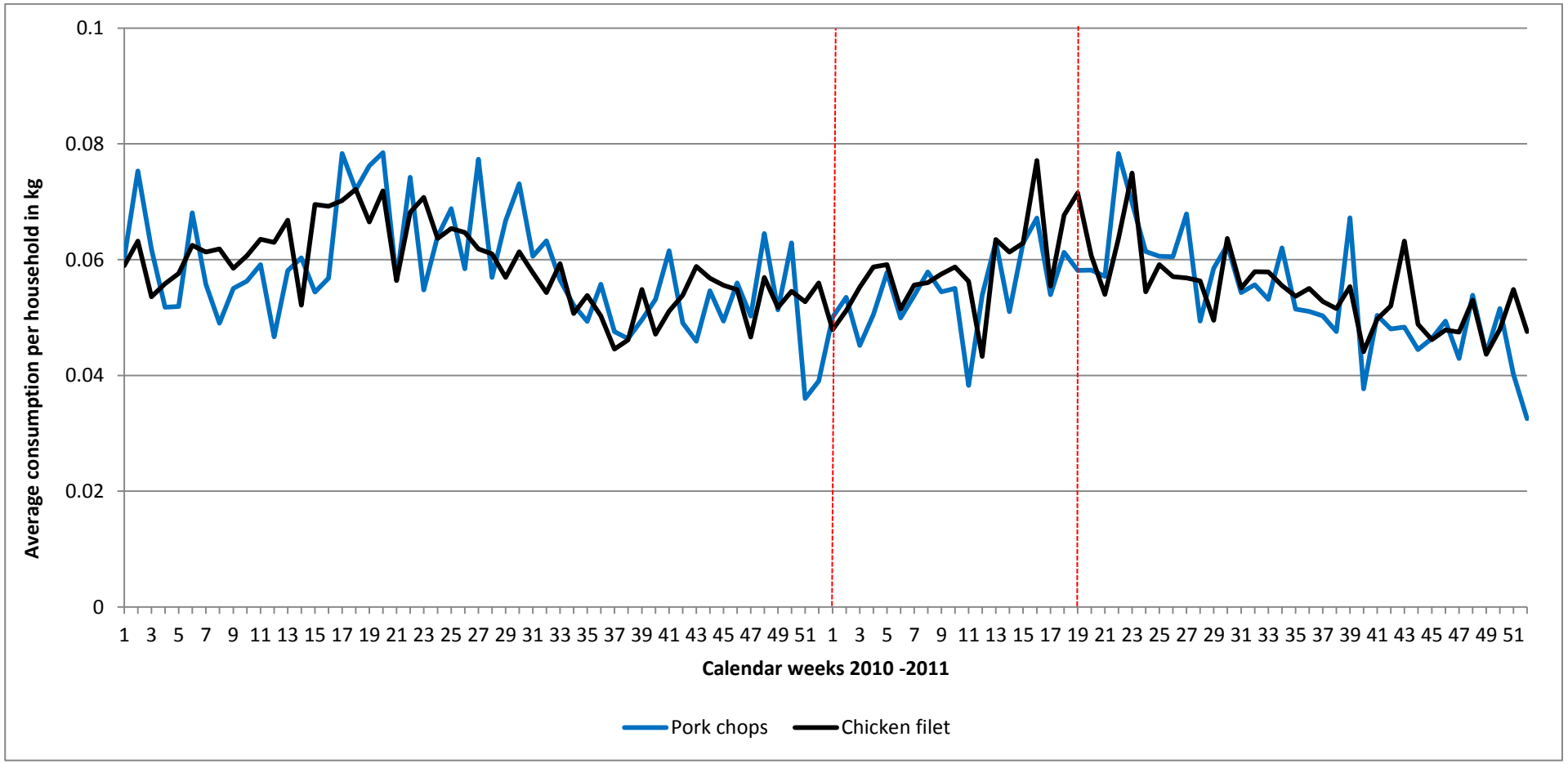
Figures

Figure 1: Media coverage by selected newspapers about the dioxin scandal



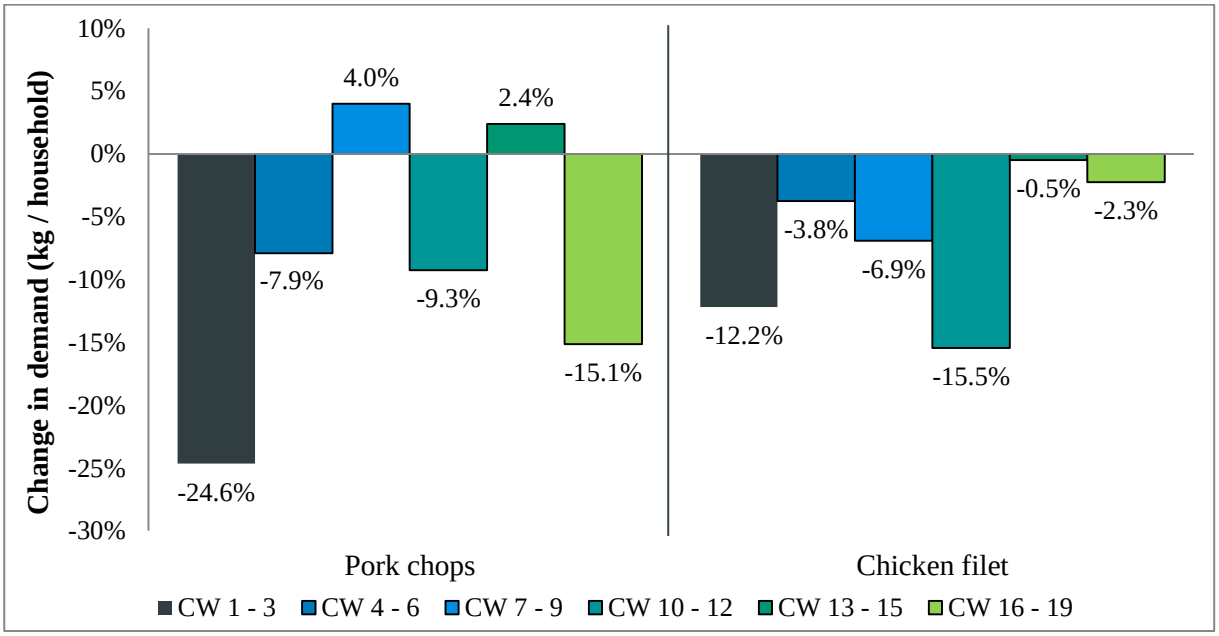
Source: own depiction based on data from Lexis Nexis and the according news archive

Figure 2: Average weekly consumption of pork chops and chicken filet per household from 2010 to 2011



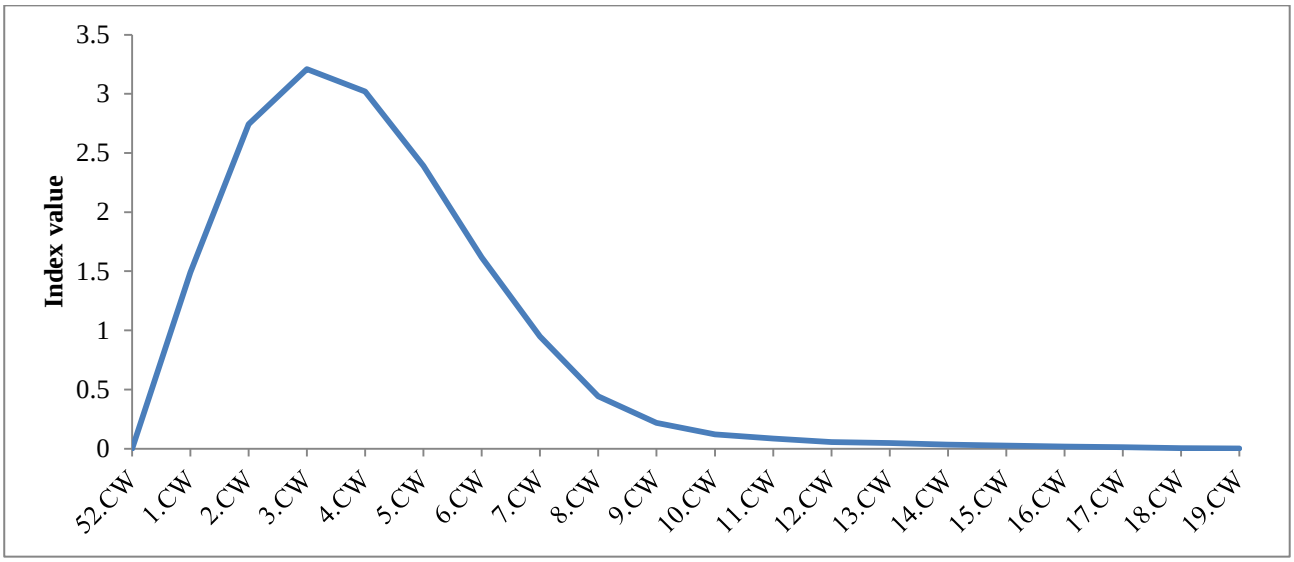
Source: own depiction based on data of the GfK

Figure 3: Changes in households demand for pork chops and chicken filet from 2010 to 2011



Source: own depiction based on data of the GfK

Figure 4: Evolution of the Food Scandal Index over time



Source: own depiction based on data from Lexis Nexis and the according news archives.

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