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Food Safety Information and Food Demand – Effects of Temporary and Permanent News

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Abstract

This paper examines the cross-impacts of food safety news concerning one product on the demand for another product, using the Danish demand for pasteurized eggs versus shell eggs as an illustrative case. The study identifies news with a temporary impact and news with a permanent impact on consumers' food demand behavior. The techniques used to identify the permanent versus temporary news are recursive estimation and parameter stability. Whereas "permanent" news is identified to be represented by a specific individual event, "temporary" news concerning salmonella in eggs is aggregated into a news-index variable. Both temporary and permanent news concerning salmonella in shell eggs appear to have significant positive impacts on the demand for pasteurized eggs. The model is estimated as an Error Correction Model. Consumers are found to adjust quite rapidly to both temporary and permanent news. Both the composition of egg consumption accounted as mean budget shares varies across socio-demographic household groups as well as the impact of the considered permanent news.

Keywords: salmonella, news, egg demand, error correction model, socio-economic groups

1. Introduction

Consumers in most industrialised countries have become more and more concerned about health issues related to food intake. This includes nutrition issues such as cholesterol and fat intake. In addition to that, major health issues as the BSE-crises, growth hormone abuse, the use of genetically modified organisms and salmonella infections have attracted increased attention during the last decade. This implies that the variety of "safe" food products has been increasing. Such products include for instance salmonella-free chicken and pasteurised eggs, which represent an alternative to substituting away from the specific food products. But how do consumers react to information on food crises and health issues? And how long does such information influence the consumers' preference for different food products?

The question of consumer response toward information has been an issue studied in several articles all using different kinds of media indexes to account for the influence of information. Most studies focus on either the consumer response to food safety or health information or the effects of advertising. For example, Brown and Schrader (1990) have studied the influence of information on the negative impact on human health of cholesterol intake on the consumption of shell eggs. They find that information about cholesterol had a significant negative impact on the consumption of eggs. Smith et al. (1988) investigate the response in milk demand following a milk contamination crisis in Hawaii, finding substantial influence from particularly the negative news coverage. Effects of advertising has been investigated by Rickertsen et al. (1995) and Rickertsen (1998) for fresh vegetables, finding only weak evidence for effects of advertising in Norway. Verbeke and Ward (2001) study the combined effects of negative press and advertising efforts for fresh meat demand, finding a negative effect of BSE-news on the demand for beef, but a positive effect of these news on the demand for pork.

The present study investigates the impacts of negative press coverage on the content of salmonella in eggs on the demand for "safe" eggs, i.e. pasteurised eggs in a dynamic setting. We distinguish between news, which have a "temporary" nature and news with a "permanent" nature, focussing on a product, which will be positively influenced by this negative publicity. In addition to analysing the extent of the negative press impact on aggregate consumption of pasteurised eggs, diversity in the impacts for different consumer groups are also investigated.

2. Methodology and data

2.1. Theoretical framework

In consumption theory it is often assumed that the consumers possess perfect information and for that reason their preferences and tastes are constant. However, in a more realistic setting, it is more relevant to assume imperfect information. When the influence of negative press coverage or the effects of advertising are considered, it is accepted that the consumer does not possess perfect information and that new or better information will change preferences.

In the following, consumers are assumed to maximise utility. Following the approach of Smith et al. (1988), inspired from work by Swartz et al. (1981), utility is assumed to depend on the quantities of goods consumed, but also on the consumers' confidence or expectations related to the quality of the product and the health characteristics (where the latter is particularly relevant when food demand is considered). This confidence in turn depends on the information available to the consumers. For instance, bad news concerning a product (e.g. that intake of a specific product may induce a health risk, as was the case with BSE-infected beef in 1996) is assumed to affect consumers' utility of the product. Formally, the consumer's optimisation problem may be stated as

$$\begin{aligned} &\max_x U = U(x, I) = U(x(q(I)) \\ &s.t. \quad x' \cdot p \leq y \end{aligned} \tag{1}$$

where x is the vector of quantities of goods, q represents the expected quality and health characteristics, I is the set of information about the product (including quality and health risk information), p is the vector of product prices, and y is the total consumption budget (often considered equal to disposable income).

If the utility function satisfies standard regularity conditions, this problem can be solved with respect to the consumed quantities of different goods, yielding the demand function $x = f(y, p, I)$, where demand of each product depends on the size of the total budget for consumption, prices and the set of available information about the product. Additional information about quality or health characteristics related to e.g. one of the products may affect the consumers' quality/risk expectation of products, and thus have an effect on their demand for the considered product, but also on other products due to substitution between different products.

Product information about foods includes many different types of information, including e.g. advertising, publication of scientific results, general information campaigns and the like. In the following, focus is concentrated on information about health risk. In this perspective, it is considered relevant to distinguish between two different categories of information:

- Information with temporary importance and expected short-run impact on consumption
- Information with permanent implications and expected long-run impacts on consumption

Information with a temporary importance may include news about current problems, e.g. the discovery of salmonella in a given lot of chicken, which has consequently been removed from the stores. "Temporary" information may also include information, which consumers receive but do not care about for a very long time.

On the other hand, information with permanent importance includes news, which substantially changes the consumers' consciousness and attitudes towards foods. The recognition that BSE could possibly be acquired by eating specific cuts of beef is an example of such information, as it in general reduced the demand for beef for a long period of time in several European countries.

The reason for distinguishing between such two categories of information is that their impacts on consumption behaviour are different. "Temporary" news may have a short-run behavioural impact, whereas "permanent" news may impose structural breaks in consumption behaviour. Having made this distinction, the demand function can be specified

$$x_i = f(p, y, I_T, I_P) \tag{2}$$

where I_T represents "temporary" information and I_P represents "permanent" information. Equation (2) provides the theoretical basis for the empirical analyses below. Precise criteria for distinguishing between the two types of information can be difficult to define. In the following, an empirical distinction is based on recursive residuals and test of parameter stability.

2.2. Data

Price and consumption data
The data material for the empirical analysis consists of weekly household panel data from a representative panel (approximately 2000 households) of Danish food consumers, 1997-2000 from GfK Denmark. For parts of the analysis on aggregated egg consumption, this panel dataset has been supplemented with weekly shop data from one of the major retail chains (Kvickly) in Denmark, 2000-2001 in order to prolong the data period.

For each of the households in the panel, a wide range of background information has been collected, including characteristics like family size, age, number of children, level of education, region, income, preferred newspapers and magazines. Furthermore, weekly shopping reports are collected from the households, reporting the households' purchases in terms of quantity, value, price, brand, special product characteristics (e.g. organic), shop, etc. Unfortunately, the level of detail in the data varies over time. For the current purpose, weekly data covering the time period July 1999-December 2000 has the most suitable level of detail.

The development in total egg expenditure (current value) and aggregate price index for eggs for the considered period are shown in figure 1.

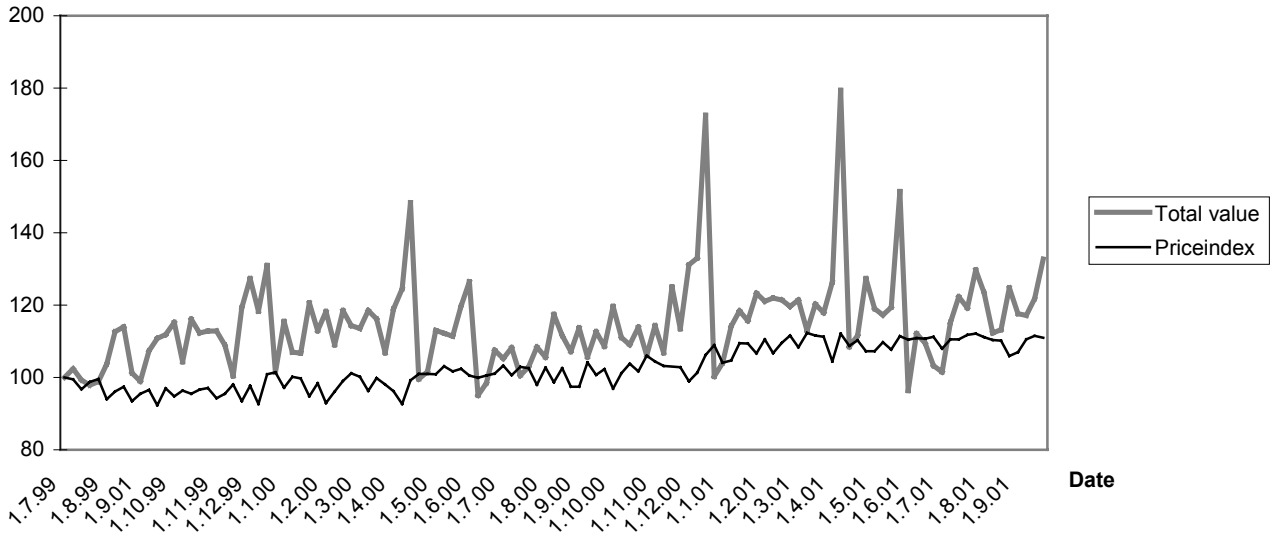

Figure 1. Total expenditure and price index for eggs, July 1999-September 2001, (Index: July 1999=100)

The total budget for eggs seems to fluctuate around a fairly stable level, however with peaks around Christmas/New Years Eve and a seemingly higher level in the spring than in the fall season. The egg price index seems to fluctuate around a slightly increasing trend. The development in pasteurised eggs' share of the egg budget in the same period is shown in figure 2.

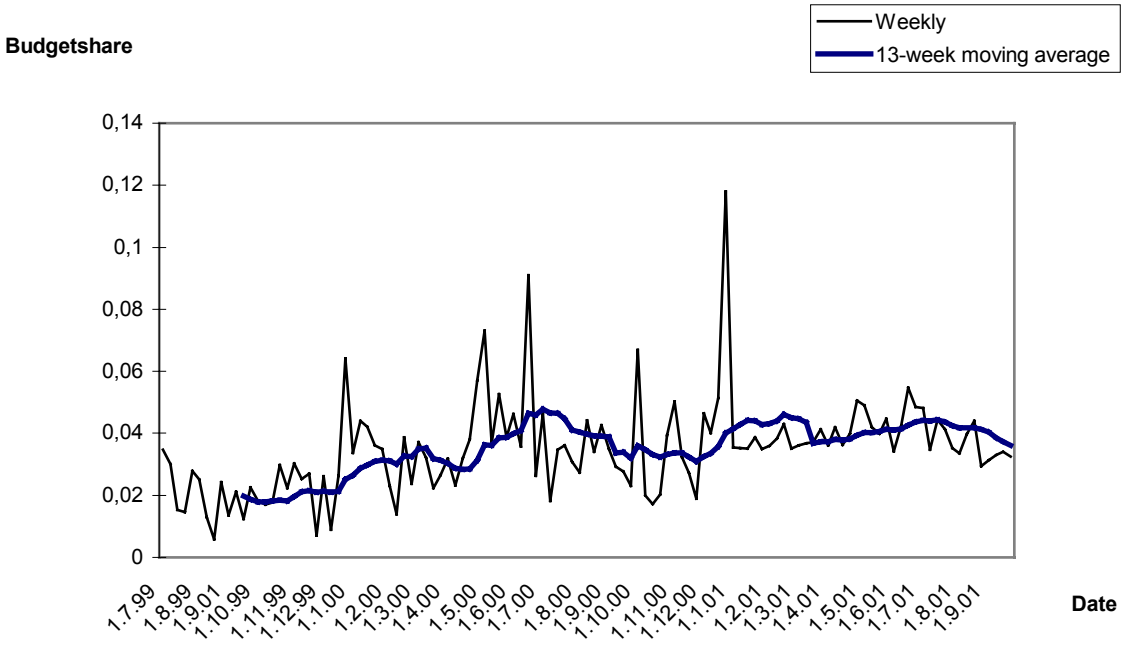

Figure 2. Budget share of pasteurised eggs, July 1999-September 2001.

The budget share of pasteurised eggs seems to have exhibited a higher level in the year 2000 than in 1999. In addition, the share has shown some peaks, in the beginning of 2000, in the summer period of 2000 and finally in the end of 2000. The peaks for Christmas/New Years Eve and summertime

eventually stems from the eating of traditional Danish dishes, which have raw eggs as main ingredient.

News data
As mentioned in the previous sub-section, we will distinguish between two types of news/information about salmonella in eggs: "temporary" and "permanent" information. Data concerning this news have been collected from Danmarks Radio (one of the two major TV stations) and 4 of the major newspapers (Berlingske Tidende, Politiken, Jyllands Posten and B.T.) in terms of articles concerning problems with salmonella in eggs. 4 main types of news are considered, and these are listed in table 1, along with an example of related issues.

Table 1. News categories and major events

News category:	Example:
Scientific news and the like	Stop for import of eggs which are suspected to have high risk of salmonella
Occurrence of salmonella etc.	Cases of farmers cheating with salmonella control
Salmonella infections due to contaminated food	21 people sick from an ice-cream dessert with raw eggs
Deaths due to due to contaminated food	2 men died after the intake of a homemade biscuit/chocolate cake with raw eggs, January 2000

Source: Danmarks Radio, Berlingske Tidende, Politiken, JyllandsPosten, B.T.

2.3 Empirical specification

The point of departure for the empirical specification is the Almost Ideal Demand (AID) model, introduced by Deaton & Muellbauer (1980). According to the AID specification, commodity *i*'s share of the total commodity group budget w_i can be derived as:

$$(3)\quad w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_{iy}(\ln y - \ln P)$$

where p_j is the price of commodity (egg type) j, y is the size of the total budget for consumption of the considered commodity group (eggs) and $\ln P = \alpha_0 + \sum_i \alpha_i \ln p_i + \tfrac{1}{2}\sum_i \sum_j \gamma_{ij} \ln p_i \ln p_j$ is an aggregate price index (of eggs). The latter can reasonably well be approximated using the Törnquist index formula: $\ln P_t - \ln P_0 = \sum_i \tfrac{1}{2}(w_{i0} + w_{it}) \cdot (\ln p_{it} - \ln p_{i0})$. In order to be theoretically consistent, the system of budget share equations is required to satisfy the properties of adding-up, linear homogeneity and Slutsky symmetry.

Two separability assumptions are applied. First, weak separability is assumed between consumption of eggs and consumption of other goods. This assumption implies that the marginal rate of substitution between shell eggs and pasteurised eggs does not depend on prices of other commodities, but also that the consumption of various types of eggs can be aggregated into one aggregate commodity ("eggs") in the overall consumption demand system. Second, we assume that the consumption of pasteurised eggs is weakly separable from all shell egg products, and that the latter can be aggregated into one aggregate commodity: "shell eggs". As the dataset applied for the present analysis only describes the consumption of these two types of eggs, it has not been possible to test the separability assumption.

The dynamics of the system is investigated using an Error Correction Model (ECM). This specification allows including both short run dynamics and adjustments towards long-run equilibrium. When the system is at rest all differences vanish and the long run relation holds. The ECM version of the budget share equations in the AID model is:

$$(4)\ \Delta w_{it} = \sum_j \gamma_{ij} \Delta \ln p_{jt} + \beta_{iy} \Delta \ln\left(\frac{y_t}{P_t}\right) - \lambda_i \left(w_{i,t-1} - \sum_j \alpha_{ij} \ln p_{j,t-1} - \phi_{iy} \ln\left(\frac{y_{t-1}}{P_{t-1}}\right)\right) + \varepsilon_{i,t}$$

where Δ´s indicates differences.

Although a weekly frequency in data implies that the number of observations is sufficient, it may be argued that the data period is relatively short for dynamic analysis involving the concept of long-run equilibrium. On the other hand, there is not considered to exist significant barriers to shifts in the composition of egg consumption (or the consumption of most other foods, for that matter).

The characteristics of the time series should be identified before any analysis is done, including the order of integration, using e.g. a Dickey-Fuller or Johansen procedure. If unit roots are encountered but the data series are cointegrated, OLS regression still yields consistent estimates of long run parameters, but the *t* statistics will be non-standard. Cointegration implies the existence of a long run equilibrium condition that can be combined with the short run dynamics of the time series within the Error Correction framework. A Dickey Fuller (DF) test and an augmented Dickey Fuller (ADF) test are applied to test for unit roots in each of the time series. The ADF and the DF test are both sensitive to the assumption of normality of the residuals, therefore a Jarque Bera´s skewness-kurtosis test is performed as well in order to check this assumption.

Construction of Media index

Several types of indices have been used in the literature to cover the effect of negative information ranging from dummy or trend variables (Tansel 1993), actual message numbers (Smith et al., 1988) cumulative message numbers (Brown and Schrader 1990, Chang and Kinnucan, 1991). Some of the indices discriminate between negative and positive news, some include lags and some of them make more complicated structures. The effect of advertising is normally covered by advertising expenditures (Rickertsen *et al*., 1995, Verbeke and Ward, 2001, Kinnucan *et al.* 1991).

Brown and Schrader (1990) make an index constructed as the accumulated number of medical articles produced supporting a link between heart diseases and cholesterol intake and the accumulated number of medical articles produced questioning a link. The basic assumption behind this index is that these scientific articles read by experts filters down to the consumer through newspapers and TV. An updated version of the Brown and Schrader index is used in several studies including Kinnucan *et al* (1997) and Chang and Kinnucan (1991). Verbeke and Ward (2001) use another approach and let the information be dependent on TV coverage of the BSE problems, while Smith *et al* (1988) let their index be based on articles in major newspapers, weighting the newspaper articles by using the Budd´s attention score[1] and this is furthermore weighted by a probability that the articles are read (newspaper market share).

[1] This system range newspaper articles according to their location in the newspaper.

Our approach can be considered as a mixture of the two last approaches, in that it is a weighted sum of the number of articles in major newspapers, and number of TV coverages within the same week (This approach will therefore include news filtered down from scientific articles)[2]. Articles are weighted according to the seriousness of the news provided, rather than according to their location in the newspaper. Mention of normally scientific related news with negative impact and the like gets a score of 0.5, news as the discovery of comprehensive content of salmonella in flocks of poultry or similar events gets a score of 1. Mention of people getting sick by eating dishes contaminated by eggs gets the score of 2, while the mention of deaths caused by salmonella in eggs gets the score of 3. Furthermore, the first time a piece of news is mentioned it gets a full score, second time half a score and thereafter a fourth of a score. The news are also weighted across medias as TV gets weight 1, while the newspapers gets a score according to the share of the consumer panel reading this specific newspaper. These mentioned weightings may seem rather ad hoc. However, they have been determined after a series of experiments, and from an intuitive point of view they are considered reasonable.

Some of the above mentioned articles analyse both positive and negative information together, either as positive versus negative information upon the same event or as generic advertising versus negative press release (Smith *et al.*1988, Verbeke and Ward, 2001, Chang and Kinnucan, 1991, Brown and Schrader, 1990, Kinnucan *et al*, 1997). The joint conclusion for the positive information is that it has almost no effect on consumer behaviour, that positive articles are much smaller in number than the negative ones, and that generic advertising has a much smaller impact than negative news. Based on these findings, we chose to cover only negative press news in our index.

Several of the indices introduced use a lag structure, as there is evidence that press stories have a cumulative effect (Verbeke and Ward 2001, Kinnucan *et al*. 1997, Rickertsen *et al.*, 1995). This includes simple declining shares to lagged index values as in Rickertsen (1995) or more sophisticated structures as in Verbeke and Ward (2001). A lagged structure of the media index has also been investigated. As a starting point the model was estimated with three lagged values of the news index:

$$\Omega_{T,t} = \phi_0 I_{T,t} + \phi_1 I_{T,t-1} + \phi_2 I_{T,t-2} + \phi_3 I_{T,t-3} \quad (4)$$

Also an index representing the sum of current and lagged index values using different values of the ϕ_i's were tried against each other and were all found insignificant. Changes in lag structure did not appear to affect the estimated results to any significant extent as in line with the results of Rickertsen et al. (1995). It is thus chosen to include only the current value of the media index in order to save degrees of freedom.

The flow of negative press coverage has been aggregated into a weekly "news index". Forker and Ward (1993) and Verbeke and Ward (2001) argue that some advertising expenditure threshold may have to be exceeded before any significant results are noticed. This is somewhat in line with our distinction between "temporary" and "permanent" information.

[2] A flaw concerning our approach is that product quality is communicated to consumers in numerous other ways than newspapers and television such as in store information, by word of mouth, etc.

3. Results

3.1 Identification of permanent and temporary news

The first stage of the empirical analysis focuses on the identification of news, which can be characterized as having permanent nature in contrast to news, which can be characterized as having a more temporary nature. The analysis tests for structural breaks in the demand parameters for pasteurized eggs. Standard stability tests were performed to test for possible structural breaks in the series of consumption of pasteurized eggs. Thus, the model was estimated in its static form and the cumulative sum of the squared recursive residuals were analyzed. Furthermore, recursive estimations of parameter values were analyzed and both analyses points at a structural break in the demand for pasteurized eggs in the beginning of January 2000, indicating that the biscuit/chocolate cake event[3] happening in the beginning of January can be characterized as a permanent news event.

3.2 Results for aggregate egg consumption

Based on the above preliminary results the biscuit/chocolate cake event in the beginning of January 2000 is characterized as a permanent news event and included as a permanent dummy in the dynamic estimation. Having thus distinguished between permanent and temporary news in the dataset, the following dynamic model specification is estimated:

$$\begin{aligned}\Delta w_{past,t} = {} & \gamma_1 \Delta \ln p_{past,t} + \gamma_2 \Delta \ln p_{oth,t} + \beta_1 \Delta \ln\left(\frac{y_t}{P_t}\right) + \eta \Delta I_{P,t} + \varphi \Delta I_{T,t} \\ & - \lambda\left(w_{t-1} - \alpha_1 \ln p_{past,t-1} - \alpha_2 \ln p_{oth,t-1} - \phi_1 \ln\left(\frac{y_{t-1}}{P_{t-1}}\right) - \delta I_{P,t} - \theta I_{T,t} - \alpha_3 \right) + \varepsilon_t\end{aligned} \tag{5}$$

where $w_{past,t}$ represents pasteurised eggs' share of the entire egg budget in period t, $p_{past,t}$ represents the price of pasteurised eggs in week t, $p_{oth,t}$ represents the aggregate price of other eggs in week t, $\frac{y_t}{P_t}$ represents the total real consumption budget for eggs in week t, $I_{T,t}$ represents the flow of information with temporary impact and $I_{P,t}$ represents the flow of information with permanent impact. $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$ is an error term.

First, each of the time series is tested for unit roots with a DF test and an augmented DF test. Results from these tests are shown in table 2.

Table 2 . DF and ADF test for unit roots

	DF - with constant	DF - with trend	ADF - with constant	ADF with trend	Unit root	Normality
Ln $\left(y/P\right)$	-8,77		-5,38		rejected	rejected
Price pasteurized eggs	-9,41		-5,42		rejected	rejected
Price other eggs	-2,98	-8,26	-0,98	-4,29	rejected	accepted
Index	-11,46		-5,96		rejected	rejected
Budgetshare pasteurized eggs	-7,85		-4,31		rejected	rejected

[3] This is a case where two men, a father and his son, died after the intake of a homemade chocolate/biscuit cake. This event got a large publicity.

For all series, the hypothesis of a unit root in levels is rejected, but also the Jarque Bera test rejects normality for all equations but the equation for the price of other eggs. Further inspection of the time series does however support the hypotheses of no unit roots. Therefore, the further analysis is based on OLS regression of the ECM model (5), i.e. no unit roots is assumed.

A dummy variable is included for each week in the summer period where consumption of pasteurized eggs via one of the traditional dishes with raw eggs in Denmark will be related with warm and sunny weather. Insignificant summer dummies are removed. The significance by excluding all other parameters one by one is tested using an ordinary F-test. The parameters of the final model are shown in table 3.

Table 3. Estimated parameters of the final model

Variable	Variable name	Estimate	Standard Error	t-value	Pr>|t|
φ	Index (Short run)	0,0023	0,0009	2,44	0,0164
γ_1	Price of pasteurized eggs (Short run)	-0,0140	0,0071	-1,97	0,0516
α_2	Price of other eggs (Long run)	0,0659	0,0078	8,50	<,0001
θ	Indeks (Long run)	0,0035	0,0013	2,64	0,0096
δ	Permanent news	0,0126	0,0024	5,17	<.0001
$D_{summer2}$	Dummy	0,0398	0,0088	4,52	<.0001
$D_{summer8}$	Dummy	0,0574	0,0087	6,61	<.0001
$D_{christmas}$	Dummy	0,0611	0,0062	9,81	<.0001
λ	Adjustment parameter	-1,0053	0,0633	-15,88	<.0001

Table 4. Test for heteroscedasticity, autocorrelation and normality of final model

	Value	Pr > ChiSq
Jarque Bera test of normality	1,94	0,38
Durbin Watson	1,89	d_L=1,336 d_H=1,741
R^2	0,79	
White's Test for heteroscedasticity	39,83	0,388
Breusch-Pagan	16,66	0,054
LM test for 1. Ordens autocorrelation	0,40	0,525
LM test for 2. Ordens autocorrelation	0,42	0,812

The results show that the short run dynamics only are influenced by the own price of pasteurized eggs and the publicity index. The long run equilibrium is influenced by the price of other eggs and the publicity index and by some dummy variables including the dummy for the biscuit-chocolate event. The model shows a larger sensitivity towards publicity in the long run compared to the response in the short run. The adjustment parameter is close to –1, suggesting that consumers adjust quickly to changes in the long-run equilibrium, e.g. due to an event, which can be considered as permanent news. Tests shown in table 4 indicate that there are no problems of non-normality, heteroscedasticity or autocorrelation in the model.

From the estimated coefficient estimates, we can calculate conditional short run and long run price elasticities according to the formula (Edgerton *et al.* ,1996)

$$\varepsilon_{ij} = \frac{\gamma_{ij} - \beta_i w_j}{w_i} - \delta_{ij} \quad (6)$$

The conditional long-run own price elasticity for pasteurized eggs is estimated to be equal to –1, and the short-run elasticity a little larger estimated to –1,4, indicating that the demand for pasteurized eggs is quite price elastic. This large price elasticity might be due to the fact that data are on a weekly basis.

The short run cross price elasticity is insignificant indicating there is no short run dynamic response to price changes of other eggs. The long run cross price elasticity representing the impact on demand for pasteurized eggs due to a price change on shell eggs is excessively large. This is however not unusual with close substitutes, of which the one represents only a minor budget share compared with the other.

Following Rickertsen *et al* (1995) an elasticity for the negative press coverage is derived as:

$$\varepsilon_{I,past} = \frac{\bar{I}_T}{\overline{w}_{past}} \left[\phi_{1j} - \beta_1 \phi_1 \left(\ln \overline{p}_j - \ln \overline{p}_i \right) \right] \quad (7)$$

$\bar{I}_T$ is the mean news index value for shell-eggs, since negative news on shell-eggs can be considered as positive news for the purchase of pasteurized eggs. $\overline{w}_{past}$ is the mean budget share for pasteurized eggs, β_1 is the estimated coefficient to real expenditure, ϕ_1 is the estimated coefficient related to the news index, and $\overline{p}_i$ and $\overline{p}_j$ are the mean prices of pasteurized and shell eggs, respectively. The news elasticity is an arbitrary measure of the responsiveness dependent on the valuation criteria for the news index. This means that it is mainly used as means of comparison. Calculated short- and long-run news elasticities are given in table 5 for two different estimations: a unified estimation on the total dataset and a divided estimation, where separate sets of parameters have been estimated before and after the biscuit-chocolate cake event, respectively.

Table 5. News elasticities

	Short run Elasticity	Long run Elasticity
Model estimated on total dataset	0,0323	0,0507
Model estimated only on data before the bisquit/chocolate cake event	0,0268	0,0253*
Model estimated only on data after the bisquit/chocolate cake event	0,0243	0,0669

* The estimate for the long run elasticity is only almost significant on 10% level

For estimations on the whole data set and for the model estimated on data after the biscuit/chocolate event, the long run news elasticity is larger than the short run elasticity. For the model estimated on data before the biscuit chocolate event the two elasticities are almost about the same size. Thus,

salmonella news seem to affect consumers' decision more after the event than before. What is also interesting is that estimated price elasticities are lower in the divided estimation than in the unified estimation, which again indicates a structural break due to the event.

3.3 Results for different household types

As noted above, no real barriers to the adjustment in consumption pattern are assumed. On the other hand, habits and attitudes can cause slower adjustment in some consumer segments than in others. The following is concerned with estimating the effects of the news index on egg demand for different socio-demographic groups, in order to investigate, whether such differences between consumer types can be identified.

In general, there is not found significant responsiveness toward the news index for any of the considered socio-demographic groups. This might be due to a combined effect of data being on weekly form and the reduced number of households in each group compared with the aggregate model. For simplicity, we therefore only consider the effect of the biscuit/chocolate case, the size and significance of the shift and the difference in mean budget share of pasteurized eggs before and after the event.

First, it is tested whether there is a significant difference between the mean budget share of pasteurized eggs before and after the biscuit/chocolate cake event for different socio-demographic groups, as well as across groups. Mean budget shares are shown in table 6 (a) – (d).

For all age groups there is a difference between the mean budget share before and after at a 5 per cent significance level. Across age groups there are no significant differences in mean budget shares before the event, while there is significant difference between the youngest age group and the groups from 50-59 years and 60 and more after the event. It might seem awkward that the youngest age groups do have such a large budget share for pasteurized eggs, as pasteurized eggs are related to the specialized cooking of desserts and the like. This may however be explained by the fact that this age group is the part of the population who has the smallest consumption of eggs pr. person pr year, according to Smed (2002)[4]. For geographical groups, there is significant difference between mean budget shares before and after the event (at a 1 per cent level for western Denmark and 5 per cent level for the capital area – for eastern Denmark, there is no significant difference). There is also no significant differences in mean budget shares between regions before the event, but after the event, the budget share of pasteurized eggs is significantly lower in Eastern Denmark than in Western Denmark. There is no significant difference between family types before the event, but singles without children have a mean budget share, which is significantly different from families with children. There is no significant differences in mean budget shares between income groups, neither before nor after the biscuit/chocolate cake event, but for singles with low income, couples with medium and high income there is a significant difference in mean budget shares before and after.

[4] The results in Smed (2002) are based on the same dataset as the estimations in this paper

Table 6a. Mean budget shares for pasteurized eggs before and after January 2000 for age groups

Age group		Mean budget share, per cent
Under 30 yrs	B	3,22
	A	5.06
30-49 yrs	B	2.63
	A	4.07
50-59 yrs	B	2.10
	A	3.65
60 yrs and more	B	1.75
	A	3.25

Table 6b. Mean budget shares for pasteurized eggs before and after January 2000 for regions

Region		Mean budget share, per cent
Capital area	B	2.61
	A	3.86
Eastern Denmark	B	2.44
	A	3.15
Western Denmark	B	2.07
	A	4.37

Table 6c. Mean budget shares for pasteurized eggs before and after January 2000 for family types

Family type		Mean budget share, per cent
Singles – no children	B	1.68
	A	3.30
Couples – no children	B	2.22
	A	3.67
Households with children <6 years	B	2.59
	A	4.38
Households with children 6-20 years	B	2.58
	A	4.14

Table 6d. Mean budget shares for pasteurized eggs before and after January 2000 for income groups

	Income		Mean budget share, per cent
Singles	Low	B	1.31
		A	2.90
	Medium	B	1.79
		A	3.30
	High	B	3.07
		A	3.20
Couples	Low	B	2.09
		A	3.09
	Medium	B	2.46
		A	4.09
	High	B	2.35
		A	4.05

* Low income: 0-149.999 dkr./yr, Medium income 150-299.999 dkr./yr , high income 300.000 and more/yr
B: Before the chocolate-biscuit cake event, A: After the chocolate-biscuit cake event

The figures in table 6 represent the total differences in the structure of the egg consumption budget before and after the biscuit chocolate cake event. However, this may comprise different price levels, different extents of news coverage, etc. In order to isolate the partial effect of the event, the full dynamic model is estimated for each of the socio economic groups. The results for the biscuit chocolate parameter are shown in table 7.

The coefficients represent the partial effect on the budget share of pasteurised eggs due to the biscuit chocolate event. For example, for households in the Capital area, the partial effect of the event was an increase in the egg budget share by 1.2 percentage points (which may be compared with the 1.25 percentage points in table 6) , and in Western Denmark by 1.76 percentage points (as compared with 2.3 percentage points in table 6).

Parameters for adjustment to long run equilibrium are not shown here but are fairly equal across socioeconomic groups and are not significantly different from 1 for any of the socioeconomic groups.

Table 7. Parameter values for the chocolate/biscuit cake event for different socio economic groups

Age groups		Income groups		Regions		Family types	
Age	Parameter value	Income group	Parameter value	Region	Parameter value	Family type	Parameter value
< 30 år	n.s	single low	0,0069	Capital area	0,0120	Singles without children	0,0125
30 - 49 yrs	0,0091	single medium	n.s	Eastern Denmark	n.s	Couples without children	0,0114
50 - 59 yrs	0,0095	single high	0,0995	Western Denmark	0,0176	Housholds with small children	n.s.
60 yrs and above	0,0128	couple low	n.s			Housholds with larger children	0,0098
		couple medium	0,0116				
		couple high	0,0152				

All in all, tables 6 and 7 show a growing responsiveness by age, a larger response in Western Denmark than in the capital area and a larger response in families without children than in families with children. Most of these differences are however not substantial.

4. Discussion

This paper has examined the cross-impacts of food safety news concerning one product on the demand for another product, using the Danish demand for pasteurized eggs versus shell eggs as an illustrative case. The analysis shows that information about salmonella in shell eggs has a significantly stimulating effect on the demand for pasteurized eggs.

The study distinguishes between news with a temporary impact and news with a permanent impact on consumers' expectations concerning food safety. In the specific case, the death of two men caused by salmonella infection from raw shell eggs is identified as permanent news, whereas remaining salmonella news related to eggs have been categorized as temporary news. Both types of news appear to have significant positive impacts on the demand for pasteurized eggs. The impacts of the permanent news have been investigated for various groupings of Danish households according to different socio-demographic criteria. Both the composition of egg consumption and the impact of the death event differ between socioeconomic groups.

In principle, the classification of news into the two categories may be discussed, although the performed tests provide a fairly strong indication of the event, which can be considered as "permanent" – an event which also is intuitively appealing, taking into consideration the total extent of media coverage and the presumably heavier emotional impacts from the death event than from other news in the study period. It might however be considered, if this difference is due to the emotional contents of the death event, or if media coverage beyond some information threshold triggers different responses than media coverage below this threshold. This issue has not been investigated in the present study, but might be a route for further investigation eventually based on a longer data set or other consumption goods.

Whereas one event provides the set of permanent news, temporary news concerning salmonella in eggs is aggregated into a news index variable. As no objective set of weights for different types of media or news is available, different weighting schemes have been attempted, and the most well-performing weighting scheme (in terms of e.g. significance in the econometric estimations) has

been selected. Still, there is room for improvements in the construction of such news index variables. Furthermore, it may deserve mention that news about salmonella in other foods (e.g. poultry or pig meat) has not been included in the news index, as they are not supposed to influence the demand for eggs. However, some consumers may possibly not be able to distinguish these types of news – hence their "subjective news index" differs from the one constructed for this analysis. This might be another route for further research

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