Consumption of Salt Rich Products in the UK: Impact of The Reduced Salt Campaign

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Abstract

This paper makes use of a leading UK supermarket's loyalty card based data which records information on purchase decisions by consumers who shop at its stores in order to assess the effectiveness and impact of the UK reduced salt campaign. We present an empirical analysis of consumption data to assess the effectiveness of the UK Food Standard Agency's (FSA) 'reduced salt campaign' on the basis of information on health related announcements undertaken by the FSA under its 'low salt campaign'. We adopt a general approach to determining structural breaks in consumption data, including making use of minimum LM unit root tests whereby structural breaks are endogenously determined from the data. We find evidence supporting the effectiveness of the FSA's reduced salt campaign.

JEL codes: Q12, Q31, I12
Keywords: structural breaks, salt consumption, low salt campaign

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1 Introduction and Literature Overview

The vital role of standards in food retailing are well known. Schemes aiming to harmonise food safety standards arise from both economic and institutional incentives, as well as through government policy. *Fulponi* (2006) assesses the role of voluntary standards in the food system taking into account the perspective of major food retailers. Fulponi concludes that '...the growing voice of civil society, changing legal and institutional frameworks, increased market concentration and buying power as well as their integration with financial markets has provided the setting for development of private standards (p. 1).' *Golan and Unnevehr* (2008) consider the role of policy factors in influencing the composition of diets through policy impacts on both food product composition and dietary outcomes. They consider the influence of policy factors on producer input costs and changes to information available to consumers. *Golan and Unnevehr* (2008) conclude that superior information (or more effective information) can induce the food industry to produce healthier foods but it does not necessarily result in more healthy diets. However, they conclude that:

> Information policy such as labelling regulations and nutrition information can create new areas of competition by raising con- sumer awareness and stimulating demand for new product attributes (p. 467).

Conditions such as high blood pressure are considered among the most important risk factor for cardiovascular disease. For instance a recent World Health Organization report that high blood pressure causes more than 50% of cardiovascular disease worldwide (Ezzati et al. 2002). There is a growing body of literature that suggests that salt intake plays a very important role in regulating blood pressure (e.g., Intersalt Cooperative Research Group, 1988; Forte et al. 1989; Lifton, 1996; He and MacGregor, 2004). Therefore public interventions aimed at raising awareness of salt as a public health issue, and inform consumers how to lower their intakes salt intake is paramount importance. Recently in the UK both the Department of Health and the Food Standards Agency (FSA) have implemented combined policy designed to prompt the food industry to add less salt to food and to persuade the public to consume smaller amount of salt at home (He and MacGregor, 2004). In this paper we focus on the latter. We aim to study empirically the implications the UK Food Standard Agency's (FSA) 'low salt campaign.Õ This campaign's target was to raise public awareness on the implication of high salt intake. We will focus on the first three stages of the campaign (a fourth stage has been recently launched). The first phase (launched in September 2004, with the key aim of ensuring that consumers were aware of why too much salt is bad for their health. In the second phase of the campaign (launched in October 2005) the consumers were encouraged to to check food labels for information on the salt content and to raise awareness of the aim to eat no more than 6g of salt a day. The third phase of the (launched in March 2007). This part of the campaign focused on the message that 75% of the salt consumer eat is already in everyday foods.

Our research is based on unique and exclusive access to a UK supermarket loyalty card dataset, the Tesco Clubcard database, which is extremely rich and detailed. Eighty percent of Tesco transactions go through Clubcard and the database covers 1.2 million consumers. The data we employ spans two years. We employ Tesco Clubcard data for weekly volumes of sales from 26 September 2005 to 17 September 2007. This time frame gives us the opportunity to assess whether any break appears within, or in proximity of, three different rounds of the 'low salt campaign'. It encompasses a period of time that incorporates the introduction of FSA's low-salt campaign. The relatively high frequency (weekly) of data available to us allows for the identification of breaks or changes in demand. Our analysis aims to determine whether a specific health related food campaign (the 'No More Than 6g of Salt a Day' or the FSA 'low-salt campaign') has led to a change in consumer behaviour and consumption of some high salt food items. We employ suitable econometric methods to test for structural breaks in our data series and, provided breaks exist, we examine whether or not these breaks are associated with the incidence of such health campaigns. More precisely, our econometric procedures allow the identification of significant changes in sales of products that are high in salt and enable us to assess the impact of health related announcements. We make use of information on volumes and sales of high salt products and their low salt counterparts, focusing in particular on typical items contained within the consumption bundles chosen by the average consumer such as on crisps, bacon and soups. Thus, our empirical analysis assesses the effectiveness of the UK Food Standard Agency's 'reduced salt campaign' based on information on health related announcements undertaken by the FSA under its 'low salt campaign'.

It is well known that structural breaks should be allowed for while testing for unit roots. If pre-determined breaks are imposed, it might lead to incorrect specification of break points. One solution for this is to make use of minimum LM unit root tests whereby structural breaks are endogenously determined from the data and we follow this method in this paper. Such LM tests are more likely to avoid spurious rejections of the unit root null in the presence of structural breaks. We build on this approach by making use of a generalised Bai and Perron (1998) type multiple structural break dating procedure in order to identify structural breaks in consumption data, which are in turn analysed with reference to FSA health-related announcements. We find evidence supporting the effectiveness of the FSA's health campaign.

Among all product considered (crisps, soups, and bacon), only bacon shows breaks that can be considered to be related to the FSA campaign. For instance, for smoked bacon and unsmoked bacon, we observe that there seems to be a downward trend generally in the consumption of both smoked and unsmoked bacon. Two breaks are identified. The first one takes place six weeks after the second round of announcements, but this is not statistically significant. The second break is statistically significant, and it takes place in proximity to the third campaign. More precisely, it occurs three weeks after the third round of FSA health related announcements conclude. We can thus conclude that the campaign appears to be effective in inducing and maintaining the downward trend in consumption of both food items which are high in salt content.This paper also aims to contribute to the more general literature on testing for food health campaign effectiveness. It should be noted that most of the literature builds on low frequency data *Mazzocchi et al.* (2004). In a similar paper, *Capacci and Mazzocchi* (2011) analyse the UK's five-a-day information campaign and attempt to distinguish positive effects of information from potentially conflicting price dynamics. They find that the campaign was successful in increasing average fruit and vegetable consumption.

2 Methodology

2.1 Motivation

We are essentially looking for *announcement effects* that are captured in consumption behaviour as captured through changes in (reductions in) consumption of food items of interest (high salt foods). Given the health status Ω of a local population P_i (in our case the catchment area from which this Tesco data is obtained), we assume that the health status of the population is dependent on a set of k variables (some exogenous and some endogenous) such that:

$$\Omega_{P_i} = f(\theta_i \dots \theta_k) \tag{1}$$

Assume that one of the variables take the following value $\theta_j = \Lambda$, such that $\Lambda \in \Gamma$, where Γ represents the information set available to an individual consumer. We assume that governmental health campaigns alter Γ and therefore Λ, which represents the individual's health related information set. Assuming that the individual is a utility maximising, rational consumer (see for instance, *LaFrance* (2008)), adverse health related information should mean that consumption of food items which reduce life expectancy or increase the probability of contracting illnesses should decline (or even fall to zero for extremely harmful items). Our paper thus aims to identify breaks in consumption data for 14 salt rich commodities (labelled ts1 to ts14, see Table 1) as well as emergent changes in consumption patterns which are associated with the three rounds of FSA's health related announcements under its 'low salt campaign'.

2.2 Lee and Strazicich's two break LM test

Lee and Strazicich (2003, 2004) propose a unit root test which allows for breaks in the data under both the null and alternative hypothesis in a consistent manner. This procedure is based on a data generating process which can be represented by:

$$y_t = \delta' X_t + \epsilon_t, \qquad \epsilon_t = \beta\epsilon_{t-1} + \varepsilon_t \tag{2}$$

where X_t represents a vector of exogenous variables while ε_t is a Gaussian *iid* error term. Lee and Strazicich allow for two changes in level and trend (breaking trends or their model 2) whereby $X_t = [1, t, D_{1t}, DT_{1t}, D_{2t}, DT_{2t}]'$ such that D_{mt}, DT_{mt} for $m = 1, 2$ are dummies with $D_{mt} = 1$ for $t \geq T_{Bm} + 1$ and 0 otherwise. $D_{mt} = t - T_{Bm}$ for $t \geq T_{Bm} + 1$ and 0 otherwise. In this representation, T_{Bm} denotes the m^{th} break date. The DGP shown in equation (2) permit breaks both unde rteh null ($\beta = 1$) and the alternative hypothesis ($\beta < 1$). In order to estimate the LM unit root test statistic, Lee and Strazicich (2003) use the following statistic:

$$\Delta y_t = \delta' \Delta X_t + \phi \tilde{Z}_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta \tilde{Z}_{t-m} + u_t \tag{3}$$

where $\tilde{Z}_t = y_t - \tilde{\Phi}_n - X_t\tilde{\delta}$ for $t = 2, ..., T$ which is the detrended series. In this equation, $\tilde{\delta}$ represents the coefficients from the regression of Δy_t on ΔX_t, $\tilde{\Phi}_n = y_1 - X_1\tilde{\delta}$ and y_1 and X_1 represent the first observations. In this method, the lagged terms of $\Delta\tilde{Z}_{t-m}$ are included in order to correct for autocorrelation. From equation 3, we obtain LM test statistics which are given by the t-statistics testing for the null hypothesis $\phi = 0$. Break dates are then identified by a grid search over all possible dates (once 10% of endpoints are removed), so that the test statistic is minimised. Critical values can be obtained form Lee and Strazicich (2003, 2004).

2.3 Bai and Perron's approach for multiple structural breaks: The theory

The following outlines our approach (see also Zeileis el al. 2003) which aims to test or assess deviations from stability in the classical linear regression model

$$y_i = x_i^T \beta + u_i \tag{4}$$

where where at time i, y_i is the observation of the dependent variable, x_i is a $k \times 1$ vector of regressors, with the first component usually equal to unity, and β_i is the $k \times 1$ vector of regression coefficients, which may vary over time. The hypothesis being tested is that the regression coefficients remain constant:

$$H_0: \ \beta_i = \beta_0 \quad (i = 1, ..., n) \tag{5}$$

against the alternative that at least one coefficient varies over time. In many applications it is reasonable to assume that there are m breakpoints, where the coefficients shift from one stable regression relationship to a different one. In many applications it is reasonable to assume that there are m breakpoints, where the coefficients shift from one stable regression relationship to a different one. Thus, there are $m + 1$ segments in which the regression coefficients are constant, and the model can be rewritten as

$$y_i = x_i^T \beta + u_i \qquad (i = i_{j-1} + 1, ..., i_j, j = 1, ..., m + 1) \tag{6}$$

where j denotes the segment index. In practice the breakpoints i_j are rarely given exogenously, but have to be estimated. `breakpoints` estimates these breakpoints by minimizing the residual sum of squares (RSS) of the equation above. We also have $\mathcal{I}_{m,n} = \{i_1, ..., i_m\}$ which denotes the set of breakpoints (or the m-partition).[1]

F statistics test against a single-shift alternative of unknown timing, i.e., model 6 with $m = 1$. Tests against this alternative are usually based on a sequence of F statistics for a change at time i: the OLS residuals $\hat{u}(i)$ from a segmented regression, i.e., one regression for each subsample, with breakpoint i, are compared to the residuals $\hat{u}$ from the unsegmented model via:

$$F_i = \frac{\hat{u}^T - \hat{u}(i)^T \hat{u}(i)}{\hat{u}(i)^T \hat{u}(i)/(n - 2k)} \tag{7}$$

These F statistics are then computed for $i = n_h, ..., n - n_h (n_h \geq k)$ and H_0 is rejected if their supremum or average or exp functional is too large (see Andrews and Ploberger (1994)). Hansen (1997) gives an algorithm for computing approximate asymptotic p values of these tests, which is implemented in `R`. A trimming parameter (ε) can also be chosen, which is defined as minimal segment size either given as a fraction relative to the sample size or as an integer giving the minimal number of observations in each segment. The asymptotic distribution depends on this trimming parameter via the imposition of the minimal length h of a segment, namely:

$$\varepsilon = \frac{h}{T} \tag{8}$$

Bai and Perron (1998, 2003) extend this approach to F tests for 0 vs. ℓ breaks and ℓ vs. $\ell + 1$ breaks with arbitrary but fixed ℓ.

[1] By convention, $i_0 = 0$ *and* $i_{m+1} = n$.

2.3.1 Dating structural changes

Given an m-partition $i_1, ..., i_m$ the least squares estimates for the β_j can easily be obtained. The resulting minimal residual sum of squares is given by

$$RSS(i_1, ..., i_m) = \sum_{j=1}^{m+1} rss(i_{j-1} + 1, i_j) \quad (9)$$

where $rss(i_{j-1} + 1, i_j)$ is the usual minimal residual sum of squares in the jth segment. The problem of dating structural changes is to find the breakpoints $\hat{i}_1, ..., \hat{i}_m$ that minimize the objective function:

$$RSS(\hat{i}_1, ..., \hat{i}_m) = argmin_{(\hat{i}_1,...,\hat{i}_m)} RSS(\hat{i}_1, ..., \hat{i}_m) \quad (10)$$

Obtaining global minimisers in 10 by a grid search is computationally burdensome. Hierarchical algorithms have been proposed to do recursive partitioning or joining of subsamples (but these will not necessarily find the global minimisers). Bai and Perron (2003) present a version of that dynamic programming algorithm for pure and partial structural change models in an OLS regression context, which is adopted in `strucchange`. The basic idea is that of Bellman's principle: the optimal segmentation satisfies the recursion:

$$RSSI_{m,n} = min_{(mn_h \leq i \leq n-n_h)} [RSS(\mathcal{I}_{m-1,i}) + rss(i + 1, n)] \quad (11)$$

Therefore it suffices to know for each point i the 'optimal previous partner' if i was the last breakpoint in an m-partition.

This methodology is valid under fairly general assumptions on regressors and disturbances. Basically, they have to be such that a functional central limit theorem holds. This is for example satisfied if u_i is a martingale difference with u_i independent of xi and the regressors x_i are (almost) stationary, which also allows for lagged dependent variables among the regressors. For the dating procedures discussed below weaker assumptions will suffice, in particular trending regressors are permitted (see Bai and Perron (1998) for further discussion).

3 Empirical results

3.1 Data

We have analysed data for a set of salt based commodities (ts 1 to ts14) using two methods, (i) Zivot and Andrews test procedure and (ii) the Bai and Perron multiple structural breakpoint test. In our data set, the time period is the following. Week 1 corresponds to Week 39 in 2005 and week 104 corresponds to Week 38 in 2007. The two relevant periods for our announcements are Week 3-10 (R2) and Week 77-86 (R3).

3.2 Results

We study the series outlined in Table 1 which are obtained form the Tesco 'ClubCard' database. As can be seen, we have some categories of chips (TS1-TS6) and some categories of bacon (TS7-TS14). The suffix 'S' denotes standard and 'US' denotes unsmoked. We analyse a total of 104 weekly observations in all which span 104 weeks [our time period period is: 2005 (39) to 2007 (38)]. There three rounds of health related announcements, which are indicated in Table 2. Table 2 indicates that the first round of

Table 1: **Data Series Codes**

Series codes
crisp.lowsalt (ts1)
crisp.standard (ts2)
kettlechips.lowsalt (ts3)
kettlechips.standard (ts4)
tescochips.lowsalt (ts5)
tescochips.standard (ts6)
bacon.unsmoked (ts7)
bacon.standard (ts8)
butcherschoice.baconUS (ts9)
butcherschoice.baconS (ts10)
cookstown.baconUS (ts11)
cookstown.baconS (ts12)
tesco.baconUS (ts13)
tesco.baconS (ts14)
Period: 2005 (39) to 2007 (38) [104 obs]

announcements (R1) lies completely out of our study period for which data is available to us, so we essentially study the impacts of Rounds 2 and 3 (R2 and R3). All our estimations are carried out using `R` 2.9.2.

Table 2: **Announcement Periods**

Announcement Periods
Round I (R1): 27/09/2004 -5/12/2004
Round II (R2): 10/10/2005 - 30/11/2005
Round III (R3): 12/03/2007-14/05/2007

3.3 Lee and Strazicich's two break LM test: Results

Table 3.3 shows the results obtained by performing the Lee and Strazicich's (2003) two break LM test on our data. The LM unit root test procedure allowing for upto two endogenous breaks is applied to our data for consumption of 14 salt rich food items. Table 3.3 indicates results for the LM test allowing for two *a priori* unknown breaks. Table 3.3 also reports k which is the number of lags selected and included in equation 3 in order to eliminate residuals serial correlation. Our results show that the unit root null hypothesis is always rejected at the 5%-level for all fourteen series in our data set.

It would be helpful to contextualise events around some breaks, for instance, breaks=43, 63 and in particular, break 66. An obvious limitation of this LM test procedure is that we assume that the number of breaks is known *a priori* and that the total number of breaks is strictly less than 3. These issues can be addressed by using the Bai and Perron procedure, for which results are presented in the next subsection.

Table 3: Lee and Strazicich LM unit root test with two breaks

Series	$T^B(breakdates)$	k $(lags)$	t-stat
label(ts1)<-("crisp.lowsalt")	59, 67	1	-7.1318∗
label(ts2)<-("crisp.standard")	26, 68	0	-8.4551∗
label(ts3)<-("kettlechips.lowsalt")	61, 67	1	-7. 5917∗
label(ts4)<-("kettlechips.standard")	13,18	3	-6.8080∗
label(ts5)<-("tescochips.lowsalt")	48, 79	1	-6.7814∗
label(ts6)<-("tescochips.standard")	48, 83	0	-7.0927∗
label(ts7)<-("bacon.unsmoked")	43, 66	0	-6.5036∗
label(ts8)<-("bacon.standard")	43, 66	0	-6.5217∗
label(ts9)<-("butcherschoice.baconUS")	63, 66	0	-6.5070∗
label(ts10)<-("butcherschoice.baconS")	63, 66	0	-6.5125∗
label(ts11)<-("cookstown.baconUS")	36, 93	6	-5.8296∗
label(ts12)<-("cookstown.baconS")	25, 44	0	-10.7711∗
label(ts13)<-("tesco.baconUS")	43, 66	0	-5.8472∗
label(ts14)<-("tesco.baconS")	36, 66	0	-6.0677∗

Results for Model 2 (breaking trends), including two changes in intercept and trend slope. See Lee and Strazicich (2003). Superscript ∗ denotes rejection of the null at the 5%-level. Break dates refer to the relevant week in our sample.

3.4 Bai and Perron's approach: Results

This section briefly examines our results based on the Bai and Perron procedure (1998) obtained using `R` and the package `strucchange`. Figures 2-6 indicate our results based on an application of such techniques for our fourteen salt based time series. Each Figure indicates the location of relevant break-dates (in dotted lines), while the `green` coloured lines on the left panels indicate the first announcement round (R2). The `blue` coloured lines on the left panels indicate the second announcement round (R3). Thus by direct visual examination, we can infer whether breaks occur before or after announcements are made. Each right hand panel indicates optimal number of breaks identified by minimising RSS (as explained earlier) and the optimal number of breaks are shown by the blue coloured lines. So each graphic indicates the optimal number of breaks and the location of each identified break point.[2]. Our results are summarised in Table 1 and discussed further in our concluding section.

For reasons of brevity, we will interpret a few results here and generalise our findings. Figure 2, top panel shows the results for crisp.lowsalt (TS1). In the left panel, we can see the period of the second announcement round (R2) demarcated clearly by the two vertical green lines. Similarly, the two vertical blue lines demarcate the time period of R3. The three dotted lines indicate the location of the three identified breaks. The right side of the top panel clearly shows that 3 optima breaks are identified based on minimising RSS. If we look at Figure 5, the middle panel for TS10 (butcherschoice.baconS), we can see R2 and R3 indicated by the blue and green lines respectively, while the vertical dotted lines indicate the three identified breaks. The right panel shows us that RSS is minimised when three breakpoints are identified, indicating that three breakpoints are optimal in this case. Likewise for the remaining twelve cases.

[2]More detailed results for individual series such as TS1 (crisp.lowsalt) and TS10 (butcherschoice.baconS) and all complete results are available from the authors

Series Series	Optimal number of breaks	Description
label(ts1)<-("crisp.lowsalt")	3	After R2, before R3
label(ts2)<-("crisp.standard")	4	B1 before R2, three breaks between R2 and R3
label(ts3)<-("kettlechips.lowsalt")	NA	NA
label(ts4)<-("kettlechips.standard")	4	Three breaks between R2 and R3
label(ts5)<-("tescochips.lowsalt")	NA	NA
label(ts6)<-("tescochips.standard")	NA	NA
label(ts7)<-("bacon.unsmoked")	NA	NA
label(ts8)<-("bacon.standard")	NA	NA
label(ts9)<-("butcherschoice.baconUS")	4	After R2, before R3
label(ts10)<-("butcherschoice.baconS")	4	After R2, before R3
label(ts11)<-("cookstown.baconUS")	NA	NA
label(ts12)<-("cookstown.baconS")	3	After R2, before R3
label(ts13)<-("tesco.baconUS")	NA	NA
label(ts14)<-("tesco.baconS")	NA	NA
R2: Round 2		
R3: Round 3		
Optimal breaks minimising RSS		
B1: First break point		

Figure 1: **Results summary**

4 Conclusions

This paper makes use of a leading UK supermarket's loyalty card based data which records information on purchase decisions by consumers who shop at its stores in order to assess the effectiveness and impact of the UK reduced salt campaign. We present an empirical analysis of consumption data to assess the effectiveness of the UK Food Standard Agency's (FSA) 'reduced salt campaign' on the basis of information on health related announcements undertaken by the FSA under its 'low salt campaign'. We adopt a general approach to determining structural breaks in consumption data, including making use of minimum LM unit root tests whereby structural breaks are endogenously determined from the data. We find evidence supporting the effectiveness of the FSA's reduced salt campaign.

We analyse data for fourteen salt based commodities (Table 1: ts1 to ts14) using three methods (i) the Zivot and Andrews test procedure (ii) Lee and Strazicich's two break LM test and (iii) the Bai and Perron multiple structural breakpoint test. In our data set, the time periods considered are the following. Week 1 corresponds to Week 39 in 2005 and week 104 corresponds to Week 38 in 2007. The two relevant periods for our announcements are Week 3-10 (R2: round two of announcements) and Week 77-86 (R3: round three of announcements).

Based on our preceding results which are summarised in Table 1, we finds that allowing for a single structural break based Zivot and Andrew's type unit root testing procedures suggest that there are six series which are stationary (ts1, ts2, ts4, ts9, ts10 and ts12 which are low salt crisps, standard crisps, standard kettle chips, Butcher's Choice bacon unsmoked, Butcher's Choice bacon standard and Cookstown bacon stan-

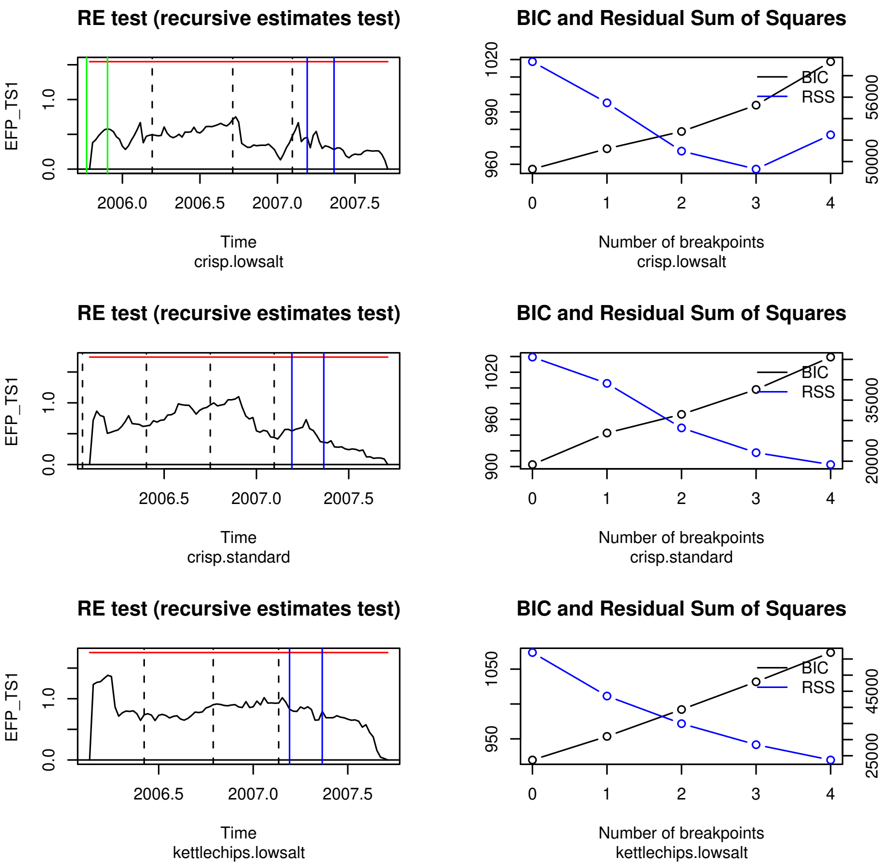

Figure 2: **BP Test Results (L) and Optimal Breakpoints (R): TS1-TS3 (top to bottom)**

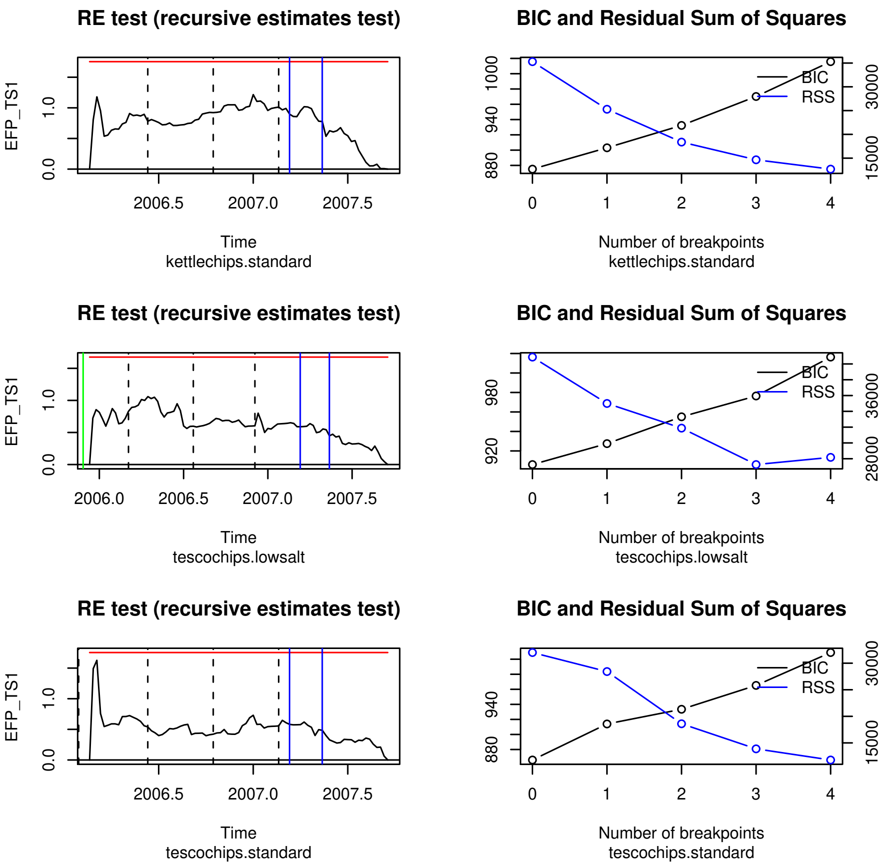

Figure 3: **BP Test Results (L) and Optimal Breakpoints (R): TS4-TS6 (top to bottom)**

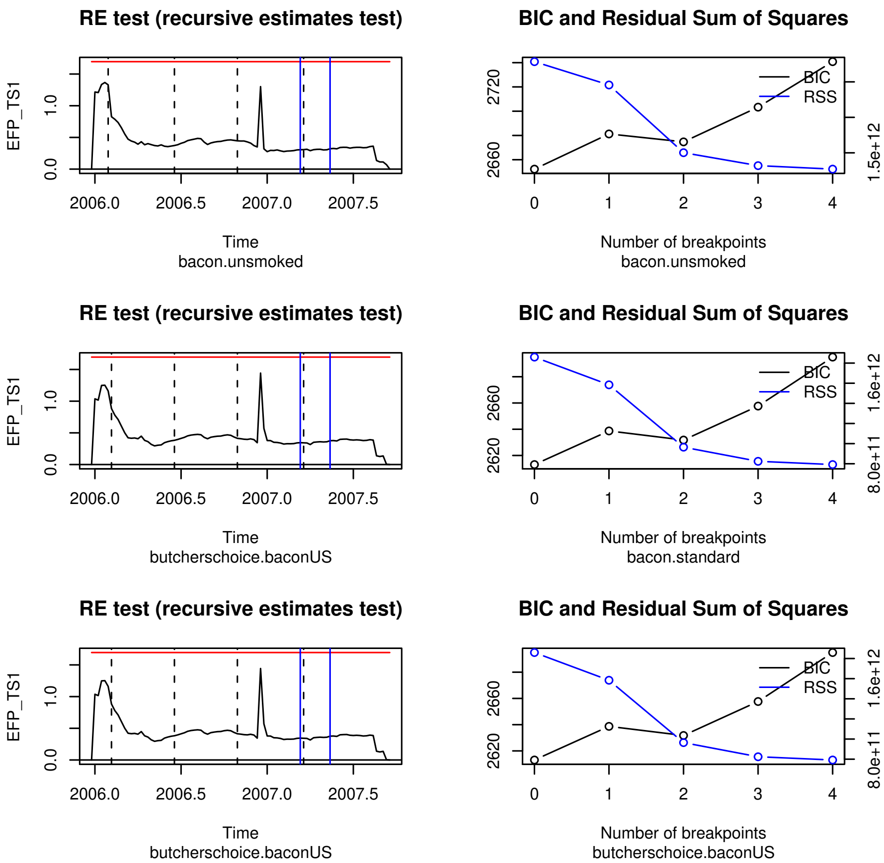

Figure 4: **BP Test Results (L) and Optimal Breakpoints (R): TS7-TS9 (top to bottom)**

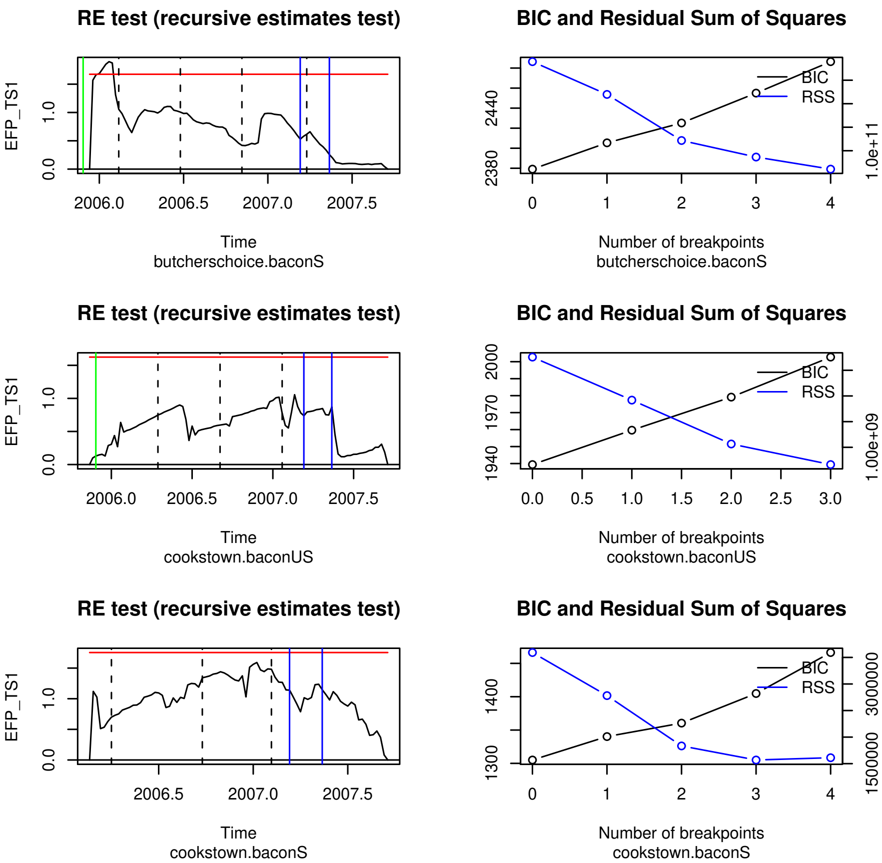

Figure 5: **BP Test Results (L) and Optimal Breakpoints (R): TS10-TS12 (top to bottom)**

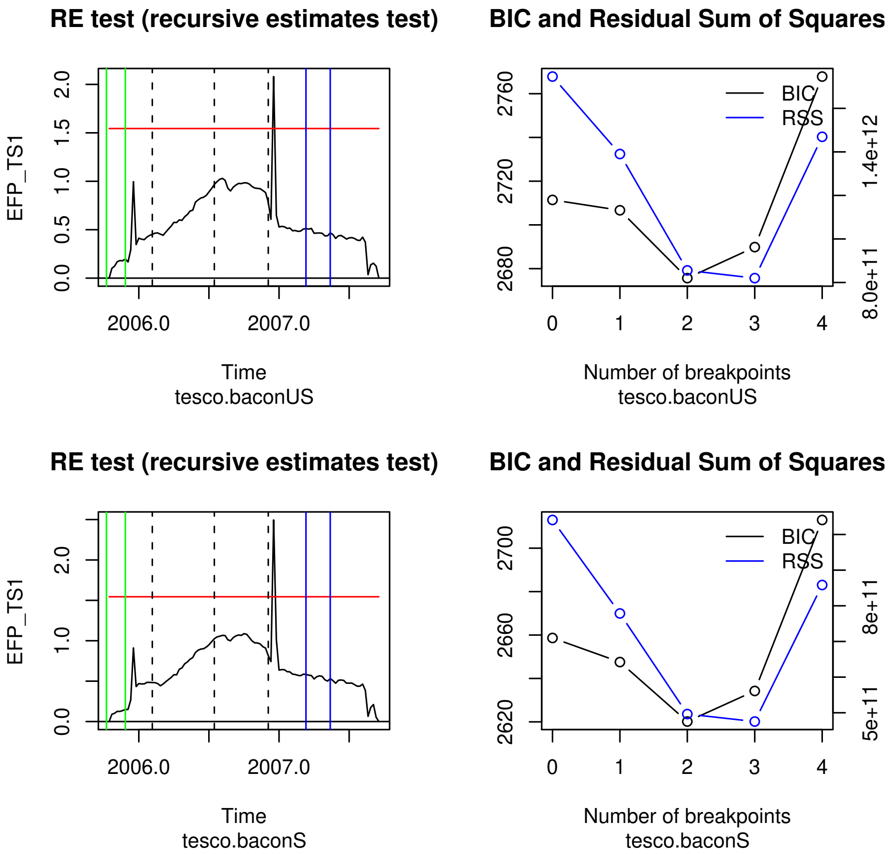

Figure 6: **BP Test Results (L) and Optimal Breakpoints (R): TS13-TS14 (top to bottom)**

dard, respectively) while the rest exhibit unit roots (they are non-stationary). The breaks identified by the Zivot and Andrews procedure are the following, low salt crisps (ts1 - week 62), standard crisps (ts2 - week 51), standardkettle chips (ts4 - week 50), Butcher's Choice bacon unsmoked (ts9 - week 90), Butcher's Choice bacon standard (ts10 - week 103) and Cookstown bacon standard (ts12 - week 36). For all series excluding ts9 and ts10 (Butcher's Choice bacon unsmoked and Butcher's Choice bacon standard, respectively), the breaks occur after the second announcement round R2, while for ts9 and ts10, the respective breaks are identified after both R2 and R3 (see Table 2). A crucial factor that influences the interpretation of these breaks is the duration of these announcement effects. In other words, it is important to consider how long such announcements effects influence behaviour of consumers and at what stage do they damp down to an insignificant effect. The literature on consumer behaviour and advertising (Mela et al., 1997; Simon and Sebastian, 1987; Kinnucan and Forker; 1986) strongly suggests that a period over 10-12 weeks is plausible for influencing consumption decisions, because in non-involved or low-involvement purchasing decisions there may be a degree of persistence in behaviour and consumption patterns may take a while to alter.

If we assume a lag of up to 12 weeks as being relevant for altering consumption behaviour, it is clear that in the case of univariate time series allowing for a single break, the only relevant cases is Butcher's Choice bacon unsmoked (ts9 - week 90), which is 'quite close' to, and after, the announcement period R3. So we have strong evidence pointing towards the significance of the breaks for Butcher's Choice bacon unsmoked. This suggests that health related announcement effects are likely to have been significant for these two cases.We also obtain results based on the Lee and Strazicich's (2003) two break LM test for our data. The LM unit root test procedure allowing for upto t wo endogenous breaks for data on consumption of fourteen salt rich food items. The LM test allows for upto two *a priori* unknown breaks. We determine the number of lags selected and this procedure allows us to avoid serial correlation within residuals. Our results show that the unit root null hypothesis is always rejected at the 5%-level for all fourteen series in our data set.

Evidence based on the Bai and Perron test result shows the following. We focus on the six time series that are revealed to be stationary on the basis of the Zivot and Andrew's test (low salt crisps, standard crisps, standard kettle chips, Butcher's Choice bacon unsmoked, Butcher's Choice bacon standard and Cookstown bacon standard which are coded as ts1, ts2, ts4, ts9, ts10 and ts12, respectively). Multiple breaks are identified for these series on the basis of the Bai and Perron procedure. Using the same reasoning as above relating to the duration of health related announcements, we can conclude that there is some evidence for the effectiveness of such announcements for the following commodities and breaks: standard crisps (ts2 - week 18), standard kettlechips (ts4 - week 18), Butcher's Choice bacon unsmoked (ts9 - week 21), Butcher's Choice bacon standard (ts10 - week 21). However, the most interesting results relate to ts9 and ts10 (Butcher's Choice bacon unsmoked and Butcher's Choice bacon standard, respectively) for week 79. Our data indicates significant structural breaks in week 79 for both ts9 and ts10. This ties in well with our evidence based on the Zivot and Andrew's test and implies that for Butcher's Choice bacon unsmoked there is strong evidence linked a significant break which follows the two announcements in periods R2 and R3. For series Butcher's Choice bacon standard, the same conclusion can be reached on the basis of the Bai and Perron procedure.

Overall, our analysis points towards empirical evidence for significant breaks in consumption data for six commodities following health related announcements and these results are very strong for two commodities, Butcher's Choice bacon unsmoked and Butcher's Choice bacon standard. This indicates that health related announcements appear to have a degree of positive impact on changing consumption patterns as far as high-salt food items are concerned.

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