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Ecolabels and The Economic Recession †

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Abstract

We consider products that vary in socio-economic quality, reflected in different eco-labels, like carbon, organic and fair trade. We find that in violation of traditional price theory, the expenditure shares on organic products declined while the expenditure shares of fair trade products increased. We evaluate alternative psychological models of decision making (a salience model and a model of reputation signalling) both of which give a plausible account of our empirical results.

Key words: eco-labels, non-parametric regression, public goods, recession, reputation signalling, scanner data, salience.

JEL Classification: D12, Q31, C32.

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1. Introduction and Motivation

Consumers buy products based not only on the product's price and quality, but also based on the public good features of these products. Public good features of a product are specific "pro-social" characteristics of the product, like whether the product is a fair trade product, or whether the product has a low carbon footprint, etc. Consumer preference for these public good attributes of a product has led to the birth and growth of a new market for so called "eco-labelled" products. These are products that, for example, bear a fair trade or a carbon reduction label. The aim of these eco-labels is to inform consumers about a product's superior public good attributes. If consumers value the public good attributes of a product, they will have a higher willingness to pay for these public good attributes. These products can then command a higher price or have increased sales. Increased sales of eco-labelled products can lead to a more environmentally sustainable level of consumption.[1] The consumer is provided with this information on the public good characteristics of products (mainly) through voluntary labelling schemes. Labelling is often considered a more appealing alternative in changing consumer behaviour towards sustainable levels of consumption compared to the more traditional means of regulation like the command-and-control and market-based approaches. Labelling has been described as the "third wave" in environmental regulation (see Tietenberg [1998]).

The effectiveness of eco-labels as a policy tool to achieve environmental goals is addressed in a growing literature. The theoretical research has focused on critically examining the design and efficacy of different labelling schemes, the effects of labelling in production and trade, and has modelled eco-friendly consumer behaviour (e.g., Khanna [2001], Nyborg, Howarth, and Brekke [2006], Ibanez and Grolleau [2008], Mason [2013]). The empirical research has focused on consumer willingness to pay for different labels, in particular labels for "green" products. However, in a market, consumers often confront goods that bear different types of labels which highlight different environmental and public good attributes. Consumer choice in this market context has received little attention. In addition, very few of such studies on consumer behaviour are based on actual observed behaviour of consumers[2]. Most of the existing empirical evidence on consumer behaviour comes from

[1] For a literature review of how the introduction of a label affects the functioning of markets and can lead to a price premium see the work by Bonroy and Constantatos [2015].

[2] Studies of eco-labels in a market context include Teisl, Roe, and Hicks [2002], Bjørner, Hansen, and Russell [2004], Sexton and Sexton [2014], Kortelainen, Raychaudhuri, and Roussillon [2016]).

work with data collected from surveys on hypothetical choices or from incentivised experimental settings, rather than from data based on actual observed purchases. Hence situations under which eco-labels can command a price premium are far from fully understood.

Our paper examines the effect of the recent recession (of September 2008) in the United Kingdom (UK) on consumers' observed expenditure for eco-labelled food products that differ in socio-economic quality. This difference is shown by different eco-labels applied on these products. Our research is motivated by an interesting observation mentioned in trade reports of purchase behaviour. These reports mention that organic grocery sales in the UK seem to have fallen, whereas fair trade sales have held up during the economic downturn (Carrigan and De Pelsmacker [2009], Bondy and Talwar [2011]). This finding contradicts the results from traditional price theory. Traditional price theory predicts that during an economic downturn, consumers would become more price sensitive. Since both organic and fair trade varieties of a good are more expensive than their non-labelled varieties, we would expect the sales shares for both of these eco-labelled categories to fall relative to the sale of conventional groceries.[3] This prediction is probably more likely to be observed in the data for grocery products, as consumers do not have the option to hold-off purchases.

The first contribution of our paper is to test the predictions of standard price theory by looking at trends in the consumer expenditure on eco-labelled grocery products. The income shock due to the credit crisis serves as a natural backdrop in which to study the effect on consumer purchases of eco-labelled products. We use supermarket loyalty card data for a range of food products sold under different eco-quality labels (non-labelled/conventional, carbon-labelled, organic and fair trade) from a noted super market chain in the United Kingdom for our study. We employ a number of "data-driven" methods to investigate how the recession impacted consumers' purchase behaviour. Results from our analysis clearly show the prediction of standard price theory is violated. We find that the share of consumer expenditure on fair trade products seem to hold up during the recession while the share of organic products seem to fall. We are not aware of any other empirical papers that study consumer behaviour using observed consumer expenditures on eco-labelled products.

[3] In Canada and the US, Fair Trade consumers did decrease their purchases (Bondy and Talwar [2011]).

The second contribution of our paper is to compare behavioural explanations for our empirical findings. We evaluate two alternative models of decision making that may give a plausible explanation for the observed departure of buyer behaviour from predictions of standard price theory. We consider a model of salience applied to consumer choice (Bordalo, Gennaioli, and Schleifer [2013] and a model of reputation signalling where image concerns and the behaviour of other consumers affect consumer choice (Ariely, Bracha, and Meier [2009]; Bénabou and Tirole [2011]). We find that both of these models explain features observed in our data.

The remainder of this paper is organized as follows. Section 2 provides background to the main eco-labels investigated in the paper followed by a description of the scanner data used in our analysis. Section 3 reports the empirical results and section 4 discusses the different theoretical psychological models of decision making and evaluates their predictions against our empirical results. Finally, section 5 concludes.

2. Background, Data and Summary Statistics

2.1. **Background on organic and fairtrade food products.** Eco-labels highlight specific sustainable aspects of the production process for a good and the associated supply chain for the good. These aspects can be further divided by the three "dimensions" of sustainability, namely (*i*) environmental aspects such as protection of water, soil, animal welfare, biodiversity as well as conservation and enhancement of landscapes, (*ii*) economic aspects, such as, fair prices and contracts for farmers and workers in the developing world; (*iii*) social aspects, such as, fair, safe and equitable working conditions and child free labour.

The three main categories of eco-labels in the food market, those for organic, carbon-labelled and for fair trade products, differ in the emphasis that they place on the three aforementioned aspects of sustainability.[4] Organic labels focus on the method of production; organic food is food which is produced using environmentally and animal friendly farming methods on organic farms.[5] Fair-trade labels focus primarily on the economic aspect by offering

[4]The Eco-label Index database lists over 450 widely recognised eco-labelling program operating in 197 countries and 25 industry sectors. This includes 148 eco-labels on food. See www.ecolabelindex.com. This database is currently the most exhaustive database on eco-labels that is available for research purposes.

[5]These methods are legally defined. In the EU, any food product sold as 'organic' falls under the EU regulations 834/2007 and 889/2008. See https://www.soilassociation.org/.

higher prices to producers (usually in developing countries), thereby improving their long-term living conditions.[6] Some Fair trade products also volunteer information on how the product (such as coffee or chocolate) was grown organically and so these products also bear an organic label, but in general this information is not required. Another point of difference between organic and fair trade labels is with respect to the use of logos (or exposition). For fair trade food there is a common and distinctive logo used in almost all markets.[7] In contrast there is no universal organic logo. Organic certifiers each have their own logo. Finally carbon labelling shows the amount of emissions of 6 greenhouse gases over a product's life cycle, i.e., starting from the good's production through to the good's disposal. This label is designed to inform consumers about the embedded carbon content of a product and to allow them to compare products, so that they can choose the product with the smallest carbon footprint.

As mentioned earlier, eco-labelling systems use the market to provide for public goods. However, these public good characteristics of eco-labelled products may be extended/combined with other private characteristics when the product is finally presented to the consumer. Consumers might infer subjective quality beliefs from a label in line with a halo effect (see Poelman, Mojet, Lyon, and Sefa-Dedeh [2008]). For example, Zanolli and Naspetti [2002] and Bougherara and Combris [2009] find that health concerns are an important primary motive for organic food consumption even without convincing proof that organic food is better for health.

Studies on the consumption of fair trade products are few, but here again private values – in particular quality attributes such as brand and flavour – play a role (see De Pelsmacker and Rayp [2005]). We will return to the role that these private values play in a consumer's buying decision in section 4 of this paper.

We note here that the sales of fair trade and organic products have exhibited substantial growth since the early 1990s. As consumers have become aware of sustainability issues in the production and in the supply chain of a good, the sales of these products have risen considerably. In the UK, sales of Fair trade products totalled 799.0 million GBP in 2009, a 4600% increase from 16.7 million GBP in 1998 (Fair trade Foundation). At its height in 2008

[6] See the definition of fair trade adopted by the international fair trade movement in 2001 at https://www.newefta.org/. Fair trade products are certified by labelling organisations such as Max Havering or Fair trade International (FLO). Details about the certification standards are given at https://www.fairtrade.org.uk.

[7] The exceptions are Mexico and USA.

– before the recession – UK sales of organic products totalled 2.1 billion GBP. Over the period 2000-2009, the UK market for organic food increased by 129% (see Soil Association Report [2009] and Soil Association Report [2014]).

2.2. **Data.** Our empirical exercise uses revealed preference (scanner) data on food consumption recorded at a leading UK retailer with a market share of over 31 percent in the UK in 2008 (TNS Worldpanel). Our data represents the purchases of around 16.5 million active (club) card account holders of this supermarket chain covering nationwide sales. Our empirical analysis focuses on weekly observations starting from the financial week 17 of 2007 and extending up to (and including) the financial week 15 in 2009. Thus our data covers a period of 104 weeks (36 weeks in 2007, 52 weeks in 2008 and 16 weeks in 2009).[8]

From the population of all 16.5 million club card accounts we select a sample of 119,094 club card accounts. This sample comprises of two equal "sub-samples" (of nearly 60,000 customers each) of two groups of customers that we call non-panellists and panellists. The panellist data is a random sample of (60,000) club card account holders, for which in addition to transactions information, additional demographic information is also available. This random sub-sample comprises of consumers who have been monitored periodically and information has been collected on them from the Shopper Thoughts Panellist surveys. For all these consumers we have item level transaction information of expenditure on the purchase of various "ethical" products (like organic, fair trade, etc.) and their substitutes for the 104 weeks. The non-panellist sample is a non-random sample based directly on a certain minimum cut-off on sustainable product sales for the last two years. Since the sample on panellist data is a random sample, we shall work exclusively with the panellist data disregarding the non-panellist sub-sample.

From the above sub-sample of panellists, we aggregate weekly expenditures (over all consumer purchases) for each of the 104 weeks in our sample

[8]We note that the weeks mentioned above are not actual calendar weeks but these are financial weeks of the supermarket chain in question. In the United Kingdom, the financial year runs from 1 April of a year to 31 March of the next year. We have data starting from calendar week 13 in 2007 (starting March 26, 2007 to April 1, 2007). So calendar week 13 corresponds to the supermarket chain's financial week 1. We use this "mapping" of calendar to (the supermarket's) financial weeks to transfer important dates. For example, Lehman Brothers filed for Chapter 11 bankruptcy protection on September 15, 2008 which was calendar week 38 in 2008 and week 61 in our data.

for the following 5 (broad) classes of products which we term :“carbon”, “organic”, “fair trade”, “carbon/organic” and “other”. The first 4 terms are self-explanatory and refer to “sustainable” products. The last category is “other” which is expenditure on items that do not belong to any of the aforementioned 4 categories. Products in this category mainly comprise of non-labelled substitutes for goods in the sustainable (or labelled goods) categories mentioned earlier. Of these categories,“organic” and “fair trade” are of main interest to us. In addition we also look at the category “carbon” because this label was introduced by the supermarket chain for its own brand products during the period covered by our analysis.

2.3. **Summary statistics.** We generate expenditure information for sustainable products and their substitutes, for all club card members in our sample over 104 weeks. This compactification makes the analysis of the trajectories of *aggregate* expenditures on sustainable goods tractable by focussing on trends at the weekly level. The summary statistics for this data set is reported in table 1.

[Insert table 1]

So, table 1 gives the summary statistics for all variables used in the analysis, where the variables of interest are aggregated at the week level and by major sustainable product groups.

3. Empirical analysis

3.1. **Preliminary analysis.** We begin our empirical analysis by looking at scatter plots of the expenditure shares of various eco-labelled products over time. These are reported in sub-figures 1a, 1b, 1c and 1d in figure 1. Note that although we do not have an exact date for the start of the recession, week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of recessionary effects. A dashed vertical line in our diagrams marks week 61. We also note that a solid vertical line in our diagrams marks week 46, which is the date at which the supermarket chain began applying carbon labels of its own on the first of several products.

From the scatter plots of these product categories it is difficult to establish any clear pattern. Organic shares seem to be falling and fair trade shares seem to show a slight upward trend. The category carbon and the category

other both do not show any discernable trend. All four aggregate product categories show a considerable degree of volatility and it is difficult to say without any smoothing of the data what the general trend is for each of these product categories over time. We develop a general analytical set-up below which allows us to formally model the effect of time on the expenditure shares of these eco-labelled product categories using smoothing techniques.

3.2. **A general framework for graphical analysis.** The following gives a common framework for the exploratory graphical analysis of our data. We want to study the (temporal) effect of a covariate T (time in weeks) on a response variable Y (aggregated expenditure shares on various sustainable product categories). We consider a simple model comprising of the single predictor T and the dependent variable Y. We can decompose the value of Y into an expected part and a random component as follows : $Y = f(T) + \epsilon$ where $f(T) = \mathbb{E}[Y|T]$, where $\mathbb{E}$ denotes the expectation operator. Our objective is to "estimate" the functional form f from the data using graphical methods. Since our predictor variable is time in weeks, we can order our data chronologically as $t_0 < t_1 < t_2 \ldots < t_{N-1} < t_N$, where t denotes the realized value of T and N the number of data points we have in our sample. We will use y to denote the realized value of Y, corresponding to the realised value of T or t, that is $y = f(t) + \epsilon$. We will use this general set up to motivate and elucidate a number of (smoothing) techniques to estimate the function f. In the paragraphs below we outline details of a number of approaches that we use to (graphically) study the effect of the recession on expenditure shares of the different product categories mentioned earlier. For details of the methods used in this section and in subsequent subsections please see Hastie, Tibshirani, and Friedman [2011].

Our first approach is to estimate f using a linear regression. Subfigures 2a, 2b, 2c and 2d in figure 2 fit ordinary least squares lines in the scatter plots for organic and fair trade expenditure shares. As a first pass, what the least squares fit reveal about the underlying trends in the expenditure shares is instructive. Our fitted lines clearly show that organic expenditure shares fall over time (figure 2a). Fair trade shares seems to rise over time (figure 2b). For categories carbon and other, we see a flat trend line (figures 2c and 2d). Our conclusions are roughly in line with our conjecture that the sales of fair trade products have held up and that the sales of organic products have plummeted during the recession. Viewed as a benchmark, sales of carbon and the residual category "other", seems not to have changed very much over the same time period. We note here that the carbon label for products came into

existence as late as week 46 of our data. So the category carbon comprises of products that were labelled after the beginning of our sample period. Thus the carbon labeled category comprises of products that are "retrospectively" assigned as carbon labeled from week 1. This does not create any problem in our analysis. We see exactly the same flat trend in sales pre and post week 46. It is clear that the share of consumer expenditure on carbon labelled products has not fallen or risen during the recession.

A natural extension to the linear specification above is to allow for a more general and flexible specification in modelling $f(x)$ by allowing for higher powers of the independent covariate T. This is achieved by using a polynomial regression. Sub-figures 3a, 3b, 3c and 3d in figure 3 show graphically the results of fitting different degrees of a polynomial regression on expenditure shares of eco-labelled products. These plots strengthen the conclusion of a downward trend in expenditure shares of organic products and an upward trend in fair trade products. Carbon products show a flat trend. The residual category comprising of all non-eco labelled products, now shows a slight U-shape with a flat trend in the mid-portion of the data.

Although the parametric linear specifications considered above are easy to implement and help us form a initial idea regarding the trends in the data, they have one major drawback. They impose a restrictive functional form on $f(x)$.[1] A non-parametric approach overcomes this limitation of assuming an (*ex-ante*) functional form for the regression specification. The non-parametric approach does not assume any specific functional form at all for $f(x)$. Instead, the approach is fully "data-driven" and makes use of the data to determine the model structure (the functional form).[2] To motivate the non-parametric approach and to test whether our parametric linear model above is correctly specified, we use the non-parametric kernel-based model specification test outlined in Hsiao, Li, and Racine [2007] which tests for consistent model specification.[3] In this test we regress each eco-labelled product category and the residual category other on time and test the validity of the linear functional form. We strongly reject the null hypothesis that the linear specification is the correct specification for all the eco-labelled product categories (p-value < 0.000). We obtain similar results with the other more flexible parametric specifications involving squared terms and higher powers of the independent variable. In all cases, this test rejects the null hypothesis of the (parametric) regression specification considered.

In sum the results of the tests for the model specification above makes us skeptical of whether parametric curve fitting – simple or flexible – can adequately capture the underlying trends in the expenditure shares of eco-labeled products. Therefore, for the sake of robustness we employ a number of additional "agnostic" data driven non-parametric techniques to inform us about the underlying trends in the expenditure shares of eco-labelled products in our data.

A natural starting point from the flexible linear regression specification to a non-parametric approach is the lowess smoother.[4] Sub-figures 4a, 4b, 4c and 4d in figure 4 show a loess fit to the data using the default band width settings.[5] The advantage gained in using a more flexible specification afforded by this non-parametric approach is clearly visible by a cursory look at figure 4. A clear upward trend characterizes the expenditure shares of fair trade products and a downward trend characterises the trend of organic products. Carbon shares are fairly constant but a slight cyclicity is now visible in the trend that was not captured earlier by the parametric methods. The U-shape for the residual category other is what we had seen earlier (using the more general polynomial specifications) and this trend is now established using the non-parametric approach as well.

A more sophisticated approach, than a lowess smoother, to smooth the data is to use a spline regression. A spline regression (of degree m) tries to approximate $f(x)$ using a piece-wise polynomial (of degree m) with the pieces of this polynomial defined over a sequence of K "knots" given by $\xi_1 < \xi_2 < \ldots < \xi_K$. The piece-wise polynomial is constrained to be smooth at the knots by the additional constraint that the fitted curve be smooth (or have continuous first and second order derivatives).[6] For our analysis we chose a regression spline or a S-spline to smooth our data.[7] Sub-figures 5a, 5b, 5c and 5d in figure 5 show the results of fitting a S-spline to our data. Again the results are broadly in agreement with the trends from other spline regressions.

Our final graphical approach is to consider a fully non-parametric model where we use kernel based methods to capture the effects of the recession on the purchases of eco-labelled products.[8] Sub-figures 6a, 6b, 6c and 6d in figure 6 show results of fitting a fully non-parametric curve to our data. We use the package "npreg" in R to run this exercise. We use the default span width settings provided by the software. A clear trend is discernable by a cursory look at the diagrams. All results are in line with the trends observed in earlier graphs.

These final results in figure 6 convincingly establish that aggregate organic expenditures shares show a negative trend and fair trade expenditures shares show a positive trend over the time period considered. For the carbon labelled category no clear trends are discernable except the slight cyclicity over the period considered. The residual category, other, shows the earlier discovered U-shape and is quite flat over most of the data period.

To sum up, in general, our results seem to clearly suggest that organic expenditure shares fall over time and a clear dip in the trajectory is visible, post week 61. For fair trade expenditure shares exactly the opposite trend is observed – for fair trade products we observe a rising trend in expenditure shares and post week 61, the trend is quite steep. For the other two categories, carbon and the residual category (other) compared with organic and fair trade expenditure shares, it is safe to say that no clear trend is discernable.

4. Alternative Underpinnings of Eco-labelled Consumption

Graphical analysis of the scanner data reveals some marked differences in the trajectories of the expenditure shares of the four eco-labelled product categories over the time period in our sample. As mentioned earlier, our interest lies mainly in comparing the trends in consumer expenditure shares for organic and fair trade product categories. Carbon labels on products were added later, during a recent phase of proliferation in eco-labelling schemes promoted by the supermarket chain (the supermarket chain dropped the carbon label in January 2012).

In the following section, we review the store availability of eco-labelled products and look at the trajectory of prices by eco-label category, during the period covered by our data. We do this to exclude shelf space allocation and divergent product prices as potential confounding factors in our analysis. Next, we discuss the traditional economic perspective on the impact of a recession on consumer purchases and show that this traditional perspective cannot explain our empirical results. We then turn to alternative explanations of our main findings including an exploration of consumers' behavioural motives. We explore how identity considerations or personal norms and social image might affect individual choices in the context of eco-labelled food.

4.1. **Supply availability.**

In our empirical analysis earlier, we have used an agnostic approach in which we used the data to inform us of any general underlying trends in the expenditure shares of organic, and fair trade products.

A potential confounder in this analysis could be the supply availability of eco-labelled products in stores. Retailers might cut back on specific eco-labelled ranges and shelf space and/or also promote other ranges. Such actions on the part of retailers could lead to endogenous changes in availability and affect the expenditure shares of eco-labelled products. Given our striking results for the expenditure share trajectory of fair trade products this potential confounding is an issue we need to address before we discuss our results from a behavioural perspective.

We note that from the early 2000s the market for fair trade products in the UK has been characterised by the main streaming of food products through conventional retail outlets, particularly supermarket multiples.[9] As part of this development, the said supermarket chain launched its own brand fair trade line in March 2004. In its 2004/5 annual report on corporate sustainability the supermarket chain highlighted that it was stocking 90 food products including 14 own brand products. By 2006/7 the number increased to 130 fair trade lines of which 30 were the supermarket chain's own-label products and in 2007/2008, UK stores of the said supermarket chain carried 188 fair trade products including 117 fair trade labelled own-brand products (The Institute of Grocery Distribution, 2015).

In January 2007, the management of this supermarket chain announced a switch of attention to carbon labelling and this label was gradually introduced on its own brand products in the UK. The annual report on corporate sustainability in 2009 and later years no longer mentions fair trade. In short : we feel that supply availability cannot be held responsible for the patterns in expenditure shares of fair trade products that we observe for 2008 and for the first months of 2009. Unfortunately, in our sample we do not have information on the availability of a product over all stores to account for availability.

4.2. **Price Changes.** UK households experienced a negative shock to their income during the recession. The negative shock was further exacerbated by an increase in the real price of food which has remained high ever since. Food prices peaked in 2008, when the annual rate of food price inflation was 5.5 percent. Although food prices started to fall in February 2009, the average annual growth rate was still almost 3.8 percent between 2007 and 2009. This increase in the price of food was unevenly distributed; there were big changes

[9] Supermarket multiples is a defined sub-set of the major supermarkets, the major ones are: Tesco, Sainsbury, Asda, Morrison, Co-operative and Waitrose. It excludes discount retailers (Aldi, Lidl).

in the relative prices of different food groups. The period 2008-2009 was characterized by a high degree of volatility and the price changes did not occur at the same time across different goods (Griffith, O'Conell, and Smith [2015]).

In this section we construct simple price indices to study price trajectories for the different eco-labelled categories used in our analysis. Recall that in our sample we have information on expenditure and quantities bought for individual products for 104 weeks. We also classify these products into three main eco-labelled groups : carbon, fair trade and organic. From the information on expenditure and quantities purchased for individual products, we back out prices for individual products. To obtain these prices we divide the expenditure on individual products by the quantities purchased of these products. We obtain these prices for individual products for each week in our sample. We plot the prices of these individual products over weeks. We show these individual level price trajectories in sub figure 7a in figure 7. The individual price trajectories are too noisy to lead to any meaningful conclusion regarding the general price trends for any of the three aforementioned categories of products. To get a better sense of the general price trends, we create a simple price index for each of the three categories of products. We aggregate the prices of the individual products by week for each of the three categories – organic, fair trade and carbon. So for each week we calculate a simple average of the individual prices of products by eco-labelled category. This process then gives us three price indices one for each category. Sub figure 7b in figure 7 shows a plot of these price indices over time. Figure 7b shows that the price for fair trade products was higher than that of the organic products at the start of the 104 weeks investigated and remained higher throughout. It also shows that the category carbon was the most expensive during this period. These results suggest that the price index trajectory by category cannot explain the observed pattern in expenditure shares for fair trade products in 2008 and in the first quarter of 2009. The category fair trade was more expensive than the category organic for weeks 1-104. In addition, the index for fair trade shows a stronger positive trend after week 50.

4.3. **Theory of buyer behaviour.** A recession affects consumer expenditures in (at least) two ways. First, a recession reduces disposable income and leads to a smaller budget available for consumption. Second, holding disposable income constant (e.g., for those households who are not affected financially), people tend to save more or pay down debts during a recession. This again leads to less money available to spend on goods and services.

The focus of traditional economic analysis has been on these budget-related issues. The common assumption in traditional economic analysis is that a household's taste does not change with changes in economic circumstances. Therefore, the utility a household derives from consumption at different levels of expenditure should be unaffected by the onset of a recession. Any adjustment in expenditure patterns seen during an economic recession would simply be due to changes in the consumption budget (see Kamakura and Du [2011]). Following this logic, we assume that households trade-off the added utility of the more expensive eco-labelled variety of a food product against the utility of a standard food product, and in particular, the supermarket's private label products (see for example, Dubé, Hitsch, and Rossi [2015]). As the household gets poorer during a recession, the marginal utility of the standard product would rise relative to the marginal utility of the product with the eco-label. This would lead to a substitution toward the standard product. Under this assumption, a recession is expected to lead to smaller (observed) expenditure shares for the eco-labelled categories and larger (observed) shares for the standard category of food products. We would expect the same effect on the marginal propensity to consume regardless of whether the household's financial loss is due to a loss of income or due to a parallel shift in prices, since money is treated as fungible in neoclassical economics (Hastings and Shapiro [2013]).

The simple linear regression fit in section 3 revealed that the general trend observed in our data is for the organic expenditure shares to fall and for the fair trade shares to rise. The expenditure share for carbon-labelled food products shows little change. Further analyses substantiated this first finding. The results also suggest that these trends pre-date the recession.[10]

Overall the observed expenditure pattern cannot be explained by the neoclassical income effect described above. First, indicators of U.K. households' perception of their own financial situation showed a gloomy picture, in

[10] The start of the great recession is usually pinpointed as the week of 15 Sept 2008 (Lehman Brothers collapse). However, the global recession time line shows two events in August and Sept 2007 that might have affected consumer spending. From 9 August 2007 (week 19 in our data) the credit markets went into free-fall and 14 Sept 2007 (week 24 in our data) is known as "run on the Rock". On the latter date, savers in the building society, Northern Rock, lost confidence and began withdrawing their savings when news spread that this bank had received emergency financial support from the Bank of England. For details see http://news.bbc.co.uk/1/hi/business/8242825.stm.

particular, from April 2008 to June 2009 (Office of National Statistics).[11] In addition, food prices in the U.K. increased substantially during the early part of the recession, as mentioned earlier. This double squeeze of lower incomes and higher food prices put pressure on consumer expenditures.

4.4. **Salience model.** With the classical theory offering no explanation for our empirical findings we discuss some alternative explanations to account for the disparate results. First, we discuss context dependent choice in which a consumer's choice is drawn to salient attributes of a product, which in our case, is a product's public good attribute (or lack of it).

The model of salience and consumer choice (Bordalo, Gennaioli, and Schleifer [2013]) combines two ideas. First, choices are made in context, as mentioned above. Second, consumers evaluate products by comparing these products with other products they are thinking about. In this model, consumers focus on and thus overweigh product attributes that are salient. Salience is determined by the degree to which an attribute varies within an evoked set of options that are brought to mind by the purchase occasion. Thus, in this model, the context is determined by the choice set itself. Evidence suggests that consumers generally consider only a subset of the options available in the market. The typical number of options in such evoked sets ranges from two to five (see Hauser and Wernerfelt [1990]).

To see how the salience model applies in our case, assume a choice set of an indivisible product – say coffee – that comes in two eco-labelled versions described by the attributes of public good quality (q) and price (p). Thus,in this choice set we have, two variants of the product denoted FT (fair trade) with (public good) quality q_{ft} and price p_{ft} and O (organic) with quality q_o and price p_o. For our case, we have $q_{ft} > q_o$ and $p_{ft} > p_o$. The consumer is fully informed about both attributes and evaluates both these products. An attribute (here either pro-social quality or price) is salient in the choice set if this attribute stands out relative to the other attributes. This means that each product in the choice set is compared to the reference product with average attributes of quality $\bar{q} = \frac{q_{ft}+q_o}{2}$ and price $\bar{p} = \frac{p_{ft}+p_o}{2}$. Salience will tilt consumer preferences toward the product with the highest quality price ratio. In our choice set of products FT and O, the public good quality of the product, or q, will be salient

[11] The Eurobarometer Consumer survey asks respondents monthly how they think the general economic situation has changed over the last 12 months. A negative balance means respondents reported their financial situation got worse, a positive balance means they reported it improved. At its lowest, in May 2009, the Euro-barometer reported an aggregate balance of negative 82.3 for the general economic situation.

for both products if $\frac{q_{ft}}{p_{ft}} > \frac{\bar{q}}{\bar{p}}$ and price will be salient if $\frac{q_o}{p_o} > \frac{\bar{q}}{\bar{p}}$. This process then leads to a ranking of the choice set.

From the above it follows that attribute sensitivity depends on attribute levels; when all options in the set become more expensive the consumer will become less price sensitive/more quality sensitive. Another observation is that the addition of other options to the choice set has potential consequences because it affects the reference product and thus the attribute that stands out. Both observations have important implications in our case study. Note that in our case the context would be a specific food category (e.g., dark chocolate bars or coffee as in our example) with goods varying in organic, fair trade or no eco-label, respectively. Consider a situation where the consumer is making a decision to buy coffee from the choice set indicated in the above set-up (so the consumer has fair trade and organic coffee choices to consider when making a decision). As show by Bordalo and co-authors the salience perspective has stark implications for the effect of changes in price or consumer budgets. When only one specific good within a choice set is affected because of a price change (say free trade coffee only is affected), the salience model predicts that consumers will substitute to the lower public good quality of the good in this category (this means an increase in the share of cheaper organic coffee in total coffee sales). When in contrast the change affects all goods in the category (all coffee) as in the case of an income change, the salience model predicts the consumer substitutes toward the higher public good quality good or free trade coffee in this case.

A simple numerical example makes this idea clear. For simplicity we assume that our exercise is that of a discrete choice between two options only – FT (fair trade) or O (organic) of coffee. First let us consider a price change in free trade coffee only. Assume that before the price change $q_{ft} = 30$, $p_{ft} = 3$, $q_o = 20$ and $p_o = 5$. So $\bar{q} = \frac{q_{ft}+q_o}{2} = \frac{30+20}{2} = 25$ and $\bar{p} = \frac{p_{ft}+p_o}{2} = \frac{3+5}{2} = 4$. Now, $\frac{q_{ft}}{p_{ft}} = \frac{30}{3} = 10$, $\frac{q_o}{p_o} = \frac{20}{5} = 4$ and $\frac{\bar{q}}{\bar{p}} = \frac{25}{4} = 6.25$. Thus, $\frac{q_{ft}}{p_{ft}} > \frac{\bar{q}}{\bar{p}} > \frac{q_o}{p_o}$ – and so the public good quality is salient and FT is chosen since it is better along the public good quality dimension. Let us assume that the price of free trade coffee increases by 7 or $\Delta p_{ft} = 7$. Now, $q_{ft} = 30$, $p_{ft} = 10$, $q_o = 20$ and $p_o = 5$. So $\bar{q} = \frac{q_{ft}+q_o}{2} = \frac{30+20}{2} = 25$ and $\bar{p} = \frac{p_{ft}+p_o}{2} = \frac{10+5}{2} = 7.5$. Now, $\frac{q_{ft}}{p_{ft}} = \frac{30}{10} = 3$, $\frac{q_o}{p_o} = \frac{20}{5} = 4$ and $\frac{\bar{q}}{\bar{p}} \frac{25}{7.5} = 3.33$. Thus, $\frac{q_{ft}}{p_{ft}} < \frac{\bar{q}}{\bar{p}} < \frac{q_o}{p_o}$ – and so now the price is salient and O is chosen since it is better along price dimension.

Now contrast this with an income change. Assume that before the income change we have the following configuration of public good quality and price : $q_{ft} = 30$, $p_{ft} = 10$, $q_o = 20$ and $p_o = 5$. So $\bar{q} = \frac{q_{ft}+q_o}{2} = \frac{30+20}{2} = 25$ and $\bar{p} = \frac{p_{ft}+p_o}{2} = \frac{10+5}{2} = 7.5$. Also, $\frac{q_{ft}}{p_{ft}} = \frac{30}{3} = 10$, $\frac{q_o}{p_o} = \frac{20}{5} = 4$ and $\frac{\bar{q}}{\bar{p}} = \frac{25}{7.5} = 3.33$. Thus, $\frac{q_{ft}}{p_{ft}} < \frac{\bar{q}}{\bar{p}} < \frac{q_o}{p_o}$ – and price is salient and O is chosen since it is better along the price dimension. Now assume that there is a negative income shock. If this consumer's earlier income was M, then a decline in this consumer's income to $M - \Delta$ leads to the same budget constraint and to the same utility-maximizing behaviour as in the situation where prices of both options FT and O each increase by Δ and income remains constant at M (because money is fungible and we assume discrete choice). Assume that $\Delta p_{ft} = \Delta_o = \Delta = 20$. Now, $q_{ft} = 10 + 20 = 30$, $p_{ft} = 30$, $q_o = 20$ and $p_o = 20 + 5 = 25$. So $\bar{q} = \frac{q_{ft}+q_o}{2} = \frac{30+20}{2} = 25$ and $\bar{p} = \frac{p_{ft}+p_o}{2} = \frac{30+25}{2} = 27.5$. Now, $\frac{q_{ft}}{p_{ft}} = \frac{30}{30} = 1$, $\frac{q_o}{p_o} = \frac{20}{25} = 0.8$ and $\frac{\bar{q}}{\bar{p}} = \frac{25}{27.5} = 0.9$. Thus, $\frac{q_{ft}}{p_{ft}} > \frac{\bar{q}}{\bar{p}} > \frac{q_o}{p_o}$ and so the public good quality is salient and FT is chosen since it is better along the public good quality dimension.

These examples illustrate that the salience model leads to starkly different predictions for a price change and for an income change. For our scenario, where the recession led to a generic change in budgets, the salience model predicts that consumers would became relatively less sensitive to price differences of products and instead focus on the public good quality of the product. One of our key empirical results – increasing fair trade shares and falling organic shares of products– is therefore clearly borne out by this model's predictions.

Another interesting insight offered by the salience model is that changes to the choice set can potentially alter the initial decision of the consumer. For our case, a particularly relevant example is the decoy effect : if a consumer is indecisive between two options, then adding a third alternative (the decoy) which is dominated by only one of the two options helps the consumer focus on the latter option's advantage relative to the other option. The decoy effect basically means that when people cannot decide between two goods they use the third good as a sort of measuring stick. The decoy, in other words, can make a complicated decision feel simple.

The decoy effect draws the attention of the consumer to the salient attribute of the dominating good. From this reasoning it follows that the supermarket chain's introduction of the carbon label on its own-brand goods from May 2008, which corresponds to week 46 in our data (indicated in our figures with a solid vertical line), may have contributed to the further drop in the sales

share of organic labelled goods. According to the salience model, the addition to the pairwise choice (organic versus fair trade) of a third decoy option (the carbon label) dominated by one of the goods (fair trade) boosts the demand of the dominating good. In our case, this translates to increased demand for fair trade products which have higher public good quality in comparison with the carbon labelled decoy. Note that this difference in public good quality relates to how the products are perceived by the consumer, this does have to align with how the products are viewed by experts.

4.5. **A model of identity and social image.** A second alternative theoretical explanation for our empirical results is offered by moral motivations and identity. Consumers who prefer to regard themselves as socially responsible individuals derive utility not only from the direct consumption of a good (the direct utility) but also from moral costs or rewards associated with the public good attribute of such consumption, i.e., identity. Following Akerlof and Kranton [2010] identity is determined by a comparison of the actual consumption to the morally ideal consumption, the "right thing to do". As explained byDasgupta and Ulph [2016], this behaviour is socially-directed even though the focus here is on a personal moral norm. According to this economic model of moral motivation individuals form beliefs about the moral standard through expectation about others' behaviour. In our case this would be the choice between eco-labelled food versus non-labelled food (Teyssier and Combris [2015]; Klockner and Ohms [2009]).

A further theoretical explanation is offered by social image considerations. Little is known about the interplay of personal norms, or self-image, and social image concerns in the context of consumption. The influence of social norms in this context is through social distinction or reputation as a motivation for pro-social behaviour. Klockner and Ohms [2009] argue that social norms have an additional direct influence on behaviour parallel to personal norms but that – in the context of food consumption – the influence of social norms can be expected to be weak. Because food consumption is for the most part not a public activity, social reputation is considered in general less compelling in explaining food consumption than theories of identity or morality (Saitone and Sexton [2017]).

However, other recent studies suggest that for eco-labelled food and fair trade in particular, social norms do play a role (Teyssier and Combris [2015]). Following Ariely, Bracha, and Meier [2009] and Bénabou and Tirole [2011], one reason why consumers are willing to pay a price premium for an eco-labelled good is that it generates public good reputation for the buyer. When a

consumer buys a public good attribute which is incorporated in a traded good this is, by construction, a signal of the consumer's monetary valuation of the public good outcome. Thus purchase of an eco-labelled good sends a clear signal of the buyer's public good preferences. This in turn can lead to eco-labelled goods being purchased without the consumer questioning, or even considering, the effectiveness of the ecolabel but merely to increase esteem (Griskevicius, Tybur, and den Bergh [2010]). Although purchasing an eco-labelled good in order to increase one's own esteem is quite selfish it can be an important factor in the demand for public good attributes. Indeed, Richardson and Stähler [2014] find this non-altruistic effect to be crucial in analysing the rise of the fair trade movement in particular. They argue that there would be no fair trade without this effect.[12]

One implication of the above for our analysis is that the preference for buying the eco-labelled product is socially embedded. Esteem obtained is influenced by other consumers' product choice and will change with the proportion of the population that is buying the product containing the pro-social characteristics. Because of the social esteem associated with the product, the behaviour of other consumers affects individual preferences and hence consumption (see Brennan and Pettit [2004]). The esteem obtained decreases with the proportion of the population that buy the product and eventually esteem is no longer attached with the product when the product has become common. In fact, in this final stage disesteem could be attached to the non-labelled product whereas no esteem is attached to the eco-labelled product. The disesteem attached to the non-labelled product would increase as the number of compliers increases (see figure 8 for a graphical exposition). Hence aggregate consumer demand is redirected toward the more socially salient product in the choice set.

Following this line of argument, the utility consumers gain from buying an eco-labelled product is divided into two parts. The first part is the functional utility which includes attributes such a taste and price. The second part is the supplementary utility associated with the eco-label. Supplementary utility includes altruism and "warm-glow" utility (Andreoni [1990]) gained from buying a good that has positive effects on the quality of life of others, on the natural environment or on animal welfare. In addition, consumers may gain supplementary utility from the esteem they gain from buying the

[12] Dubé, Luo, and Fang [2015] provide experimental evidence supporting self-signalling whereby consumers are partially motivated to buy a product for its public good attribute. Specifically they find crowding out of demand when price discounts dampen the self-signal of altruistic motivation.

good. Bernheim [1994] argues that because people care about status they care about other peoples' perceptions of their preferences. Since preferences are unobservable, they use their actions as a signalling device for their preferences.

To formalise this insight, consider a choice set as before of an indivisible eco-labelled product with two varieties: FT with (pro-social) quality q_{ft} and price p_{ft} and product O with quality q_o and price p_o with $q_{ft} > q_o$ and $p_{ft} > p_o$. Note that quality in this context refers to both the functional utility (taste etc.) and the supplementary utility associated with the eco-label (self-identity and social esteem). Quality of product i as perceived by an individual consumer can then be written as $q_i = w(v_i) + m(s, n_i, N_i)$ where v_i is the hedonic value of good i; s is the exogenous level of scrutiny; n_i denotes the consumer's belief of the moral standard, and N_i is the consumer's belief about the proportion of the population that buy the product (see Teyssier and Combris [2015]). Let consumers be distributed across some range $\mu[0,1]$ according to the density function $f(\mu)$ with utility $u = \mu(q - p)$.

We identify the consumer who is indifferent between buying the basic eco-labelled product and not buying it, with the condition : $WTP_O = 0$ which gives $\mu_o q_o - p_o = 0$ thus the preference level is : $\mu_o = \frac{p_o}{q_o}$. Similarly, we can identify the consumer who is indifferent between the two eco-labelled products, using the condition: $WTP_{O-FT} = 0$ which gives $\mu_{ft} q_{ft} - p_{ft} = \mu_{ft} q_o - p_o$ and leads to a preference level: $\mu_{ft} = \frac{p_{ft} - p_o}{q_{ft} - q_o}$.

If $f(\mu)$ is uniform on $[0,1]$ then $f(\mu) = 1$ and we have aggregate demand from three different groups of consumers (Fischer and Lyon [2014]) :

(1) Those that do not buy an eco-labelled product : $D^0 = \frac{p_o}{q_o}$.
(2) Those that buy the eco-labelled product O: $D^O = \frac{(p_{ft} - p_o)}{(q_{ft} - q_o)} - \frac{p_o}{q_o} = \frac{q_o - p_o q_{ft}}{q_o - p_o q_{ft}}$
(3) Those that buy the eco-labelled product FT : $D^{FT} = 1 - \frac{(p_{ft} - p_o)}{(q_{ft} - q_o)} = \frac{(q_{ft} - q_o - (p_{ft} - p_o)}{(q_{ft} - q_o)}$

It follows that a change in the price or in the perceived quality of product O will affect the aggregate demand of all three categories of consumers. In contrast such changes for product FT will only affect demand for FT and O. In particular : $\frac{\partial D^F T}{\partial q_o} = \frac{p_f t - p_o}{(q_{ft} - q_o)^2}$ and $\frac{\partial D^O}{\partial q_{ft}} = \frac{p_o - p_{ft}}{(q_{ft} - q_o)^2}$.

Relevant in our case is what happens to the non-altruistic effect when the price of a product with pro-social characteristics changes (i.e., this product becomes relatively more expensive). For consumers that value social reputation, the increase in the signalling value counteracts the effect of the price

increase, in effect crowding-in reputational motives for buying (Brennan and Pettit [2004]). Thus, if reputation is an important motive for buying goods with public good characteristics, then this reputation effect can lead to a reversal of reactions to changes in consumer prices/budgets (from that predicted by traditional price theory) as observed in our empirical results for the fair trade label.[13]In addition anecdotal evidence suggests that the organic label was losing market appeal in the first year of our time series. Much of this was driven by a public debate over whether organic food is actually healthier than conventional grown farm produce from a nutritional perspective. Wier et al. [2008] find that UK markets for organic food purchases appear to be vulnerable to consumer dissatisfaction, particularly among heavy users of organic food products. Their results confirm the results of Weatherall et al. [2003] that UK consumers of organic appear to change concerns and attitudes over time. This debate about the functional utility will also affect the esteem associated with the organic label. It follows from our exposition earlier, that a drop in perceived quality of product O leads to a change in the aggregate demand for all three categories of consumers. This offers a further explanation for our empirical results.

5. Conclusion and General Remarks

This paper examined the effects of the recent recessionary economic conditions on consumers' observed expenditure for eco-labelled (or "sustainable") grocery products. Traditional price theory predicts that during an economic downturn consumers become more price sensitive. Therefore, when household incomes changes, consumers' should change their spending and we would expect the sales share of eco-labelled goods to fall since these are relatively more expensive. Using this theoretical underpinning, we look at the effect that the recent recession (which began in the last quarter of 2008) had on the sales of these grocery products. We find that the economic recession had widely different effects on expenditure shares of different eco-labelled products. Expenditure shares on organic products declined over the time period under study while the expenditure shares of fair trade products increased over the same period. Expenditure shares for carbon-labelled products did not

[13]Kahsay, Andersen, and Hansen [2014] report empirical evidence on reverse price reactions for the Danish milk market where organic milk enjoys a 30 percent market share. Analysis of scanner data on the effects of price discount weeks showed that the most reputation concerned consumers reduced demand (-6%) for organic milk during price discount week; the least concerned increased demand (+12%) and overall demand increased slightly (+3%).

show any discernable trend over the same time period. We evaluate alternative psychological models of decision making in explaining this violation of the standard theory of consumer behaviour, *viz.*, a salience model and a model of reputation signalling. Both the salience model and the model of reputation signalling offer insights that explain the differences in sales patterns observed for the eco-labelled products in our data.

Neo-classical households treat money as fungible. Fungibility implies that individual units of money allow substitution or interchangeability. If consumers resort to category budgeting and if money is fungible, then if a consumer overspends her planned expenditure for one category of goods, she should underspend in a different category of goods to compensate. One implication of the fungibility of income is that a consumer should choose the same commodity bundle if prices increase by a certain percentage as she chooses when income decreases by the same percentage. Consider a situation where we have a good that comes in several varieties that differ in quality and we have a consumer choosing just one indivisible unit of the good. If money is fungible, then the utility maximising consumer will choose the same good, whether she faces a decrease in income (income-decrease scenario) or a rise in prices (price-increase scenario). If money is not fungible then the consumer will substitute more towards the low-quality variety of the good in the price-increase scenario compared to the income-decrease scenario. Or equivalently, the consumer will substitute (relatively) more towards the high-quality variety of the good in the income-decrease scenario. Laboratory experiments substantiated by theory (e.g., Abeler [2017] and references therein) seem to indicate that consumers do indeed behave in a way that suggests that money is not fungible.

For our scenario, during a recession the non-fungibility of income implies that households will substitute towards the higher pro-social quality product or fair trade varieties of a product. So fair trade shares will increase over time. Therefore, the results that we find in our paper appear to be in agreement with the idea that consumers do not consider income as fungible. We note, in this context, the work by Hastings and Shapiro [2013] who test the fungibility of income using a panel data set on retail gasoline purchases in the US. They find that during the second half of 2008, during the financial recession, households in their data set substituted to higher-octane (better quality) gasoline. This is a result that mirrors our own result in this paper. Hastings and Shapiro [2013] reject the null hypothesis of fungiblity. In addition they use their data to compare three different models that can account for their findings - a model of category budgeting, a model of loss aversion

based on Koszegi and Rabin (2006), and a model of salience based on Bordalo, Gennaioli, and Schleifer [2013]. They find that predictions from the model of category budgeting fits their data best and the fit of the other two models is limited. Hastings and Shapiro [2013] make use of a rich data set comprising of panel microdata from a large U.S. grocery retailer with gasoline stations on site. They have transaction-level data on all gasoline and grocery purchases from 2006 to 2009 over 69 different retail locations all over the US. They focus on gas purchases and for each gasoline transaction, their data include the date, a store identifier, the number of gallons pumped, the grade of gasoline bought (regular, midgrade, or premium), and the amount paid for the transaction. While, like us, they use transaction level data (but on gasoline transactions), unlike us, their data set also has information on store identifiers and household identifiers linked to a retailer loyalty card. This rich data set allows them to construct a price series by store, grade, and date equal to the modal price across all gasoline transactions. They can also match transactions over time for a given household using the household identifier linked to the retailer loyalty card. So their data allows them to match gasoline transactions to grocery transactions by the same household. This is critical for testing the hypothesis of fungibility of income – that is whether households treat "gas money" as fungible with other income. They also have details of household income which is provided by the household to the retailer when applying for this loyalty card. Unfortunately, the quality of our data prevents us from carrying out such an exercise. We do not have (complete) data on any of the aforementioned variables, *viz*., store identifiers and household income – for reasons of data confidentiality. Moreover we only have transaction data on selected "ethical" products in our dataset (and their close substitutes) and only for transactions at the supermarket chain (this is a drawback of Hastings *et. al.* as well that they only consider transactions from a single retailer).

Another paper of relevance to our work is the work by Griffith and Nesheim [2013] who design a novel hedonic price method for a basket of goods and use this model to estimate the willingness to pay (WTP) for organic products using scanner data. They have a very rich dataset with detailed data on product characteristics and information on region where stores are located over time. They also have data on these products from different supermarket chain stores (so their data, unlike our data, is not exclusive to only one super market chain). They regress the (log) price of the good on the above variables, including most importantly, a number of characteristics of the good (including whether the good is organic) and a number of other variables like promotions, etc.that explain the variability in prices. The specification that they use is

quite flexible because of the large number of characteristics on which the dependent variable is regressed. Their results show a lot of variability in the consumer willingness to pay for different organic products. Their findings are important because their method allows one to estimate WTP for each household by user group (for example, devoted users of organic, casual users of organic, etc.) to test for social preferences. However, again, we are unable to carry out such tests since we do not have complete information on the location and type of stores and we also do not have detailed information on product characteristics.

Despite the academic interest, econometric analysis of supermarket retail data across sales of organic and fair trade grocery products is sparse. Our analysis is a first attempt at studying the effects on consumer purchase behaviour of eco-labelled products using market data under recessionary conditions.

TABLES AND GRAPHS

TABLE 1. Summary Statistics : Weekly Consumer Expenditure (Two Years) [a]

Variable	Mean	Std. Dev.	N
Total Amount Spent	595154.731	43596.953	104
Amount Spent on Organic	58116.917	4792.906	104
Amount Spent on Fair trade	12915.078	2989.469	104
Amount Spent on Carbon	17557.151	4219.054	104
Amount Spent on Carbon-Fair trade	1819.389	840.675	104
Amount Spent on other products	504746.192	36844.508	104

[a] The above table shows summary statistics for the *weekly* expenditure on each major eco-labelled product category - organic, fair trade, carbon, carbon-fair trade and the residual category, other. All figures shown are in pounds (£) and in levels. These statistics are compiled from scanner-level (revealed preference) data on food consumption recorded at Tesco, a leading UK retailer with a market share over 31 percent in 2008. The data represents the purchases of around 16.5 million active Tesco ClubCard holders covering a nationwide representation of sales. Our empirical analysis focuses on weekly observations for financial week 17 of 2007 up to and including financial week 15 in 2009. Thus the date covers a period of 104 weeks (36 weeks in 2007, 52 weeks in 2008 and 16 weeks in 2009) as shown in the last column of the above table. For more details see section 2.2 in the text.

NOTES

[1]Although having higher order terms of the independent covariate (as in the polynomial regression) allows for more flexibility in modelling trends (than say a simple regression specification) and can reveal new trends in the data (for example, the U-shape in the residual expenditure category in our last exercise with the polynomial regression) the specification is not as flexible as in a fully non-parametric approach.

[2]This feature of the non-parametric approach enables the non-parametric approach to reveal structure in data that one cannot model with conventional parametric methods. The "cost" of the non-parametric approach is computational intensity, but computational intensity is not an issue given the size of our data.

[3]We use the command npcmstest in the package np in R to implement this test.

[4]Essentially a lowess smoother tries to fit a "local" linear regression to a set of points x_i around the point of interest x in the data where x_i is sufficiently close to x (the closeness is dictated by a selected bandwidth). As these methods are well known we do not outline details of the method. We refer the reader to Hastie, Tibshirani, and Friedman [2011] for further details.

[5]We use a data driven cross-validation method to select the bandwidth when we model the relationship between expenditure shares of eco-labelled products and time using kernel based methods.

[6]To fit a spline we need to choose the knots and then fit the spline by OLS. In practice, we choose the degrees of freedom of the spline instead of choosing the placement of the knots. Once the degrees of freedom are specified the knots are then placed at uniform quantiles of the data. In the spline regressions that we report, for the sake of robustness, we choose a number of different degrees

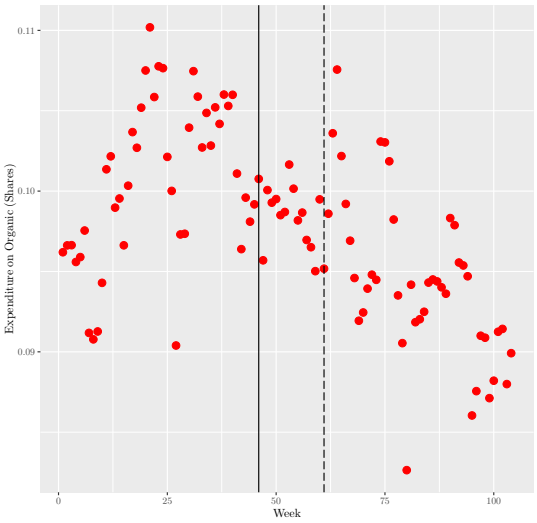
of freedom. We show the results only for a few degrees of freedom (2,5, 7 and 10) although our results are quite robust over a wide range of degrees of freedom.

[7]The most popular choice of the degree of the spline or m is 3, or a cubic spline. A cubic spline is technically a B-spline (or a basis spline), which is a stable variant of the simple smooth spline. A major drawback of B-splines is that B-splines give misleading results at the boundary of the predictors. To guard against this drawback of B-splines, one can use N-splines (or natural splines) which impose additional boundary constraints (linearity) on the spline to make it better behaved at the boundaries. While this approach removes the problems of the cubic/B-Splines a better (alternative) approach to smooth the data is to fit a spline with knots at every data point in the data, fit a polynomial and impose a penalty for roughness (instead of specifying the position of the knots in the data and fitting a piecewise polynomial over these knots – as done with B and N-splines approach). This is the S-spline approach, that we report in our paper. Note that if unconstrained, the S-spline curve would interpolate every y_i and fit the data perfectly. To prevent such over-fitting a smoothing constraint is imposed on the curve. Formally the above translates to the following optimization exercise :

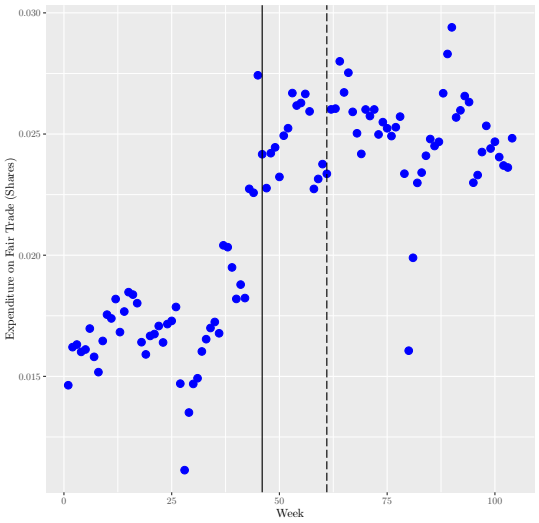
$$\sum_{i=1}^{n}(y_i - f(x_i))^2 + \lambda \int f''(t)^2\, dt$$

where the first term is sum of squared errors, the second term is the roughness penalty. The integration is over the range of x (and $f''(t)$ denotes the second derivative of x) and λ is a tuning parameter which controls the degree of the penalty. For details see Hastie, Tibshirani, and Friedman [2011].

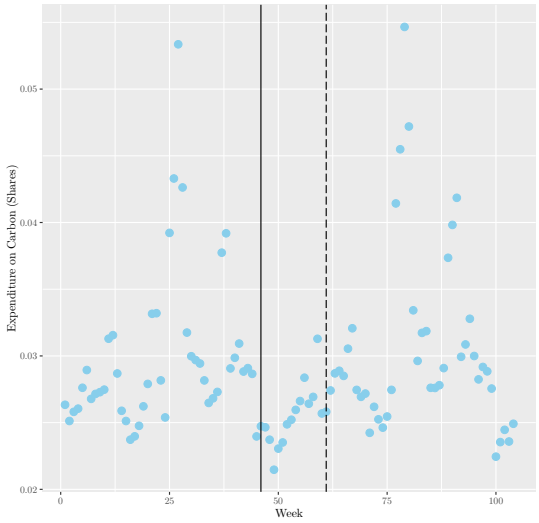
[8]The kernel smoother approximates $f(x)$ with $\hat{f}(x) = \sum y_i \hat{w}(x_i, x)$ where $\hat{w}(x_i, x)$ are the weights on y_i given by $\hat{w}(x_i, x) = \dfrac{k(x_i, x)}{\sum_j k(x_j, x)}$ where k is an even function and is called the kernel, and $\sum_j k()$ is a normalizing constant so the weights add up to one for each. We use the well known Gaussian kernel given by $N(0, \sqrt{h})$ where h is the window width or bandwidth. For details see Hastie, Tibshirani, and Friedman [2011].



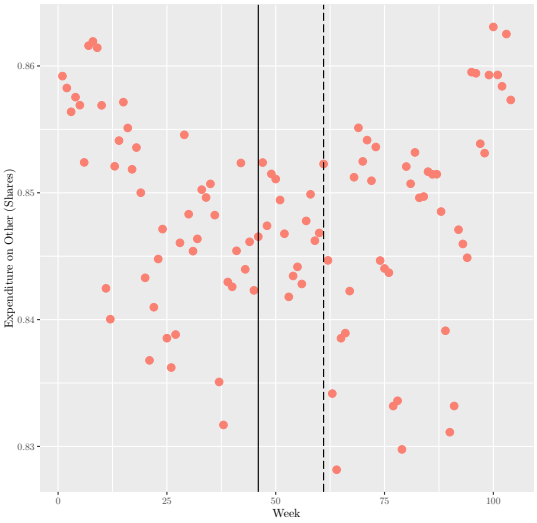
(a) Organic expenditure shares.



(b) Fair trade expenditure shares.

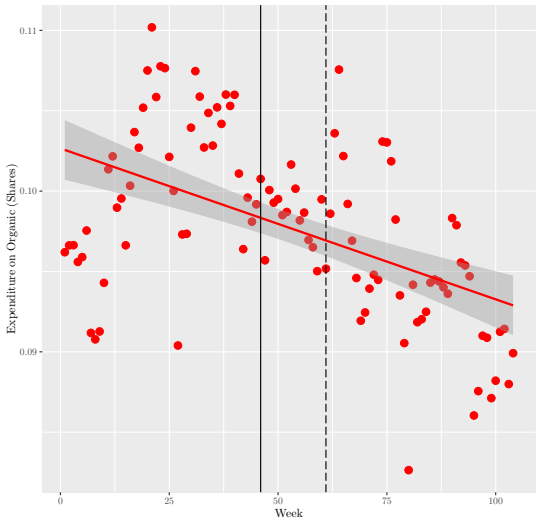


(c) Carbon expenditure shares.

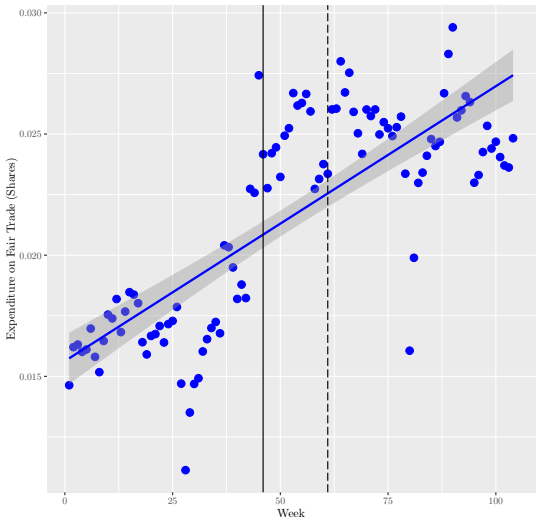


(d) Other expenditure shares.

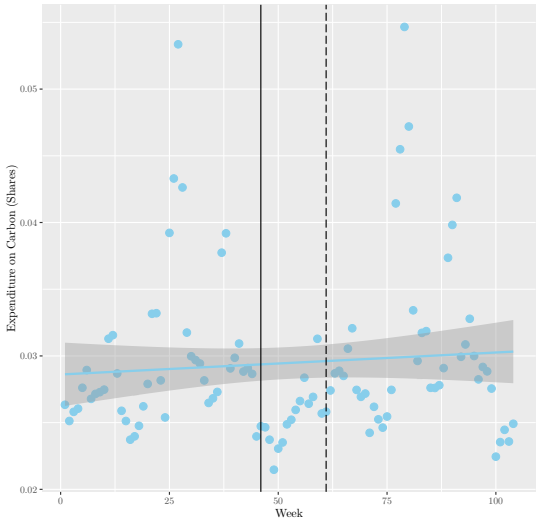
FIGURE 1. Figure shows expenditure shares of various product categories over time. A dashed vertical line in our diagrams marks week 61. Week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of the recession. A solid vertical line in our diagrams marks week 46 which is the date at which the supermarket chain began applying carbon labels on the first of several products.



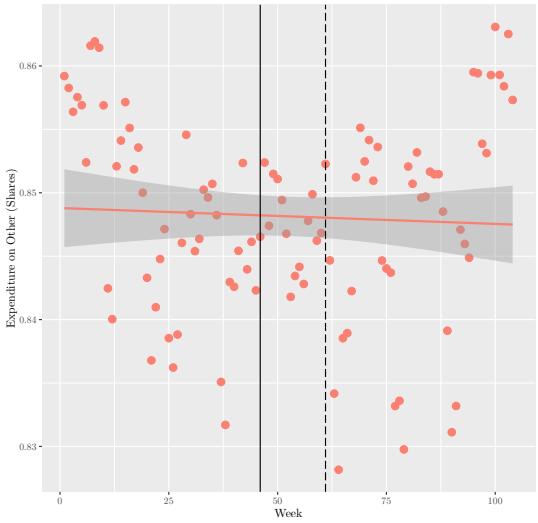
(a) Organic expenditure shares.



(b) Fair trade expenditure shares.

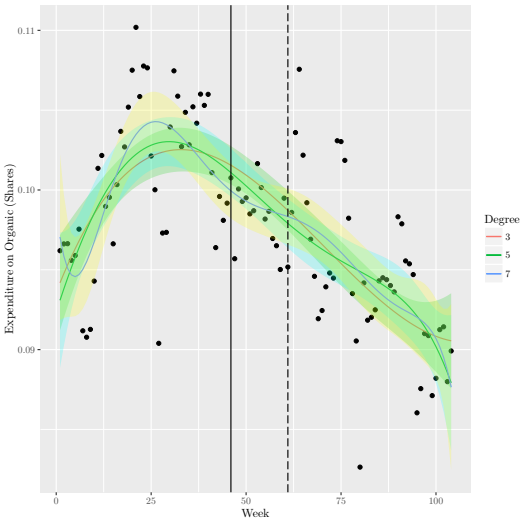


(c) Carbon expenditure shares.

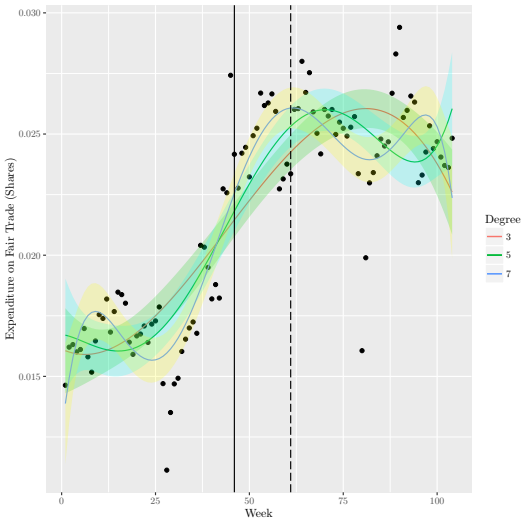


(d) Other expenditure shares.

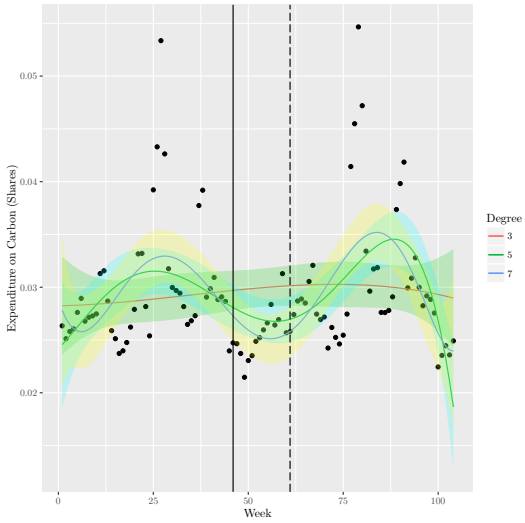
FIGURE 2. Linear regression fit on expenditure shares of various product categories over time. A dashed vertical line in our diagrams marks week 61. Week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of the recession. A solid vertical line in our diagrams marks week 46 which is the date at which the supermarket chain began applying carbon labels on the first of several products.



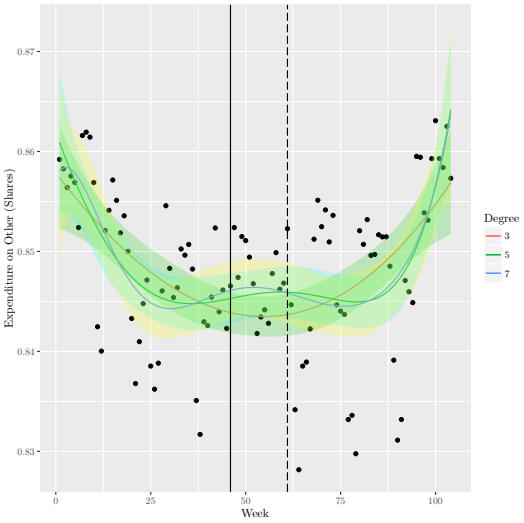
(a) Organic expenditure shares.



(b) Fair trade expenditure shares.

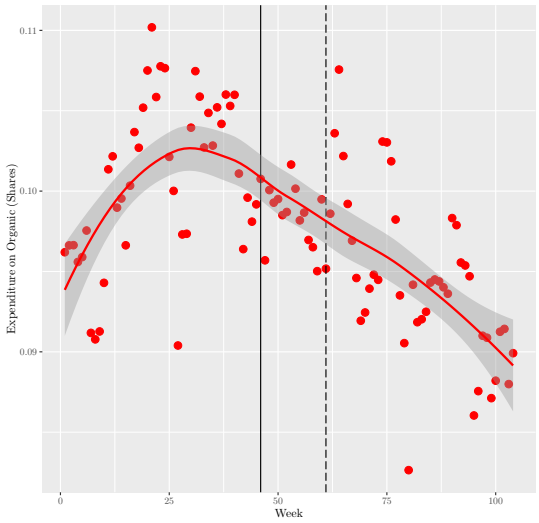


(c) Carbon expenditure shares.

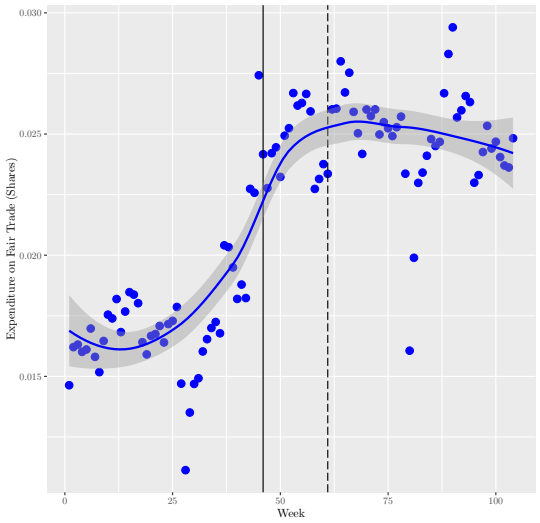


(d) Other expenditure shares.

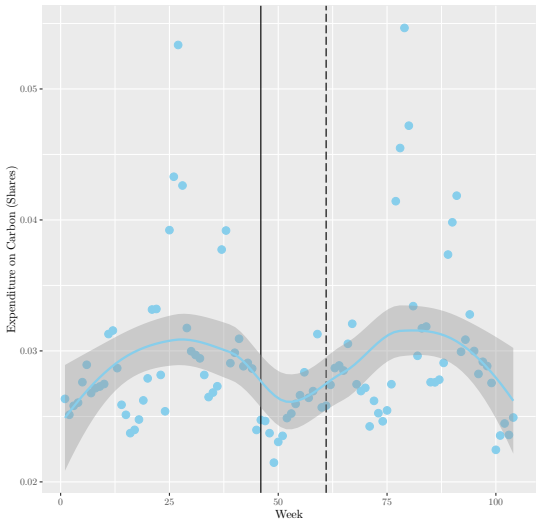
FIGURE 3. Polynomial fit on organic and fair trade expenditure shares of various product categories over time. A dashed vertical line in our diagrams marks week 61. Week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of the recession. A solid vertical line in our diagrams marks week 46 which is the date at which the supermarket chain began applying carbon labels on the first of several products.



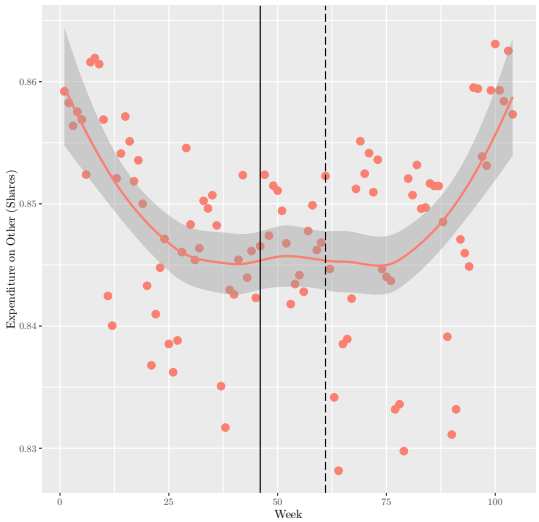
(a) Organic expenditure shares.



(b) Fair trade expenditure shares.

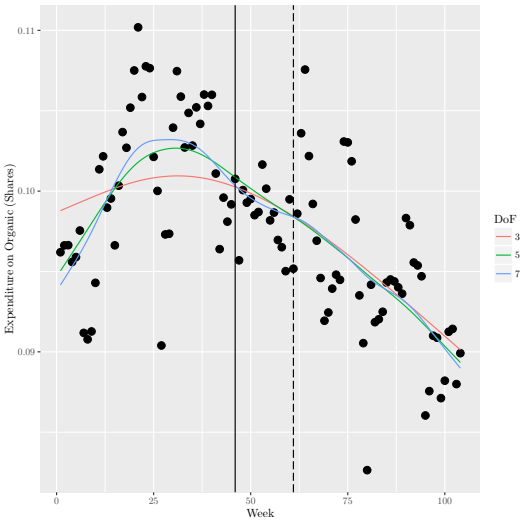


(c) Carbon expenditure shares.

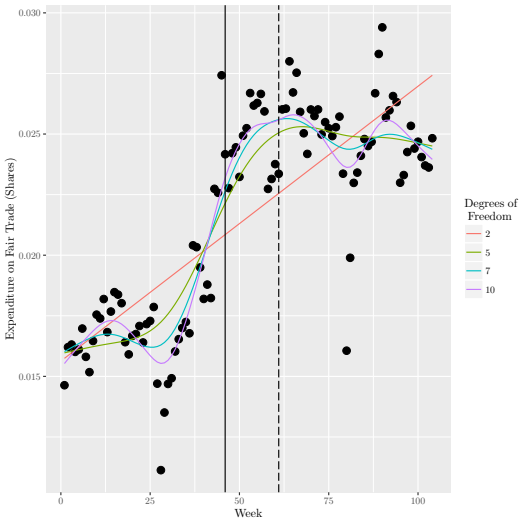


(d) Other expenditure shares.

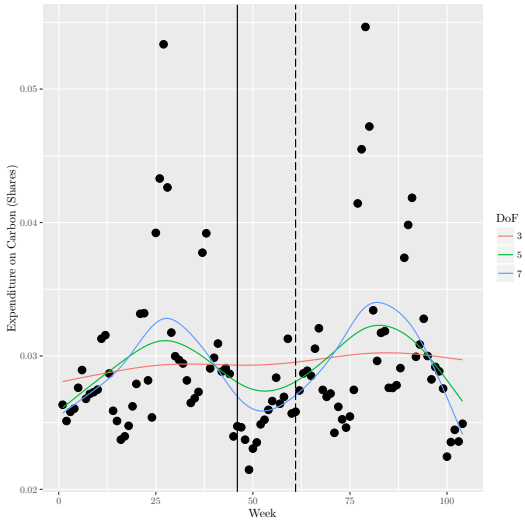
FIGURE 4. Loess fit on organic and fair trade expenditure shares of various product categories over time. A dashed vertical line in our diagrams marks week 61. Week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of the recession. A solid vertical line in our diagrams marks week 46 which is the date at which the supermarket chain began applying carbon labels on the first of several products.



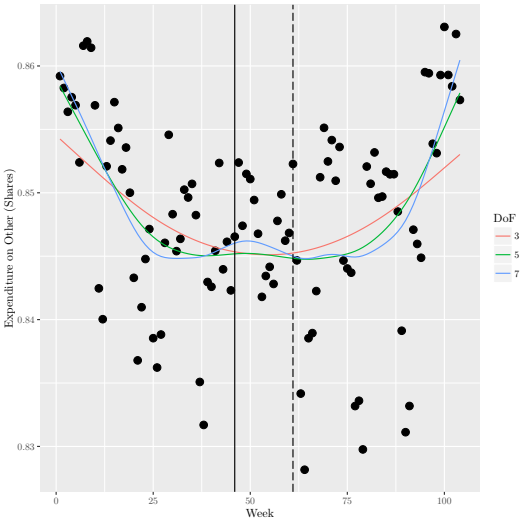
(a) Organic expenditure shares.



(b) Fair trade expenditure shares.

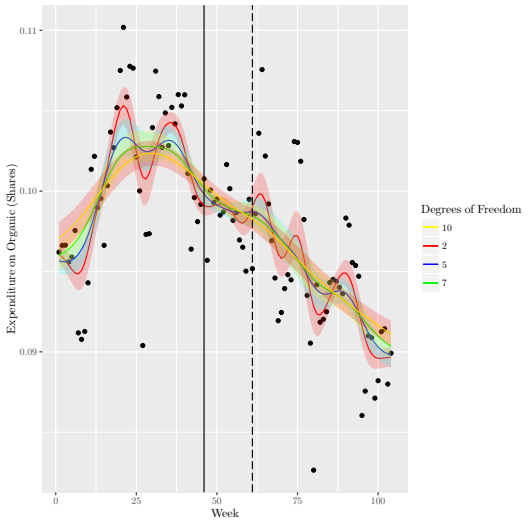


(c) Carbon expenditure shares.

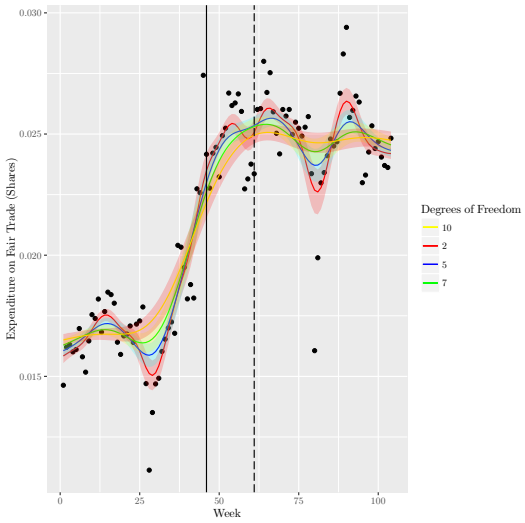


(d) Other expenditure shares.

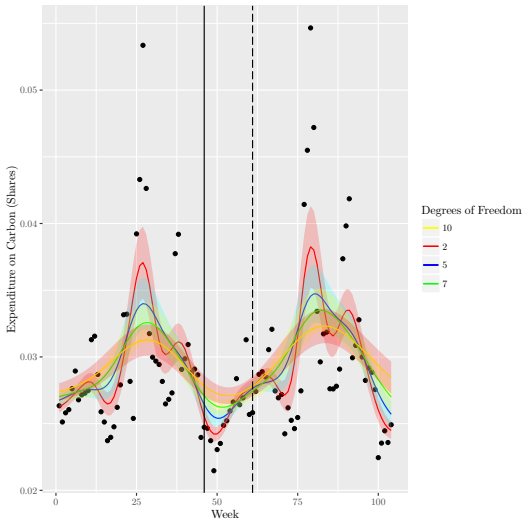
FIGURE 5. S-spline regression on organic and fair trade expenditure shares of various product categories over time. A dashed vertical line in our diagrams marks week 61. Week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of the recession. A solid vertical line in our diagrams marks week 46 which is the date at which the supermarket chain began applying carbon labels on the first of several products.



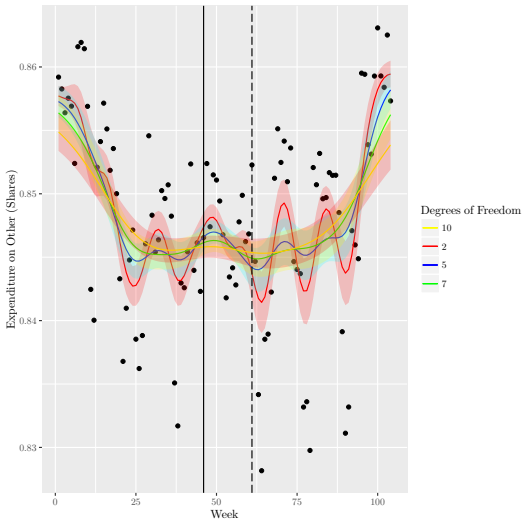
(a) Organic expenditure shares.



(b) Fair trade expenditure shares.

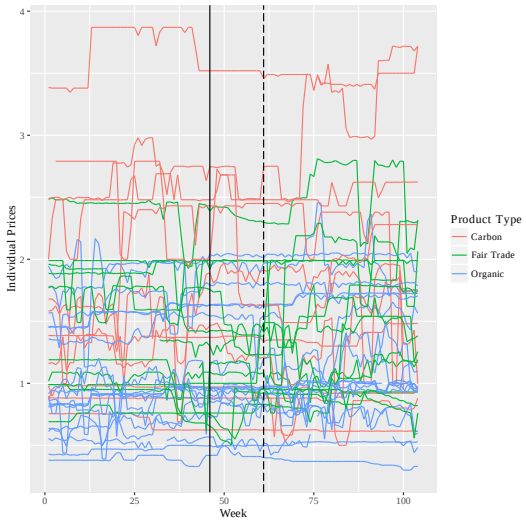


(c) Carbon expenditure shares.

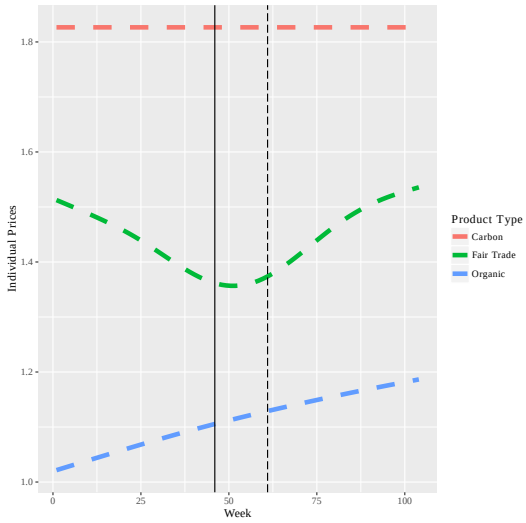


(d) Other expenditure shares.

FIGURE 6. Non-parametric regression on organic and fair trade expenditure shares of various product categories over time. A dashed vertical line in our diagrams marks week 61. Week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of the recession. A solid vertical line in our diagrams marks week 46 which is the date at which the supermarket chain began applying carbon labels on the first of several products.



(a) Individual product prices.



(b) Price indices.

FIGURE 7. Figure 7a above shows price trajectories for individual products for all 104 weeks grouped by category into 3 different product groups. Figure 7b shows a price index constructed as an average of individual prices. A dashed vertical line in our diagrams marks week 61. Week 61 in our data corresponds to the week in which Lehman Brothers collapsed (September 15, 2008). This date could be regarded as the date of the onset of the recession. A solid vertical line in our diagrams marks week 46 which is the date at which the supermarket chain began applying carbon labels on the first of several products.

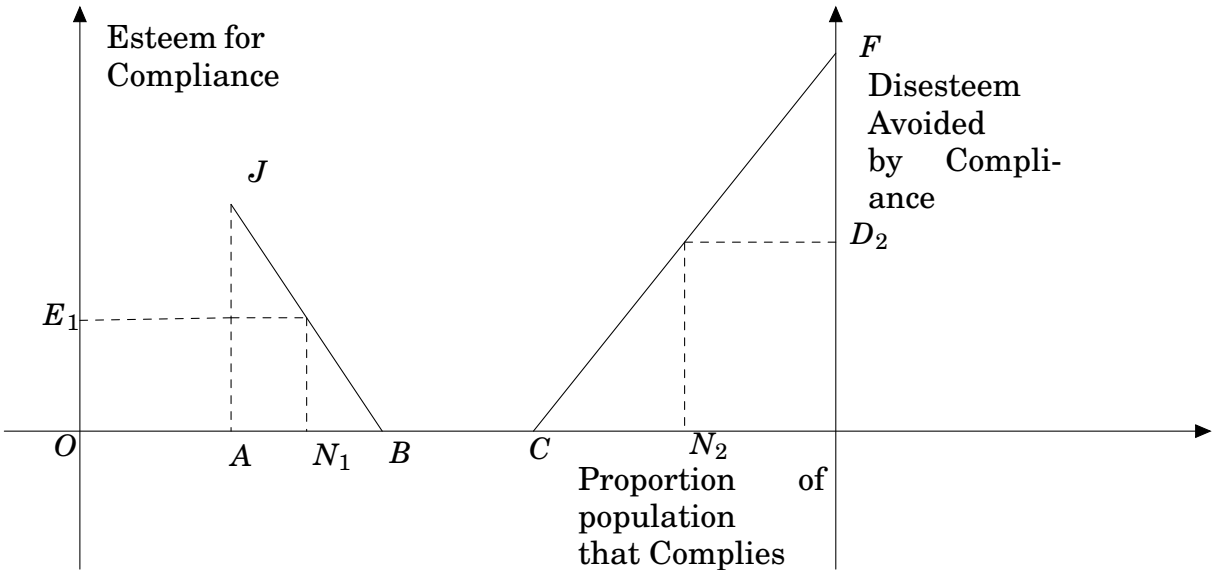


FIGURE 8. Figure 8 shows the relation between esteem, disesteem and the proportion of a population that complies with a specific behavioural practice. Over the range 0 to A, the behaviour has not yet been registered as an ideal. Over the range A to B it becomes established. If the number of compliers is N_1, an amount of esteem of E_1 is allocated to all those who comply. As the proportion of the compliers increases from A to B, the esteem obtained from it decreases. At B, the behavioural practice has become so common that esteem is no longer is attached to it. In the final range from C to 100%, disesteem is attached to non-compliance whereas no esteem is available for compliance. If the number of compliers is N_2, an amount of disesteem of D_2 is allocated to all those who do not comply. In this range C to 100%, most comply with the behavioural practice and non-compliance is distinctive. The disesteem attached to non-compliance increases as the number of compliers increases. Source: Brennan and Pettit [2004], page 239.

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