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Relative price changes as a tool to stimulate more healthy food choices – A Danish household panel study

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ABSTRACT

The increased prevalence of lifestyle-related illnesses particularly in western countries calls for public action. A poor diet is a key explanatory factor to this development. Previous research has addressed the problem of unhealthy food consumption behavior by looking at how taxes may function as an instrument to change purchase behavior from less healthy products to healthier ones. In this paper we address this issue by looking at the effects of discounts depending on whether healthy or less healthy products are available at a discount. Our study is based on weekly purchase data from a Danish household panel for the period 2010–2011. Interestingly, from a public health perspective our findings suggest that there is an asymmetric effect of discounts depending on the fat content of the product. Furthermore, our results point at two classes of consumers where the asymmetric effects go in different directions.

Introduction

Lifestyle-related illnesses, such as cardiovascular diseases, can be attributed to poor diets and too little physical activity. Public health care, as in Denmark, combined with such adverse health behavior lead to large costs for the individual and for society. Hence there is a need for knowledge about the effectiveness of public health models. According to Moorman and Price (1989) consumer policy remedies focus on education, information, and market restraints. Seiders and Petty (2004) add financial incentives to this list. These remedies may all be seen as instruments reducing various obstacles to healthy eating by making it less troublesome and/or less expensive to stick to a balanced diet.

The results related to educational campaigns targeted healthy eating provide a mixed pattern. In the thorough review of the effectiveness of different policies to promote healthy eating in Europe Capacci et al. (2012) emphasize that the evaluations of such campaigns are often done in terms of impact on attitudes or self-reported behavior. When it comes to actual change in consumption of healthy products Capacci et al. (2012) report of only minor increases. However, Shankar et al. (2013) report a reduction in salt intake by approximately 10% following the UK Food Standards Agency's salt campaign.

Grunert and Wills (2007) present a review of European research on consumer response to nutrition information on food labels. The response variables are perception of the label, liking, understanding and use. The general conclusion is that there is an urgent need for more research studying consumers' use of nutritional information on food labels in a real-world setting. A few studies of the effects of front of pack (FOP) labeling on actual sales exist. Sacks et al. (2009) and Sacks et al. (2011) are unable to identify any systematic effects supporting a decrease in the demand for high-fat products following label introduction. The individual effect of FOP labeling as a public health model may hence be questioned and other tools like relative price changes induced by taxes may be considered either as an alternative or as a supplementary tool.

Restriction remedies comprise constraints limiting marketing and distribution to population subgroups that are disproportionately influenced (for instance children) as well as zoning restrictions (mandating healthy choice in product selection). To the best of our knowledge, no empirical investigations addressing the effect of zoning restrictions have been carried out.

The Capacci et al. (2012) review also summarizes the distribution of studies by type of policy action. According to their findings out of 129 studies only 4 studies are related to fiscal measures.

In October 2011, the Danish government introduced a tax on saturated fats with the declared aim to improve health (Smed, 2012). Such a tax will naturally change the relative price of low-fat products compared to high-fat ones. Andreyeva et al. (2010) reviewed studies on price elasticity for food measured at

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a category level. Modeling the effect of taxes at the product group level may, of course, provide some insight, but Andreyeva et al. (2010) conclude that there is an urgent need for studies estimating price effects on substitutions from unhealthy to healthy food. The purpose of our study is to address that need. This we will do by focusing on price effects on the demand for individual products within a product group that varies with respect to fat content.[2]

Former studies of the effect of food price changes on food-purchasing patterns are either observational or experimental. The main advantage of observational studies is that it is real world data based on actual purchases and the main drawback is of course that we cannot manipulate prices as we can in an experimental setting. Hence studies based upon observational data can measure correlations between purchases and price changes, but not causal effects.

In Epstein et al. (2012) there is a comprehensive review of experimental research on the relation between food price changes and food purchasing patterns. They conclude that many of the studies are done in a laboratory setting with hypothetical products and hypothetical budget constraints, but the studies show a substitution of healthier foods when prices of less healthy foods were increased and vice versa.

Apart from laboratory settings Epstein et al. (2012) discuss results from experiments done in a cafeteria setting, vending machine experiments and supermarket experiments. Only one cafeteria study examined substitution effects and that study showed the substitution of healthier beverages when soda was taxed. French et al. (1997) found that reducing the price of low-fat items in vending machines by 50% increased the proportion of low-fat snack products purchased from 25% to 46% during a four-week baseline period. When prices returned to normal, the proportion of low-fat snacks purchased went back to 23% indicating that price does indeed influence decision-making. Another study pointing in the same direction (Jeffery et al., 1994) found that a three-week cafeteria intervention where prices of fruit and salad were reduced by 50% led to a threefold increase in sales of these items with the total number of items purchased remaining constant. Obviously, price changes have to be significant to create more long-term effects on choice, but the price changes in the studies referred to above are very dramatic. The above mentioned studies share the feature that they only look at price changes for healthy products. The four experimental studies discussed by Epstein et al. (2012) and carried out in a supermarket setting are also limited to a study of the effect of price changes in a healthy product category (fruit and vegetables).

Talukdar and Lindsey (2013) presents a study based upon analysis of extensive scanner data and a controlled experiment in a supermarket. They focus on effects of price changes both for healthy and unhealthy products and allow for and find asymmetric responses to a price increase and decrease respectively. Based upon the scanner data Talukdar and Lindsey (2013) find opposite patterns of demand response for healthy and unhealthy food. Their conclusion is that for unhealthy food, consumer's demand response sensitivity is greater for a price decrease than that for a price increase, relative to the last purchase price, and for healthy products they find the opposite pattern. The analysis was based upon individual transaction data for 52 consecutive weeks. 8 categories were studied. Four relatively healthy categories (e.g. grapes, raisins) and four relatively unhealthy categories (e.g. potato chips, white bread) were examined. Reactions to price changes across time within a given category were studied. The dependent variable was quantity purchased by a given household in a given category per week and the main explanatory variables were price paid per relevant standardized unit and a price movement indicator.

In line with Talukdar and Lindsey (2013) we also allow for a differential effect of healthy and unhealthy products respectively. In contrast to the Talukdar and Lindsey (2013) between-category study we concentrate on data from a household panel representing choices *within* a product category. We also allow for different segments of customers with different purchasing patterns and reactions to price changes. However, contrary to the Talukdar and Lindsey study we only focus on the effect of price decreases. We observe discounts between 0% and 20% of the regular price and the main purpose is to investigate whether it is easier to change the consumption pattern from high fat products to low fat products by changing relative prices than vice versa. We are, of course, aware that a discount in a given week is not the same as a permanent change in relative price, but a study with the purpose of identifying differences in substitution effects due to discounts on low fat and high fat products may be seen as an indicator of the likelihood that a corresponding permanent relative price change will change purchasing patterns. We concentrate on the yoghurt category. Yoghurt is an obvious example of a category where the effect of storage is very limited, so demand effects in subsequent periods due to stockpiling are assumed to be negligible.

The model

The multinomial logit model has an extensive application history in marketing. We apply a finite mixture variant (also known as a latent class model) allowing for different segments of households as our brand choice model and use the statistical program LatentGold Choice 4.5 to estimate our model based on first choices. Our approach will provide a two-dimensional decomposition of sales response by behavior and segment.

The conditional logit model for purchase probabilities is our starting point and has the form[3]

$$P(y_{it} = m|z_{it}^{att}) = \frac{\exp(\eta_{m|z_{it}})}{\sum_{m'=1}^{M} \exp(\eta_{m'|z_{it}})}$$

where y_{it} is a multinomial variable indicating the consumer's first choice, z_{it}^{att} is a vector representing the explanatory variables related to the attributes for the alternatives, $\eta_{m|z_{it}}$ is the systematic component in the utility function for the alternative m for household i at replication t. The term $\eta_{m|z_{it}}$ is a linear function of an alternative-specific constant β_m^{con} and attribute effects β_p^{att}. That is,

$$\eta_{m|z_{it}} = \beta_m^{con} + \sum_{p=1}^{P} \beta_p^{att} z_{it}^{att}$$

The implication of this equation is that if any alternative is excluded from the choice set A, its choice probability is allocated among the remaining alternatives proportional to their original choice probabilities. This is the so-called Independence of Irrelevant Alternatives (IIA) assumption and it is typically not a reasonable assumption in a choice set with close substitutes. Our latent class approach accounts for household heterogeneity by assuming that some households differ with respect to some of the parameters in $\eta_{m|z_{it}}$. Allowing for more than one segment also resolves the problem with the IIA assumption that now is assumed to hold within a class[4] (Train (2003, p-139–140)). In order to indicate that the choice probabilities depend on class membership x_k, the logistic model is now of the form

[2] According to Popkin et al. (2006) the proportion of saturated fatty acid influences the risk of coronary heart disease. Hence we will allow ourselves to use the terms low fat/high fat products and healthy/unhealthy products interchangeably in this article.

[3] The description of our model draws heavily on the Technical Manual accompanying Latent Gold Choice (Vermunt and Magidson, 2004).

[4] The LC statistical criteria would reject the aggregate model in favor of $K > 1$ classes.