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# The Impacts of Fat Taxes and Thin Subsidies on Nutrient Intakes

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## Abstract

This paper examines the health effects of a fiscal food policy based on a combination of fat taxes and thin subsidies. The fat tax is based on the saturated fat content of food items while the thin subsidy is applied to select fruit and vegetable items. The policy is designed to be revenue neutral so the subsidy exactly offsets the revenue from the fat tax. A model of food demand is estimated using Bayesian methods that accounts for censoring and infrequency of purchase (the problem of unit values is also discussed). The estimated demand elasticities are used to compute nutrient elasticities which demonstrate how consumption of specific nutrients changes based on price changes in particular foods from the fiscal policy. Results show that although the fat tax decreases saturated fat intake, consumption of other important nutrients is also decreased, which may lead to negative health outcomes.

**JEL Codes**: D30, D60, H20, I10, I30.
**Keywords**: fat tax, nutrient elasticities, obesity, thin subsidy.

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# 1 Introduction

Obesity and other chronic diseases that are associated with poor dietart choices such as diabetes, heart disease, stroke, and cancer have become leading causes of death (McGinnis and Nestle 1989). Changes in the individual diet have resulted in fundamental shifts in the distribution of body weight. In England the proportion of adults with a healthy body mass index (BMI), between 18.5 and 24.9, has fallen from 41.0% in 1993 to 32.5% in 2008 resulting from the rapid increase in overweight and obesity (HSE 2008). There is also accumulating evidence from the United States that the upper half of the weight distribution has become larger; between the 1970s and 2000 median BMI among American adults increased from 24.6 to 26.3 (or by 8.9%), whereas the 95% percentile of the distribution rose from 33.9 to 39.6 (or by 16.8%). A similar shift in the shape of the distribution took place for American children (Anderson, Butcher and Levine, 2003). Similarly in England in the decade from 1993 to 2003, the upper part of the BMI distribution experienced significant BMI increases and the middle portion intermediate increases, while the lower tail remained largely unchanged (Wardle and Boniface, 2007).

Past information and education campaigns to improve healthy eating have proved ineffective in the UK (Foresight 2007). Officials across the spectrum of the medical and health community have made urgent calls for a more system-wide approach to dealing with the growing obesity epidemic. One element of such an approach that governments have considered is taxing unhealthy foods (fat taxes) and/or subsidising healthy foods (thin subsidies). The 'fat tax' concept has often been dismissed as relatively ineffective because wealthy consumers are not very responsive to food prices; and regressive because poor consumers spend the largest share of their incomes on food, particularly 'cheap' energy-dense food; and unfair because the tax falls on those who are not obese as well as on those who are.

One response to the first criticism is that previous studies have investigated only low-level taxes, usually at VAT rates, currently 17.5%. It is generally accepted that cigarette taxes have been effective (Goel and Nelson, 2006) and they are applied, in the UK, at much higher levels, as are taxes on alcohol. The evidence suggests that people respond to large incentives. A fat tax alone would inevitably be highly regressive, as indeed are tobacco and alcohol taxes, so recent proposals suggest combining it with a thin subsidy to encourage fruit and vegetable consumption. Poorer people are most responsive to prices (Deaton, 1997) and can be expected to increase their fruit and vegetable intakes quite substantially; as well as benefiting their health the subsidy receipts would offset the regressive effects of the fat tax.

The extent to which the tax and subsidy combination is effective and its differential impact on sectors of society is the empirical question addressed in this paper. A model of demand is estimated to obtain elasticity estimates, which are then used to simulate the effects of changes in the distribution of nutrient consumption in England resulting from the imposition of fat taxes and thin subsidies. In particular, a revenue neutral fiscal policy is developed where the fat-tax is imposed on certain foods based on saturated fat content while the thin-subsidy is placed selected fruits and vegetables groups. The estimated demand elasticities will determine the impact of the fiscal policy in terms of consumption changes while the nutrient elasticities will ascertain the impact of the policy on selected nutrient intakes.

This paper is organized as follows. The next section describes the methodology. The demand model and estimation strategy closely follows the approach in Tiffin and Arnoult (2010) while the process of converting demand elasticities into nutrient elasticities follows Huang (1996). The data and the simulated fiscal food policy are discussed in the third section. Empirical results are presented in section four. The final section concludes.

## 2 Materials and Methods

Theoretically consistent models of demand are estimated which permit the simulation of the effects of changes in food prices which result from the imposition of fat taxes and thin subsidies on the distributions of food consumption in England. The estimation of demand systems that are explicitly based on microeconomic theory is a well established area of the applied econometric literature. The most commonly employed model is the Almost Ideal Demand System (AIDS, Deaton and Muellbauer, 1980) which uses a cost function to represent consumer's preferences. The demand equations are derived explicitly from the cost function, which are expressed as follows:

$$s_{it} = \alpha_i + \sum_{j=1}^{m+1} \gamma_{ij} \ln\left(p_{jt}\right) + \beta_i \ln\left(\frac{e_t}{P_t}\right) + u_{it} \tag{1}$$

$$i = 1, \ldots, m+1 \text{ and } t = 1, \ldots, T \tag{2}$$

$$\left(u_{1t}, \ldots, u_{mt}\right)^{'} \sim N\left(\mathbf{0}, \mathbf{\Sigma}\right) \tag{3}$$

where $s_{it}$ is the share of total expenditure $(e_t)$ accounted for by expenditure on the $i^{th}$ good in the $t^{th}$ household, $p_{jt}$ is the price of the $j^{th}$ good to the $t^{th}$ household, and $P_t = \prod_j p_{jt}^{s_{jt}}$is the Stone price index. Note that the vector $(u_{1t}, \ldots, u_{mt})$ excludes the $(m+1)^{th}$ equation so that $\Sigma$ is positive definite. The treatment of censored observations is an important issue to consider when estimating demand models. Such censored observations occur when the level of consumption of a particular good in a household is zero during the survey period. To address censoring, the Infrequency of Purchase Model (IPM), introduced by Blundell and Meghir (1987), is incorporated into the AIDS model using the approach outlined in Wales and Woodland (1983, p. 270). Full details of the estimation strategy are available in Tiffin and Arnould (2010).

Once the matrix of price elasticities is computed the next step is compute the nutrient elasticities. The nutrient elasticities provide information on how intake of specific nutrients, such saturated fat or protein, may change as a result of a combination of fat taxes and thin subsidies. The technique developed by Huang (1996,1999) is used to link the demand model to nutrient availability. The basic premise of the approach in Huang (1996) is that changes in the price of a particular food or in total expenditure will affect the consumption of all food items and will simultaneously change intakes in a variety of different nutrients. Three pieces of information are needed: the expenditure elasticities, price elasticities, and the nutrient values of each food.

Define $a_{ki}$ as the amount of the $k^{th}$ nutrient obtained from a unit of the $i^{th}$ food and let $\phi_k$ be the total amount of that nutrient obtained over the different food items consumed. An expression for $\phi_k$ is given by

$$\phi_k = \sum_i a_{ki} q_i, \tag{4}$$

where $k = 1, ..., K$ is the total number of nutrients and $q_i$ is the quantity demanded (i.e., the Marshallian demand) of the $i^{th}$ food. Since demand is a function of prices $(p)$ and expenditure $(m)$, the Marshallian demand function is represented by $q_i = f\,(p, m)$. Changes in nutrient availability can therefore be expressed as

$$d\phi_k = \sum_i a_{ki} \left[ \sum_j \frac{\partial q_i}{\partial p_i} dp_j + \frac{\partial q_i}{\partial m} dm \right]. \tag{5}$$

The relative change in nutrient availability can also be expressed in terms of relative changes in food prices and per capita expenditure as

$$\frac{d\phi_k}{\phi_k} = \sum_j \left( \sum_i \varepsilon_{ij} a_{ki} \frac{q_i}{\phi_k} \right) \left( \frac{dp_j}{p_j} \right) + \left( \sum_i \eta_i a_{ki} \frac{q_i}{\phi_k} \right) \left( \frac{dm}{m} \right), \tag{6}$$

where $\varepsilon_{ij}$ denotes price elasticities and $\eta_i$ denotes expenditure elasticities.

Equation 6 is equivalently written as

$$\frac{d\phi_k}{\phi_k} = \left( \pi_{kj} \frac{dp_j}{p_j} \right) + \left( \rho_k \frac{dm}{m} \right), \tag{7}$$

where $\pi_{kj}$ is a price elasticity measure that relates the effect of a price change in the $j^{th}$ food on the availability of the $k^{th}$ nutrient, and $\rho_k$ is an income elasticity measure that relates the effect of a change in total expenditure on the availability of that specific nutrient. The calculation of the nutrient elasticities represents a weighted average of the price and expenditure elasticities, with weights expressed as each food's share in the contribution to the $k^{th}$ nutrient.

In practice, the calculation of the $K \times (G+1)$ matrix of nutrient elasticities ($NE$) for the case of $K$ nutrients and $G$ foods is obtained by multiplying the $K \times G$ nutrient share matrix of each food ($NS$) by the $G \times (G+1)$ matrix of food demand elasticities ($FE$)

$$NE = NS \times FE. \tag{8}$$

Based on the measurements of nutrient elasticity, a change in the price of a food or in per capita expenditure will affect all food quantities demanded through the interdependent demand relationships, resulting in simultaneous changes in the levels of nutrient availability (Huang 1996).

Household level data from the UK Expenditure and Food Survey (EFS) is used to estimate the demand model. The data are collected via completion of 2-week diary for each individual in the household over the age of seven, which is then augmented with the use of till reciepts (discussed in more detail in the next section). The EFS (starting in 2001-2002) is the result of the merger between the Family Expenditure Survey (FES) and the National Food Survey (NFS), two well established surveys and important sources of information for government and the broad research community on UK spending and food consumption patterns. In this paper, the 2003-2004 data set is used, which is the latest (at the time of starting to work with the data) complete data set available from the Economic and Social Data Service (ESDS). The 2003-2004 sample is based on 7,014 households in 672 postcode sectors stratified by Government Office Region in England and Wales.

Individual food items are converted into aggregate food groups that can be identified for a fat tax or thin subsidy using a hierarchical approach. First, seven main food groups are identified: dairy and eggs, meat and fish, staples and starches, fruits and vegetables, fats and sugars, drinks, and hot takeaway. Next, each of the seven main food groups is composed of sub-food groups (29 in total) listed in the first two columns of Table 1 (a complete listing of the individual food items used in each level of aggregation is available upon request). Table 1 also presents the household averages for quantity consumed, unit value, and budget share for the sub-food groups. Mean quantities consumed per household are in kilogrammes or litre equivalent and unit values per household are in GBP per kilogram or litre equivalent (except eggs, which are in pence per unit). Meat and fish compose the largest share of the average household budget at about 22 percent. This is followed by drinks and fruits and vegetables both at 16 percent, fats and sugars at 15 percent, dairy and eggs at 14 percent, staples and starches at 12 percent, and hot takeaway at 5 percent.

While broad aggregates simplify the analysis, detailed information is inevitably lost in the aggregation process. For example, the "milk" category includes both full-fat and skimmed milk, and the price elasticities may potentially differ between these two sub-category items. Moreover, by following a hierarchical approach, the price elasticities obtained from a given estimated model assumes that expenditure on the group of foods within that model remains constant as the price change takes place. For example, the own price elasticity for beef, which is obtained from the meat and fish system, assumes that the total expenditure on the five types of meat and fish in the model remains constant. Since a reduction in the price of beef is likely to induce consumers to spend more on all types of meat and fish, this assumption is generally unrealistic. To account for this problem, estimates from the two-level hierarchy are combined using the approach suggested by Edgerton (1997) to give overall elasticities. These elasticities do not assume that expenditure within the groupings remains constant.

# 3 Results

## 3.1 Nutrient contents

The EFS data provide the nutrient contents of 45 different nutrients for each individual food item. Table 2 shows the nutritive values for the 29 sub-food groups for selected nutrients (the full nutrient content of the food groups for all 45 nutrients is available upon request). Food energy is measured in food calories (kcal); protein, fat, and carbohydrates in grams; and calcium and iron in milligrams. The nutritive content provided is per gram or millitre equivalent of the respective food item (except eggs which is given per a medium size egg). The food items that tend to contain the most energy per unit include (excluding eggs): all fats; biscuits, cakes, and pastries; candies and other sugars; breakfast cereals; other starches and staples; and cheeses. The food energy contents of these groups are related to higher food nutrient contents of protein, fats and carbohydrates.

For example, cheese has high contents of both animal protein and fats, but is low in carbohydrates. Breakfast cereals and other starches and staples have high carbohydrate content, but are lower in protein and fat. The fruit and vegetable sub-food groups are higher in calcium and vegetable proteins than most of the other groups, but are generally lower in total energy. The other fruits and vegetables category is an exception as these items correspond to fruit and vegetable based ready-made meals and other takeaway products, which are higher both in total energy and in saturated fats. The meat products are both high in animal proteins and total energy and in the case of beef, pork, and lamb, are also high in saturated fats

By multiplying the amount of each sub-food group consumption by its nutritive values the food shares of nutrients are obtained. The share matrix is presented in Table 3, which is also the $S$ matrix used in the Huang (1996) approach to obtain the nutrient elasticities. Total energy consumption is mostly derived from breads, all fats, biscuits, cakes and pastries, candies and other sugars, and tea and coffee, which together contribute nearly 50 percent to total energy intake. The fruit and vegetable food groups contribute very little to overall energy intake at less than 7 percent. Combined consumption of milk and cream, all fats, and biscuits, cakes, and pastries give most of the nutritive content of saturated fat (42 percent). Carbohydrates are mostly obtained from breads (20 percent), though biscuits, cakes, and pastry yield another 10 percent. Calcium intake is mostly based from milk and cream (27 percent) and bread (15 percent).

## 3.2 The fiscal food policy

The fat tax applied to selected food groups is based on saturated fatty acid content. The subsidy is applied to most of the fruit & vegetable groups, except the one-a-day and other fruits and vegetables group. The one-a-day group is excluded since intake of each of the food items in this group only count once for the recommended servings of fruits and vegetables. The other fruits and vegetables group is excluded because these items consist of ready-made meals and other takeaway products and contain relatively higher quantities and are actually taxed.

The fiscal policy used, based on a combination of taxes and subsidies, is designed to be a revenue-neutral scheme. The choice of saturated fatty acids as the prime target of the fat tax is justified by evidence from the medical literature. Saturated fats are an important risk factor in the occurrence of coronary heart disease (Hu et al. 1997), higher systolic blood pressure (Esrey et al. 1996), and higher plasma concentration of cholesterol (Ascherio et al. 1994). Fruit and vegetables, on the other hand, are positively linked to lower risks of various cancers (Ames et al. 1995; Riboli and Norat 2003), major chronic diseases (Hung et al. 2001), and ischaemic stroke (Joshipura et al. 2001).

Specifically, the fiscal scheme simulation increases the price of each food group by 1% for every percent of saturated fats the group contains. The EFS data set contains nutrient conversion tables that are used to convert food group items into nutrient content. For example, since milk contains 1.72% of saturated fats, its price increasing by 1.72%. A ceiling of 15% is placed on the simulated price increase. To offset this tax burden, and to encourage the consumption of fruit and vegetables, a subsidy on fruit and vegetables is introduced, so as to exactly cancel the costs of the fat tax paid by consumers. Table 4 presents the tax and subsidy rates applied to the different component food group items and assigns an index number to each group.

## 3.3 Demand elasticity estimates

The demand elasticities computed for this paper contain 870 estimates of own- and cross-price elasticities and expenditure elasticities for 29 food groups. Only the own-price and expenditure elasticities obtained from the alternative demand approach are listed in Table 5. Full results for the econometric estimation of the models are available from the authors on request. All of the estimated own-price elasticities are statistically significant and have the expected negative sign. A number of the food groups are price elastic (i.e., have an own-price elasticity greater than unity) and include other meats, other staples/starches, frozen fruits/vegetables, other fruits/vegetables, water, and hot takeaway. Of particular interest is the fact that the "other" food categories for meats, staples/starches, and fruit/vegetables all include ready-made and cold takeaway items. The smallest own-price elasticities (less than 0.7) are found for cheeses, milk/cream, fish, and all fats, which are all relatively inelastic. The own-price elasticities for eggs, breads, breakfast cereals, rice/pasta, and biscuits, cakes, and pastry are also generally of small magnitude indicating relative in elasticity. The remaining food categories are very close to being unit-elastic.

In terms of the expenditure elasticities, all are positive and statistically significant. While most of the expenditure elasticities are less than one, a few food groups are associated with being superior goods such as other dairy, other meats, other staples/starches, other fruits/vegetables, fresh fruits/vegetables, alcohol, water, and hot takeaway. Again, the "other" products include ready-made products and cold takeaway items. For example, other dairy is composed of, among other items, ice cream, milk puddings, and takeaway products such as milkshakes. Moreover, those food items with expenditure elasticities greater than one also have own-price elasticities greater than, or close to, one as well (except the biscuits, cakes, and pastry group). The smallest expenditure elasticities (less than 0.6) are for eggs and tinned/processed fruits and vegetables.

## 3.4 Nutrient intake changes

The matrix of food demand elasticities and the matrix of nutrient shares are used to calculate the 45 individual nutrient elasticities for each of the 29 food groups (oomplete elasticity matrices are available by request). The nutrient elasticities are then used to assess changes in nutrient intakes based on the simulated fiscal food policy. The total change in nutrient intakes based on the simulated combination of fat taxes and thin subsidies are presented in Table 6. The changes represent average impacts for the sample of households included in the survey data set.

As seen by the figures reported in Table 6, the fiscal food policy does result in some potentially desired changes in nutrient intakes. Average intake of saturated fats fall by 6.2%. Intakes of other nutrients associated with diet-related chronic disease also fall including total fat (-6.0%), mono-unsaturated fat (-6.1%), polyunsaturated fat (-5.7%), cholesterol (-4.6%), and sodium (-3.7%). Average intake of total sugar also falls by 2.4%. Breaking the down the decrease of total sugar intake reveals that particular sugar nutrients fall more than others. For example, sucrose falls by 4.2% and lactose falls by 4.5% while maltose falls by 1.8%. The fall in lactose is attributed to a reduction in the consumption of key dairy products resulting from the fat tax. The fall in sucrose is likewise caused by a decrease in consumption of biscuits, cakes, and pastries as well as other candies and sweets which tend to also be high in saturated fat.

Some nutrient intakes actually increase as a result of the fat tax being coupled with a thin subsidy on select fruit and vegetable food items. Average intake of carotene increases by a notable 9.4% while vitamin C increases by 5.3%. There is also a slight increase in folate intake 0.2%. Consumption of dietary fibre also increases between 1.7% and 1.9%, depending on the nutritional definition of fibre used in the analysis (i.e., Southgate vs. Englyst). The thin subsidy, however, also results in an increase in average intakes of both glucose (1.4%) and fructose (3.8%) since fresh fruits and vegetables tend to be high in these sugars. While the relationship between obesity, diabetes and glucose intake has been well established in the literature, consumption of fructose has become increasingly an important issue.

For example, recent animal experiements have shown that animals fed a diet supplemented with fructose rather than glucose or starch have higher rates of diseases associated with metabolic syndrome such as insulin resistence, high triglycerides in the bloodstream, high blood pressure, abdominal obesity, arterial damage, kidney disease, and fatty liver tissue (Nakagawa et al. 2002). Moreover, recent human-based studies show that higher fructose intake levels can result in similar problems in humans including decreased insulin sensitivity, microvascular disease, kidney damage, high blood pressure, glomerular hypertension, and increased apolipoprotein-B concentrations (Brown et al. 2008; Glushakova et al. 2008; Swarbrick et al. 2008). Given the latest evidence, important issues arise about the public health implications of a diet high in fructose, which could represent a possible negative externality of a fiscal food policy that includes a subsidy on fruits and vegetables.

The general trend, however, in changes in nutrient intakes resulting from the simulated fiscal food policy depicted in Table 6 is that most nutrient intakes tend to fall as a result of the combination of fat taxes and thin subsidies. Total energy consumption falls by 3.8% on average, total carbohydrate intake decreases by 2.3% and animal protein intake falls by 4.6%. Altogether, intake changes for these macronutrients are not particularly worrying, especially given that the average person in the UK consumes more calories than recommended by the Department Health. Consumption of carbohydrates, animal protein, and fat is also above recommended levels. However, the changes depicted in Table 6 are non-trivial and it remains unclear what health repercussions may arise from such substantial dietary changes.

Moreover, potentially worrying are the significant declines seeen across the different micronutrients examined. As a result of the fat tax applied to many of the dairy products, average calcium intake falls by 3.0%. Low calcium intake is of concern since calcium-deficiency is associated with osteoporosis, poor blood clotting, and rickets. Average intake of vitamin D falls by 4.8%, which could amplify the negative health effects of calcium deficiency since vitamin D is needed by the body to absorb calcium. Average iron intake falls by 1.0% which could exacerbate problems associated with anemia. Retinol, or vitamin A, intake falls by 5.9%.

Retinol deficiency, which is common in many developing countries, causes damage to the cornea of the eye and can lead to night blindness, especially in children. Average vitamin B12 intake falls by 4.3%. Intake levels of vitamin B12 that are marginally below normal can result in fatigue, poor memory, and in some cases depression while severe deficiency of vitamin B12 can result in serious damage to the brain and central nervous system, which is often irreversible (Bottiglieri 1996; Clark 2008). Vitamin E intake falls by 4.8% on average. While acute vitamin E deficiency is quite raw, low intake levels have been shown to be associated with impaired immune resposne, ataxia, retinal damage, and myopathy or muscle weakness (Kowdley 1992; Brigelius-Flohé and Traber 1999).

## 4 Conclusion

Obesity is of increasing concern throughout the developed world. Some estimates suggest that by 2015, 60% of men and 50% of women will be obese. Being obese increases the risks of a range of chronic health problems including heart disease, type 2 diabetes and high blood pressure. Additionally it has been shown that increased levels of fruit and vegetable consumption will contribute to a reduction in the incidence of some cancers. As a result, there is an increase in interest in public health policies that are designed to reduce the impacts of diet related disease. One such policy is a fiscal intervention designed to reduce the consumption of calorie and fat dense food via a fat-tax and to encourage the consumption of fruit and vegetables via a thin susbsidy.

The extent to which a fiscal food policy is effective can be judged based on if the policy successfully redistributes consumption away from unhealthy foods towards healther food choices. Of particular importance is not just how consumption of specific food items shifts, but how changes in nutrient consumption are affected by a policy of food taxes and subsidies. This paper explores the linkage between food choice and nutrient consumption as the demand for food items shifts because of price changes.

Demand elasticities are obtained from a theoretically consistent demand model that accounts for censoring that occurs in most consumer surveys. The demand elasticities are then used to calculate nutrient elasticities which describe how nutrient consumption changes due to price changes in specific food groups. While the fat tax seems to be effective in reducing the average intake of saturated fats, there are potentially negative consequences.

Given that the groups with the highest fat tax rate applied to them account for the largest share of energy intake in the average UK diet, total energy intake declines as a result of the tax. Moreover, the fat tax also results in decreased consumption of important nutrients such as dietary fibre, and vitamins A, D, and E. The thin subsidy does appear to increase consumption of fruits and vegetables and therefore increase consumption of key nutrients, like carotene, sugar intake also increases substantially. Further, since energy supply from fruits and vegetables does not account for a large share of total energy supply, the decrease in calorie intake resulting from the tax is not fully compensated for by the subsidy on fruit and vegetable items.

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Table 1: Major food groups

| Main Food Groups | Sub-Food Groups | Mean Consumption | Mean Unit Value | Mean Budget Share |
|---|---|---|---|---|
| Dairy & Eggs | Cheeses | 0.63 | 0.51 | 0.03 |
| | Eggs | 0.01 | 11.71 | 0.01 |
| | Milk & cream | 8.59 | 0.06 | 0.06 |
| | Other dairy | 2.10 | 0.21 | 0.04 |
| Meat & Fish | Beef | 0.80 | 0.48 | 0.03 |
| | Lamb | 0.24 | 0.55 | 0.01 |
| | Pork | 1.15 | 0.55 | 0.05 |
| | Poultry | 1.15 | 0.45 | 0.04 |
| | Fish | 0.66 | 0.57 | 0.03 |
| | Other meats | 1.43 | 0.46 | 0.06 |
| Staples & Starches | Breads | 3.71 | 0.11 | 0.04 |
| | Breakfast cereals | 0.72 | 0.29 | 0.02 |
| | Rice & pasta | 0.69 | 0.18 | 0.01 |
| | Potatoes | 3.17 | 0.09 | 0.02 |
| | Other starches | 0.65 | 0.55 | 0.03 |
| Fruit & Vegetables | Fresh | 6.96 | 0.17 | 0.11 |
| | Frozen | 0.36 | 0.15 | 0.01 |
| | Tinned & processed | 0.75 | 0.16 | 0.01 |
| | One-a-day only | 2.17 | 0.13 | 0.02 |
| | Other fruit & veg | 0.29 | 0.44 | 0.01 |
| Fats & Sugars | All fats | 1.05 | 0.29 | 0.02 |
| | Biscuit, cakes, pastry | 1.64 | 0.36 | 0.05 |
| | Chips and Crisps | 1.03 | 0.40 | 0.03 |
| | Candies & other sweets | 1.34 | 0.46 | 0.05 |
| Beverages | Alcohol | 3.67 | 0.41 | 0.10 |
| | Soft drinks | 9.46 | 0.06 | 0.04 |
| | Tea & coffee | 0.26 | 0.83 | 0.02 |
| | Water | 1.11 | 0.04 | 0.00 |
| Hot Takeaway | | 0.58 | 1.01 | 0.05 |

Table 2: Nutritive content of food

| | Total Energy kcal | Saturated Fat g | Animal Protein g | Vegetable Protein g | Carbs g | Calcium mg | Iron mg |
|---|---|---|---|---|---|---|---|
| Cheeses | 3.255 | 0.166 | 0.196 | 0.000 | 0.031 | 5.280 | 0.002 |
| Eggs | 76.238 | 1.602 | 6.357 | 0.000 | 0.000 | 28.990 | 0.966 |
| Milk & cream | 0.575 | 0.018 | 0.034 | 0.000 | 0.049 | 1.173 | 0.001 |
| Other dairy | 1.018 | 0.027 | 0.030 | 0.001 | 0.135 | 0.969 | 0.001 |
| Beef | 2.116 | 0.063 | 0.197 | 0.001 | 0.006 | 0.099 | 0.017 |
| Lamb | 1.848 | 0.063 | 0.154 | 0.000 | 0.000 | 0.081 | 0.013 |
| Pork | 2.124 | 0.055 | 0.164 | 0.003 | 0.024 | 0.332 | 0.007 |
| Poultry | 1.235 | 0.019 | 0.158 | 0.000 | 0.001 | 0.051 | 0.005 |
| Fish | 1.288 | 0.014 | 0.147 | 0.007 | 0.037 | 0.670 | 0.009 |
| Other meats | 2.182 | 0.051 | 0.092 | 0.032 | 0.125 | 0.384 | 0.014 |
| Breads | 2.350 | 0.005 | 0.000 | 0.086 | 0.485 | 1.526 | 0.018 |
| Breakfast cereals | 3.508 | 0.008 | 0.001 | 0.080 | 0.770 | 0.881 | 0.109 |
| Rice & pasta | 2.914 | 0.003 | 0.001 | 0.072 | 0.666 | 0.183 | 0.010 |
| Potatoes | 0.475 | 0.001 | 0.000 | 0.012 | 0.100 | 0.057 | 0.003 |
| Other starches | 3.257 | 0.048 | 0.029 | 0.073 | 0.443 | 1.583 | 0.017 |
| Fresh | 0.317 | 0.001 | 0.000 | 0.008 | 0.067 | 0.159 | 0.003 |
| Frozen | 0.535 | 0.002 | 0.000 | 0.036 | 0.082 | 0.312 | 0.009 |
| Tinned & processed | 0.653 | 0.001 | 0.000 | 0.018 | 0.148 | 0.201 | 0.008 |
| One-a-day only | 0.703 | 0.004 | 0.000 | 0.024 | 0.111 | 0.218 | 0.006 |
| Other fruit & veg | 1.731 | 0.023 | 0.002 | 0.032 | 0.185 | 0.487 | 0.008 |
| All fats | 6.367 | 0.192 | 0.007 | 0.004 | 0.032 | 0.153 | 0.002 |
| Biscuit, cakes, pastry | 4.063 | 0.085 | 0.010 | 0.048 | 0.595 | 0.846 | 0.017 |
| Chips and Crisps | 2.710 | 0.053 | 0.000 | 0.038 | 0.346 | 0.154 | 0.011 |
| Candies & other sweets | 3.926 | 0.048 | 0.024 | 0.003 | 0.811 | 0.574 | 0.008 |
| Alcohol | 0.515 | 0.000 | 0.000 | 0.002 | 0.012 | 0.065 | 0.002 |
| Soft drinks | 0.242 | 0.000 | 0.000 | 0.000 | 0.064 | 0.037 | 0.000 |
| Tea & coffee | 0.730 | 0.005 | 0.003 | 0.052 | 0.114 | 0.804 | 0.024 |
| Water | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hot Takeaway | 1.937 | 0.032 | 0.079 | 0.044 | 0.168 | 0.580 | 0.010 |

Table 3: Nutritive share of food

| | Total Energy kcal | Saturated Fat g | Animal Protein g | Vegetable Protein g | Carbs g | Calcium mg | Iron mg |
|---|---|---|---|---|---|---|---|
| Cheeses | 0.029 | 0.089 | 0.082 | 0.000 | 0.002 | 0.089 | 0.003 |
| Eggs | 0.008 | 0.010 | 0.031 | 0.000 | 0.000 | 0.006 | 0.013 |
| Milk & cream | 0.069 | 0.132 | 0.192 | 0.000 | 0.047 | 0.268 | 0.007 |
| Other dairy | 0.030 | 0.047 | 0.042 | 0.002 | 0.032 | 0.054 | 0.005 |
| Beef | 0.024 | 0.042 | 0.104 | 0.001 | 0.001 | 0.002 | 0.023 |
| Lamb | 0.006 | 0.013 | 0.025 | 0.000 | 0.000 | 0.001 | 0.006 |
| Pork | 0.034 | 0.054 | 0.125 | 0.002 | 0.003 | 0.010 | 0.014 |
| Poultry | 0.020 | 0.018 | 0.121 | 0.000 | 0.000 | 0.002 | 0.009 |
| Fish | 0.012 | 0.008 | 0.064 | 0.003 | 0.003 | 0.012 | 0.010 |
| Other meats | 0.044 | 0.061 | 0.087 | 0.034 | 0.020 | 0.015 | 0.034 |
| Breads | 0.122 | 0.014 | 0.001 | 0.236 | 0.201 | 0.151 | 0.118 |
| Breakfast cereals | 0.035 | 0.005 | 0.000 | 0.043 | 0.062 | 0.017 | 0.137 |
| Rice & pasta | 0.028 | 0.002 | 0.000 | 0.037 | 0.051 | 0.003 | 0.012 |
| Potatoes | 0.002 | 0.000 | 0.000 | 0.002 | 0.003 | 0.000 | 0.001 |
| Other starches | 0.029 | 0.026 | 0.012 | 0.035 | 0.032 | 0.027 | 0.019 |
| Fresh | 0.031 | 0.004 | 0.000 | 0.043 | 0.052 | 0.030 | 0.038 |
| Frozen | 0.003 | 0.000 | 0.000 | 0.010 | 0.003 | 0.003 | 0.006 |
| Tinned & processed | 0.007 | 0.000 | 0.000 | 0.010 | 0.012 | 0.004 | 0.011 |
| One-a-day only | 0.021 | 0.008 | 0.000 | 0.038 | 0.027 | 0.013 | 0.024 |
| Other fruit & veg | 0.007 | 0.006 | 0.000 | 0.007 | 0.006 | 0.004 | 0.004 |
| All fats | 0.093 | 0.170 | 0.005 | 0.003 | 0.004 | 0.004 | 0.003 |
| Biscuit, cakes, pastry | 0.093 | 0.118 | 0.011 | 0.058 | 0.109 | 0.037 | 0.048 |
| Chips and Crisps | 0.039 | 0.046 | 0.000 | 0.029 | 0.040 | 0.004 | 0.019 |
| Candies & other sweets | 0.073 | 0.054 | 0.021 | 0.003 | 0.121 | 0.020 | 0.018 |
| Alcohol | 0.004 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.003 |
| Soft drinks | 0.012 | 0.000 | 0.000 | 0.000 | 0.026 | 0.004 | 0.000 |
| Tea & coffee | 0.096 | 0.044 | 0.019 | 0.366 | 0.121 | 0.203 | 0.398 |
| Water | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hot Takeaway | 0.030 | 0.030 | 0.058 | 0.036 | 0.021 | 0.017 | 0.019 |

Table 4: Fiscal food policy

| Index | Sub-food Group | Tax/Subsidy |
|---|---|---|
| 1 | Cheeses | 15.00% |
| 2 | Eggs | 3.20% |
| 3 | Milk & cream | 1.82% |
| 4 | Other dairy | 2.69% |
| 5 | Beef | 6.28% |
| 6 | Lamb | 6.30% |
| 7 | Pork | 5.54% |
| 8 | Poultry | 1.86% |
| 9 | Fish | 1.36% |
| 10 | Other meats | 5.08% |
| 11 | Breads | 0.46% |
| 12 | Breakfast cereals | 0.79% |
| 13 | Rice & pasta | 0.29% |
| 14 | Potatoes | 0.12% |
| 15 | Other starches | 4.76% |
| 16 | Fresh | -26.76% |
| 17 | Frozen | -26.76% |
| 18 | Tinned & processed | -26.76% |
| 19 | One-a-day only | 0.42% |
| 20 | Other fruit & veg | 2.26% |
| 21 | All fats | 15.00% |
| 22 | Biscuit, cakes, pastry | 8.52% |
| 23 | Chips and Crisps | 5.26% |
| 24 | Candies & other sweets | 4.76% |
| 25 | Alcohol | 0.01% |
| 26 | Soft drinks | 0.00% |
| 27 | Tea & coffee | 0.55% |
| 28 | Water | 0.00% |
| 29 | Hot Takeaway | 3.15% |

Table 5: Demand elasticities

| Index | Sub-food Group | Own-price | Stand. Dev. | Expenditure | Stand. Dev. |
|---|---|---|---|---|---|
| 1 | Cheeses | -0.655 | 0.030 | 0.878 | 0.014 |
| 2 | Eggs | -0.747 | 0.030 | 0.502 | 0.023 |
| 3 | Milk & cream | -0.601 | 0.032 | 0.965 | 0.012 |
| 4 | Other dairy | -0.981 | 0.037 | 1.352 | 0.018 |
| 5 | Beef | -0.853 | 0.041 | 0.829 | 0.019 |
| 6 | Lamb | -0.910 | 0.041 | 0.834 | 0.023 |
| 7 | Pork | -0.842 | 0.037 | 0.851 | 0.019 |
| 8 | Poultry | -0.948 | 0.021 | 0.830 | 0.016 |
| 9 | Fish | -0.688 | 0.039 | 0.799 | 0.019 |
| 10 | Other meats | -1.636 | 0.108 | 1.654 | 0.034 |
| 11 | Breads | -0.717 | 0.027 | 0.876 | 0.013 |
| 12 | Breakfast cereals | -0.729 | 0.030 | 0.835 | 0.014 |
| 13 | Rice & pasta | -0.781 | 0.025 | 0.806 | 0.020 |
| 14 | Potatoes | -0.946 | 0.028 | 0.771 | 0.025 |
| 15 | Other starches | -1.267 | 0.055 | 1.517 | 0.022 |
| 16 | Fresh | -0.985 | 0.022 | 1.103 | 0.008 |
| 17 | Frozen | -1.105 | 0.044 | 0.642 | 0.023 |
| 18 | Tinned & processed | -0.908 | 0.039 | 0.518 | 0.021 |
| 19 | One-a-day only | -0.805 | 0.031 | 0.667 | 0.017 |
| 20 | Other fruit & veg | -1.213 | 0.053 | 1.553 | 0.033 |
| 21 | All fats | -0.607 | 0.029 | 0.641 | 0.019 |
| 22 | Biscuit, cakes, pastry | -0.751 | 0.025 | 1.007 | 0.016 |
| 23 | Chips and Crisps | -0.890 | 0.033 | 0.817 | 0.018 |
| 24 | Candies & other sweets | -0.983 | 0.041 | 1.379 | 0.020 |
| 25 | Alcohol | -1.000 | 0.022 | 1.091 | 0.008 |
| 26 | Soft drinks | -0.930 | 0.022 | 0.856 | 0.011 |
| 27 | Tea & coffee | -0.929 | 0.025 | 0.626 | 0.010 |
| 28 | Water | -1.816 | 0.067 | 1.774 | 0.029 |
| 29 | Hot Takeaway | -1.097 | 0.136 | 1.358 | 0.134 |

Table 6: Total changes in nutrient intakes

| Nutrient | Change | Nutrient | Change |
|---|---|---|---|
| Vegetable Protein | -0.008 | Glucose | 0.014 |
| Animal Protein | -0.046 | Fructose | 0.038 |
| Fat | -0.06 | Sucrose | -0.042 |
| Saturates | -0.062 | Maltose | -0.018 |
| Mono-unsaturates | -0.061 | Lactose | -0.045 |
| Poly-unsaturates | -0.057 | Other sugars | -0.014 |
| Carbohydrate | -0.023 | Total sugars | -0.024 |
| Energy - Kcal | -0.038 | Non-milk extr sugars | -0.047 |
| Calcium | -0.03 | Alcohol | -0.001 |
| Iron | -0.01 | Fibre:Southgate | 0.017 |
| Retinol | -0.059 | Fibre:Englyst | 0.019 |
| Carotene | 0.094 | Potassium | -0.005 |
| Retinol equivalent | -0.011 | Magnesium | -0.008 |
| Thiamin | -0.009 | Copper | -0.009 |
| Riboflavin | -0.016 | Zinc | -0.022 |
| Niacin Equivalent | -0.015 | Vitamin B6 | -0.005 |
| Vitamin C | 0.053 | Vitamin B12 | -0.043 |
| Vitamin D | -0.045 | Phosphorus | -0.024 |
| Folate | 0.002 | Manganese | -0.005 |
| Sodium | -0.037 | Biotin | -0.008 |
| Starch | -0.022 | Pantothenic acid | -0.014 |
| Cholesterol | -0.046 | Vitamin E | -0.048 |