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The weak effects of a "fat tax" on French households' food purchases: A nutritional approach

The WHO (World Health Organization) regards overweight and obesity as one of the major worldwide public health concerns. In France, according to the National Individual Survey on Food Consumers (INCA2 2006-2007), 38.9 % of men and 24.2 % of women are overweight and 11.6 % of men and women are obese. In 2002, according to the French Institute of Research in Health Economics (IRDES), the medical cost of obesity was estimated at between 1.5 and 4.6 % of health expenditure. The spread of obesity and its economic consequences led public authorities to think about measures to modify food consumption behaviours. By estimating a demand system, we assess the effect and relevance of a tax policy on food with high calories, fat and sugar content, called a "fat tax". We show that the impact of this "fat tax" on purchases of food, nutrients and calories is weak. Its impact on body weight is also weak in the short run, but tends to increase in the long run. Lastly, while the "fat tax" generates high tax revenues, it mainly affects modest households.

Nutritional information and price interventions are supposed to be the two most relevant tools to act on food consumption behaviours. Both price intervention and taxation have the dual objectives of reducing unhealthy food consumption and generating tax revenue to finance public health policies (subsidies on healthy food and physical exercise, nutritional education etc.) In order to assess the influence of taxes and subsidies applied to the prices of certain foods on the prevalence of overweight and obesity, Etilé (2008) and Bonnet *et al.* (2009) estimated some BMI (Body Mass Index) price elasticities. Based on a thorough breakdown of food products into 32 nutrients (see frame) which allows identification of all the arbitrages between nutrients, the present work completes and enriches these analyses. The results show that improvements in energy obtained through taxation are often offset by pernicious effects regarding vitamins and/or minerals. In addition, we put forward an estimation of the impact of the tax on weight by gender, age and lifestyle, on tax revenue and on the welfare of households.

Demand for nutrients is slightly sensitive to price increase

The demand system is estimated over the 1996-2001 period (see frame), that is to say before the implementation of the first PNNS (French National Nutrition and Health Program). This study period was chosen because it allows the quantification of tax effects in the absence of nutritional information.

The estimation of this demand system will give us a first subset of results on elasticities. They confirm the theoretical consistency of the model and give specific information. The own-price elasticities are negative, which means that demand tends to decrease when prices increase, except for alcoholic beverages in modest households whose price elasticity is null. Most of them are significant and lower than 1, with the exception of red meat, fish, dried fruit, prepared meals, salt-fat products and bottled waters, which are more sensitive to price increases.

Modest households' demand for fish, dried fruit, milk products, cheese/butter/cream, oils, salt-fat products and bottled waters is less sensitive to price variations than that of well-off households. The opposite effect is observed in the case of fresh fruit and vegetables and alcoholic beverages. We observe substantial disparities across income class for fresh fruit and vegetables while we get no disparity across income class for fruit juices.

Frame: Methodology

In our study, the households' food demand is modelled via a complete AI (Almost Ideal) demand system. In this system, each product's budget share is explained by its own price, other goods' prices and the total expenditure that this demand system implies. Therefore, the estimation of the complete food demand system requires information on the quantities, expenditures and prices of all foods across a broad sample of households.

In France, the TNS Worldpanel is the main representative source of information on food expenditure. Each annual survey collects information on the food purchases of about 5,000 households. All the households involved in the survey recorded their purchases with a bar code reader. For products without bar codes (fresh products) purchases were recorded with a code notebook provided to the households. To make the survey on products without bar codes less complicated, the households were divided into two subpanels: the first recorded meat, fish and wine while the second recorded fresh fruit and vegetables. To facilitate the estimation procedure, food products were broken down into 22 categories. We disaggregated these 22 categories of products into 32 nutrients (energy, animal and vegetable proteins, carbohydrates (sugar, starch), lipids (saturated, polyunsaturated and monounsaturated fatty acids), cholesterol, alcohol, fibres, vitamin A (retinol, beta-carotene), vitamins B1, B2, B3, B5, B6, B9, B12,C, D, E, iron, calcium, magnesium, phosphorus, potassium) according to the REGAL (French food databases) food composition tables (Favier J-C., Ireland-Ripert J., Toque C. and Feinberg M. (1995) – Table de Composition, Paris: INRA editions, CNEVA-CIQUAL, Lavoisier TEC&DOC.).

Though the TNS Worldpanel covers all the food items at a highly disaggregated level, the subpanel structure does not give all the required information. We do not have the quantities and expenditures for all the food products for a given household. So a complete demand system cannot be estimated. To solve the problem of incomplete data, we built cohorts. The sample was split into two variables: (i) a geographical variable made up of 6 modalities, grouping together the adjacent regions for which we observed similarities in the category of over- and under-consumed goods; and, (ii) a variable of income classes made up of 4 modalities. This gave us 24 cohorts. The problem of unobserved data for the quantities and expenditures of households was solved by assigning the average estimated quantities and expenditures to all the households in the cohort they belonged to, for the period under consideration.

The prices were derived from the unit values obtained by dividing the expenditures by the purchased quantities of a given good. But we could not estimate these values for all products. This problem was solved by proceeding as before, but with the difference that unit values were calculated from regional averages. They were corrected for quality effects. They reflect both the average market price and the quality choices of consumers.

Cross-price elasticities measure the sensitivity of demand for a product to the price variations of another product. They are usually rather weak but do reveal some effects worthy of note. Decreasing the fresh vegetables price strongly decreases potato purchases and, to a lesser extent, salt-fat products purchases. A rise in the price of non-alcoholic beverages (except fruit juices) leads to a decrease in the purchases of potatoes, prepared meals and salt-fat products. This result is interesting because sodas are generally drunk while eating these products providing arguments for taxing soft drinks.

Following Huang and Lin (2000), we apply a calories and nutrients conversion matrix to the food elasticities and derive the calorie and nutrient elasticities from the elasticities of food demand. As in Huang and Lin (2000) and Beatty and LaFrance (2005), demand for calories and nutrients are not very sensitive to price variations. However, a rise in the price of all food categories, except fish, brings a decrease in

global calorie intakes. In the same way, there are disparities in the elasticities of calorie intakes according to income class for the majority of food categories: that of sugar-fat products is 34 % higher for modest households than for well-off households. However, a cheese/butter/cream and the sugar-fat products price increase induces a decrease in saturated fatty acids purchases and simultaneously an increase in the purchases of polyunsaturated fatty acids known to be healthier. But we don't find that same simultaneity for prepared meals: a rise in the price of these products induces a of course a decrease in saturated fatty acids purchases but to the detriment of purchases in polyunsaturated fatty acids.

The weak and ambivalent impact on calorie and nutrient purchases of the "fat tax"

In our analysis, the "fat tax" is defined as an increase in the value added tax (VAT) rates of some of the products so that it induces a 10 % rise in prices. To reduce calorie purchases, goods to be taxed are chosen according to their contribution to the global energy intakes and according to the price-elasticities of the energy intakes of the 22 food categories. To reduce the energy intakes in the most effective way, prices of prepared meals, cheese/butter/cream and sugar-fat products must be increased as a priority.

If the "fat tax" is simultaneously applied to these three categories of products, it will induce a 3.4 % reduction of the well-off households' calorie purchases and a 3.6 % reduction of the modest households' ones.

However, it is the prepared meal taxation that has the greatest impact on the modest and well-off households' calorie purchases (see graph). It leads to additional beneficial nutritional effects: reduction of sodium purchases, increase of beta-carotene and vitamin D purchases. However, these positive effects are obtained to the detriment of vegetable protein, polyunsaturated and monounsaturated fatty acids, and vitamins B1, B6, and E.

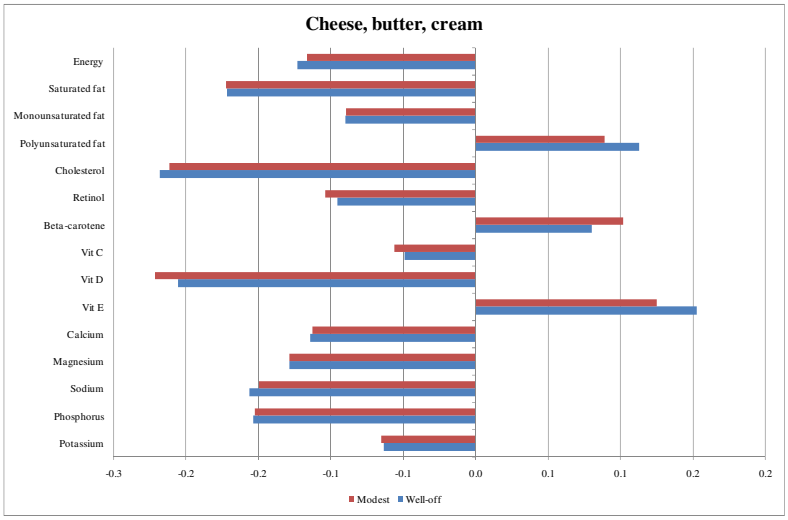
The second product category implying a great impact on the calorie purchases differs according household's category. For well-off households it is the cheese/butter/cream category which reduces the number of calories purchased while for modest households, it is the sugar-fat one. The taxation, of these two categories of products will induce the greatest decreases in saturated fatty acid and cholesterol purchases while encouraging the increase in the purchases of polyunsaturated fatty acids unlike the prepared meals. However, these positive effects are offset by the drop in the purchase of most of vitamins, calcium, magnesium, potassium and of phosphorous.

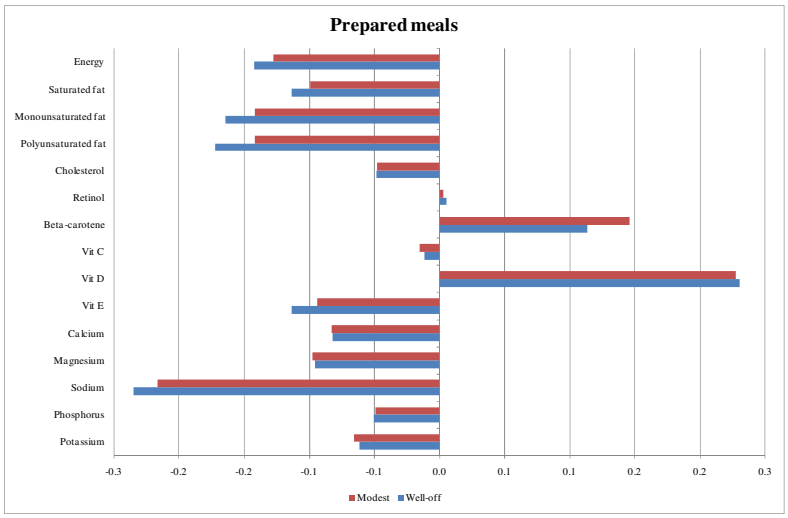
Taxing these products induce a decrease in the calories purchased, particularly via the drop in saturated fatty acid purchases and would respect the PNNS prescriptions. But the effects remain weak and ambivalent for some healthy nutrients.

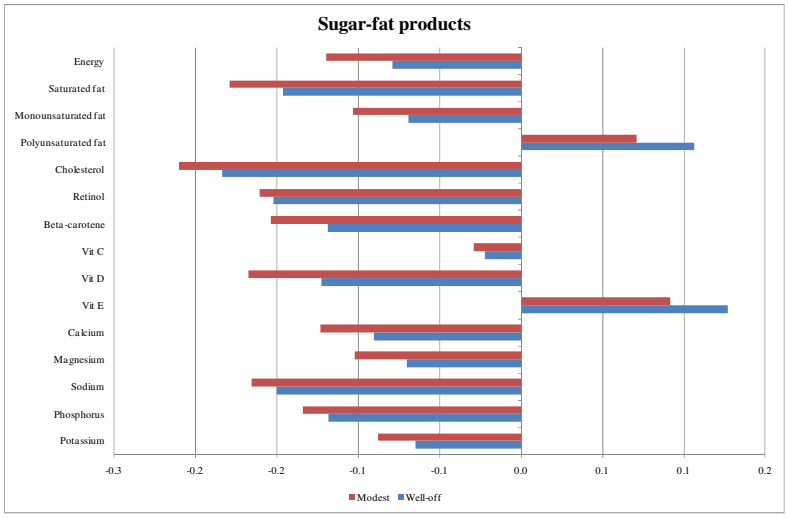
In the long-run: significant effects on individuals' body weight

Kozusko (2001) defines the body-weight dynamic according to caloric and nutritional intakes, and energy expenditure according to gender, age and lifestyle. Using this physiological model, we computed the short- and long-run effects of the "fat tax" on body weight. A 10% rise in prices for the cheese/butter/cream category, prepared meals, sugar-fat products would reduce calorie purchases respectively by 16.65 and 17.58 kcal/day; 19.30 and 19.25 kcal/day; and 10.69 and 18.02 kcal/day on average. These effects are globally weak but, if the price drop continues in the long run it may have an impact on body weight. For example, for a man between 30 and 60 years old, weighing 70 kg, practising light physical activity and belonging to a well-off household, implementation of the tax on these three categories of products would lead to a reduction in weight of 136g after a month, 1.351 kg after a year and 2.7 kg 9 years later, reaching a weight of 67.3 kg.

Graph – Variation (in %) in the quantity of nutrients purchased by well-off and modest households if cheese/butter/cream category, prepared meals or sugar-fat products prices increase by 10 % over a four-week period







The "fat tax" generates high tax revenues but has a greater effect on modest households

Despite the slight effect of taxation on nutrient purchases, it generates a big increase in tax revenues. A 10% rise in the price of cheese/butter/cream products, prepared meals and sugar-fat products induces an increase in average tax revenues per household and per 4-week period of 1.80 €; 1.09 € and 2.15 € respectively, for modest households. The global increase in tax revenues for this set of products is of 16.3 %, 9.23 % and 16.59 %.

The short-run welfare cost is defined as the decrease in total food expenditures that a household living in an environment with no tax is willing to accept while remaining indifferent to living in an environment with tax. The tax's regressive properties are calculated by setting household income per 4-week period against this cost. In this definition of welfare, we do not take into account the long-run positive effects of the tax on the household's health. With this restriction, the "fat tax" is extremely regressive. Set against their income, it generates much higher welfare costs for modest households than for well-off ones. Therefore, a 10% tax on cheese/butter/cream, prepared meals and sugar-fat products induces relative costs of 0.057 %, 0.036 % and of 0.050 % for well-off households, and 0.19 %, 0.12 % and 0.22 % for modest households, on average.

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