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The welfare effects of health-based food tax policy

Tommi Härkänen [a], Kaisa Kotakorpi [b,e,*], Pirjo Pietinen [a], Jukka Pirttilä [c,e], Heli Reinivuo [a], Ilpo Suoniemi [d]

[a] National Institute for Health and Welfare, Finland
[b] University of Turku, Finland
[c] UNU-WIDER, University of Tampere, Finland
[d] Labour Institute for Economic Research, Finland
[e] CESifo, Germany

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ABSTRACT

This paper examines the effects of health-oriented food tax reforms on the distribution of tax payments, food demand and health outcomes. We offer an illustration of how one can take into account the uncertainty related to both demand estimation and health estimates and to produce confidence intervals for the overall health effects instead of only point estimates. Taxation of sugar could lead to a statistically significant reduction in both the incidence of type 2 diabetes and coronary heart disease. The health effects appear to be most pronounced for low-income individuals, and the reforms may therefore reduce health inequality. This effect undermines the traditional regressivity argument against the heavy taxation of unhealthy food.

Introduction

Obesity is one of the most severe threats to public health in developed countries.[1] Since obesity is a major determinant of a number of illnesses, including coronary heart disease (CHD) and, especially, type 2 diabetes (T2D), governments have become increasingly interested in the possibility of using tax policy to guide consumers' dietary choices.[2]

The traditional view in economics has been that taxation can have a corrective role only if consumption causes negative externalities. However, recent literature on behavioural economics has shown that consumers sometimes make sub-optimal decisions even from the point of view of their own welfare. In particular, consumers often behave myopically, and therefore consume too much of goods with delayed negative effects – excess consumption of unhealthy food and the resulting rise in obesity rates is an important example of this type of behaviour (see e.g. O'Donoghue and Rabin, 2006). Taxation can potentially be used to counteract this tendency for over-consumption.[3]

The use of tax policy tools in influencing diet choices has attracted a large amount of recent research.[4] One part of the earlier empirical literature on health-based differentiation in food taxation has concentrated on estimating the impact of price changes on the demand for certain food categories such as soft drinks (Fletcher et al., 2010; Dharmasena and Capps, 2012; Gustavsen and Rickertsen, 2011), different types of butter and margarine (Griffith et al., 2010), dairy products (Chouinard et al., 2007) or grain products (Nordström and Thunström, 2009, 2011), often without a full-scale assessment of the potential health impacts. Another strand of earlier work has examined broader models of commodity demand (see e.g. Irz, 2010; Allais et al., 2010; Smed et al., 2007), again without a full analysis of the health issue. A few papers concentrate on detailed analysis of the health effects, but this literature often uses existing

* Corresponding author. Address: Department of Economics, Turku School of Economics, 20014 University of Turku, Finland. Tel.: +358 2 3339339.
E-mail address: kaisa.kotakorpi@utu.fi (K. Kotakorpi).

[1] See Brunello et al. (2009) for a recent survey on this issue.

[2] Various types of health-motivated food taxes have been discussed and/or implemented, to name a few countries, in the US, the UK, France, Denmark and Finland.

[3] Relatedly, Lusk and Schroeter (2012) argue that policies such as the soda tax are hard to justify unless traditional rationality assumptions are relaxed. On the other hand, even if one dislikes paternalism in general, heavy taxation of unhealthy food may be justified by externalities arising through higher public health care expenditures, as well as by the need to protect children from the long-term consequences of their parents' unhealthy lifestyles (Brunello et al., 2009).

[4] See Mytton et al. (2012) and Eyles et al. (2012) for surveys.

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estimates on commodity demand or just assumed cross-price elasticities (Mytton et al., 2007; Nnoaham et al., 2009).[5]

One exception is the paper by Tiffin and Arnoult (2011) that offers both a full commodity demand analysis and also examines the health effects of a fat tax. Finally, Jensen and Smed (2013) evaluates the outcomes of the Danish health-motivated fat tax.

In most of the existing literature, point estimates of health impacts are combined with estimated demand changes to obtain an estimate of the health effects of tax changes. Confidence intervals of these final health effects have typically not been reported.[6] A recent review by Eyles et al. (2012) concludes that taking proper account of this uncertainty is a key feature missing from earlier literature. It is important to note that significance in each stage of the analysis is a necessary, but not a sufficient condition for joint significance.[7] That is, even if the demand response caused by price changes, as well as the change in disease incidence caused by a change in demand are both statistically significant, the overall health effect is not necessarily so. Briggs et al. (2013) and Finkelstein et al. (2013) report the confidence intervals for the impact on overweight of taxes levied on sugar-sweetened drinks, but the uncertainty in health outcomes (disease incidence) has not been addressed so far.

A general worry raised in previous literature is that food tax reforms that involve price increases on unhealthy types of food and subsidies for healthier food items would be heavily regressive (see e.g. Allais et al., 2010). However, if low-income individuals have more elastic demand and/or higher levels of consumption of unhealthy food and/or poorer health to start with, the beneficial health effects of the high taxation of unhealthy food would also be greatest for them. The regressivity argument against the heavy taxation of (unhealthy) food may therefore be overturned when not only the monetary cost but also the beneficial health effects of taxation are taken into account (Kotakorpi, 2008). While Tiffin and Arnoult (2011) do not examine the issue in detail, they also point out that a possible widening of inequality in the income dimension may thus be counteracted by narrower inequality in the health dimension.[8] Nnoaham et al. (2009) study income group differences in the health and economic impacts of targeted food taxes and subsidies, but find no clear pattern for the health effects across income groups. However, they assume that price elasticities do not differ between income groups, thus assuming away a key channel through which different income groups may be differently affected by tax changes.

This paper provides an example of how to conduct a comprehensive analysis of health-based tax policy, including both an estimation of a complete food demand system and a simulation of the health consequences of changes in the consumption of different kinds of food, accounting for the uncertainty inherent in each step of the analysis. First, we use household-level budget share data from the Finnish Household Budget surveys (1995, 1998, 2001 and 2006) to estimate demand elasticities for different categories of food, using a quadratic extension of the almost ideal demand system (QAIDS) drawing on Banks et al. (1997).[9] Second, we use these elasticity estimates to assess the effects of health-oriented tax reforms on the demand of different food categories. We consider two types of tax reforms: (i) an excise tax on sugar that leads to a price increase for all foods containing (added) sugar; and (ii) a reduction in the VAT rates for fresh fish, fruit and vegetables. Third, we combine detailed data on the nutrient content of different foods and the Health 2000 Survey (Aromaa and Koskinen, 2004; Männistö et al., 2008), which represents the food intake in the Finnish population, to calculate the corresponding changes in the intake of nutrients and energy. Fourth, the implied changes in the incidence of obesity and overweight and the most important overweight-related diseases (CHD and T2D) are then calculated using the results of meta-analyses reported in the literature. We also briefly discuss the possible cost savings for the public health system from tax policy changes.

This study contributes to the literature in three main ways. First, we report confidence intervals of the health effects of food tax reforms, fully taking into account the sources of uncertainty in the four steps of the analysis described in the previous paragraph. In contrast to the earlier approaches used in the literature, we apply a bootstrap procedure that allows for externally estimated parameters. This is particularly useful for datasets that researchers often use in this context as it allows for separate estimation of the parameters involved in the different steps of the analysis. The parameters can be estimated using available data as we do for commodity demand, the population distributions of the body mass index, and food intake in the Finnish population. Some of the parameter estimates and their estimated variances can on the other hand be obtained from earlier literature and used in the analysis as externally estimated parameters, as we do in the case of the risk of contracting CHD or T2D.

Our second contribution is in analysing a general sugar tax, the impacts of which have received less attention in the earlier work than for example fat taxes or more narrowly targeted taxes on sugar-sweetened beverages. Our paper provides a comprehensive analysis of the health effects of an excise tax on sugar, combining demand estimation with a simulation of the health effects of tax reform.

Third, we pay particular attention to the way in which the effects of food taxation are distributed between population groups by examining both the monetary incidence of taxation as well as potential heterogeneity in health outcomes. In analysing differences in health outcomes across income groups, we take into account both heterogeneous responses to tax policy, as well as differences in prior eating habits and health status (body weight) across income groups.[10]

The paper proceeds by first discussing, in Section 'Demand system estimation', commodity demand estimation methods and the corresponding results. Section 'The tax reforms' introduces the tax reforms that we consider. Section 'Calculating the health effects of the tax reforms' describes the methods for assessing the health impacts and their confidence intervals. Section 'Conclusion' concludes.

Demand system estimation

Data and descriptive analysis

To estimate the food demand system, we use repeated cross sections of the Household Budget Survey of Statistics Finland from

[5] Powell and Chaloupka (2009) provide a review of articles studying the link between food prices and obesity. Two of the studies reviewed, Miljkovic and Nganje (2008) and Miljkovic et al. (2008) consider the effects of sugar prices.

[6] Nnoaham et al. (2009) provide estimates for a "worst case" and "best case" scenario of outcomes associated with each tax reform that they consider. Cash et al. (2005) analyse subsidies on fruit and vegetables and use Monte Carlo simulations to obtain confidence intervals for the associated health effects. They utilise own price elasticities (obtained from earlier literature) and ignore cross-price effects. Eyles et al. (2012) conclude that ignoring cross-price effects is another major shortcoming of much of the earlier literature.

[7] To see this consider a simplified case where joint effect is estimated as a product of statistically independent and unbiased estimators, $\hat{f}\hat{a}$, with estimators for their variance. Using $Var(\hat{f}\hat{a}) = Var(\hat{f})Var(\hat{a}) + (E\hat{f})^2 Var(\hat{a}) + (E\hat{a})^2 Var(\hat{f})$ gives "t-values" $\frac{1}{t^2_{\hat{f}\hat{a}}} = \frac{Var(\hat{f}\hat{a})}{(E\hat{f})^2 (E\hat{a})^2} = \frac{1}{t^2_{\hat{f}}}\frac{1}{t^2_{\hat{a}}} + \frac{1}{t^2_{\hat{f}}} + \frac{1}{t^2_{\hat{a}}}$. Therefore, $t_{\hat{f}\hat{a}} > \alpha \Rightarrow \min\{t^2_{\hat{f}}, t^2_{\hat{a}}\} > \alpha$.

[8] See Gruber and Köszegi (2004) for an analysis of the incidence of sin taxes in the context of cigarette taxation.

[9] Irz (2010) also examines food demand using Finnish data. His main point is methodological: he uses macro-level data and explicitly models the link between composite demand and physical quantities, which leads to a novel way to estimate nutrient elasticities. He also simulates the effects of tax changes, and we discuss below some of the differences in our results to his findings.

[10] Gustavsen and Rickertsen (2011, 2013) use quantile regression analysis and allow changes in demand to depend on the quantity of consumption.