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Potential dietary outcomes of changing relative prices of healthy and less healthy foods: The case of ready-to-eat breakfast cereals ☆

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ABSTRACT

Many prevalent and costly health disorders in the U.S. can be attributed in part to poor diets, overconsumption of calories, and physical inactivity. Taxing less healthy foods and subsidizing healthy foods as a strategy to improve diet and health has attracted growing interest among policy makers and researchers. We test this strategy by using national household purchase data to estimate a censored, price and expenditure endogenous demand system for 12 food groups that are commonly consumed at breakfast: low- and high-nutrition ready-to-eat breakfast cereals, eggs, breads, hot cereals, breakfast bars, juice, whole and reduced-fat milk, yogurt, meats, and coffee. The estimated demand elasticities are applied to nationally representative food intake data to simulate—under the assumption of perfectly price elastic supply—the potential dietary improvement from taxing low-nutrition and subsidizing high-nutrition ready-to-eat breakfast cereals. We find that the demand for both types of cereals is own-price inelastic, suggesting that consumers are not likely to make large shifts in consumption of cereals if the price changes. Thus only limited dietary improvement can be expected from taxes and subsidies. Furthermore, when the healthfulness of breakfast foods is evaluated using a comprehensive list of nutrients and food components, a price intervention strategy may result in unintended, adverse impacts. Our simulation results suggest that the hypothetical price intervention actually increases the calorie content of foods consumed at breakfast.

1. Introduction

In the U.S. there are several highly prevalent health disorders, which can be attributed in part to poor diets, overconsumption of calories, and physical inactivity (CDC, 2015; Ogden et al., 2014; USDHHS/USDA, 2015). These disorders, such as obesity, hypertension, and cardio-vascular disease impose considerable economic costs through increased health care expenditure and lost productivity (Cawley and Meyerhoefer, 2012; Finkelstein et al., 2009). Consequently, dietary improvement has been a long-term policy goal of the U.S. Federal Government. Federal policy prescriptions have included (1) providing healthy foods directly to individuals and increasing the resources available to households to buy food through an array of food and nutrition assistance programs administrated by the USDA (Oliveira, 2014), (2) increasing the information available to individuals about what constitutes a healthy diet (USDHHS/USDA, 2015), and (3) mandatory nutrition and menu labeling requirements enacted in 1994 and 2014 (FDA, 2015).

Under the premise that food prices are important determinants of consumers' food choices, policy makers and researchers have been interested in fiscal policies aimed at influencing the relative prices of foods via taxes or subsidies to promote healthier food choices. In 2008, the U.S. Congress authorized a pilot project to evaluate subsidizing the purchase of fruits, vegetables, or other healthful foods among individuals who participate in the Supplementary Nutrition Assistance Program (FNS/USDA, 2015). Using a random assignment design, a 30% rebate resulted in a 26% increase in fruit and vegetable consumption (Bartlett et al., 2014). Similarly, price intervention has been found to be effective in steering consumers toward a more healthful diet (Duffey et al., 2010; French et al., 2001, 2003; Thow et al., 2014) and relative prices of healthful and less healthful foods have been associated with changes in health conditions (Meyerhoefer and Leibtag, 2010; Powell et al., 2013; Rahkovsky and Gregory, 2013). On the other hand, other researchers found that taxes and subsidies have limited effect on food consumption, diet or health (Dharmasena and Capps, 2012; Dharmasena et al., 2014; Finkelstein et al., 2010; Fletcher et al.,

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2010; Kuchler et al., 2005; Lin et al., 2010, 2011; Mytton et al., 2012; Sharma et al., 2014; Tiffin et al., 2014; Zhen et al., 2010).

The findings that fiscal policy has limited effects on food consumption, diet or health are not surprising because many researchers find that the demand for food and beverages is price inelastic, especially when broadly defined food groups are specified in the demand system. In a review article Andreyeva et al. (2010) reported that the own-price elasticities for foods and beverages range between −0.27 and −0.81. As stated by McCloskey (1982), the "... first fundamental theorem of taxation: a tax has little effect on inelastic goods ..." (p. 309). However, the demand for broadly defined foods is less responsive to price changes than the demand for disaggregated foods because potential substitutions between closely related foods are omitted when they are aggregated into the same category. Further, the cross-price effects need to be incorporated into the analysis in order to examine the full effectiveness of fiscal policy on food consumption (Capacci et al., 2012; Cornelsen et al., 2014; Zhen et al., 2013). Clearly, more research on the effectiveness of fiscal policy on dietary improvement is needed (Thow et al., 2010). More recently, the 2015 Dietary Guidelines Advisory Committee (DGAC, 2015) concludes that "... Economic and pricing approaches, using incentives and disincentives should be explored to promote the purchase of healthier foods and beverages."

In a study evaluating the effectiveness of a supermarket shelf nutrition-information system, Rahkovsky et al. (2013) estimated a demand system of ready-to-eat (RTE) breakfast cereals, in which four categories of cereals were specified based on their nutritional profiles. In an extension of this work, Lin et al. (2014) used the estimated demand to simulate the dietary outcomes of the nutrition information system as well as a hypothetical fiscal policy of subsidizing more nutritious RTE cereals and taxing nutrition-poor RTE cereals. They found that both intervention strategies resulted in significantly increased sales of more nutritious RTE cereals at the expense of less nutritious RTE cereals, but the resulting dietary improvement was small. A major limitation of these studies is that foods and beverages that are closely related to RTE cereals consumption were omitted from the demand system. The omission of closely related foods may result in biased demand price elasticities, and the cross-price effects of omitted foods are absent in the simulation of dietary changes.

Our research objective was to investigate the dietary outcomes of implementing a hypothetical fiscal policy targeting ready-to-eat breakfast cereals (hereafter, RTE cereals), namely taxing low-nutrition and subsidizing high-nutrition RTE cereals. We used household purchase data from a national panel to estimate a demand system of 12 groups of foods and beverages that are commonly consumed at breakfast (hereafter, breakfast foods), including low- and high-nutrition ready-to-eat breakfast cereals, eggs, breads, hot cereals, breakfast bars, juice, whole and reduced-fat milk, yogurt, meats, and coffee. Because most households did not purchase all of the breakfast foods, and household characteristics influence both the quality of the foods chosen and total expenditure on breakfast foods, we specified a censored demand with endogenous prices and total breakfast food expenditure. We found that the demand for both types of cereals is own-price inelastic, suggesting that consumers are not likely to make large shifts in consumption of cereals if the price changes. Thus only limited dietary improvement can be expected from taxes and subsidies. Furthermore, when the healthfulness of breakfast foods is evaluated using a comprehensive list of nutrients and food components, a price intervention strategy may result in unintended, adverse impacts. Our simulation results suggest that the hypothetical price intervention actually increases the calorie content of foods consumed at breakfast.

Section 2 describes the data used in this study focusing on their unique roles in modeling and simulation analyses. Section 3 defines the empirical demand model and reports demand elasticity estimates. Section 4 explains the simulation method to analyze fiscal policy impacts on selected dietary quality measures and reports simulation results. Section 5 concludes.

2. Data

2.1. Data sources

Two nationwide food purchase and consumption datasets are supplemented with a nutrition database to estimate the impact of fiscal policies that change the price of RTE cereals on dietary outcomes. We estimated demand for RTE cereals using household food purchase data from the 2006 Nielsen Homescan panel (Einav et al., 2008). Since the hypothetical fiscal policy studied here was to lower the price of nutrition-rich RTE cereals and raise the price of nutrition-poor RTE cereals, we needed to classify RTE cereals into two categories according to their nutritional profiles. In this study, we fitted a wide array of nutrient and food component data into the nutrition scoring algorithm developed for the Guiding Stars Program (Fischer et al., 2011) to classify RTE cereals into nutrition-rich and nutrition-poor cereals. Since the nutritional data required for this classification was not included in the Homescan data, we turned to the Nutrition Facts Panel data found in the Gladson data (Gladson, 2015). We attached the nutrition data from Gladson to the RTE cereals reported by Homescan participants by using the Uniform Product Code (UPC), which is available in both data sets. Finally, we applied the demand elasticity estimates to the dietary recall data found in the 2005–6 National Health and Nutrition Examination Survey (NHANES) (CDC/NCHS, 2009) to simulate policy changes.

2.1.1. Nielsen homescan panel

Nielsen maintains a national panel of households who record their grocery purchases from all retail outlets (including supermarkets, super centers, club warehouses, convenience stores, drug stores, health food stores, etc.) (Einav et al., 2008). Each household (approximately 40,000) in the full 2006 Homescan panel was supplied with a scanner device to report food and beverage purchases by scanning the Uniform Product Code (UPC) for packaged foods. This study used the subsample—Fresh Foods Panel (n = 7534). Households in this subsample were supplied with an additional code book to record both UPC and non-UPC items, such as unpacked produce, meats packaged by the store, and bakery products. After excluding six households with missing demographic data, there are 7528 households included in our analysis. Each purchased item was recorded with the date, the quantity purchased, expenditure for that quantity, promotional information including whether or not the item was on sale or purchased with coupons, store type, and detailed product characteristics. In 2006, RTE cereal purchase data contain 4162 unique UPCs. We represented the price paid for each purchased item as a unit value—the ratio of reported expenditures (net any promotional and sale discounts) to the reported quantities. In order to derive consistent prices for demand estimation, all quantities were measured on the basis of ready to serve. For example, frozen concentrated juice, frozen dough, and ground and instant coffee were converted to ready-to-serve weights or fluid ounces before they are added to their respective groups.

Household purchase data are available more recently than 2006, but we used 2006 data because Americans' eating patterns shifted during the recession of 2007–2009 (Todd, 2005) and reverted back to the before-recession pattern in 2011–12