AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity

Zhen Miao, John C. Beghin, and Helen H. Jensen

Working Paper 10-WP 518
December 2010

Center for Agricultural and Rural Development
Iowa State University
Ames, Iowa 50011-1070
www.card.iastate.edu

Zhen Miao is a PhD candidate and graduate research assistant in the Department of Economics and Center for Agricultural and Rural Development (CARD), John Beghin is the Marlin Cole Professor of International Agricultural Economics in the Department of Economics, and Helen Jensen is a professor of economics in the Department of Economics and CARD, all at Iowa State University.

The authors acknowledge partial financial support from USDA under the National Research Initiative Program (2006-55215-16720). Beghin also acknowledges support from the Marlin Cole Professorship.

This paper is available online on the CARD Web site: www.card.iastate.edu. All rights reserved. Permission is granted to excerpt or quote this information with appropriate attribution to the authors.

Questions or comments about the contents of this paper should be directed to Helen Jensen, 578E Heady Hall, Iowa State University, Ames, Iowa 50011-1070; Ph: (515) 294-6253; Fax: (515) 294-6336; E-mail: hhjensen@iastate.edu.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

Iowa State University does not discriminate on the basis of race, color, age, religion, national origin, sexual orientation, gender identity, sex, marital status, disability, or status as a U.S. veteran. Inquiries can be directed to the Director of Equal Opportunity and Diversity, 3680 Beardshear Hall, (515) 294-7612.

Abstract

We extend the existing literature on food taxes targeting obesity. First, we incorporate the implicit substitution between sugar and fat nutrients implied by a complete food demand system and by conditioning on how food taxes affect total calorie intake. Second, we propose a methodology that accounts for the ability of consumers to substitute leaner low-fat and low-sugar items for rich food items within the same food group. This substitution is integrated into a demand system in addition to substitution among food groups. Simulations of a tax on added sugars show that the impact of the tax on consumption patterns is understated and the effect on welfare loss overstated when abstracting from this substitution within food groups.

Keywords: discretionary calories; fat; food demand; health policy nutrition; low-fat, low-sugar substitutes; obesity; sugar; sweeteners; tax.

JEL code: I18, Q18

ACCOUNTING FOR PRODUCT SUBSTITUTION IN THE ANALYSIS OF FOOD TAXES TARGETING OBESITY

The United States faces a major health problem in the high prevalence of obesity and its underlying cause—an imbalance between energy intake and energy requirements (Ogden et al. 2007). Obesity is associated with excessive morbidity and raises concerns about determinants of dietary choice. Policy analysts and policymakers have considered several instruments to induce consumers to more closely adhere to current dietary guidance, including targeted taxes on soda and fatty foods.

The objective of this article is to explore the consumption and welfare effects of taxes that target two important sources of excess calorie intake: added sugars and sweeteners, and discretionary solid fats. These food components are present in various foods. Most of the existing research on food taxes and obesity treat the food group in a demand system as a composite of food items with a fixed (e.g., average) content of nutrient or food components. This body of research proceeds to assess the effect of the tax on a single target ingredient and the consequent changes on the taxed nutrient. In contrast, very few studies consider sub-categories within food groups or account for the possible trade-off between targeted food components such as added sugars and fats, and the overall effect on total calorie intake. For example, Smed, Jensen, and Denver (2007) considered taxes on various combinations of foods and food components, and the combination of several tax instruments and their impact on food and nutrient consumption in Denmark. They find that consumers trade off sugar and saturated fat when only one of these components is taxed by abating one but increasing the other. Smith, Lin, and Lee (2010) find cross-product substitution within the beverage group to

be important. However, to our knowledge, no study has yet provided a systematic approach to account for the substitution between fatty and sweet food and their leaner close substitutes, and this is the void we fill.

We investigate the attribution of excess (i.e., discretionary) calories and the welfare loss when taxes are imposed on calories from added sugar, both on composite food groups as well as on sub-categories within composite food groups. By explicitly recognizing differences in the composition of the food groups, we can evaluate potential substitution that occurs both across food groups as well as within food groups. An important conjecture to investigate is that the welfare cost of abating sugar and associated calories could be systematically overstated by ignoring consumers' response to a tax as they substitute toward leaner and lighter offerings of the targeted items within food groups. The ineffectiveness of "obesity taxes" may have been overstated.

We extend the existing literature with a methodological and empirical contribution. Our study focuses on the two major sources of discretionary calories: fat (especially saturated fat) and added sugars and sweeteners. First, we incorporate the implicit substitution between sugar and fat nutrients implied by a complete food demand system and by conditioning on how food taxes affect total calorie intake. Second, we propose an empirical methodology that accounts for the ability of consumers to substitute leaner low-fat and low-sugar items for rich food items within the same food group. This substitution is integrated into a food demand system in addition to substitution among food groups. The model is calibrated to recent U.S. data to investigate the impact of a tax on added sugar. Simulations show that the impact of the tax on consumption patterns and

reduction of calorie intake is understated, and the effect on welfare loss is overstated when abstracting from the substitution within food groups.

We focus on taxes rather than subsidies for "thin" foods because a subsidy on healthy foods may not decrease calorie intake although the diet quality may improve. For example, French et al. (2001) showed such ambiguity with subsidies on low-fat, healthy snacks.

Background

The literature on obesity taxes finds that these taxes can change consumers' dietary choices, but their effectiveness is often limited (Powell and Chriqui, forthcoming), and taxes on selected foods tend to be regressive, falling disproportionally on poor consumers (Allais, Bertail, and Nichèle 2010; Smith, Lin, and Lee 2010). Demand for nutrients is found to be price inelastic. There is some limited evidence that there is a trade-off between "bad" food components (e.g., fat and sweeteners) when only one nutrient is targeted (Smed, Jensen, and Denver 2007). Fat and soda taxes can be effective, but with significant caveats. Gustavsen (2005) found that the increase of a tax on soft drinks works well, mostly with heavy consumers of soft drinks among the Norwegian households studied. Schroeter, Lusk, and Tyner (2008) also found the consumption of high-calorie foods to decrease when the price of high-calorie foods increased, but changes in consumption and body weight depend on the substitutability or complementarity among high-calorie and low-calorie foods and their relative effect on weight. Applying a tax on caloric soft drinks is relatively more efficient than offering a small subsidy on diet soft drinks in reducing calorie intake and weight. Richards, Patterson, and Tegene (2007) showed that the addiction (habit persistence) to

carbohydrates is a significant determinant of consumption and that taxes can effectively control excessive nutrient intake.

Other researchers have questioned the effectiveness of a tax. Kuchler, Tegene, and Harris (2004) found that neither consumption nor diet quality would change much with relatively low tax rates on unhealthy snacks. Allais, Bertail, and Nichèle (2010) show that a fat tax may have unintended effects, such as reducing intakes of calcium and potassium of consumers. Since food demand is price inelastic, these taxes can provide revenue to support other ways of addressing obesity (Powell and Chriqui forthcoming; Smith, Lin, and Lee 2010; and Kuchler, Tegene, and Harris 2005).

An important and often neglected aspect of the policy design is the possible trade-off between sugar and fat and the related total effect on calorie intake when a tax is imposed. Richards, Patterson, and Tegene (2007) found that taxing pretzels did not reduce the carbohydrate intake and actually increased fat and calorie intake. Taxing nuts reduced fat intake but increased carbohydrate intake. Taxing potato chips successfully reduced fat, carbohydrate, and calorie intake since there were few close substitutes. Smed, Jensen, and Denver (2007) showed that a sugar tax reduced sugar consumption but increased saturated fat consumption. A tax on saturated fat combined with a subsidy on fiber decreased saturated fat consumption but increased sugar demand. Combining the tax on saturated fat with a subsidy on fiber and a tax on sugar solves the latter problem. Their results suggest the importance of accounting for substitution possibilities among food choices.

Policy Instruments

The growing prevalence of obesity and the social costs associated with poor dietary choices motivate government intervention because of externalities. Obesity has significant external effects on the health care system, employers, and other people (Bhattacharya and Bundorf 2005), which are typically not internalized when people make food choices.

One policy instrument designed to limit discretionary calorie intake is a calorie tax broadly defined. The calorie tax raises the price of calorie-intensive foods proportionate to their calorie content in order to encourage consumers to substitute away from high-calorie foods toward low-calorie foods. Whether or not the calorie tax will be effective depends on consumers' response to the price changes of high-calorie foods and the availability of acceptable low-calorie substitutes. Under some proposals, the revenues generated from the calorie tax would finance a "thin" subsidy on healthy foods such as fruits and vegetables (Yaniv, Rosin, and Tobol 2009; and Cash, Sunding, and Zilberman 2005) or education programs to promote dietary health.

A calorie tax could be applied at different levels: calories associated with targeted food groups, items, or specific food components, such as fat, saturated fat, or sweeteners added in foods. Ad valorem taxes applied on high-calorie food items change food prices and act directly on the food demand system, leading to changes in food choices. The changes in food demand translate into nutrient intake changes. Through a fixed linear conversion, an ad valorem tax can be applied in a flexible way to a larger set of goods or to all goods by levying a tax on the calories contained in many or all food items.

An alternative approach is to levy taxes directly on the nutrients or food components themselves (e.g., fat or sweeteners). Essentially, the tax on the nutrient itself is translated into changes in food prices. Food price changes lead to food demand changes, and these lead to nutrient intake changes. Richards, Patterson, and Tegene (2007) argued that targeting the nutrients or food components is more effective than targeting foods because consumers can switch to other foods when the tax is targeted initially at the product level. Smed, Jensen, and Denver (2007) also found that taxing nutrients has a larger effect on nutrient intake than taxing foods. We formalize this idea next.

Target Food Components

In our study, the Dietary Guidelines for Americans (USDA/DHHS 2005) and the related Food Guide (USDA/ARS 2006) are used as a reference for defining the food groups and sub-categories within the food groups that capture low-/high-fat and sweetener substitutes within each food group. Following the Dietary Guidelines, the concept of discretionary calories is used to identify excess calorie intake. Discretionary calories are available to form an upper limit to additional intake after recommended food choices are met and come from foods that include calories above those available from nutrient-dense foods—foods that are low fat or free of fat and added sugar—but allow little room for other calories without increased physical activity (USDA/DHHS 2005). Calories from added sugars, solid fats, and alcoholic beverages all contribute to discretionary calories. Fats above the lowest available fat level in food sold in retail outlets such as fats in whole milk compared to skim milk and fats and oils added at the table or in the cooking process are the discretionary fats. Discretionary fats come from plant or fish sources (as discretionary oils), and from animal sources, hydrogenated vegetable oils, and a few plant

sources such as coconut oil and palm kernel (as discretionary solid fat) (Bowman, Friday, and Moshfegh 2008). Solid fats contain more saturated fats and/or transfats than do oils. (See Technical Appendix A in the Supplemental Appendices document for further details.) The recommendations on fat consumption in the 2005 Dietary Guidelines (those in place at the time of this study) are to keep consumption of calories from saturated fats to less than 10% and calories from total fat to between 20% and 35% of total calories; limit food products high in saturated fat and/or trans fatty acid; and choose meat and poultry items that are low in fat, and dry beans and milk products that are low fat or fat free.

Added sugars are the sugars and syrups added to the food at the table or added in the food processing or preparation process. For details on added sugars, see Technical Appendix B. Added sugars provide few nutrients but do provide calories. The major sources of added sugars in the U.S. diet are soft drinks; candies; cakes, cookies, pies; fruit drinks; and dairy desserts and milk products such as ice cream, sweetened yogurt, and sweetened milk. The Dietary Guidelines recommend that individuals decrease the consumption of sweetened beverages to reduce caloric intake and control weight, (USDA/DHHS 2005).

Recent data from the National Health and Nutrition Examination Survey (NHANES) (CDC 2009), a nationally representative survey of the non-institutionalized population, show that for adults (19 years and older) the usual intake of oils is 21.3 grams/day for males and 17.1 grams/day for females; the usual intake of solid fats is 55.7 grams/day for males and 39.5 grams/day for females in 2001-2004. For the same period, the usual intake of added sugars is 25.4 grams/day for males and 18.3 grams/day for

females (National Cancer Institute 2008). The daily amount of saturated fat would need to be below 22 grams for a reference 2000 total calorie intake, and below 24 grams for an intake of 2,200 total calories.

Food Demand Elasticities

Two approaches are used to estimate the price and income elasticities of nutrients. One is to directly estimate the nutrient elasticities as the function of price, income, and demographic variables (Abdulai and Aubert 2004; and Shankar 2009). The other is to estimate the demand system for foods and assume fixed nutrient contents per unit of each food type and derive nutrient elasticities from food demand. The nutrient intake change is derived through the food demand change (Smed, Jensen, and Denver 2007; and Allais, Bertail, and Nichèle 2010). For both approaches, nutrients are price inelastic.

Aggregation is an issue with the indirect approach since there exist nutrient content differences within the aggregate food group. For example, the fat content in milk differs between skim and whole milk. Chouinard et al. (2010) and Smith, Lin, and Lee (2010) show that consumers can change their nutrient intake by substituting skim milk for whole milk. We address the important aspect of substitution within food groups in effecting changes due to targeted nutrition-related price policies. We consider a complete food demand system that accounts for the ability of abating sugar and fat and associated calories when there is substitution among food products and within food categories between sugary and fatty items and leaner ones.

Model

We start with the calibrated LinQuad demand system (Beghin, Bureau, and Drogué 2004; and Miao, Beghin, and Jensen 2010) as a foundation and extend this demand system by

incorporating more nutrient information into its standard form and by explicitly accounting for close substitutes with much variation in fat and/or sweetener content within most composite food groups. The substitution within food groups is incorporated using the Armington constant elasticity of substitution (CES) function form for each composite group.

Let $\mathbf{D} = [D_1, ..., D_n]'$ be the vector of demands for the target sweet and fatty composite food groups, $\mathbf{P} = [P_1, ...P_n]'$ be the corresponding price vector, $\mathbf{P_R} = [P_{R1}, ...P_{Rz}]'$ be the price vector for all the remaining foods $\mathbf{R} = [R_1, ..., R_z]'$, and I be the income level. The consumer's utility maximization problem under the budget constraint is

$$\underset{\mathbf{D},\mathbf{R}}{Max}\ U(\mathbf{D},\mathbf{R}) \quad s.t.\ \ \mathbf{P'D} + \mathbf{P_R'R} \le I\,, \tag{1}$$

where U represents the utility function.

The LinQuad incomplete demand systems approach (LaFrance 1998) is flexible in its ability to reflect consumer preferences by incorporating the quadratic price term. It is also easy to calibrate while imposing proper curvature. The LinQuad Marshallian demand equations are

$$\mathbf{D} = \boldsymbol{\varepsilon} + \mathbf{VP} + \boldsymbol{\chi}(I - \boldsymbol{\varepsilon}'\mathbf{P} - \frac{1}{2}\mathbf{P'VP})\,, \tag{2}$$

where $\boldsymbol{\chi}, \boldsymbol{\varepsilon},$ and $\mathbf{V}$ are preference parameters. Symmetry of the Slutsky substitution matrix implies $v_{ij} = v_{ji}$. The Marshallian price elasticity for food group *i* with respect to price *j* is

$$\eta_{ij}^{M} = [v_{ij} - \chi_i(\varepsilon_j + \sum_k v_{jk}P_k)]\frac{P_j}{D_i}\,. \tag{3}$$

The income elasticity for the same food group is

$$\eta_{iI} = \chi_i \frac{I}{D_i}. \tag{4}$$

A CES Function Form for Composite Food Groups

Each food group is further decomposed into a CES composite of four sub-categories of High fat & High sugar (HH), High fat & Low sugar (HL), Low fat & High sugar (LH), and Low fat & Low sugar (LL) based on the content intensity of added sugars and discretionary fat in food items within the group. The elasticity of substitution between any two sub-categories within each composite food group is high and constant. The consumer utility function is rewritten as

$$\begin{aligned} &U(\mathbf{D},\mathbf{R}) = U(D_1, D_2, \ldots, D_n, \mathbf{R}) \\ &= U([D_{1HH}, D_{1HL}, D_{1LH}, D_{1LL}], [D_{2HH}, D_{2HL}, D_{2LH}, D_{2LL}], \ldots, [D_{nHH}, D_{nHL}, D_{nLH}, D_{nLL}], \mathbf{R}). \end{aligned} \tag{5}$$

The CES composite form for each food group *i* is

$$D_i = (\alpha_{iHH} D_{iHH}^{-\rho_i} + \alpha_{iHL} D_{iHL}^{-\rho_i} + \alpha_{iLH} D_{iLH}^{-\rho_i} + \alpha_{iLL} D_{iLL}^{-\rho_i})^{-\frac{1}{\rho_i}}, \tag{6}$$

where $\alpha_{iHH}, \alpha_{iHL}, \alpha_{iLH}, \alpha_{iLL}$ represent consumers' preferences among the sub-categories within group *i*. The elasticity of substitution within each composite food group σ_i satisfies $\sigma_i = 1/(1+\rho_i)$ and with $\sigma_i \in [0, \infty)$, from complementarity to perfect substitution.

The price of each composite food group is a function of the sub-categories' prices

$$P_i = (\alpha_{iHH}^{\sigma_i} P_{iHH}^{1-\sigma_i} + \alpha_{iHL}^{\sigma_i} P_{iHL}^{1-\sigma_i} + \alpha_{iLH}^{\sigma_i} P_{iLH}^{1-\sigma_i} + \alpha_{iLL}^{\sigma_i} P_{iLL}^{1-\sigma_i})^{\frac{1}{1-\sigma_i}}. \tag{7}$$

From the consumer's optimization, the demand for each sub-category *K* within a particular composite food group *i* is a function of the demand for the composite food group and the relative price of sub-categories within the composite food group, or

$$D_{iK} = \alpha_{iK}^{\sigma_i} D_i \left(\frac{P_{iK}}{P_i}\right)^{-\sigma_i}, \; K = HH, HL, LH, LL. \tag{8}$$

So the expenditure shares of any sub-category *K* in the group *i* can be expressed as

$$s_{iK} = \frac{D_{iK}P_{iK}}{D_i P_i} = \frac{\alpha_{iK}^{\sigma_i} D_i (\frac{P_{iK}}{P_i})^{-\sigma_i} P_{iK}}{D_i P_i} = \alpha_{iK}^{\sigma_i} (\frac{P_{iK}}{P_i})^{-\sigma_i+1},\ K = HH, HL, LH, LL. \quad (9)$$

This share decreases as its relative price increases if $\sigma_i > 1$ and vice versa if $\sigma_i < 1$.

The CES structure leads to the own-price elasticity for any sub-category *K* being a function of the cost share of the sub-category in the composite food group and the elasticity of substitution σ_i within in the composite food group

$$\eta_{iK} = -\sigma_i(1 - s_{iK}),\ K = HH, HL, LH, LL, \quad (10)$$

or eventually for calibration purposes to $\sigma_i = \eta_{iK} / (s_{iK} - 1)$.

Conversion between Foods and Nutrients

The above system of equations is modeled in the form of the final products that consumers consume. We are also interested in the nutrient intakes implied by these consumption decisions. A conversion matrix converts the food consumption implied by **D** into the nutrients in food component consumption or $\mathbf{D'C} = \mathbf{N}$, with $\mathbf{N} = [N^O, N^F, N^S, N^{cal}]$ being the vector of aggregate nutrients/food components and calories contained in the final products **D**. Superscripts *O, F, S, cal* represent discretionary liquid oil, discretionary solid fat, added sugar, and calories contained, respectively. The nutrients could also be extended to total fat, saturated fat, monounsaturated fat, and polyunsaturated fat. $\mathbf{C} = [C^O, C^F, C^S, C^{cal}]$ is the conversion matrix between food and nutrients/food component and calories with similar superscripts. The price elasticity for the fat nutrient in food is

$$\mu_i^F = \frac{\partial N^F / N^F}{\partial P_i / P_i} = \sum_j (\eta_{ji} \frac{D_j C_j^F}{\sum_l D_l C_l^F}), \quad (11)$$

and similarly for the other nutrients in food by substituting their superscripts in (11).

Welfare Effects of Taxes

A tax imposed proportionally to added sugars at a tax rate t^S leads to new prices $\mathbf{P^1} = \mathbf{P^0} + \mathbf{C^S} t^S$ and consumer welfare changes, which are measured by the equivalent variation, *EV*:

$$EV = (I - \boldsymbol{\varepsilon}'\mathbf{P^1} - \frac{1}{2}\mathbf{P^1}'\mathbf{V}\mathbf{P}^1)\exp(\boldsymbol{\chi}\mathbf{P^0} - \boldsymbol{\chi}\mathbf{P^1}) - (I - \boldsymbol{\varepsilon}'\mathbf{P^0} - \frac{1}{2}\mathbf{P^0}'\mathbf{V}\mathbf{P^0}). \quad (12)$$

Data and Calibration

Several national-level data sources were used in developing the underlying parameters used in our estimates and calculations.

Food, Nutrient and Food Component Intake

The NHANES 2003-2004 data were used to develop estimates of consumption of food and beverage intakes. The Dietary Interview data contain detailed food intake information for foods and beverages consumed during a 24-hour recall period, with the food amounts reported in the "as-consumed" form. We narrowed the sample to individuals age 20 and older who have records for both interview days and weighted the data to represent the national population. Women who were pregnant, and adults who had incomplete information on household income or household size were excluded from the sample. After screening, the sample size was 3,015 individuals.

The MyPyramid Equivalence Database (MPED) 2.0 was used to convert the amounts of food intake into intake of discretionary fat (liquid and solid) and added sugar.

Sugar substitutes were not included in added sugars. For a representative individual, the daily calorie intake was 2,187 calories, with consumption of 19.85 grams of discretionary oil, 46.58 grams of discretionary solid fat, and 82.33 grams of added sugars per day. We focus on solid fat and added sugar.

Food Groupings

The composite food groups included in the LinQuad demand system are determined by grouping the available foods that participants consumed into 25 food groups, and within each food group, into categories based on the relative amount of discretionary solid fat and of added sugar. Discretionary vegetable oils are not considered as a categorical criterion because many of these oils are "good" oil and the Guidelines focus mostly on solid fat as explained previously. The 25 food groups were defined from available USDA food groupings of foods as eaten based on relative calorie contribution and policy interest. See Appendix 1 for a detailed listing of foods in the food groups.

The initial consumption of calorie and nutrients from the 25 composite food groups are shown in Table 1. By applying prices from the USDA Center for Nutrition and Policy Promotion (CNPP) Food Price database (USDA/CNPP 2009), we estimate a daily food expenditure for all foods of $5.25 per capita for the total of the 25 composite food groups. Most of the calories that people consume daily are obtained from the composite food group "Breads, etc." (51, 52, and 54), "Grain mixtures" (58-59), and two meats groups. "Oil & Salad dressing" (82-83), "Breads, crackers and snacks" (51, 52, and 54), and "Dry beans, legumes, etc." (41-43), which includes peanut butter, are the leading sources of the discretionary oil; "Grain mixtures" (58-59), "Cakes, etc." (53 and 55), "Cheeses" (14), and "Meats" (20-24) are the top sources of discretionary solid fat; and

"Soft drinks, carbonated" (924), "Sugars and sweets" (91), and "Cakes, pastries, etc." (53 and 55) are the leading sources of added sugar.

Within each food group, four sub-categories are distinguished based on the calorie percentages from discretionary fat and added sugars of each food (high fat/high sugar; high fat/low sugar; low fat/high sugar; low fat/low sugar). The measures used to identify the four sub-categories within each composite food group are carried out in two alternative ways. One way, and the way reported in the analysis that follows, is by setting the cut-off value based on the Dietary Guidelines (2005). According to the Guidelines, the discretionary calorie allowance accommodated by a 2,200 calorie level for an individual is 290 calories, or 13% of total calories. If these discretionary calories are equally divided between discretionary solid fat and added sugar, the cut-off value for the sub-categories of the composite food groups would be 6.59% of total calories for each component (solid fat and added sugar). The other categorical approach is to delineate high/low by comparing the calorie percentage from discretionary fat and added sugars of each individual food item to the average level of the composite food group. The ex ante concern was that the chosen approach might influence the results, which, ex post, it does not.

Food items with higher values than the cut-off/average are classified as high fat/high sugar, while foods with equal or lower values than the cut-off/average are classified as low fat/low sugar. With 25 composite food groups in the LinQuad demand system and each food group divided into four sub-categories (25x4), the calories, nutrients, and expenditure data are available for the 100 sub-categories (Technical Appendix C) and provided here for selected foods in Table 2. In the rest of the article, we

report results for the cut-off decomposition and refer readers to the Technical Appendix tables for results using the average decomposition of the four types of goods. Qualitative results are similar.

Demand Parameters

To recover the parameter values in the LinQuad demand system, measures of the income elasticity η_{iI}, own-price elasticity η_{ii}^{M}, cross-price elasticity η_{ij}^{M}, income I, prices P_i, and consumption levels D_i are needed. We obtain them from the following sources.

(1) Income elasticity η_{iI} and price elasticity $\eta_{ii}^{M}, \eta_{ij}^{M}$

The USDA/ERS Commodity and Food Elasticity Dataset provides a collection of existing elasticities. The estimates come mostly from academic and government research, as published in journals and working papers. We augment these elasticities with others from Bhuyan and Lopez (1997); Reed, Levedahl, and Clark (2003); Reed, Levedahl, and Hallahan (2005); and Chouinard et al. (2010). If more than one estimate appears in the same paper, we narrow our choice as follows: we choose unconditional rather than conditional elasticities, and the most recent-year elasticities. Furthermore, we take the average of the elasticities in the same year, and the average of the elasticities for different brands of the same type of food. When available, we choose estimates for national rather than regional markets, and estimates that are for all the households instead of for disaggregated income groups. Finally, we eliminate positive own-price elasticities, and estimates for specialty foods such as organic milk with very small consumption shares because they would cause a problem in equation (10) by implying an extreme σ. After this initial selection, we remove outlying elasticities that are outside two standard

deviations of the mean level of the elasticities for the composite food group and then take the average for the remaining ones.[1]

The summary statistics for the retail Marshallian own-price elasticities and income andtotal expenditure elasticities in the United States from USDA/ERS Commodity and Food Elasticity Database and other sources are listed in Table 3. The composite food groups “Cheeses” (14), “Meat mixtures” (27, 28, and 77), and “Grain mixtures” (58-59) turn out to be price elastic while others are price inelastic. The food groups “Creams” (12), “Milk desserts and sauces” (13), “Cheeses” (14), “Dry beans, etc.” (41-43), “Sugars and sweets” (91), “Coffee & Tea” (921-923), “Soft drinks, carbonated” (924), “Alcoholic beverages” (93), and “Water” (94) are inferior goods. All the available cross-price elasticities, available from the same sources (see Technical Appendix D), are small in absolute value, which means the substitutability or complementarily among the final products will be limited.

(2) Income I

Annual household income in the NHANES 2003-2004 is reported as a range value in dollars. We choose the midpoint of the minimum and maximum of the range as the representative household income for all the individuals who fall in the range. Per capita income is obtained by dividing the household income in dollars by the household size. Based on the survey sample, the daily income for a representative consumer is $52.68.

[1] Andreyeva, Long, and Brownell (2010) provide a recent systematic review of price elasticities for foods. Although the list of foods differs, the central values for most of the price elasticities are alike except for “cheese” and “sweets/sugars.”

(3) Price and quantities

The CNPP Food Prices Database provides the cost of the foods consumed in 2003-2004. It shows the average national prices of about 4,600 food items in the "as consumed" form, matched by code to the NHANES 2003-04. The "as consumed" form of the food accounts for the loss and gain during the cooking process and the weight of any inedible portion. The food prices are the weighted averages of food prices at all food outlets and for all portion sizes, and reflect the location where the foods are purchased. There are no available "as purchased" food prices mapped to the USDA food codes, so we choose the "as consumed" food prices. The maintained assumption is that the purchased and finally prepared forms of any item are similar. For most of the food items, the food price from CNPP can be exactly matched to the consumption and nutrient data by the USDA food codes and a few missing prices are replaced by close substitutes. Prices from Bureau of Labor Statistics Consumer Price Index Database are used for all the "Alcoholic beverages" and the means of U.S. city average price in 2003 and 2004 for "Malt beverages," "Bourbon whiskey," "Vodka," and "Wine" are matched to the USDA food codes.

The expenditures on the foods are obtained by multiplying quantities of foods in the NHANES 2003-2004 times the food prices in the CNPP Food Price Database and BLS CPI Database. This allows aggregation by expenditures. And we also implicitly assume that the home preparation share for foods is the same for all foods, an approximation for which we have no other choice. All the prices for composite foods and sub-categories are initially set at $1 per unit, and expenditures become the new quantities. This type of normalization is standard in calibration, and results are independent of this normalization.

(4) Elasticity of substitution σ_i

We use the same source and screening process of the own-price elasticities for the sub-categories as elasticities for the composite food groups to derive the within-group elasticities of substitution using equation (10). The problem is overidentification since for each own-price elasticity, four corresponding elasticities of substitution can be calculated from equation (10) based on which of the four sub-categories the own-price elasticity is assigned to. We take the mean of the elasticity of substitution for each sub-category after removing the outliers that are outside two standard deviations of the mean level. Small shares of the sub-category in the composite food group will lead to small values of elasticity of substitution. For shares that are lower than 5%, the corresponding elasticity of substitutions is removed.

The cut-off classification approach shows that 98.82% of products in the composite "Cheese" (14) group are High fat & Low sugar, which gives an elasticity of the value 86.94. The cut-off classification approach also shows that 90.13% of products in the composite "Grain mixtures" (58-59) group are High fat & Low sugar, which gives an elasticity of the value 15.27. Since these two values are not credible, we replace them with the ones obtained from the average classification measure. The final calculated σ_i's under the cut-off approach are listed in Table 4.

Implementation and Results

We calibrate the LinQuad demand system for the 25 composite food groups using the own-price and income/total expenditure elasticities from Table 3 and the available cross-price elasticities (Technical Appendix D). The Marshallian price elasticity matrix for the composite food groups is recovered with the parameters in the LinQuad demand system

(see Technical Appendix E). The parameters are used in the calculation of the demand for foods, calorie, nutrients, and the welfare evaluation. The parameters within each composite food group are derived from the values of the elasticity of substitution σ_i from Table 4 through equations (8)-(9).

Next we implement a tax scenario with the simple demand system and then with the augmented system with the within-group substitution to explore what is missed when one abstracts from this important substitution.

A Tax on Calories from Added Sugar

Our analysis focuses on a food tax proportional to calories from added sugars embodied in each food type. The calorie and nutrient densities for the composite food groups before tax are measured in calorie/nutrient content per unit of food (see Technical Appendix F). Since we normalized initial prices to one dollar, these densities can be interpreted as the calories and nutrients per dollar of consumption.

The composite food groups "Sugars and sweets" (91), "Soft drinks, carbonated" (924), "Cakes, etc." (53 and 55), "Milk desserts and sauces" (13), and "Fruit juices" (612, 641, 642, 644, and 92) are the most intensive in added sugar (Technical Appendix G). The added sugars densities of the sub-categories within the composite food groups vary significantly within food groups. For example, the cut-off based measure shows that the added sugars density for the LH sub-category in "Soft drink, carbonated" (924) is high while that of the LL sub-category is zero since they are unsweetened or sugar free.

A representative consumer expends $5.25 per day on the 25 composite food groups, which provide 2,187 calories. We choose the ratio of the daily expense to the total calorie intake as the price of calories consumed (here, equal to $5.25/2187 =

$0.0024/calorie). This is approximate of course but a transparent way to derive the calorie price. The policy scenario looks at the impact of a 10% tax on the price of calories. That is, the unit price of each calorie is assumed to be 0.24¢ and rises up to 0.264¢ with the tax. As an example, a 12-ounce can of coke contains 140 calories, which are all from added sugar. By imposing a 10% tax on calories from added sugar, the tax would be equivalent to 3.35¢. This tax is reasonable and in the vicinity of tax proposals being debated (see, for example, Adamy 2009; Powell and Chriqui forthcoming; and Smith, Lin, and Lee 2010).

Results Based on the Simple Demand System (No Sub-categories)

The 10% tax on calories from added sugars is proportionate to the added sugars density of food groups. The results are shown in Table 5. The new composite food prices inclusive of the tax can also be calculated (see Technical Appendix H). Table 5 shows that with a 10% tax on the price of calories from added sugar, the demands in most composite food groups decrease except for "Potatoes" (71), "Fats" (81), "Water" (94), and "Alcoholic beverages" (93). The demands for "Soft drinks, carbonated" (924), "Sugar and sweets" (91), "Cakes, etc." (53 and 55), "Fruit juices" (612, 641, 642, 644, and 92), and "Milk desserts and sauces" (13) decrease the most since these groups are the most intensive in added sugars.

Calorie and nutrient consumption changes along with the quantities in the demand system. Since the simulation is based on the composite food groups only, the calorie and nutrient components for each composite food group are assumed to remain constant throughout the policy shock. The changes in calorie and nutrient intakes from each composite food group are exactly the same as those changes in the demands of the

composite food groups. The exceptions are “Soft drinks, carbonated” (924), which has no discretionary solid fat content, and “Water” (94). The corresponding nutrient consumptions from these composite food groups remain at zero throughout the simulation.

With the tax, the total calorie intake from the 25 composite food groups decreases 1.56%, or 34.09 calories per day (Table 6). The total discretionary solid fat and added sugars intakes obtained from all food groups decrease 0.90% and 5.53%, respectively, for amounts equivalent to 3.91 calories, and 18.95 calories assuming that solid fat provides 9 calories/gram while added sugars provide 4 calories/gram (Table 7). Over half (53.4%) of the reduction in the daily calorie intake comes from the reduction in the added sugars consumption. Nearly 70% of the reduction in the daily calorie intake (23.72 calories out of 34.09 calories) is achieved from the reduction in discretionary oil, discretionary solid fat, and added sugars consumption.

Simulation with the Expanded Demand System (With Sub-categories in Composite Groups)

Table 5 shows the results for the cut-off approach to sub-categories. Each sub-category within any composite food group faces a different specific tax given heterogeneous intensity of added sugar. The HH and LH sub-categories see larger price increases than the other two categories because they are both “high” in the added sugar. The new composite food prices in this simulation based on sub- categories are derived from equation (8), reflecting the new shares of each sub-category (see Technical Appendix H). Differences are minor between the new composite food prices with or without accounting for the within-group substitution. Not surprisingly, the 10% tax on calories from added

sugars causes decreases in the demands of most composite food groups except “Potatoes” (71), “Fats” (81), “Water” (94), and “Alcoholic beverages” (93), just as the simulation based on composite food groups only did. Magnitudes are also comparable, as shown in Table 5.

More interestingly, Table 5 also provides the proportional changes of sub-categories. The demands of HH and LH sub-categories within the composite food group decrease. Both measures show that the “Fruits” (61-67) group has big reductions in the demand of LH and HH sub-categories. “Soft drinks, carbonated” (924), “Sugars and sweets” (91), and “Coffee and Tea” (921-923) all have around 15% reductions in their HH or LH sub-categories demands. The group “Fruit juices” (612, 641, 642, 644, and 92)” has a 10% reduction in the LH sub-category demand. The group “Breads, etc.” (51, 52, and 54) has comparatively big reductions in HH and LH sub-categories demands. The largest demand increases—over 15%—are in the HL and LL sub-categories for “Milk desserts and sauces” (13). The group “Soft drinks, carbonated” (924) has the second-largest demand increase in LL sub-category at over 10%; “Sugars and sweets” (91), “Fruit juices” (612, 641, 642, 644, and 92), “Cakes, etc.” (53 and 55), “Pastas and cereals” (56-57), and “Creams” (12) have relatively large increases in the HL and LL sub-categories demands as well. For those HL and LL sub-categories that have decreases in demands, the magnitudes of the decreases are small compared to the decreases in HH and LH sub-categories.

Comparing the calorie/nutrient densities before and after the tax shows that added sugars densities for all of the composite food groups decline to lower levels with the tax (see details in Technical Appendices F-1 to F-3). But whether the calorie and

discretionary solid fat densities decrease or not varies for different composite food groups. This suggests that consumers switch to low-sugar choices within food groups but the side effects on the discretionary solid fat and oil choices depend on the particular composite food group. Tables 6 and 7 present the calorie and nutrient intake changes induced by the tax on calories from added sugar.

The total calorie intake reduction is about 2%, equivalent to 47 calories per day. The total discretionary solid fat intake reduction is small, at 0.87% (3.64 calories). The total added sugars intake reduction is around 11%, or 35 calories per day. Nearly three-fourths of the reduction in the daily calorie intake is achieved from the reduction in the added sugars consumption.

Comparison of Simulations With and Without Sub-categories Within the Composite Food Groups

With the tax implemented, calorie and nutrient intakes obtained by accounting for sub-categories deviate from those obtained without sub-categories. The differences show up not only in the magnitude of the changes but also a few times in their direction.

For the calorie, discretionary solid fat, and added sugars intakes (Tables 6 and 7), simulations without sub-categories show that for some groups, a tax on calories from added sugars leads to decreases in the total calorie intake from the composite food group but increases in total calorie intake when allowing within-group substitution ("Dry beans, etc." (41-43), and "Pastas and cereals" (56-57)). In addition, for solid fat, the group "Pastas and cereals" (56-57) shows a decrease without the CES composite good approach but an increase once the within-group substitution is accounted for. For added sugar, the group "Fats" (81) shows a small increase without the CES but a decrease with the within-

group substitution. As shown in Table 6, several foods exhibit much larger caloric decreases once the within-group substitution is accounted for, especially in food types intensive in added sugar, such as “Soft drinks” (924) and “Coffee and tea” (921-923). In aggregate, the decrease in calorie intake is considerably underestimated by the simple approach (a 2.17% versus a 1.56% decrease). As shown at the bottom of Table 7, the aggregate reduction in added sugars in the simple approach is underestimated by nearly 100% (a 5.53% versus a 10.78% decrease without and with the substitution).

Conversely, in some cases, ignoring the substitution within the food group leads to overstating reductions, as for solid fat intake for “Sugar and sweets” (91) (a 6.85% reduction versus a 1.23% reduction). Similar discrepancies are present for other food groups as well. Total discretionary solid fat consumption decreases less when accounting for the within-group substitution, but the aggregate difference is small, as shown at the bottom of Table 7 (a 0.90% reduction versus a 0.87% reduction).

The real expenditure changes under either approach are small. Table 8 shows the welfare losses due to the tax. Although the welfare losses are small, they are relatively much larger when using the simple approach that does not account for the within-group substitution. The simple method without the within-group substitution considerably overstates the cost of abating added sugars. The cost of abating added sugars is twice as large in the simple approach in comparison to the approach that accounts for the within-group substitution. Overall, the simple method overstates the cost of abating calories by over 40% with a tax on calories from added sugars. The efficiency measure is expressed as the ratio of dollars of EV per unit abated (grams or calories). Data and simulation

results for the average measures are included in Technical Appendices I-M for comparison and reference.

Summary and Discussion

In the context of obesity taxes, we investigated the importance of accounting for consumers' possibilities to substitute low-fat and low-sugar substitutes for high-fat and high-sugar food items that are targeted by taxes. To do so, we incorporated an explicit CES nesting of four close substitutes (with high or low intensity of added sugar, and discretionary fats) into a demand system for 25 food composite goods relevant for obesity policy analysis. We incorporated the four-substitute CES structure into the LinQuad demand system and calibrated the augmented demand system for the (25x4) goods using NHANES data and estimates of price and income elasticities. The calibration step was done conservatively to avoid outlying elasticity values and to reflect central estimates available in the literature. Then we implemented a tax on calories from added sugars to show the implications of ignoring within-food-group substitution possibilities. This abstraction characterizes most of the literature analyzing food taxes.

Accounting for this substitution within food groups has important consequences on the assessment of food taxes targeting obesity. With taxes in place, the internal composition of the food group changes toward leaner and lighter choices to abate the taxes. Hence, the estimated impact on calorie and added sugars intake now reflects these choices and thus shows larger reductions when the within-group substitution occurs; the estimated welfare cost of the tax is much smaller than when it is estimated by abstracting from this within-group substitution. The EV per unit of calorie/nutrient consumption

reduction is considerably overstated by the simpler approaches that overlook the consumers' ability to substitute within food groups.

The framework of this study could be extended. First, we only investigated the results when a tax is imposed on calories from added sweeteners. A tax on other nutrients and other tax designs could be considered, including some "thin" subsidies. One could also include more demographics in the analysis to explore the consumption patterns of at-risk sub-demographic groups. Finally, the analysis could incorporate various external effects on health and morbidity.

References

Abdulai, A., and D. Aubert. 2004. Nonparametric and Parametric Analysis of Calorie Consumption in Tanzania. *Food Policy* 29: 113-129.

Adamy, J. 2009. Soda Tax Weighted to Pay for Health Care. *The Wall Street Journal* May 12 http://online.wsj.com/article/SB124208505896608647.html (accessed June 2010).

Allais, O., P. Bertail, and V. Nichèle. 2010. The Effects of a Fat Tax on French Households' Purchases: A Nutritional Approach. *American Journal of Agricultural Economics* 92(1): 228-245.

Andreyeva, T., M.W. Long, and K.D. Brownell. 2010. The Impact of Food Prices on Consumption: A Systematic Review of Research on the Price Elasticity of Demand for Food. *American Journal of Public Health* 100(2): 216-222.

Beghin, J.C., J. Bureau, and S. Drogué. 2004. The Calibration of Incomplete Demand Systems in Quantitative Analysis. *Applied Economics* 36(8): 839-847.

Bhattacharya, J., and M.K. Bundorf. 2005. The Incidence of the Healthcare Costs of Obesity. NBER Working Paper 11303.

Bhuyan, S., and R.A. Lopez. 1997. Oligopoly Power in the Food and Tobacco Industries. *American Journal of Agricultural Economics* 79(3): 1035-1043.

Bowman, S.A., J.E. Friday, and A.J. Moshfegh. 2008. *MyPyramid Equivalents Database, 2.0 for USDA Survey Foods, 2003-2004: Documentation and User Guide.* Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture. http://www.ars.usda.gov/ba/bhnrc/fsrg (accessed August, 2009).

Bureau of Labor Statistics. 2010. Consumer Price Index-Average Price Data & All Urban Consumers (Current series). http://www.bls.gov/data/#prices (accessed April, 2010).

Cash, S.B., D.L. Sunding, and D. Zilberman. 2005. Fats Taxes and Thin Subsidies: Prices, Diet, and Health Outcomes. *Acta Agriculturae Scandinavica Section C*2 (3-4): 167-174.

Centers for Disease Control and Prevention, National Center for Health Statistics (CDC). 2009. National Health and Nutrition Examination Survey 2003-2004. http://www.cdc.gov/nchs/nhanes/nhanes2003-2004/nhanes03_04.htm (accessed September, 2009).

Chouinard, H.H., D.E. Davis, J.T. LaFrance, and J.M. Perloff. 2010. Milk Marketing Order Winners and Losers. *Applied Economic Perspectives and Policy* 32(1): 59-76.

French, S.A., R.W. Jeffery, M. Story, K.K. Breitlow, J.S. Baxter, P. Hannan, and M.P. Snyder. 2001. Pricing and Promotion Effects on Low-Fat Vending Snack Purchases: The CHIPS Study. *American Journal of Public Health* 91(1): 112-117.

Gustavsen, G. 2005. Public Policies and the Demand for Carbonated Soft Drinks: A Censored Quartile Regression Approach. Paper presented at the Congress of the European Association of Agricultural Economists, Copenhagen, Denmark, 24-27 August.

Kuchler, F., A Tegene, and J.M. Harris. 2004. Taxing Snack Foods: What to Expect for Diet and Tax Revenues. Agriculture Information Bulletin No. 747-08, Economics Research Service, U.S. Department of Agriculture, August.

———. 2005. Taxing Snacks Foods: Manipulating Diet Quality or Financing Information Programs? *Review of Agricultural Economics* 27(1): 4-20.

LaFrance, J.T. 1998. The LINQUAD Incomplete Demand Model. Working Paper,

Department of Agricultural and Resource Economics, University of California, Berkeley.

Miao, Z., J. Beghin, and H.H. Jensen. 2010. Taxing Sweets: Sweetener Input Tax or Final Consumption Tax? Selected Paper prepared for presentation at the Agricultural and Applied Economics Association 2010 AAEA, CAES & WAEA Joint Annual Meeting, Denver, Colorado, 25-27 July.

National Cancer Institute. 2008. Usual Dietary Intakes: Food Intakes, US Population, 2001-04. Bethesda, MD. http://riskfactor.cancer.gov/diet/usualintakes/pop/ (accessed November, 2009).

Ogden, C.L., M.D. Carroll, M.A. McDowell, and K.M. Flegal. 2007. Obesity Among Adults in the United States— No Statistically Significant Change Since 2003–2004. National Center for Health Statistics Data Brief No. 1. http://www.cdc.gov/nchs/data/databriefs/db01.pdf (accessed October, 2009).

Powell, L.M., and J.F. Chriqui. Forthcoming. Food Taxes and Subsidies: Evidence and Policies for Obesity Prevention. In J. Cawley, ed., *The Handbook of the Social Science of Obesity*. Oxford: Oxford University Press.

Reed, A.J., J.W. Levedahl, and J.S. Clark. 2003. Commercial Disappearance and Composite Demand for Food with an Application to U.S. Meats. *Journal of Agricultural and Resource Economics* 28(1): 53-70.

Reed, A.J., J.W. Levedahl, and C. Hallahan. 2005. The Generalized Composite Commodity Theorem and Food Demand Estimation. *American Journal of Agricultural Economics* 87(1): 28-37.

Richards, T.J., P.M. Patterson, and A. Tegene. 2007. Obesity and Nutrient Consumption:

A Rational Addiction? *Contemporary Economic Policy*. 25(3): 309-324.

Schroeter, C., J. Lusk, and W. Tyner. 2008. Determining the Impact of Food Price and Income Changes on Body Weight. *Journal of Health Economics* 27: 45-68.

Shankar, B. 2009. Fat Chance: Modelling the Socio-Economic Determinants of Dietary Fat Intake in China. Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, 16-22 August.

Smed, S., J.D. Jensen, and S. Denver. 2007. Socio-economic Characteristics and the Effect of Taxation as a Health Policy Instrument. *Food Policy* 32: 5-6.

Smith, T.A., B.H. Lin, and J.Y. Lee. 2010. Taxing Caloric Sweetened Beverages: Potential Effects on Beverage Consumption, Calorie Intake, and Obesity. Economic Research Report Number 100. U.S. Department of Agriculture, Economic Research Service, July.

U.S. Department of Agriculture, Agricultural Research Service (USDA/ARS). 2006. USDA Food and Nutrient Database for Dietary Studies, 2.0. Agricultural Research Service, Food Surveys Research Group.

U.S. Department of Agriculture, Center for Nutrition Policy and Promotion (USDA/CNPP). 2009. CNPP Food Prices Database, 2003-04. http://www.cnpp.usda.gov/usdafoodplanscostoffood.htm (accessed September, 2009).

U.S. Department of Agriculture and Department of Health and Human Services (USDA/DHHS). 2005. *Dietary Guidelines for Americans, 2005.*Washington, DC. http://www.health.gov/dietaryguidelines/dga2005/document/default.htm (accessed October, 2009).

U.S. Department of Agriculture, Economic Research Service (USDA/ERS). 2008.

Commodity and Food Elasticities. http://www.ers.usda.gov/Data/Elasticities (accessed October. 2009).

——. 2009. Food Availability Data System. http://www.ers.usda.gov/Data/FoodConsumption/FoodAvailIndex.htm (accessed October. 2009).

Yaniv, G., O. Rosin, and Y. Tobol. 2009. Junk-Food, Home Cooking, Physical Activity and Obesity: The Effect of the Fat Tax and the Thin Subsidy. *Journal of Public Economics* 93(5-6): 823-830.

Table 1. Initial Consumption of Calorie and Nutrients from Composite Food Groups

Composite food groups	Initial consumption			
	Calorie (kcal)	Discretionary oil (g)	Discretionary solid fat (g)	Added sugars (g)
Milk and milk drinks (11)	102.05	0.10	2.99	2.85
Creams (12)	14.83	0.11	1.13	0.54
Milk desserts and sauces (13)	46.39	0.04	2.21	3.86
Cheeses (14)	59.98	0.01	4.39	0.05
Meats (20-24)	172.88	0.99	4.03	0.06
Organ meats, sausages and lunchmeats (25)	58.55	0.01	2.81	0.08
Fish and shellfish (26)	27.75	0.29	0.50	0.04
Meat mixtures (27, 28, 77)	161.10	1.61	3.69	0.98
Eggs (31-35)	46.78	0.30	1.91	0.05
Dry beans, legumes, and nuts (41-43)	73.62	2.81	0.32	0.61
Breads, Crackers and salty snacks from grain (51, 52, 54)	262.36	2.83	3.10	3.75
Cakes, pastries & other grain products (53, 55)	140.55	0.59	4.75	10.00
Pastas and cereals (56-57)	97.14	0.25	0.34	2.91
Grain mixtures (58-59)	244.54	0.96	7.66	0.55
Fruits excluding juice (61-67, excluding 612, 641, 642, 644)	49.60	0.01	0.00	0.63
Fruit juices & Nonalcoholic beverages (612, 641, 642, 644, 92)	76.79	0.00	0.01	7.95
Potatoes (71)	102.70	1.96	2.83	0.03
Other vegetables (72-76)	62.15	0.61	1.08	0.94
Fats (81)	26.61	1.02	1.94	0.02
Oils & Salad dressings (82-83)	44.98	4.44	0.12	0.67
Sugars and sweets (91)	72.44	0.90	0.58	10.92
Coffee & Tea (921-923)	22.02	0.00	0.16	3.38
Soft drinks, carbonated (924)	129.16	0.00	0.00	30.67
Alcoholic beverages (93)	92.05	0.00	0.02	0.79
Water (94)	0.06	0.00	0.00	0.00
Total	2187.06	19.85	46.58	82.33

Table 2. Calories, Nutrients, and Expenditures of Selected Foods by Cut-off Measure

Composite food groups	Sub-categories[a]	Share of Total Calories[b]	Percent contribution to total calories			Food expenditure ($)
			Discret. oil[c]	Discret. solid fat[c]	sugars[c]	
Milk and milk drinks (11)	aggregate	4.67%	0.85%	26.38%	11.16%	0.22
	HH	1.09%	1.44%	19.88%	38.96%	0.05
	HL	2.73%	0.00%	36.96%	0.00%	0.11
	LH	0.23%	5.72%	1.22%	40.83%	0.01
	LL	0.61%	1.76%	0.16%	0.00%	0.06
Creams (12)	aggregate	0.68%	6.49%	68.51%	14.48%	0.03
	HH	0.28%	0.01%	64.28%	34.42%	0.01
	HL	0.39%	11.27%	72.24%	0.12%	0.01
	LL	0.00%	0.00%	0.00%	0.00%	0.00
Milk desserts and sauces (13)	aggregate	2.12%	0.78%	42.88%	33.31%	0.07
	HH	1.92%	0.56%	43.45%	35.48%	0.07
	HL	0.14%	1.97%	51.55%	0.66%	0.00
	LH	0.06%	5.43%	3.20%	43.43%	0.00
	LL	0.00%	0.44%	0.19%	0.00%	0.00
Cheeses (14)	aggregate	2.74%	0.15%	65.93%	0.31%	0.14
	HH	0.01%	0.03%	25.84%	24.46%	0.00
	HL	2.72%	0.15%	66.31%	0.25%	0.14
	LL	0.01%	0.24%	3.43%	0.00%	0.00
Breads, Crackers & snacks from grain products (51, 52, 54)	aggregate	12.00%	9.70%	10.63%	5.72%	0.24
	HH	1.49%	1.32%	26.79%	22.19%	0.04
	HL	3.88%	4.82%	20.94%	2.05%	0.08
	LH	1.73%	10.42%	0.16%	9.13%	0.01
	LL	4.90%	15.86%	1.24%	2.41%	0.11
Cakes, pastries & other grain products (53, 55)	aggregate	6.43%	3.78%	30.44%	28.45%	0.18
	HH	5.38%	2.07%	34.01%	31.01%	0.13
	HL	0.50%	1.99%	23.39%	1.56%	0.02
	LH	0.54%	22.04%	1.87%	28.25%	0.02
	LL	0.01%	36.35%	6.04%	0.00%	0.00
Pastas and cereals (56-57)	aggregate	4.44%	2.32%	3.20%	11.99%	0.12
	HH	0.17%	2.07%	13.19%	33.05%	0.01
	HL	0.17%	0.81%	29.17%	0.02%	0.00
	LH	1.93%	2.13%	1.28%	24.34%	0.07
	LL	2.17%	2.63%	2.06%	0.28%	0.03
Grain mixtures (58-59)	aggregate	11.18%	3.52%	28.19%	0.91%	0.53
	HH	0.08%	0.19%	27.04%	7.91%	0.00
	HL	10.01%	1.63%	31.09%	0.75%	0.48
	LH	0.05%	3.13%	0.00%	14.30%	0.00
	LL	1.04%	21.95%	1.76%	1.26%	0.05
Fruit juices (612, 641, 642, 644, 92)	aggregate	3.51%	0.04%	0.08%	41.41%	0.16
	HH	0.02%	0.42%	15.04%	57.78%	0.00
	LH	1.83%	0.07%	0.01%	78.86%	0.09
	LL	1.66%	0.00%	0.00%	0.00%	0.08
Sugars and sweets (91)	aggregate	3.31%	11.23%	7.19%	60.30%	0.10
	HH	1.38%	23.69%	16.40%	39.94%	0.05
	HL	0.01%	16.81%	38.56%	4.10%	0.00
	LH	1.84%	2.34%	0.35%	78.43%	0.04
	LL	0.08%	0.00%	0.00%	0.05%	0.00

Soft drinks, carbonated (924)	aggregate	5.91%	0.00%	0.00%	95.00%	0.30
	LH	5.80%	0.00%	0.00%	96.74%	0.21
	LL	0.11%	0.00%	0.00%	0.00%	0.09

[a] HH stands for High fat & High sugar; HL stands for High fat & Low sugar; LH stands for Low fat & High sugar; LL stands for Low fat & Low sugar.
[b] Calorie distribution within this column sums to 100%.
[c] Each gram of discretionary oil and of discretionary solid fat provides 9 calories; each gram of added sugars provides 4 calories.

Table 3. Own-Price and Income (Total Expenditures) Elasticities of Composite Food Groups

Composite food groups	Elasticities							
	Own-Price Elasticity				Income (Total Expenditures) Elasticity			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Milk and milk drinks (11)	-0.75	0.27	-0.24	-1.49	0.04	0.57	1.01	-0.56
Creams (12)	-0.45	0.13	-0.29	-0.60	-0.13	0.12	0.02	-0.26
Milk desserts and sauces (13)	-0.65	0.28	-0.34	-0.87	-0.19	0.31	0.04	-0.41
Cheeses (14)	-1.03	0.61	-0.33	-1.90	-0.08	0.28	0.50	-0.41
Meats (20-24)	-0.79	0.32	-0.07	-1.52	0.78	0.43	1.57	-0.06
Organ meats, sausages and lunchmeats (25)	-0.82	0.42	-0.36	-1.37	0.81	NA	0.81	0.81
Fish and shellfish (26)	-0.46	0.37	-0.18	-1.11	0.99	1.49	2.99	-0.48
Meat mixtures (27, 28, 77)	-1.51	0.78	-0.95	-2.06	0.58	0.95	1.26	-0.09
Eggs (31-35)	-0.11	0.05	-0.06	-0.15	0.35	0.67	0.82	-0.12
Dry beans, legumes, and nuts (41-43)	-0.77	0.50	-0.12	-1.19	-0.36	0.15	-0.21	-0.51
Breads, Crackers and salty snacks from grain (51, 52, 54)	-0.80	0.31	-0.35	-1.15	0.00	0.54	0.73	-0.55
Cakes, pastries & other grain products (53, 55)	-0.70	NA	-0.70	-0.70	0.13	NA	0.13	0.13
Pastas and cereals (56-57)	-0.56	0.29	-0.15	-0.91	0.22	0.52	0.79	-0.23
Grain mixtures (58-59)	-1.51	0.78	-0.95	-2.06	0.58	0.95	1.26	-0.09
Fruits excluding juice (61-67, excluding 612, 641, 642, 644)	-0.62	0.39	-0.03	-1.38	0.63	0.71	2.05	-0.47
Fruit juices & Nonalcoholic beverages (612, 641, 642, 644, 92)	-0.87	0.37	-0.15	-1.53	0.39	0.99	2.12	-1.36
Potatoes (71)	-0.24	0.09	-0.17	-0.37	0.29	NA	0.29	0.29
Other vegetables (72-76)	-0.52	0.44	-0.01	-1.51	0.19	0.30	0.80	-0.27
Fats (81)	-0.41	0.26	-0.14	-0.99	0.63	0.68	1.01	-0.68
Oils & Salad dressings (82-83)	-0.76	0.29	-0.43	-1.13	0.44	0.52	1.03	0.05
Sugars and sweets (91)	-0.74	0.54	0.00	-1.64	-0.20	0.29	0.19	-0.72
Coffee & Tea (921-923)	-0.60	0.45	-0.19	-1.07	-0.27	0.17	-0.15	-0.39
Soft drinks, carbonated (924)	-0.95	0.36	-0.55	-1.26	-0.03	0.08	0.03	-0.09
Alcoholic beverages (93)	-0.90	0.87	-0.29	-2.17	-0.48	NA	-0.48	-0.48
Water (94)	-0.33	NA	-0.33	-0.33	-0.20	NA	-0.20	-0.20

Sources: USDA/ERS Commodity and Food Elasticity 2008; Bhuyan and Lopez 1997; Reed, Levedahl, and Clark 2003; Reed, Levedahl, and Hallahan 2005; Chouinard, et al. 2010.

Note: NA = not available, i.e., only one elasticity is available.

Table 4. Elasticity of Substitution by Cut-off Measure

Composite food groups	Elasticity of substitution Cut-off measure
Milk and milk drinks (11)	1.05
Creams (12)	0.89
Milk desserts and sauces (13)	3.82
Cheeses (14)	2.49
Meats (20-24)	1.63
Organ meats, sausages and lunchmeats (25)	1.60
Fish and shellfish (26)	0.98
Meat mixtures (27, 28, 77)	3.65
Eggs (31-35)	2.33
Dry beans, legumes, and nuts (41-43)	1.29
Breads, Crackers and salty snacks from grain (51, 52, 54)	1.21
Cakes, pastries & other grain products (53, 55)	1.49
Pastas and cereals (56-57)	0.97
Grain mixtures (58-59)	2.40
Fruits excluding juice (61-67, excluding 612, 641, 642, 644)	5.61
Fruit juices & Nonalcoholic beverages (612, 641, 642, 644, 92)	1.73
Potatoes (71)	0.49
Other vegetables (72-76)	1.03
Fats (81)	0.98
Oils & Salad dressings (82-83)	1.18
Sugars and sweets (91)	1.41
Coffee & Tea (921-923)	1.03
Soft drinks, carbonated (924)	2.22
Alcoholic beverages (93)	2.64
Water (94)	[a]

[a] All the products in this composite food group are defined as Low Fat & Low Sugar.

Table 5. Demand Changes with Tax on Calories from Added Sugars by Cut-off Measure

Composite food groups	Relative change in demand (%)					
	Without CES	With CES				
		Composite	HH[a]	HL[a]	LH[a]	LL[a]
Milk and milk drinks (11)	-0.45%	-0.44%	-3.85%	0.82%	-3.83%	0.82%
Creams (12)	-0.63%	-0.63%	-2.77%	1.06%	NA	1.08%
Milk desserts and sauces (13)	-2.82%	-2.81%	-4.04%	16.52%	-3.93%	17.03%
Cheeses (14)	-0.06%	-0.06%	-3.81%	-0.05%	NA	0.02%
Meats (20-24)	-0.36%	-0.36%	-1.04%	-0.35%	NA	-0.35%
Organ meats, sausages and lunchmeats (25)	-0.55%	-0.54%	NA	-0.54%	-1.14%	-0.47%
Fish and shellfish (26)	-0.80%	-0.78%	NA	-0.79%	-1.89%	-0.77%
Meat mixtures (27, 28, 77)	-0.42%	-0.41%	-3.40%	-0.41%	-2.75%	-0.04%
Eggs (31-35)	-0.36%	-0.36%	-1.85%	-0.34%	-36.08%	-0.21%
Dry beans, legumes, and nuts (41-43)	-0.17%	-0.17%	-2.98%	0.44%	-1.25%	0.29%
Breads, Crackers and salty snacks from grain (51, 52, 54)	-1.20%	-1.18%	-4.55%	-0.03%	-8.17%	-0.10%
Cakes, pastries & other grain products (53, 55)	-3.87%	-3.84%	-5.41%	3.75%	-1.15%	4.07%
Pastas and cereals (56-57)	-0.13%	-0.15%	-2.67%	2.18%	-1.06%	2.09%
Grain mixtures (58-59)	-0.23%	-0.23%	-2.07%	-0.19%	-4.00%	-0.35%
Fruits excluding juice (61-67, excluding 612, 641, 642, 644)	-0.46%	-0.43%	-6.40%	-1.46%	-21.78%	0.90%
Fruit juices & Nonalcoholic beverages (612, 641, 642, 644, 92)	-3.42%	-3.29%	-4.91%	NA	-9.63%	4.35%
Potatoes (71)	0.48%	0.47%	-0.87%	0.48%	NA	0.46%
Other vegetables (72-76)	-0.42%	-0.41%	-3.99%	-0.21%	-4.57%	-0.21%
Fats (81)	0.04%	0.05%	-4.84%	0.13%	NA	-0.06%
Oils & Salad dressings (82-83)	-1.39%	-1.39%	-1.06%	0.28%	-2.82%	-0.33%
Sugars and sweets (91)	-6.85%	-6.69%	-1.05%	6.40%	-14.35%	6.79%
Coffee & Tea (921-923)	-2.17%	-2.07%	-3.94%	0.57%	-13.32%	0.57%
Soft drinks, carbonated (924)	-9.36%	-8.92%	NA	NA	-17.40%	11.09%
Alcoholic beverages (93)	0.00%	0.00%	-0.96%	NA	-1.06%	0.29%
Water (94)	0.03%	0.03%	NA	NA	NA	0.03%

Note: NA = not available, i.e., no food item is classified into the particular sub-category.

[a] HH stands for High fat & High sugar; HL stands for High fat & Low sugar; LH stands for Low fat & High sugar; LL stands for Low fat & Low sugar.

Table 6. Percentage Change in Calories with Tax on Calories from Added Sugars

Composite food groups	Calories consumption		
	Initial consumption (calorie)	Consumption change (%)	
		Without CES	With CES by Cut-off measure
Milk and milk drinks (11)	102.05	-0.45%	-0.51%
Creams (12)	14.83	-0.63%	-0.54%
Milk desserts and sauces (13)	46.39	-2.82%	-2.63%
Cheeses (14)	59.98	-0.06%	-0.05%
Meats (20-24)	172.88	-0.36%	-0.36%
Organ meats, sausages and lunchmeats (25)	58.55	-0.55%	-0.54%
Fish and shellfish (26)	27.75	-0.80%	-0.79%
Meat mixtures (27, 28, 77)	161.10	-0.42%	-0.44%
Eggs (31-35)	46.78	-0.36%	-0.36%
Dry beans, legumes, and nuts (41-43)	73.62	-0.17%	0.04%
Breads, Crackers and salty snacks from grain (51, 52, 54)	262.36	-1.20%	-1.79%
Cakes, pastries & other grain products (53, 55)	140.55	-3.87%	-4.33%
Pastas and cereals (56-57)	97.14	-0.13%	0.54%
Grain mixtures (58-59)	244.54	-0.23%	-0.23%
Fruits excluding juice (61-67, excluding 612, 641, 642, 644)	49.60	-0.46%	-1.20%
Fruit juices & Nonalcoholic beverages (612, 641, 642, 644, 92)	76.79	-3.42%	-2.98%
Potatoes (71)	102.70	0.48%	0.47%
Other vegetables (72-76)	62.15	-0.42%	-0.70%
Fats (81)	26.61	0.04%	0.05%
Oils & Salad dressings (82-83)	44.98	-1.39%	-0.96%
Sugars and sweets (91)	72.44	-6.85%	-8.24%
Coffee & Tea (921-923)	22.02	-2.17%	-7.88%
Soft drinks, carbonated (924)	129.16	-9.36%	-16.89%
Alcoholic beverages (93)	92.05	0.00%	0.09%
Water (94)	0.06	0.03%	0.03%
Total	2187.06	-1.56%	-2.17%

Table 7. Percentage Change in Calories from Discretionary Solid Fat and Added Sugars with Tax on Calories from Added Sugar

Composite food groups	Discretionary solid fat consumption			Added sugars consumption		
	Initial consumption (g)	Consumption change rate		Initial consumption (g)	Consumption change rate	
		Without CES	With CES by Cut-off measure		Without CES	With CES by Cut-off measure
Milk and milk drinks (11)	2.99	-0.45%	-0.02%	2.85	-0.45%	-3.85%
Creams (12)	1.13	-0.63%	-0.44%	0.54	-0.63%	-2.75%
Milk desserts and sauces (13)	2.21	-2.82%	-2.38%	3.86	-2.82%	-4.01%
Cheeses (14)	4.39	-0.06%	-0.05%	0.05	-0.06%	-0.77%
Meats (20-24)	4.03	-0.36%	-0.37%	0.06	-0.36%	-0.74%
Organ meats, sausages and lunchmeats (25)	2.81	-0.55%	-0.54%	0.08	-0.55%	-0.78%
Fish and shellfish (26)	0.50	-0.80%	-0.79%	0.04	-0.80%	-0.82%
Meat mixtures (27, 28, 77)	3.69	-0.42%	-0.47%	0.98	-0.42%	-0.79%
Eggs (31-35)	1.91	-0.36%	-0.34%	0.05	-0.36%	-4.99%
Dry beans, legumes, and nuts (41-43)	0.32	-0.17%	-0.10%	0.61	-0.17%	-1.41%
Breads, Crackers and salty snacks from grain (51, 52, 54)	3.10	-1.20%	-1.46%	3.75	-1.20%	-4.09%
Cakes, pastries & other grain products (53, 55)	4.75	-3.87%	-4.84%	10.00	-3.87%	-5.01%
Pastas and cereals (56-57)	0.34	-0.13%	0.80%	2.91	-0.13%	-1.19%
Grain mixtures (58-59)	7.66	-0.23%	-0.20%	0.55	-0.23%	-0.58%
Fruits excluding juice (61-67, excluding 612, 641, 642, 644)	0.00	-0.46%	-3.39%	0.63	-0.46%	-21.72%
Fruit juices & Nonalcoholic beverages (612, 641, 642, 644, 92)	0.01	-3.42%	-5.15%	7.95	-3.42%	-9.59%
Potatoes (71)	2.83	0.48%	0.48%	0.03	0.48%	0.42%
Other vegetables (72-76)	1.08	-0.42%	-0.30%	0.94	-0.42%	-4.08%
Fats (81)	1.94	0.04%	0.11%	0.02	0.04%	-2.44%
Oils & Salad dressings (82-83)	0.12	-1.39%	-0.34%	0.67	-1.39%	-2.19%
Sugars and sweets (91)	0.58	-6.85%	-1.23%	10.92	-6.85%	-10.68%
Coffee & Tea (921-923)	0.16	-2.17%	-1.57%	3.38	-2.17%	-12.40%
Soft drinks, carbonated (924)	0.00	0.00%	0.00%	30.67	-9.36%	-17.40%
Alcoholic beverages (93)	0.02	0.00%	-0.96%	0.79	0.00%	-1.04%
Water (94)	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Total	46.58	-0.90%	-0.87%	82.33	-5.53%	-10.78%

Table 8. Welfare Loss per Unit of Nutrient Consumption Reduced with Tax on Calories from Added Sugars

	Without CES	With CES by Cut-off measure
EV/Calorie reduction ($/calorie)	0.0023	0.0016
EV/Discretionary solid fat reduction ($/g)	0.1842	0.1843
EV/Added sugars reduction ($/g)	0.0169	0.0084

Note: EV is equivalent variation.

Appendix Table 1. Food Groups and Details on Foods Included in the Food Groups

Food Group	Detailed Components
Milks and milk drinks (11)	
Creams (12)	Dairy cream, cream substitutes, sour cream
Milk desserts and sauces (13)	Milk desserts (frozen), puddings, and white sauces and gravies
Cheeses (14)	Cheese, cheese mixtures and soups
Meats (20-24)	Beef , Pork, Lamb, veal, game, other carcass meat & Poultry
Organ meats, sausages and lunchmeats (25)	
Fish and shellfish (26)	
Meat in mixtures (27, 28, 77)	Meat, poultry, fish with nonmeat items and sandwiches with meat; Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; Vegetables with meat, poultry, fish
Eggs (31-35)	Eggs, egg mixtures, substitutes and egg-based frozen plate meals
Dry beans, legumes and nuts (41-43)	Legumes (including frozen and soups), nuts, nut butters, seeds and carob products
Breads, Crackers & snacks from grain (51, 52, 54)	Yeast breads, rolls; Quick breads; Crackers and salty snacks from grain products
Cakes, pastries & other grain products (53, 55)	Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products
Pasta and cereals (56-57)	Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked
Grain mixtures (58-59)	Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein
Fruits excluding juice (61-67, excluding 612+641+642+644)	
Fruit juices (612, 641, 642, 644, 92)	Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated). Includes fruitades and drinks, energy drinks, and other noncarbonated beverages.
Potatoes (71)	White potatoes and Puerto Rican starchy vegetables
Other vegetables (72-76)	Dark green, deep yellow, tomatoes and tomato mixtures, other vegetables
Fats (81)	Table fats, cooking fats
Oils (82-83)	Vegetable oils & salad dressings
Sugars and sweets (91)	Sugars, syrups, honey, jellies, ices, and candies
Coffee & Tea (921-923)	Coffee and tea
Soft drinks, carbonated (924)	Soft drinks, carbonated
Alcoholic beverages (93)	Beers, cordials/liquers, wines, and distilled liquors
Water (94)	Water, noncarbonated. Includes tap water, bottled water, and bottled/fortified water

Technical Appendix to Working Paper 10-WP 518

Accounting for Product Substitution in the Analysis of Food Taxes Targeting Obesity

Zhen Miao, John C. Beghin, and Helen H. Jensen

This Technical Appendix includes detailed information on definitions of categories and terms, and computations and related assumed values. The manuscript presents results on the use of the "cut-off" measure for disaggregating foods within each food group. The Technical Appendix includes details on both the "cut-off" measure and the alternative "average" measure. The cut-off measure defines sub-categories by setting the cut-off value based on the Dietary Guidelines (2005). We make the assumption that discretionary calories are equally divided between discretionary solid fat and added sugar, and the cut-off value for the sub-categories of the composite food groups would be 6.59% of total calories for each component (fat and added sugar). We use these values to indicate "H" (high) or "L" (low) fat and "H" (high) or "L" (low) sugar. The other approach, "average" measure, delineates high/low by comparing the calorie percentage from discretionary fat and added sugars of each individual food item to the average level of the composite food group.

List of Appendix Tables

Appendix A. Definition, Example, Health Effect, and Intake Guidelines for Saturated Fat, Unsaturated Fat, and Trans Fat
Appendix B. Definition, Source and Example of Discretionary Fats and Added Sugar
Appendix C. Calories, Nutrients, and Expenditures of Foods
- **Appendix C-1.** Calories, Nutrients, and Expenditures of Foods by Cut-off Measure
- **Appendix C-2.** Calories, Nutrients, and Expenditures of Foods by Average Measure

Appendix D. Cross-Price Elasticities of Composite Foods
Appendix E. Marshallian Elasticities of Composite Foods
Appendix F. Calorie and Nutrient Densities of Composite Food Groups
- **Appendix F-1.** Calorie and Nutrient Densities of Composite Food Groups before Tax
- **Appendix F-2.** Calorie and Nutrient Densities of Composite Food Groups with Tax on Calories from Added Sugars by Cut-off Measure
- **Appendix F-3.** Calorie and Nutrient Densities of Composite Food Groups with Tax on Calories from Added Sugars by Average Measure

Appendix G. Added Sugars Densities of Composite Food Groups and Sub-Categories
- **Appendix G-1.** Added Sugars Densities of Composite Food Groups and Sub-Categories by Cut-off Measure
- **Appendix G-2.** Added Sugars Densities of Composite Food Groups and Sub-Categories by Average Measure

Appendix H. New Prices with Tax on Calories from Added Sugar
- **Appendix H-1.** New Prices with Tax on Calories from Added Sugars by Cut-off Measure
- **Appendix H-2.** New Prices with Tax on Calories from Added Sugars by Average Measure

Appendix I. Demand Change with Tax on Calories from Added Sugars by Average Measure
Appendix J. Elasticity of Substitution by Average Measure
Appendix K. Percentage Change in Calories with Tax on Calories from Added Sugars by Average Measure
Appendix L. Percentage Change in Calories from Discretionary Solid Fat and Added Sugars with Tax on Calories from Added Sugars by Average Measure
Appendix M. Calorie Sources with Tax on Calories from Added Sugars (Calories)
Appendix N. Welfare Loss per Unit of Nutrient Consumption Reduced with Tax on Calories from Added Sugars by Average Measure

Appendix A. Definition, Example, Health Effect, and Intake Guidelines for Saturated Fat, Unsaturated Fat, and Trans Fat

Fat Type		Definition	Presence in food	Health effects	Intake guidelines
Saturated fat		Saturated fats are typically solid at room temperature.	The majority of saturated fats come from animal sources, including meat and dairy products. Examples are fatty beef, lamb, pork, poultry with skin, beef fat (tallow), lard and cream, butter, cheese and other dairy products made from whole or reduced-fat (2%) milk. In addition, many baked goods and fried foods can contain high levels of saturated fats. Some plant foods, such as palm oil, palm kernel oil and coconut oil, also contain primarily saturated fats.	Saturated fats increase the cholesterol level in the blood. High level of blood cholesterol increases the risk of heart disease and stroke.	The American Heart Association recommends limiting saturated fats to less than 7% of total daily calories. That means no more than 140 calorie (16 grams) saturated fats for a 2000 calorie need per day.
Unsaturated fat	Monounsaturated fat	Monounsaturated fats are typically liquid at room temperature but start to turn solid when chilled.	Examples of foods high in monounsaturated fats include vegetable oils such as olive oil, canola oil, peanut oil, sunflower oil and sesame oil. Other sources include avocados, peanut butter, and many nuts and seeds.	Monounsaturated and/or polyunsaturated fats can help decrease bad cholesterol levels in the blood and decrease the risk of heart disease and stroke. Monounsaturated fats are also high in vitamin E. Polyunsaturated fats also include essential fats that the body needs such as omega-6 and omega-3.	Limit the total fats to less than 25–35% of the calories intake per day. The majority of those fats should be monounsaturated or polyunsaturated. Have foods containing monounsaturated and/or polyunsaturated fats instead of foods that contain saturated and/or trans fats.
	Polyunsaturated fat	Polyunsaturated fats are typically liquid at room temperature and when chilled.	Foods high in polyunsaturated fat are vegetable oils including soybean oil, corn oil and safflower oil, as well as fatty fish such as salmon, mackerel, herring and trout. Other sources include some nuts and seeds such as walnuts and sunflower seeds.		
Trans fat		Trans fats (trans fatty acids or partially hydrogenated oils) are created in an industrial process that adds hydrogen to liquid vegetable oils to make them more solid.	Trans fats can be found in fried foods like French fries and doughnuts, and baked goods including pastries, pie crusts, biscuits, pizza dough, cookies, crackers, and stick margarines and shortenings	Trans fats increase the bad (LDL) cholesterol levels and decrease the good (HDL) cholesterol levels. Trans fats increase the risk of heart disease and stroke. It's also associated with a higher risk of type 2 diabetes.	The American Heart Association recommends limiting trans fats to less than 1% of total daily calories. That means no more than 20 calories (2 grams) from trans fats for a 2000 calorie need per day. No more industrially manufactured trans fats given the naturally occurring trans fat that have been consumed.

Source: American Heart Association 2009.

Appendix B. Definition, Source and Examples of Discretionary Fats and Added Sugar

Source of discretionary calories	Definition	Subgroup	Definition	Example	Sources
Discretionary fat	The fat above the lowest available fat level	Discretionary liquid oil	Oils are fats that are liquid at room temperature. Foods that are mainly oil include mayonnaise, some salad dressing and soft tub or squeeze margarine.	Vegetable oils used in cooking	Oils from a plant source and not described as "Hydrogenated" or "shortening"
					Fish
					Nuts and seeds
					Margarine described as "tub" or "liquid" types. If the type (stick/tub/liquid) of the margarine is not included in the description, it is classified as an oil if the recipe ingredient is an oil, or if it contains less than 80% total fat
		Discretionary solid fat	Solid fats are fats that are solids at room temperature. Solid fats mainly come from animal sources or from vegetable oils that have been hydrogenated.	Butter, beef tallow, stick margarine, and shortenings	From an animal source other than fish
					A blend of animal and plant sources (e.g., butter and margarine blend)
					Described as "hydrogenated"
					Described as "shortening"
					Cocoa fat/ fat in chocolate (not liquid)
					Derived from coconut or palm oil
					Margarine described as "stick". If the type of margarine (stick/tub/liquid) is not included in the description, or if the recipe ingredient is classified as solid or if the fat content was 80% or greater, it is classified as a solid fat
Added sugar	Added sugars are sugars consumed directly or added to foods at the table, or used as ingredients in processed and prepared foods such as breads, cakes, soft drinks, jams, chocolates, and ice cream. Added sugars do not include naturally occurring sugars such as lactose in milk or fructose in fruit.			White sugar, brown sugar, raw sugar, corn syrup, corn syrup solids, high fructose corn syrup, malt syrup, maple syrup, pancake syrup, fructose sweetener, liquid fructose, honey, molasses, anhydrous dextrose, crystal dextrose, and dextrin	

Source: Bowman, S.A., J.E. Friday, and A.J. Moshfegh 2008.

Appendix C. Calories, Nutrients, and Expenditures of Foods

Appendix C-1. Calories, Nutrients, and Expenditures of Foods by Cut-off Measure

Composite food groups	Sub-categories[a]	Calorie distribution within column[b]	Discretionary oil density[c]	Discretionary solid fat density[d]	Added sugars density[e]	Food expenditure (dollars)
11 Milks and milk drinks		4.67%	0.85%	26.38%	11.16%	0.22
	HH	1.09%	1.44%	19.88%	38.96%	0.05
	HL	2.73%	0.00%	36.96%	0.00%	0.11
	LH	0.23%	5.72%	1.22%	40.83%	0.01
	LL	0.61%	1.76%	0.16%	0.00%	0.06
12 Creams and cream substitutes		0.68%	6.49%	68.51%	14.48%	0.03
	HH	0.28%	0.01%	64.28%	34.42%	0.01
	HL	0.39%	11.27%	72.24%	0.12%	0.01
	LL	0.00%	0.00%	0.00%	0.00%	0.00
13 Milk desserts, sauces, gravies		2.12%	0.78%	42.88%	33.31%	0.07
	HH	1.92%	0.56%	43.45%	35.48%	0.07
	HL	0.14%	1.97%	51.55%	0.66%	0.00
	LH	0.06%	5.43%	3.20%	43.43%	0.00
	LL	0.00%	0.44%	0.19%	0.00%	0.00
14 Cheeses		2.74%	0.15%	65.93%	0.31%	0.14
	HH	0.01%	0.03%	25.84%	24.46%	0.00
	HL	2.72%	0.15%	66.31%	0.25%	0.14
	LL	0.01%	0.24%	3.43%	0.00%	0.00
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry		7.90%	5.15%	20.98%	0.14%	0.58
	HH	0.07%	0.13%	44.26%	8.84%	0.01
	HL	5.22%	1.43%	30.58%	0.08%	0.34
	LL	2.61%	12.72%	1.16%	0.02%	0.24

25 Organ meats, sausages and lunchmeats, and meat spreads		2.68%	0.19%	43.27%	0.54%	0.16
	HL	1.99%	0.26%	58.26%	0.43%	0.09
	LH	0.04%	0.00%	0.00%	13.31%	0.01
	LL	0.65%	0.01%	0.10%	0.04%	0.07
26 Fish and shellfish		1.27%	9.50%	16.16%	0.56%	0.19
	HL	0.92%	8.37%	21.75%	0.70%	0.12
	LH	0.00%	37.10%	0.00%	11.61%	0.00
	LL	0.35%	12.34%	1.64%	0.18%	0.07
27+28+77 Meat Mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish		7.37%	9.02%	20.60%	2.44%	0.43
	HH	0.17%	3.55%	17.92%	10.78%	0.01
	HL	5.91%	7.55%	24.95%	2.16%	0.31
	LH	0.08%	19.20%	0.46%	12.38%	0.01
	LL	1.21%	16.31%	0.97%	2.01%	0.11
31-35 Eggs		2.14%	5.68%	36.79%	0.42%	0.07
	HH	0.00%	0.01%	35.70%	12.39%	0.00
	HL	2.10%	5.09%	37.42%	0.36%	0.07
	LH	0.00%	0.00%	0.00%	89.76%	0.00
	LL	0.04%	38.16%	3.49%	0.00%	0.00
41-43 Dry beans, peas, other legumes, nuts, and seeds		3.37%	34.34%	3.92%	3.29%	0.12
	HH	0.16%	0.53%	11.42%	16.95%	0.01
	HL	0.52%	16.95%	18.17%	0.13%	0.01
	LH	0.27%	10.43%	1.38%	24.20%	0.03

	LL	2.42%	42.93%	0.65%	0.77%	0.07
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products		12.00%	9.70%	10.63%	5.72%	0.24
	HH	1.49%	1.32%	26.79%	22.19%	0.04
	HL	3.88%	4.82%	20.94%	2.05%	0.08
	LH	1.73%	10.42%	0.16%	9.13%	0.01
	LL	4.90%	15.86%	1.24%	2.41%	0.11
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products		6.43%	3.78%	30.44%	28.45%	0.18
	HH	5.38%	2.07%	34.01%	31.01%	0.13
	HL	0.50%	1.99%	23.39%	1.56%	0.02
	LH	0.54%	22.04%	1.87%	28.25%	0.02
	LL	0.01%	36.35%	6.04%	0.00%	0.00
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked		4.44%	2.32%	3.20%	11.99%	0.12
	HH	0.17%	2.07%	13.19%	33.05%	0.01
	HL	0.17%	0.81%	29.17%	0.02%	0.00
	LH	1.93%	2.13%	1.28%	24.34%	0.07
	LL	2.17%	2.63%	2.06%	0.28%	0.03
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein		11.18%	3.52%	28.19%	0.91%	0.53
	HH	0.08%	0.19%	27.04%	7.91%	0.00
	HL	10.01%	1.63%	31.09%	0.75%	0.48
	LH	0.05%	3.13%	0.00%	14.30%	0.00
	LL	1.04%	21.95%	1.76%	1.26%	0.05
61-67 (excluding 612+641+642+644)		2.27%	0.16%	0.06%	5.07%	0.23

Fruits, excluding juice						
	HH	0.00%	2.08%	32.37%	24.16%	0.00
	HL	0.00%	0.08%	29.07%	2.81%	0.00
	LH	0.21%	0.56%	0.01%	54.82%	0.01
	LL	2.05%	0.11%	0.00%	0.00%	0.21
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)		3.51%	0.04%	0.08%	41.41%	0.16
	HH	0.02%	0.42%	15.04%	57.78%	0.00
	LH	1.83%	0.07%	0.01%	78.86%	0.09
	LL	1.66%	0.00%	0.00%	0.00%	0.08
71 White potatoes and Puerto Rican starchy vegetables		4.70%	17.20%	24.79%	0.10%	0.12
	HH	0.00%	0.00%	57.91%	16.92%	0.00
	HL	2.78%	0.01%	41.62%	0.00%	0.07
	LL	1.92%	42.10%	0.39%	0.24%	0.05
72-76 Other vegetables		2.84%	8.87%	15.64%	6.06%	0.40
	HH	0.06%	8.30%	16.16%	31.64%	0.00
	HL	1.19%	4.83%	36.25%	0.29%	0.11
	LH	0.26%	5.25%	0.05%	51.52%	0.02
	LL	1.33%	13.23%	0.24%	0.98%	0.27
81 Fats		1.22%	34.46%	65.63%	0.26%	0.02
	HH	0.01%	0.00%	71.20%	25.40%	0.00
	HL	0.81%	2.18%	98.54%	0.00%	0.01
	LL	0.41%	99.15%	0.10%	0.39%	0.00
82-83 Oils & Salad dressings		2.06%	88.85%	2.39%	5.98%	0.04
	HH	0.01%	6.86%	28.14%	21.48%	0.00
	HL	0.15%	83.18%	9.13%	1.17%	0.00
	LH	0.55%	79.86%	0.48%	16.54%	0.02

	LL	1.34%	94.05%	2.15%	2.01%	0.02
91 Sugars and sweets		3.31%	11.23%	7.19%	60.30%	0.10
	HH	1.38%	23.69%	16.40%	39.94%	0.05
	HL	0.01%	16.81%	38.56%	4.10%	0.00
	LH	1.84%	2.34%	0.35%	78.43%	0.04
	LL	0.08%	0.00%	0.00%	0.05%	0.00
921-923 Coffee & Tea		1.01%	0.11%	6.57%	61.48%	0.12
	HH	0.13%	0.29%	23.30%	44.96%	0.01
	HL	0.08%	0.47%	40.93%	0.00%	0.01
	LH	0.57%	0.00%	0.00%	98.14%	0.02
	LL	0.22%	0.14%	0.00%	0.01%	0.08
924 Soft drinks, carbonated		5.91%	0.00%	0.00%	95.00%	0.30
	LH	5.80%	0.00%	0.00%	96.74%	0.21
	LL	0.11%	0.00%	0.00%	0.00%	0.09
93 Alcoholic beverages		4.21%	0.05%	0.19%	3.45%	0.68
	HH	0.02%	0.26%	38.65%	11.18%	0.00
	LH	0.60%	0.32%	0.05%	23.39%	0.14
	LL	3.59%	0.00%	0.00%	0.05%	0.53
94 Water		0.00%	0.00%	0.00%	0.00%	0.00
	LL	0.00%	0.00%	0.00%	0.00%	0.00

[a] HH stands for High fat & High sugar; HL stands for High fat & Low sugar; LH stands for Low fat & High sugar; LL stands for Low fat & Low sugar.
[b] Calorie distribution within this column sums to 100%.
[c] Percentage contribution of discretionary oil to the total calories in the food. Each gram of discretionary oil provides 9 calories.
[d] Percentage contribution of discretionary solid fat to the total calories in the food. Each gram of discretionary solid fat provides 9 calories.
[e] Percentage contribution of discretionary added sugars to the total calories in the food. Each gram of added sugars provides 4 calories.

Appendix C-2. Calories, Nutrients, and Expenditures of Foods by Average Measure

Composite food groups	Sub-categories[a]	Calorie distribution within column[b]	Discretionary oil density[c]	Discretionary solid fat density[d]	Added sugars density[e]	Food expenditure (dollars)
11 Milks and milk drinks		4.67%	0.85%	26.38%	11.16%	0.22
	HH	0.17%	0.11%	33.53%	27.79%	0.01
	HL	2.40%	0.00%	39.50%	0.00%	0.10
	LH	1.15%	2.52%	14.09%	41.16%	0.05
	LL	0.94%	1.14%	6.57%	0.03%	0.07
12 Creams and cream substitutes		0.68%	6.49%	68.51%	14.48%	0.03
	HH	0.02%	0.10%	72.59%	27.75%	0.00
	HL	0.35%	0.00%	84.34%	0.68%	0.01
	LH	0.24%	0.00%	60.47%	38.67%	0.01
	LL	0.08%	57.57%	19.80%	0.44%	0.00
13 Milk desserts, sauces, gravies		2.12%	0.78%	42.88%	33.31%	0.07
	HH	1.09%	0.02%	48.73%	36.54%	0.03
	HL	0.37%	0.17%	58.97%	21.37%	0.01
	LH	0.36%	1.25%	21.74%	45.75%	0.02
	LL	0.30%	3.72%	27.30%	21.49%	0.01
14 Cheeses		2.74%	0.15%	65.93%	0.31%	0.14
	HH	0.00%	0.00%	87.06%	2.51%	0.00
	HL	1.87%	0.16%	71.47%	0.00%	0.08
	LH	0.23%	0.01%	59.98%	3.64%	0.01
	LL	0.64%	0.16%	51.80%	0.00%	0.04
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry		7.90%	5.15%	20.98%	0.14%	0.58
	HH	0.28%	3.31%	38.58%	3.35%	0.02
	HL	3.88%	1.05%	35.20%	0.00%	0.23

	LH	0.11%	17.24%	9.28%	1.36%	0.01
	LL	3.63%	9.31%	4.78%	0.00%	0.33
25 Organ meats, sausages and lunchmeats, and meat spreads		2.68%	0.19%	43.27%	0.54%	0.16
	HH	0.65%	0.06%	59.98%	1.19%	0.02
	HL	1.29%	0.36%	58.48%	0.05%	0.07
	LH	0.06%	0.03%	4.44%	10.68%	0.01
	LL	0.67%	0.01%	0.97%	0.00%	0.07
26 Fish and shellfish		1.27%	9.50%	16.16%	0.56%	0.19
	HH	0.35%	5.92%	32.02%	1.41%	0.04
	HL	0.18%	9.23%	27.70%	0.00%	0.02
	LH	0.19%	22.78%	8.16%	1.16%	0.02
	LL	0.55%	7.33%	4.81%	0.00%	0.12
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish		7.37%	9.02%	20.60%	2.44%	0.43
	HH	1.45%	7.14%	29.14%	4.66%	0.05
	HL	2.23%	2.86%	33.18%	0.53%	0.14
	LH	1.70%	21.15%	9.96%	5.16%	0.09
	LL	1.98%	6.89%	9.32%	0.63%	0.16
31-35 Eggs		2.14%	5.68%	36.79%	0.42%	0.07
	HH	0.26%	0.20%	48.03%	1.56%	0.01
	HL	0.57%	2.13%	45.67%	0.00%	0.02
	LH	0.16%	15.16%	23.24%	3.02%	0.01
	LL	1.15%	7.32%	31.80%	0.00%	0.04
41-43 Dry beans, peas, other		3.37%	34.34%	3.92%	3.29%	0.12

legumes, nuts, and seeds						
	HH	0.23%	0.38%	9.91%	17.24%	0.01
	HL	0.52%	17.05%	18.19%	0.07%	0.01
	LH	0.26%	16.61%	0.05%	21.34%	0.02
	LL	2.37%	43.26%	0.66%	0.72%	0.07
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products		12.00%	9.70%	10.63%	5.72%	0.24
	HH	1.43%	1.31%	27.97%	22.32%	0.04
	HL	2.60%	7.11%	26.27%	0.82%	0.05
	LH	3.53%	9.82%	0.52%	7.87%	0.04
	LL	4.44%	13.82%	3.93%	1.52%	0.10
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products		6.43%	3.78%	30.44%	28.45%	0.18
	HH	1.43%	0.86%	35.49%	38.80%	0.03
	HL	2.04%	0.47%	44.83%	20.75%	0.05
	LH	1.50%	6.08%	18.80%	42.53%	0.04
	LL	1.45%	8.95%	17.25%	14.54%	0.05
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked		4.44%	2.32%	3.20%	11.99%	0.12
	HH	0.64%	1.65%	7.15%	27.50%	0.02
	HL	0.99%	2.92%	9.22%	0.00%	0.01
	LH	1.16%	2.59%	0.16%	27.59%	0.04
	LL	1.65%	2.02%	0.20%	2.15%	0.03
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein		11.18%	3.52%	28.19%	0.91%	0.53
	HH	0.60%	0.28%	35.83%	4.62%	0.04

	HL	5.58%	0.54%	38.45%	0.35%	0.28
	LH	1.09%	11.22%	13.14%	3.76%	0.05
	LL	3.91%	6.14%	16.58%	0.33%	0.16
61-67 (excluding 612+641+642+644) Fruits, excluding juice		2.27%	0.16%	0.06%	5.07%	0.23
	HH	0.00%	3.02%	16.54%	20.51%	0.00
	HL	0.01%	43.61%	13.33%	0.56%	0.00
	LH	0.21%	0.52%	0.00%	54.89%	0.01
	LL	2.05%	0.01%	0.00%	0.00%	0.21
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)		3.51%	0.04%	0.08%	41.41%	0.16
	HH	0.02%	0.42%	15.04%	57.78%	0.00
	HL	0.00%	0.81%	3.79%	40.58%	0.00
	LH	1.70%	0.08%	0.00%	82.79%	0.08
	LL	1.79%	0.00%	0.00%	2.11%	0.08
71 White potatoes and Puerto Rican starchy vegetables		4.70%	17.20%	24.79%	0.10%	0.12
	HH	0.00%	0.00%	57.91%	16.92%	0.00
	HL	2.59%	0.01%	43.40%	0.00%	0.06
	LH	0.19%	33.46%	2.93%	2.35%	0.01
	LL	1.91%	38.76%	1.85%	0.00%	0.05
72-76 Other vegetables		2.84%	8.87%	15.64%	6.06%	0.40
	HH	0.05%	0.19%	19.81%	37.92%	0.00
	HL	1.08%	4.33%	38.35%	0.24%	0.10
	LH	0.45%	31.61%	0.85%	32.90%	0.02
	LL	1.26%	4.89%	1.25%	0.21%	0.28
81 Fats		1.22%	34.46%	65.63%	0.26%	0.02
	HH	0.00%	0.00%	77.32%	14.26%	0.00

	HL	0.78%	0.00%	101.35%	0.00%	0.01
	LH	0.06%	83.25%	3.26%	4.33%	0.00
	LL	0.38%	98.25%	1.61%	0.00%	0.01
82-83 Oils & Salad dressings		2.06%	88.85%	2.39%	5.98%	0.04
	HH	0.07%	72.50%	7.68%	10.21%	0.00
	HL	0.79%	91.08%	4.93%	2.87%	0.01
	LH	0.58%	78.33%	0.36%	16.01%	0.02
	LL	0.62%	97.54%	0.48%	0.17%	0.01
91 Sugars and sweets		3.31%	11.23%	7.19%	60.30%	0.10
	HH	0.11%	8.30%	13.43%	72.39%	0.01
	HL	1.26%	25.41%	17.09%	36.40%	0.04
	LH	1.44%	0.40%	0.09%	87.21%	0.03
	LL	0.50%	7.54%	1.37%	39.73%	0.02
921-923 Coffee & Tea		1.01%	0.11%	6.57%	61.48%	0.12
	HH	0.01%	0.00%	25.42%	68.31%	0.00
	HL	0.21%	0.38%	30.39%	25.14%	0.01
	LH	0.57%	0.00%	0.00%	98.14%	0.02
	LL	0.22%	0.14%	0.00%	0.01%	0.08
924 Soft drinks, carbonated		5.91%	0.00%	0.00%	95.00%	0.30
	LH	4.87%	0.00%	0.00%	98.03%	0.18
	LL	1.03%	0.00%	0.00%	80.68%	0.12
93 Alcoholic beverages		4.21%	0.05%	0.19%	3.45%	0.68
	HH	0.03%	0.29%	29.41%	14.88%	0.00
	LH	0.62%	0.31%	0.00%	22.61%	0.15
	LL	3.56%	0.00%	0.00%	0.00%	0.52
94 Water		0.00%	0.00%	0.00%	0.00%	0.00
	LL	0.00%	0.00%	0.00%	0.00%	0.00

[a] HH is High fat & High sugar; HL is High fat & Low sugar; LH is Low fat & High sugar; LL is Low fat & Low sugar.
[b] Calorie distribution within this column sums to 100%.
[c] Percentage contribution of discretionary oil to the total calories in the food. 1 g discretionary oil = 9 calories

[d] Percentage contribution of discretionary solid fat to the total calories in the food. 1 g discretionary solid fat = 9 calories.
[e] Percentage contribution of discretionary added sugars to the total calories in the food. 1 g added sugars = 4 calories.

Appendix D. Cross-Price Elasticities of Composite Foods

Composite food groups	11	12	13	14	20-24	25	26	27+28+77	31-35	41-43	51+52+54	53+55	56-57	58-59	61-67 (excluding 612+641+642+644)	612+641+642+644+92	71	72-76	81	82-83	91	921-923	924	93	94
11 Milks and milk drinks		-9.E-03	1.E-01	1.E-02	-1.E-02	6.E-02	-2.E-02		4.E-02	-1.E-02			2.E-02		-1.E-02	-1.E-02	6.E-03	8.E-03	2.E-02		-6.E-03	1.E-02		3.E-02	
12 Creams and cream substitutes			6.E-02	7.E-02															-6.E-03						
13 Milk desserts, sauces, gravies				9.E-02															9.E-02						
14 Cheeses					-8.E-02	5.E-01	7.E-02		6.E-02	2.E-02			8.E-03		6.E-03	-3.E-02	-4.E-03	-7.E-03	-4.E-02		-3.E-02	2.E-02		-1.E-02	
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry						-6.E-03	-7.E-02		-9.E-03	2.E-02	-7.E-02		-5.E-02		4.E-03	5.E-03	4.E-02	1.E-03	-2.E-03		-1.E-02	6.E-03		1.E-02	
25 Organ meats, sausages and lunchmeats, and meat spreads							-1.E-02		-1.E-02	3.E-02	-2.E-01		-8.E-02		1.E-02	-2.E-02	-3.E-03	3.E-02	-2.E-02		-5.E-03	-7.E-03		3.E-03	
26 Fish and shellfish									-6.E-02	-3.E-02	-1.E-01		-5.E-02		-3.E-02	7.E-03	4.E-02	-2.E-02	-7.E-02		-3.E-02	2.E-03		-3.E-03	
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish																									
31-35 Eggs										-5.E-03	-2.E-01		-3.E-02		-2.E-02	3.E-02	-2.E-03	-1.E-03	-1.E-02		-2.E-02	8.E-03		9.E-03	
41-43 Dry beans, peas, other legumes, nuts, and seeds													3.E-02		6.E-03	-2.E-02	-6.E-02	-1.E-03	-1.E-02		2.E-02	-5.E-03		8.E-03	
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products													2.E-02		-1.E-02	-6.E-03			-3.E-02						
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products																									
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked															5.E-04	7.E-03	2.E-02	2.E-02	-4.E-02		1.E-01	-4.E-02		1.E-02	
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein																									
61-67 (excluding 612+641+642+644) Fruits																-1.E-02	1.E-02	-8.E-03	2.E-02		-1.E-02	-3.E-03		3.E-04	

612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)																	-2.E-02	9.E-04	-2.E-02		7.E-02	-2.E-02		1.E-02	
71 White potatoes and Puerto Rican starchy vegetables																		-3.E-03	-3.E-02		4.E-02	6.E-02		-2.E-02	
72-76 Other vegetables																			-5.E-02		-3.E-02	1.E-03		4.E-03	
81 Fats																				6.E-03	2.E-02	4.E-03		3.E-02	
82-83 Oils & Salad dressings																									
91 Sugars and sweets																						-4.E-02		-3.E-03	
921-923 Coffee & Tea																								3.E-03	
924 Soft drinks, carbonated																									
93 Alcoholic beverages																									
94 Water																									

Sources: USDA/ERS 2008; Bhuyan and Lopez 1997; Reed, Levedahl, and Clark 2003; Reed, Levedahl, and Hallahan 2005; Chouinard et al. 2010.

Appendix E. Mashallian Elasticities of Composite Foods

Composite food groups	11	12	13	14	20-24	25	26	27+28+77	31-35	41-43	51+52+54	53+55	56-57	58-59	61-67 (excluding 612+641+642+644)	612+641+642+644+92	71	72-76	81	82-83	91	921-923	924	93	94
11 Milks and milk drinks	-7.E-01	-9.E-03	1.E-01	1.E-02	-1.E-02	6.E-02	-2.E-02	-1.E-04	4.E-02	-1.E-02	-2.E-04	-1.E-04	2.E-02	-2.E-04	-1.E-02	-1.E-02	6.E-03	8.E-03	2.E-02	-2.E-05	-6.E-03	1.E-02	-2.E-04	3.E-02	-1.E-06
12 Creams and cream substitutes	-7.E-02	-4.E-01	6.E-02	7.E-02	5.E-04	1.E-04	6.E-05	5.E-04	1.E-04	4.E-04	6.E-04	4.E-04	2.E-04	6.E-04	2.E-04	3.E-04	2.E-04	8.E-04	-6.E-03	5.E-05	3.E-04	4.E-04	7.E-04	2.E-03	5.E-06
13 Milk desserts, sauces, gravies	3.E-01	2.E-02	-7.E-01	9.E-02	7.E-04	2.E-04	9.E-05	7.E-04	2.E-04	5.E-04	8.E-04	5.E-04	3.E-04	9.E-04	4.E-04	4.E-04	3.E-04	1.E-03	9.E-02	8.E-05	4.E-04	5.E-04	1.E-03	3.E-03	7.E-06
14 Cheeses	2.E-02	1.E-02	5.E-02	-1.E+00	-8.E-02	5.E-01	7.E-02	3.E-04	6.E-02	2.E-02	4.E-04	2.E-04	8.E-03	4.E-04	6.E-03	-3.E-02	-4.E-03	-7.E-03	-4.E-02	3.E-05	-3.E-02	2.E-02	5.E-04	-1.E-02	3.E-06
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	-9.E-03	-4.E-04	-1.E-03	-2.E-02	-8.E-01	-7.E-03	-7.E-02	-3.E-03	-9.E-03	2.E-02	-7.E-02	-2.E-03	-5.E-02	-4.E-03	4.E-03	5.E-03	4.E-02	1.E-03	-1.E-03	-3.E-04	-1.E-02	6.E-03	-5.E-03	1.E-02	-3.E-05
25 Organ meats, sausages and lunchmeats, and meat spreads	8.E-02	-5.E-04	-1.E-03	4.E-01	-3.E-02	-8.E-01	-1.E-02	-3.E-03	-1.E-02	3.E-02	-2.E-01	-2.E-03	-8.E-02	-4.E-03	1.E-02	-2.E-02	-3.E-03	3.E-02	-2.E-02	-3.E-04	-5.E-03	-7.E-03	-5.E-03	3.E-03	-3.E-05
26 Fish and shellfish	-2.E-02	-6.E-04	-2.E-03	5.E-02	-2.E-01	-1.E-02	-5.E-01	-4.E-03	-6.E-02	-3.E-02	-1.E-01	-3.E-03	-5.E-02	-5.E-03	-3.E-02	7.E-03	4.E-02	-2.E-02	-7.E-02	-4.E-04	-3.E-02	2.E-03	-6.E-03	-4.E-03	-3.E-05
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	-2.E-03	-3.E-04	-1.E-03	-2.E-03	-2.E-03	-5.E-04	-3.E-04	-2.E+00	-6.E-04	-2.E-03	-3.E-03	-2.E-03	-1.E-03	-3.E-03	-1.E-03	-1.E-03	-1.E-03	-4.E-03	-1.E-04	-2.E-04	-1.E-03	-2.E-03	-3.E-03	-1.E-02	-2.E-05
31-35 Eggs	1.E-01	-2.E-04	-6.E-04	1.E-01	-7.E-02	-2.E-02	-2.E-01	-1.E-03	-1.E-01	-5.E-03	-2.E-01	-1.E-03	-3.E-02	-2.E-03	-2.E-02	3.E-02	-2.E-03	-1.E-03	-1.E-02	-1.E-04	-2.E-02	8.E-03	-2.E-03	9.E-03	-1.E-05
41-43 Dry beans, peas, other legumes, nuts, and seeds	-2.E-02	2.E-04	6.E-04	2.E-02	1.E-01	4.E-02	-5.E-02	1.E-03	-2.E-03	-8.E-01	2.E-03	1.E-03	3.E-02	2.E-03	6.E-03	-2.E-02	-5.E-02	-1.E-03	-1.E-02	2.E-04	2.E-02	-5.E-03	2.E-03	8.E-03	1.E-05
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	1.E-05	2.E-06	5.E-06	9.E-06	-2.E-01	-1.E-01	-1.E-01	1.E-05	-7.E-02	1.E-05	-8.E-01	1.E-05	2.E-02	2.E-05	-1.E-02	-6.E-03	6.E-06	2.E-05	-3.E-02	1.E-06	8.E-06	9.E-06	2.E-05	6.E-05	1.E-07
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	-5.E-04	-7.E-05	-2.E-04	-4.E-04	-4.E-04	-1.E-04	-6.E-05	-5.E-04	-1.E-04	-4.E-04	-6.E-04	-7.E-01	-2.E-04	-6.E-04	-2.E-04	-3.E-04	-2.E-04	-8.E-04	-2.E-05	-5.E-05	-3.E-04	-3.E-04	-7.E-04	-2.E-03	-4.E-06
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	4.E-02	-1.E-04	-4.E-04	9.E-03	-2.E-01	-1.E-01	-8.E-02	-9.E-04	-2.E-02	3.E-02	4.E-02	-7.E-04	-6.E-01	-1.E-03	5.E-04	7.E-03	2.E-02	2.E-02	-4.E-02	-1.E-04	1.E-01	-4.E-02	-1.E-03	1.E-02	-8.E-06
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	-2.E-03	-3.E-04	-1.E-03	-2.E-03	-2.E-03	-5.E-04	-3.E-04	-2.E-03	-6.E-04	-2.E-03	-3.E-03	-2.E-03	-1.E-03	-2.E+00	-1.E-03	-1.E-03	-1.E-03	-4.E-03	-1.E-04	-2.E-04	-1.E-03	-2.E-03	-3.E-03	-1.E-02	-2.E-05
61-67 (excluding 612+641+642+644) Fruits, excluding juice	-2.E-02	-4.E-04	-1.E-03	2.E-03	1.E-02	9.E-03	-2.E-02	-2.E-03	-8.E-03	9.E-04	-1.E-02	-2.E-03	-7.E-04	-3.E-03	-6.E-01	-1.E-02	1.E-02	-8.E-03	2.E-02	-3.E-04	-1.E-02	-3.E-03	-4.E-03	-1.E-04	-2.E-05
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	-2.E-02	-2.E-04	-6.E-04	-2.E-02	2.E-02	-1.E-02	1.E-02	-2.E-03	1.E-02	-1.E-02	-1.E-02	-1.E-03	5.E-03	-2.E-03	-2.E-02	-9.E-01	-2.E-02	8.E-04	-2.E-02	-2.E-04	7.E-02	-2.E-02	-2.E-03	1.E-02	-1.E-05
71 White potatoes and Puerto Rican starchy vegetables	1.E-02	-2.E-04	-5.E-04	-6.E-03	2.E-01	-3.E-03	7.E-02	-1.E-03	-1.E-03	-6.E-02	-1.E-03	-8.E-04	2.E-02	-1.E-03	2.E-02	-2.E-02	-2.E-01	-3.E-03	-3.E-02	-1.E-04	4.E-02	6.E-02	-2.E-03	-2.E-02	-1.E-05
72-76 Other vegetables	4.E-03	-1.E-04	-3.E-04	-3.E-03	8.E-03	1.E-02	-6.E-03	-8.E-04	1.E-05	-2.E-03	-9.E-04	-6.E-04	7.E-03	-9.E-04	-3.E-03	9.E-04	-7.E-04	-5.E-01	-5.E-02	-8.E-05	-3.E-02	1.E-03	-1.E-03	4.E-03	-7.E-06
81 Fats	2.E-01	-9.E-03	3.E-01	-3.E-01	-3.E-02	-1.E-01	-7.E-01	-2.E-03	-6.E-02	-8.E-02	-4.E-01	-2.E-03	-3.E-01	-3.E-03	2.E-01	-1.E-01	-2.E-01	-1.E+00	-4.E-01	6.E-03	2.E-02	4.E-03	-4.E-03	3.E-02	-2.E-05
82-83 Oils & Salad dressings	-2.E-03	-2.E-04	-7.E-04	-1.E-03	-2.E-03	-4.E-04	-2.E-04	-2.E-03	-4.E-04	-1.E-03	-2.E-03	-1.E-03	-8.E-04	-2.E-03	-8.E-04	-9.E-04	-8.E-04	-3.E-03	3.E-03	-8.E-01	-1.E-03	-1.E-03	-3.E-03	-8.E-03	-2.E-05
91 Sugars and sweets	-1.E-02	1.E-04	3.E-04	-4.E-02	-5.E-02	-5.E-03	-6.E-02	8.E-04	-1.E-02	2.E-02	9.E-04	6.E-04	1.E-01	1.E-03	-2.E-02	1.E-01	5.E-02	-1.E-01	4.E-03	8.E-05	-7.E-01	-4.E-02	1.E-03	-2.E-03	7.E-06
921-923 Coffee & Tea	3.E-02	2.E-04	4.E-04	3.E-02	4.E-02	-6.E-03	8.E-03	1.E-03	6.E-03	-5.E-03	1.E-03	8.E-04	-4.E-02	1.E-03	-2.E-03	-3.E-02	6.E-02	9.E-03	9.E-04	1.E-04	-4.E-02	-6.E-01	2.E-03	3.E-03	1.E-05
924 Soft drinks, carbonated	1.E-04	2.E-05	5.E-05	9.E-05	1.E-04	3.E-05	2.E-05	1.E-04	3.E-05	9.E-05	1.E-04	9.E-05	5.E-05	2.E-04	6.E-05	6.E-05	5.E-05	2.E-04	5.E-06	1.E-05	7.E-05	9.E-05	-1.E+00	6.E-04	1.E-06
93 Alcoholic beverages	1.E-02	3.E-04	8.E-04	-2.E-03	2.E-02	5.E-03	4.E-03	2.E-03	2.E-03	2.E-03	2.E-03	1.E-03	3.E-03	2.E-03	5.E-03	6.E-03	-1.E-03	8.E-03	1.E-03	2.E-04	2.E-04	1.E-03	3.E-03	-9.E-01	2.E-05
94 Water	8.E-04	1.E-04	3.E-04	6.E-04	7.E-04	2.E-04	1.E-04	8.E-04	2.E-04	6.E-04	9.E-04	6.E-04	4.E-04	1.E-03	4.E-04	4.E-04	3.E-04	1.E-03	3.E-05	9.E-05	5.E-04	6.E-04	1.E-03	4.E-03	-3.E-01

Note: Elasticities are from USDA/ERS 2008; Bhuyan and Lopez 1997; Reed, Levedahl, and Clark 2003; Reed, Levedahl, and Hallahan 2005; Chouinard et al. 2010.

Appendix F. Calorie and Nutrient Densities of Composite Food Groups

Appendix F-1. Calorie and Nutrient Densities of Composite Food Groups before Tax

Composite food groups	Calorie/Nutrient Density			
	Calorie (calorie/ unit)	Discretionary oil (g/unit)	Discretionary solid fat (g/unit)	Added sugars (g/unit)
11 Milks and milk drinks	453.60	0.43	13.29	12.66
12 Creams and cream substitutes	558.38	4.03	42.50	20.21
13 Milk desserts, sauces, gravies	626.99	0.55	29.87	52.22
14 Cheeses	431.13	0.07	31.58	0.34
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	295.77	1.69	6.90	0.10
25 Organ meats, sausages and lunchmeats, and meat spreads	355.25	0.08	17.08	0.48
26 Fish and shellfish	143.56	1.52	2.58	0.20
27+28+77 Meat mixtures Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	377.55	3.78	8.64	2.30
31-35 Eggs	629.78	3.97	25.74	0.66
41-43 Dry beans, peas, other legumes, nuts, and seeds	626.27	23.90	2.73	5.15
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	1102.37	11.88	13.02	15.75
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	801.62	3.37	27.11	57.01
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	842.53	2.17	2.99	25.25
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	461.44	1.81	14.45	1.05
61-67 Fruits (excluding 612+641+642+644)	220.10	0.04	0.01	2.79
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	466.92	0.02	0.04	48.33
71 White potatoes and Puerto Rican starchy vegetables	855.79	16.35	23.57	0.22
72-76 Other vegetables	153.86	1.52	2.67	2.33
81 Fats	1386.80	53.09	101.12	0.89
82-83 Oils & Salad dressings	1226.56	121.08	3.26	18.35
91 Sugars and sweets	708.08	8.84	5.66	106.74
921-923 Coffee & Tea	187.36	0.02	1.37	28.80
924 Soft drinks, carbonated	431.83	0.00	0.00	102.56
93 Alcoholic beverages	136.28	0.01	0.03	1.18
94 Water	38.88	0.00	0.00	0.00

Appendix F-2. Calorie and Nutrient Densities of Composite Food Groups with Tax on Calories from Added Sugars by Cut-off Measure

Composite food groups	Calorie/Nutrient Density			
	Calorie	Discretionary oil (g/unit)	Discretionary solid fat (g/unit)	Added sugars (g/unit)
11 Milks and milk drinks	453.26	0.42	13.35	12.22
12 Creams and cream substitutes	558.84	4.10	42.58	19.78
13 Milk desserts, sauces, gravies	628.11	0.56	30.00	51.57
14 Cheeses	431.16	0.07	31.59	0.33
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	295.78	1.69	6.89	0.10
25 Organ meats, sausages and lunchmeats, and meat spreads	355.27	0.08	17.08	0.48
26 Fish and shellfish	143.56	1.52	2.58	0.20
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	377.44	3.78	8.64	2.29
31-35 Eggs	629.73	3.97	25.75	0.63
41-43 Dry beans, peas, other legumes, nuts, and seeds	627.55	24.00	2.73	5.09
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	1095.59	11.85	12.99	15.29
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	797.58	3.40	26.83	56.32
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	848.36	2.19	3.02	24.99
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	461.43	1.81	14.46	1.04
61-67 Fruits (excluding 612+641+642+644)	218.41	0.04	0.01	2.19
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	468.42	0.02	0.04	45.18
71 White potatoes and Puerto Rican starchy vegetables	855.79	16.35	23.57	0.22
72-76 Other vegetables	153.42	1.51	2.68	2.24
81 Fats	1386.72	53.04	101.18	0.87
82-83 Oils & Salad dressings	1231.90	121.70	3.30	18.20
91 Sugars and sweets	696.32	9.23	5.99	102.17
921-923 Coffee & Tea	176.24	0.02	1.38	25.76
924 Soft drinks, carbonated	394.04	0.00	0.00	93.01
93 Alcoholic beverages	136.41	0.01	0.03	1.16
94 Water	38.88	0.00	0.00	0.00

Appendix F-3. Calorie and Nutrient Densities of Composite Food Groups with Tax on Calories from Added Sugars by Average Measure

Composite food groups	Calorie/Nutrient Density			
	Calorie	Discretionary oil (g/unit)	Discretionary solid fat (g/unit)	Added sugars (g/unit)
11 Milks and milk drinks	453.29	0.42	13.35	12.23
12 Creams and cream substitutes	556.76	4.08	42.45	19.66
13 Milk desserts, sauces, gravies	625.35	0.55	29.76	51.93
14 Cheeses	431.16	0.07	31.59	0.33
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	295.77	1.69	6.89	0.10
25 Organ meats, sausages and lunchmeats, and meat spreads	355.22	0.08	17.08	0.48
26 Fish and shellfish	143.55	1.52	2.58	0.20
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	377.02	3.77	8.63	2.29
31-35 Eggs	629.79	3.97	25.74	0.66
41-43 Dry beans, peas, other legumes, nuts, and seeds	627.57	23.99	2.73	5.10
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	1100.10	11.91	13.01	15.42
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	797.85	3.39	26.96	56.14
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	846.75	2.18	3.02	25.02
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	461.51	1.80	14.46	1.04
61-67 Fruits (excluding 612+641+642+644)	218.43	0.04	0.01	2.20
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	468.35	0.02	0.04	45.07
71 White potatoes and Puerto Rican starchy vegetables	855.79	16.35	23.57	0.22
72-76 Other vegetables	153.27	1.49	2.68	2.26
81 Fats	1386.72	53.05	101.18	0.88
82-83 Oils & Salad dressings	1230.31	121.57	3.27	18.19
91 Sugars and sweets	694.56	9.20	5.89	101.73
921-923 Coffee & Tea	174.74	0.02	1.37	25.37
924 Soft drinks, carbonated	412.40	0.00	0.00	97.41
93 Alcoholic beverages	136.41	0.01	0.03	1.16
94 Water	38.88	0.00	0.00	0.00

Appendix G. Added Sugars Densities of Composite Food Groups and Sub-Categories

Appendix G-1. Added Sugars Densities of Composite Food Groups and Sub-Categories by Cut-off Measure

Composite food groups	Added sugars per unit of food (g/unit)				
	Composite	HH	HL	LH	LL
11 Milks and milk drinks	12.66	48.04	0.00	47.79	0.00
12 Creams and cream substitutes	20.21	46.23	0.18	NA	0.00
13 Milk desserts, sauces, gravies	52.22	55.56	1.20	55.24	0.00
14 Cheeses	0.34	16.50	0.27	NA	0.00
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	0.10	4.48	0.07	NA	0.01
25 Organ meats, sausages and lunchmeats, and meat spreads	0.48	NA	0.51	4.42	0.02
26 Fish and shellfish	0.20	NA	0.29	12.20	0.05
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	2.30	11.06	2.28	9.10	1.24
31-35 Eggs	0.66	7.42	0.59	219.77	0.00
41-43 Dry beans, peas, other legumes, nuts, and seeds	5.15	28.55	0.25	14.03	1.40
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	15.75	46.41	5.37	81.82	6.00
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	57.01	68.82	2.15	36.53	0.00
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	25.25	53.68	0.05	35.23	0.99
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	1.05	9.14	0.86	17.88	1.54
61-67 Fruits (excluding 612+641+642+644)	2.79	14.03	4.41	48.34	0.00
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	48.33	57.34	NA	90.08	0.00
71 White potatoes and Puerto Rican starchy vegetables	0.22	29.36	0.01	NA	0.49
72-76 Other vegetables	2.33	40.04	0.17	46.37	0.26
81 Fats	0.89	55.73	0.00	NA	2.03
82-83 Oils & Salad dressings	18.35	15.33	3.35	31.48	8.74
91 Sugars and sweets	106.74	57.70	2.77	175.90	0.05
921-923 Coffee & Tea	28.80	47.42	0.00	161.43	0.00
924 Soft drinks, carbonated	102.56	NA	NA	149.07	0.00
93 Alcoholic beverages	1.18	4.97	NA	5.37	0.02
94 Water	0.00	NA	NA	NA	0.00

Appendix G-2. Added Sugars Densities of Composite Food Groups and Sub-Categories by Average Measure

Composite food groups	Added sugars per unit of food (g/unit)				
	Composite	HH	HL	LH	LL
11 Milks and milk drinks	12.66	45.98	0.00	48.25	0.02
12 Creams and cream substitutes	20.21	11.32	0.88	71.19	0.72
13 Milk desserts, sauces, gravies	52.22	72.88	32.11	51.82	26.61
14 Cheeses	0.34	3.08	0.00	3.50	0.00
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	0.10	2.29	0.00	0.97	0.00
25 Organ meats, sausages and lunchmeats, and meat spreads	0.48	1.86	0.06	3.94	0.00
26 Fish and shellfish	0.20	0.71	0.00	0.73	0.00
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	2.30	7.59	0.48	5.50	0.44
31-35 Eggs	0.66	2.27	0.00	4.29	0.00
41-43 Dry beans, peas, other legumes, nuts, and seeds	5.15	17.22	0.14	15.80	1.29
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	15.75	46.54	2.15	35.95	3.56
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	57.01	113.19	42.66	82.52	22.23
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	25.25	42.42	0.01	39.25	5.54
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	1.05	3.47	0.39	4.47	0.45
61-67 Fruits (excluding 612+641+642+644)	2.79	18.11	0.78	48.37	0.00
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	48.33	57.34	51.84	94.67	2.52
71 White potatoes and Puerto Rican starchy vegetables	0.22	29.36	0.01	4.85	0.00
72-76 Other vegetables	2.33	47.41	0.14	39.26	0.05
81 Fats	0.89	36.05	0.00	17.44	0.00
82-83 Oils & Salad dressings	18.35	18.57	14.80	31.45	0.56
91 Sugars and sweets	106.74	46.16	58.49	230.12	54.34
921-923 Coffee & Tea	28.80	168.24	21.28	161.43	0.00
924 Soft drinks, carbonated	102.56	NA	NA	149.15	36.70
93 Alcoholic beverages	1.18	6.26	NA	5.17	0.00
94 Water	0.00	NA	NA	NA	0.00

Appendix H. New Prices with Tax on Calories from Added Sugar

Appendix H-1. New Prices with Tax on Calories from Added Sugars by Cut-off Measure

Composite food groups	New Price with Tax					
	Without CES	With CES				
		Composite	HH	HL	LH	LL
11 Milks and milk drinks	1.0122	1.0119	1.0461	1.0000	1.0459	1.0000
12 Creams and cream substitutes	1.0194	1.0192	1.0444	1.0002	NA	1.0000
13 Milk desserts, sauces, gravies	1.0501	1.0498	1.0533	1.0012	1.0530	1.0000
14 Cheeses	1.0003	1.0003	1.0158	1.0003	NA	1.0000
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	1.0001	1.0001	1.0043	1.0001	NA	1.0000
25 Organ meats, sausages and lunchmeats, and meat spreads	1.0005	1.0005	NA	1.0005	1.0042	1.0000
26 Fish and shellfish	1.0002	1.0002	NA	1.0003	1.0117	1.0000
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	1.0022	1.0022	1.0106	1.0022	1.0087	1.0012
31-35 Eggs	1.0006	1.0006	1.0071	1.0006	1.2110	1.0000
41-43 Dry beans, peas, other legumes, nuts, and seeds	1.0049	1.0049	1.0274	1.0002	1.0135	1.0013
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	1.0151	1.0149	1.0446	1.0052	1.0786	1.0058
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	1.0547	1.0544	1.0661	1.0021	1.0351	1.0000
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	1.0242	1.0241	1.0515	1.0001	1.0338	1.0009
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	1.0010	1.0010	1.0088	1.0008	1.0172	1.0015
61-67 Fruits (excluding 612+641+642+644)	1.0027	1.0024	1.0135	1.0042	1.0464	1.0000
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	1.0464	1.0449	1.0551	NA	1.0865	1.0000
71 White potatoes and Puerto Rican starchy vegetables	1.0002	1.0002	1.0282	1.0000	NA	1.0005
72-76 Other vegetables	1.0022	1.0022	1.0384	1.0002	1.0445	1.0002
81 Fats	1.0009	1.0008	1.0535	1.0000	NA	1.0019
82-83 Oils & Salad dressings	1.0176	1.0175	1.0147	1.0032	1.0302	1.0084
91 Sugars and sweets	1.1025	1.1002	1.0554	1.0027	1.1689	1.0001
921-923 Coffee & Tea	1.0276	1.0261	1.0455	1.0000	1.1550	1.0000
924 Soft drinks, carbonated	1.0985	1.0938	NA	NA	1.1431	1.0000
93 Alcoholic beverages	1.0011	1.0011	1.0048	NA	1.0052	1.0000
94 Water	1.0000	1.0000	NA	NA	NA	1.0000

Appendix H-2. New Prices with Tax on Calories from Added Sugars by Average Measure

Composite food groups	New Price with Tax					
	Without CES	With CES				
		Composite	HH	HL	LH	LL
11 Milks and milk drinks	1.0122	1.0119	1.0441	1.0000	1.0463	1.0000
12 Creams and cream substitutes	1.0194	1.0191	1.0109	1.0008	1.0684	1.0007
13 Milk desserts, sauces, gravies	1.0501	1.0500	1.0700	1.0308	1.0498	1.0255
14 Cheeses	1.0003	1.0003	1.0030	1.0000	1.0034	1.0000
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	1.0001	1.0001	1.0022	1.0000	1.0009	1.0000
25 Organ meats, sausages and lunchmeats, and meat spreads	1.0005	1.0005	1.0018	1.0001	1.0038	1.0000
26 Fish and shellfish	1.0002	1.0002	1.0007	1.0000	1.0007	1.0000
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	1.0022	1.0022	1.0073	1.0005	1.0053	1.0004
31-35 Eggs	1.0006	1.0006	1.0022	1.0000	1.0041	1.0000
41-43 Dry beans, peas, other legumes, nuts, and seeds	1.0049	1.0049	1.0165	1.0001	1.0152	1.0012
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	1.0151	1.0150	1.0447	1.0021	1.0345	1.0034
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	1.0547	1.0543	1.1087	1.0410	1.0792	1.0213
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	1.0242	1.0241	1.0407	1.0000	1.0377	1.0053
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	1.0010	1.0010	1.0033	1.0004	1.0043	1.0004
61-67 Fruits (excluding 612+641+642+644)	1.0027	1.0024	1.0174	1.0007	1.0464	1.0000
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	1.0464	1.0448	1.0551	1.0498	1.0909	1.0024
71 White potatoes and Puerto Rican starchy vegetables	1.0002	1.0002	1.0282	1.0000	1.0047	1.0000
72-76 Other vegetables	1.0022	1.0022	1.0455	1.0001	1.0377	1.0000
81 Fats	1.0009	1.0009	1.0346	1.0000	1.0167	1.0000
82-83 Oils & Salad dressings	1.0176	1.0175	1.0178	1.0142	1.0302	1.0005
91 Sugars and sweets	1.1025	1.0999	1.0443	1.0562	1.2210	1.0522
921-923 Coffee & Tea	1.0276	1.0259	1.1615	1.0204	1.1550	1.0000
924 Soft drinks, carbonated	1.0985	1.0959	NA	NA	1.1432	1.0352
93 Alcoholic beverages	1.0011	1.0011	1.0060	NA	1.0050	1.0000
94 Water	1.0000	1.0000	NA	NA	NA	1.0000

Appendix I. Demand Change with Tax on Calories from Added Sugars by Average Measure

Composite food groups	Demand change rate					
	Without CES	With CES				
		Composite	HH	HL	LH	LL
11 Milks and milk drinks	-0.45%	-0.43%	-3.62%	0.80%	-3.83%	0.80%
12 Creams and cream substitutes	-0.63%	-0.62%	-0.09%	0.56%	-3.63%	0.57%
13 Milk desserts, sauces, gravies	-2.82%	-2.82%	-4.42%	-1.23%	-2.80%	-0.78%
14 Cheeses	-0.06%	-0.06%	-0.51%	0.00%	-0.58%	0.00%
20-24 Meats: Beef & Pork & Lamb, veal, game, other carcass meat & Poultry	-0.36%	-0.36%	-0.69%	-0.35%	-0.49%	-0.35%
25 Organ meats, sausages and lunchmeats, and meat spreads	-0.55%	-0.54%	-0.69%	-0.50%	-0.92%	-0.49%
26 Fish and shellfish	-0.80%	-0.79%	-0.82%	-0.77%	-0.82%	-0.77%
27+28+77 Meat mixtures: Meat, poultry, fish with nonmeat items & Frozen and shelf-stable plate meals, soups, and gravies with meat, poultry, fish base; gelatin and gelatin-based drinks & Vegetables with meat, poultry, fish	-0.42%	-0.41%	-1.44%	-0.06%	-1.04%	-0.05%
31-35 Eggs	-0.36%	-0.36%	-0.38%	-0.35%	-0.41%	-0.35%
41-43 Dry beans, peas, other legumes, nuts, and seeds	-0.17%	-0.17%	-1.48%	0.38%	-1.33%	0.26%
51+52+54 Yeast breads, rolls & Quick breads & Crackers and salty snacks from grain products	-1.20%	-1.19%	-4.25%	0.20%	-3.22%	0.05%
53+55 Cakes, cookies, pies, pastries & Pancakes, waffles, French toast, other grain products	-3.87%	-3.84%	-8.29%	-2.67%	-5.93%	-0.91%
56-57 Pastas, cooked cereals, rice & Cereals, not cooked or ns as to cooked	-0.13%	-0.15%	-1.37%	1.68%	-1.15%	1.27%
58-59 Grain mixtures, frozen plate meals, soups & Meat substitutes, mainly cereal protein	-0.23%	-0.23%	-0.73%	-0.10%	-0.94%	-0.11%
61-67 Fruits (excluding 612+641+642+644)	-0.46%	-0.44%	-8.32%	0.47%	-21.58%	0.89%
612+641+642+644+92 Fruit juices & Nectars & Vinegar & Nonalcoholic beverages (excluding Coffee & Tea & Soft drinks, carbonated)	-3.42%	-3.29%	-4.90%	-4.08%	-10.23%	3.87%
71 White potatoes and Puerto Rican starchy vegetables	0.48%	0.47%	-0.81%	0.48%	0.26%	0.48%
72-76 Other vegetables	-0.42%	-0.41%	-3.99%	-0.24%	-3.36%	-0.23%
81 Fats	0.04%	0.05%	-2.48%	0.12%	-1.16%	0.12%
82-83 Oils & Salad dressings	-1.39%	-1.39%	-1.42%	-1.05%	-2.65%	0.36%
91 Sugars and sweets	-6.85%	-6.67%	-1.64%	-2.76%	-16.04%	-2.38%
921-923 Coffee & Tea	-2.17%	-2.05%	-15.37%	-1.43%	-14.81%	0.95%
924 Soft drinks, carbonated	-9.36%	-9.12%	NA	NA	-16.34%	1.61%
93 Alcoholic beverages	0.00%	0.00%	-1.24%	NA	-0.97%	0.29%
94 Water	0.03%	0.03%	NA	NA	NA	0.03%

Appendix J. Elasticity of Substitution by Average Measure of Defining Sub-Categories

Composite food groups	Elasticity of substitution
	Average measure
11 Milks and milk drinks	1.04
12 Creams and cream substitutes	0.65
13 Milk desserts, sauces, gravies	0.88
14 Cheeses	1.71
20-24 Meats: Beef & Pork & Lamb….	1.56
25 Organ meats….	1.14
26 Fish and shellfish	0.70
27+28+77 Meat mixtures: Meat etc with nonmeat items	2.04
31-35 Eggs	0.15
41-43 Dry beans, …	1.15
51+52+54 Yeast breads, …	1.09
53+55 Cakes, cookies, pies, …	0.94
56-57 Pastas, cooked cereals, …	0.76
58-59 Grain mixtures, frozen plate …	2.15
61-67 Fruits (excluding 612+641+642+644)	5.55
612+641+642+644+92 Fruit juices …	1.72
71 White potatoes …	0.46
72-76 Other vegetables	0.86
81 Fats	0.77
82-83 Oils & Salad dressings	1.04
91 Sugars and sweets	1.01
921-923 Coffee & Tea	1.18
924 Soft drinks, carbonated	1.96
93 Alcoholic beverages	2.55
94 Water	[a]

[a] All the products in this composite food group are defined as Low Fat & Low Sugar.

Appendix K. Percentage Change in Calories with Tax on Calories from Added Sugars by Average Measure

Composite food groups	Calories consumption		
	Initial consumption (calorie)	Consumption change (%)	
		Without CES	With CES by Average measure
11 Milks and milk drinks	102.05	-0.45%	-0.50%
12 Creams and cream substitutes	14.83	-0.63%	-0.91%
13 Milk desserts, sauces, gravies	46.39	-2.82%	-3.07%
14 Cheeses	59.98	-0.06%	-0.05%
20-24 Meats: Beef & Pork & Lamb….	172.88	-0.36%	-0.36%
25 Organ meats….	58.55	-0.55%	-0.55%
26 Fish and shellfish	27.75	-0.80%	-0.79%
27+28+77 Meat mixtures: Meat etc with nonmeat items	161.10	-0.42%	-0.55%
31-35 Eggs	46.78	-0.36%	-0.36%
41-43 Dry beans, …	73.62	-0.17%	0.04%
51+52+54 Yeast breads, …	262.36	-1.20%	-1.39%
53+55 Cakes, cookies, pies, …	140.55	-3.87%	-4.29%
56-57 Pastas, cooked cereals, …	97.14	-0.13%	0.35%
58-59 Grain mixtures, frozen plate …	244.54	-0.23%	-0.22%
61-67 Fruits (excluding 612+641+642+644)	49.60	-0.46%	-1.19%
612+641+642+644+92 Fruit juices …	76.79	-3.42%	-2.99%
71 White potatoes …	102.70	0.48%	0.47%
72-76 Other vegetables	62.15	-0.42%	-0.79%
81 Fats	26.61	0.04%	0.05%
82-83 Oils & Salad dressings	44.98	-1.39%	-1.09%
91 Sugars and sweets	72.44	-6.85%	-8.46%
921-923 Coffee & Tea	22.02	-2.17%	-8.65%
924 Soft drinks, carbonated	129.16	-9.36%	-13.21%
93 Alcoholic beverages	92.05	0.00%	0.09%
94 Water	0.06	0.03%	0.03%
Total	2187.06	-1.56%	-1.95%

Appendix L. Percentage Change in Calories from Discretionary Solid Fat and Added Sugars with Tax on Calories from Added Sugars by Average Measure

Composite food groups	Discretionary solid fat consumption			Added sugars consumption		
	Initial consumption (g)	Consumption change rate		Initial consumption (g)	Consumption change rate	
		Without CES	Initial consumption (g)		Without CES	Without CES
11 Milks and milk drinks	2.99	-0.45%	-0.02%	2.85	-0.45%	-3.81%
12 Creams and cream substitutes	1.13	-0.63%	-0.74%	0.54	-0.63%	-3.35%
13 Milk desserts, sauces, gravies	2.21	-2.82%	-3.19%	3.86	-2.82%	-3.35%
14 Cheeses	4.39	-0.06%	-0.05%	0.05	-0.06%	-0.57%
20-24 Meat: Beef & Pork & Lamb….	4.03	-0.36%	-0.37%	0.06	-0.36%	-0.66%
25 Organ meats….	2.81	-0.55%	-0.56%	0.08	-0.55%	-0.78%
26 Fish and shellfish	0.50	-0.80%	-0.80%	0.04	-0.80%	-0.82%
27+28+77 Meat mixtures: Meat etc with nonmeat items	3.69	-0.42%	-0.55%	0.98	-0.42%	-1.05%
31-35 Eggs	1.91	-0.36%	-0.36%	0.05	-0.36%	-0.40%
41-43 Dry beans, …	0.32	-0.17%	0.05%	0.61	-0.17%	-1.13%
51+52+54 Yeast breads, …	3.10	-1.20%	-1.26%	3.75	-1.20%	-3.27%
53+55 Cakes, cookies, pies, …	4.75	-3.87%	-4.38%	10.00	-3.87%	-5.32%
56-57 Pastas, cooked cereals, …	0.34	-0.13%	0.65%	2.91	-0.13%	-1.06%
58-59 Grain mixtures, frozen plate …	7.66	-0.23%	-0.18%	0.55	-0.23%	-0.61%
61-67 Fruits (excluding 612+641+642+644)	0.00	-0.46%	-3.72%	0.63	-0.46%	-21.49%
612+641+642+644+92 Fruit juices …	0.01	-3.42%	-4.86%	7.95	-3.42%	-9.81%
71 White potatoes …	2.83	0.48%	0.47%	0.03	0.48%	0.23%
72-76 Other vegetables	1.08	-0.42%	-0.34%	0.94	-0.42%	-3.33%
81 Fats	1.94	0.04%	0.11%	0.02	0.04%	-1.38%
82-83 Oils & Salad dressings	0.12	-1.39%	-1.07%	0.67	-1.39%	-2.26%
91 Sugars and sweets	0.58	-6.85%	-2.74%	10.92	-6.85%	-11.05%
921-923 Coffee & Tea	0.16	-2.17%	-2.10%	3.38	-2.17%	-13.69%
924 Soft drinks, carbonated	0.00	0.00%	0.00%	30.67	-9.36%	-13.68%
93 Alcoholic beverages	0.02	0.00%	-1.24%	0.79	0.00%	-0.98%
94 Water	0.00	0.00%	0.00%	0.00	0.00%	0.00%
Total	46.58	-0.90%	-0.88%	82.33	-5.53%	-9.47%

Appendix M. Calorie Sources with Tax on Calories from Added Sugars (Calories)

	Total calories	Calories from discretionary solid fat and added sugar[a]	Calories from discretionary oil[b]	Calories from discretionary solid fat[b]	Calories from Added sugars[b]
Initial consumption	2187.06 (100%)	748.55 (34.23%)	178.64 (8.17%)	419.24 (19.17%)	329.31 (15.06%)
After tax (Without CES)	2152.98 (100%)	726.59 (33.75%)	176.87 (8.22%)	415.48 (19.30%)	311.11 (14.45%)
After tax (With CES by Cut-off measure)	2139.70 (100%)	709.39 (33.15%)	177.54 (8.30%)	415.59 (19.42%)	293.80 (13.73%)
After tax (With CES by Average measure)	2144.51 (100%)	713.65 (33.28%)	177.38 (8.27%)	415.54 (19.38%)	298.11 (13.90%)

Note: Numbers in parentheses are the share of total calories in the row.

[a] This column is the summation of the last two columns in the table.

[b] Each gram of discretionary oil and discretionary solid fat is assumed to provide 9 calories, each gram of added sugars is assumed to provide 4 calories.

Appendix N. Welfare Loss per Unit of Nutrient Consumption Reduced with Tax on Calories from Added Sugars by Average Measure

	Without CES	With CES by Average measure
EV/Calorie reduction ($/calorie)	0.0023	0.0018
EV/Discretionary oil reduction ($/g)	0.3905	0.5360
EV/Discretionary solid fat reduction ($/g)	0.1842	0.1827
EV/Added sugars reduction ($/g)	0.0169	0.0096

Note: EV is equivalent variation.

References to Technical Appendix

American Heart Association. 2009. Fats 101 http://www.americanheart.org/ (accessed December 2009).

Bhuyan, S., and R.A. Lopez. 1997. Oligopoly Power in the Food and Tobacco Industries. *American Journal of Agricultural Economics* 79(3): 1035-1043.

Bowman, S.A., J.E. Friday, and A.J. Moshfegh. 2008. MyPyramid Equivalents Database, 2.0 for USDA Survey Foods, 2003-2004: Documentation and User Guide. Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. http://www.ars.usda.gov/ba/bhnrc/fsrg (accessed August 2009).

Chouinard, H.H., D.E. Davis, J.T. LaFrance, and J.M. Perloff. 2010. Milk Marketing Order Winners and Losers. *Applied Economic Perspectives and Policy* 32(1): 59-76.

Reed, A.J., J.W. Levedahl, and J.S. Clark. 2003. Commercial Disappearance and Composite Demand for Food with an Application to U.S. Meats. *Journal of Agricultural and Resource Economics* 28(1): 53-70.

U.S. Department of Agriculture, Economic Research Service (USDA/ERS). 2008. Commodity and Food Elasticities. http://www.ers.usda.gov/Data/Elasticities (accessed October 2009).