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Taxing Caloric Sweetened Beverages

Potential Effects on Beverage Consumption, Calorie Intake, and Obesity

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Taxing Caloric Sweetened Beverages:

Potential Effects on Beverage Consumption, Calorie Intake, and Obesity

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Abstract

The link between high U.S. obesity rates and the overconsumption of added sugars, largely from sodas and fruit drinks, has prompted public calls for a tax on caloric sweetened beverages. Faced with such a tax, consumers may reduce consumption of these sweetened beverages and substitute nontaxed beverages, such as bottled water, juice, and milk. This study estimated that a tax-induced 20-percent price increase on caloric sweetened beverages could cause an average reduction of 37 calories per day, or 3.8 pounds of body weight over a year, for adults and an average of 43 calories per day, or 4.5 pounds over a year, for children. Given these reductions in calorie consumption, results show an estimated decline in adult overweight prevalence (66.9 to 62.4 percent) and obesity prevalence (33.4 to 30.4 percent), as well as the child at-risk-for-overweight prevalence (32.3 to 27.0 percent) and the overweight prevalence (16.6 to 13.7 percent). Actual impacts would depend on many factors, including how the tax is reflected in consumer prices and the competitive strategies of beverage manufacturers and food retailers.

Keywords

Sugar-sweetened beverages (SSB), soft drinks, soda tax, added sugars, obesity, and beverage demand

Acknowledgments

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Contents

Summary

The prevalence of obesity among the U.S. population has increased markedly over the past three decades. Latest figures indicate that two-thirds of adults are either overweight or obese, and growing numbers of children are overweight as well. Associations between obesity and certain dietary trends, such as eating away from home and drinking beverages sweetened with sugar and/or high-fructose and other corn syrups (e.g., sodas, fruit drinks, sports and energy drinks, and powdered mixes) have received increasing attention.

What Is the Issue?

According to 1999-2004 National Health and Nutrition Examination Survey (NHANES) data on food intake, the average American consumed 22.5 teaspoons of added sugar per day, with almost half attributed to sodas and fruit drinks. Under a 2,400-calorie diet conforming to the 2005 *Dietary Guidelines for Americans*, 22.5 teaspoons of added sugars nearly exhausts the discretionary calorie allowance. High U.S. obesity rates have prompted the Institute of Medicine of the National Academies of Sciences and some State and local government officials to suggest a tax on caloric sweetened beverages. This study examines the potential effects of such a tax on total beverage consumption, calorie intake, and the prevalence of overweight and obesity among Americans.

What Did the Study Find?

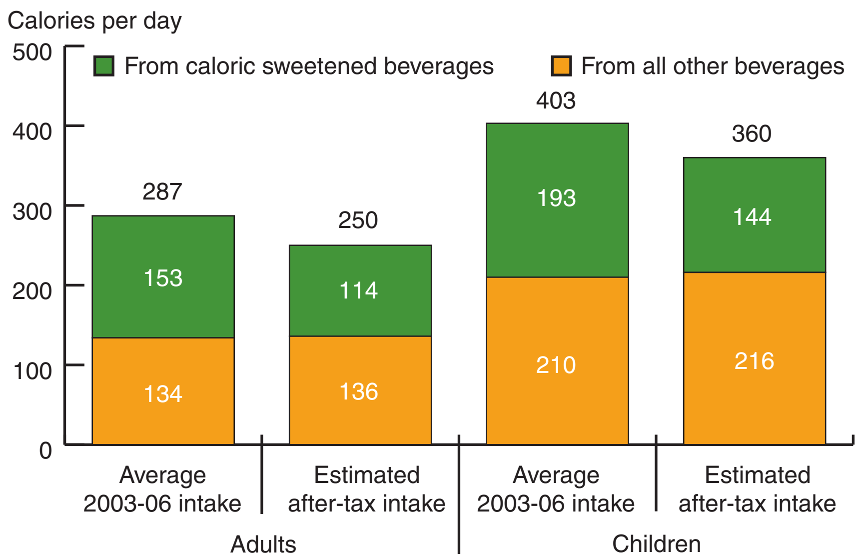
This study analyzed the effects of a hypothetical tax on caloric sweetened sodas, fruit drinks, sports and energy drinks, and powdered mixes. The study found that consumers facing a higher price induced by a tax would react by adjusting their choices among alternative beverages, such as diet drinks, bottled water, juice, coffee/tea, or milk. Results suggest that:

- A tax-induced 20-percent increase in the price of caloric sweetened beverages could reduce net calorie intake from all beverages by 37 calories per day for the average adult. The effects for children were estimated to be larger—an average reduction of 43 calories per day.

- By assuming that 1 pound of body fat has about 3,500 calories, and assuming all else remains equal, the daily calorie reductions would translate into an average reduction of 3.8 pounds over a year for adults and 4.5 pounds over a year for children.

- The weight loss induced by the tax could reduce the overweight

A 20-percent price increase from a tax on caloric sweetened beverages is estimated to reduce total calorie intake from beverages by 13 percent for adults and by 11 percent for children



Source: Economic Research Service calculations based on the National Health and Examination Survey data, 2003-06.

prevalence among adults from 66.9 to 62.4 percent and the prevalence of obesity from 33.4 to 30.4 percent. For children, the at-risk-of-overweight prevalence would decline from 32.3 to 27.0 percent and the overweight prevalence would decline from 16.6 to 13.7 percent.

These reductions in the proportion of overweight and obese Americans are the result of two factors:

1. A large group of individuals are overweight or obese by only a few pounds, and a small reduction in calorie intake could change their weight classification; and

2. Many overweight and obese Americans consume large amounts of caloric sweetened beverages. For example, 10.6 percent of overweight adults consumed more than 450 calories per day from caloric sweetened beverages—nearly three times the average amount of 152 calories consumed by adults.

A tax on caloric sweetened beverages would affect all those who consume them—overweight, obese, and healthy weight individuals. Our estimates of changes in overweight and obesity rates do not capture potential improvements in weight status among those with healthier weights. There are many individuals, however, who are a few pounds shy of the Body Mass Index (BMI) cutoffs for overweight and obese. The tax-induced reduction in calorie intake could not only reduce obesity rates but also help keep certain borderline individuals from joining the ranks of the obese or overweight.

The estimated impact of these measures would depend on, among other factors, the size and type of tax and how the tax is reflected in the prices consumers pay. Manufacturers' and retailers' responses to the tax would affect how much of the tax is passed on to consumers. Differences in the at-home and away-from-home food markets are also likely to influence how a tax would affect prices consumers pay (e.g., bottled and canned soda purchases in grocery stores versus free beverage refills from soda fountains in fast food restaurants).

How Was the Study Conducted?

Two national datasets were used in this analysis: (1) actual consumer grocery purchases of beverages from 1998-2007 Nielsen Homescan panels, and (2) individual daily beverage intake data with corresponding measured height and weight from the 2003-06 National Health and Nutrition Examination Survey (NHANES). Beverages in each dataset were grouped into eight categories based on calorie content (caloric sweetened beverages, diet drinks, skim milk, low-fat milk, whole milk, 100 percent fruit and vegetable juice, coffee/tea, and bottled water). Using the purchase data, a demand system was specified to estimate how beverage-purchasing decisions would change as a result of a price increase for caloric sweetened beverages. Price elasticity estimates were then applied to individual beverage intake data reported in NHANES to estimate changes in caloric intake for each beverage category in response to a tax-induced 20-percent increase in the price of caloric sweetened beverages. By calculating changes in calorie consumption among all beverages and assuming that 1 pound of body fat has about 3,500 calories, we estimated the change in each NHANES respondent's body weight to calculate after-tax overweight and obesity prevalence in the U.S. population.

Background

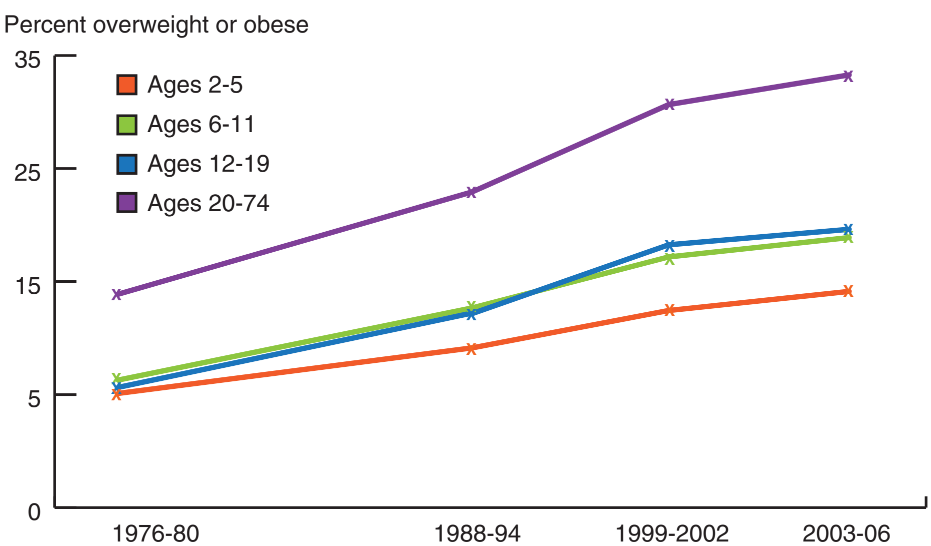
Obesity prevalence among the U.S. population has increased markedly over the past three decades, with the latest figures indicating that two-thirds of U.S. adults are either overweight or obese, and growing numbers of children are either overweight or at risk for overweight (fig. 1). Some research suggests that if current obesity rates persist, 86 percent of American adults will be either overweight or obese by 2030 (Wang et al., 2008). According to a quantitative review of the literature, Tsai et al. (2010) concluded that the U.S. national aggregate medical costs (in 2008 dollars) of overweight was $15.8 billion and obesity was $98.1 billion, totaling $113.9 billion. As researchers evaluate American weight gain and intervention strategies to tackle this health problem, associations between obesity and certain dietary trends, such as eating out and drinking caloric sweetened beverages, have received greater attention.

According to two systematic reviews of the literature, consumption of beverages sweetened with sugar and/or high-fructose and other corn syrups is linked to risks for obesity and type 2 diabetes (Malik et al., 2006; Vartanian et al., 2007). Positive associations between weight gain and caloric sweetened beverage consumption, however, do not necessarily imply causality (Dietz, 2006). Nevertheless, caloric sweetened beverages have been targeted as part of a tax policy to reduce calorie intake, improve diet and health, and generate revenue that governments can use to address obesity-related health and economic burdens (Brownell and Frieden, 2009; Jacobson and Brownell, 2000; Powell and Chaloupka, 2009; Institute of Medicine, 2009).

Figure 1

Overweight and obesity rates, 1976-2006

The number of overweight children and obese adults has more than doubled over the past thirty years



Notes: Overweight children (ages 2-19) are defined by sex- and age-specific BMI ≥ 95th percentile based on Centers for Disease Control and Prevention growth charts (CDC, 2009b); obese adults (ages 20-74) are defined by a BMI of ≥ 30.

Source: Centers for Disease Control and Prevention (CDC), National Health and Nutrition Examination Surveys (NHANES).

In 2009, 33 States levied sales taxes on sodas, both nondiet and diet, at an average rate of 5.2 percent (Bridging the Gap, 2010). Missouri, Virginia, and Utah had the lowest soda sales tax rates at less than 2 percent, while the highest rates (7 percent) were assessed in Indiana, Mississippi, New Jersey, and Rhode Island. Thirteen other States had tax rates of at least 6 percent. Many States also implemented similar taxes on vending machine sales, or levied additional taxes on manufacturers, distributors, wholesalers, or retailers of sodas (see Appendix Tables 1 and 2 for more information). Recent studies investigating links between State-level soda taxes and Body Mass Index (BMI)[1] among children and adolescents (Powell et al., 2009; Sturm et al., 2010; Fletcher et al., 2010), as well as adults (Fletcher et al., 2008), have shown little-to-no association.

These findings of minimal effects of State-level soda sales taxes on weight outcomes are not surprising. Soda sales taxes are generally small and infrequently changed, whereas BMI has been growing until recent years. Moreover, a sales tax is not reflected in the shelf price; it is rung up at the checkout counter with other food purchases. As a result, consumers may be unaware of the tax and unresponsive to a sales tax increase when making retail purchases (McLaughlin, 2009).

Proponents of taxing caloric sweetened beverages suggest that relatively higher tax rates are necessary to have measurable effects, as in the case of tobacco taxation (Engelhard et al, 2009). For example, Brownell and colleagues (2009) propose "an excise tax of 1 cent per ounce for beverages that have any added caloric sweetener." Assuming the tax would be wholly passed on to the consumer, their proposed tax rate could range widely depending on brand, container size, and sale price. For example, a 12-pack of 12-ounce cans of branded soda priced at $6 would carry a tax of $1.44 (24 percent), while a discounted 2-liter container of soda priced at $1 would carry a tax of $0.68 (68 percent).

Taxing food to reduce consumption hinges on the fundamental economic principle that consumers respond to a higher price by purchasing less. Therefore, the success of a beverage tax partly depends on how much consumers curtail their consumption in response to the higher beverage price (own-price elasticity). A recent review of food demand research revealed an own-price elasticity for sodas and other beverages of -0.8 to -1.0, depending on category definitions (Andreyeva et al., 2009).[2] This elasticity range has been used to predict consumers' responses to taxing sodas in recent studies (Brownell et al., 2009; Chaloupka et al., 2009). Yale University's Rudd Center for Food Policy and Obesity uses an own-price elasticity of -1.2 to calculate the revenues generated by a tax on caloric sweetened beverages (Rudd Center, 2010).

For our evaluation, deficiencies in these reported elasticities exist. First, consumers will respond to a particular beverage tax by adjusting their purchases of alternative beverages (cross-price elasticity). Without estimates of cross-price elasticities, researchers have relied solely on the own-price elasticity and assumed away cross-price effects (Brownell et al., 2009; Chaloupka et al., 2009). Secondly, many studies have included sodas and/or fruit drinks in their analysis, but have not differentiated between nondiet and diet (e.g., Kinnucan et al., 2001; Yen et al., 2004; Zheng and Kaiser,

[1] Body Mass Index (BMI) is a measure of weight adjusted for height calculated as an individual's weight in kilograms divided by the square of his or her height in meters.

[2] The -0.8 estimate is based on 14 studies with categories that included soft drinks, carbonated soft drinks, juice and soft drinks, soda, soda and fruit ades, nonalcoholic beverages, other beverages, or simply beverages. The -1.0 estimate is based on seven studies with categories that included soft drinks, carbonated soft drinks, soda or fruit ades, or soda. The range for all 14 studies was 0.13-3.18.

2008). To estimate reductions in energy intake and obesity, a distinction must be made between caloric sweetened beverages and their low-calorie counterparts. Few demand studies to date have separated regular soft drinks from their low-calorie counterparts—one did not include cross-price effects of alternative beverages (Bergtold et al., 2004), while another examined only soft drinks (Dhar et al., 2003) and excluded sweetened sports, energy, and fruit drinks. As a result, the literature lacks the demand elasticity estimates needed to fully examine the effect of taxing caloric sweetened beverages.

In this study, the previous limitations are addressed by analyzing grocery purchases from a panel of American households over a 10-year period (1998-2007). Specifically, we estimate a beverage demand system in which all beverage purchases are categorized by calorie content. The estimated demand elasticities are then applied to individuals' beverage intake data from a nationally representative survey, which enables us to estimate changes in calorie consumption due to changes in purchasing decisions when the price of caloric sweetened beverages increases as a result of a tax. The national intake survey data are ideal for this study because, in addition to intake data, they have a nutrient database for all beverages consumed, as well as measured height and weight for each respondent. By calculating the net change in calorie consumption after consumers adjust their after-tax beverage purchases, we can estimate the reduction in body weight, and thus, overweight and obesity prevalence in the U.S. population.

Trends in U.S. Beverage Consumption, 1977–2006

Total calorie intake among the U.S. population has increased over the past 30 years (USDA/ERS-Nutrient Availability, 2010). The majority of the increase comes from snacking on both food and beverages (Piernas and Popkin, 2009). A previous study found that the percentage of total calorie intake from beverages increased from 14.2 to 21.0 percent over 1997-2002, largely from caloric sweetened beverages (Duffey and Popkin, 2007). Because caloric intake from beverages is less satiating compared with solid foods (DiMeglio and Mattes, 2000; Mattes, 1996, 2006; Stull et al., 2008) and many caloric sweetened beverages lack sufficient nutrient content, the link between sweetened beverage consumption and weight gain has attracted attention (Dennis et al., 2009).

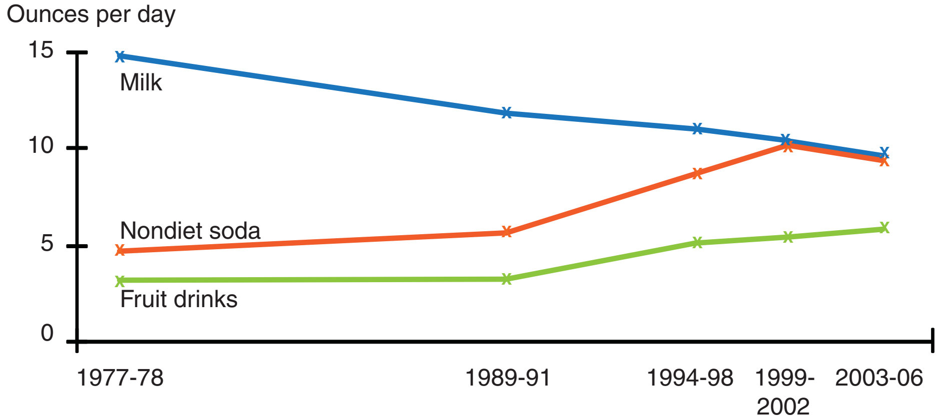
Trends in American beverage consumption have changed dramatically over the past three decades (fig. 2). The popularity of caloric sweetened sodas and fruit drinks in American diets has increased at the expense of milk, especially since the late 1980s. Today, adults consume nearly twice as many ounces of caloric sweetened sodas as milk. Children's milk consumption was over three times that of their soda consumption in the late 1970s, but children consumed roughly equal amounts of each beverage by 2003-06. Further, the consumption of fruit drinks has been on the rise for both adults and children. These consumption trends correlate with the prevalence of overweight children and obese adults in the United States and have prompted a call for caloric sweetened beverages to be consumed more judiciously in lieu of more nutritious beverages (e.g., milk and juices) or low-calorie beverages (e.g., water and diet drinks).

Figure 2

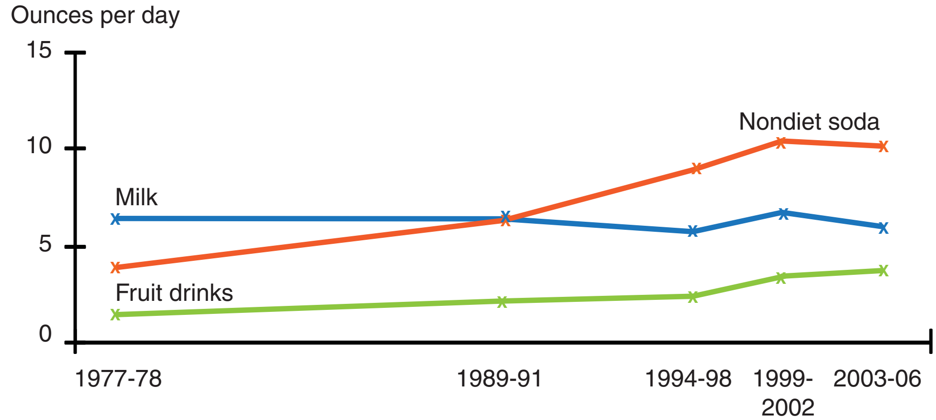
Beverage consumption, 1977-2006

Daily milk consumption among children has declined to similar consumption levels as nondiet sodas, while nondiet soda consumption among adults surpasses milk

Children (ages 2-19)



Adults (ages 20 and older)



Source: ERS calculations based on USDA's 1977-78 Nationwide Food Consumption Survey (NFCS) data, 1989-91 and 1994-98 Continuing Survey of Food Intakes by Individuals (CSFII), and the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics 1999-2006 National Health and Nutrition Examination Survey (NHANES).

Consumption of Added Sugars by the American Population

Every 5 years, the U.S. Government updates the *Dietary Guidelines for Americans* to help consumers choose diets that meet their nutritional needs. The *Guidelines* set recommended consumption amounts for the major food groups. The *Guidelines* do not include recommendations for added sugars, but instead include a "discretionary calorie allowance" for diets that include and do not exceed the recommended amounts of each food group in the *Guidelines* (*Dietary Guidelines for Americans,* Appendix A-3, 2005). Added sugars include cane and beet sugars, honey, molasses, and corn and other syrups used for home baking and sweetening, as well as sugars commonly added to processed foods and beverages, but not the naturally occurring sugars in fruit or milk.

For diets following the *Guidelines*, the discretionary calorie allowance may be used to increase the amount of food selected from each food group; to consume foods that are not in the lowest fat form (such as 2 percent milk or medium-fat meat); to add oil, fat, or sugars to foods; to consume alcohol; or to consume foods that contain added sugars (*Dietary Guidelines for Americans,* 2005). Like the recommendations for major food groups, the allowance is based on an individual's energy (calorie) requirement which, in turn, is determined by age, gender, body weight and height, physical activity level, and pregnancy/lactation status. For example, a 2,400-calorie diet conforming to the *Guidelines,* which may be appropriate for a moderately active adult male with a median height and weight for that height (BMI=22.5), includes a discretionary allowance of 362 calories, which is equivalent to roughly 23 teaspoons (tsp) of added sugars. Likewise, a moderately active 4 to 8 year old child on a 1,400-calorie diet conforming to the *Guidelines* would have 171 discretionary calories, equal to about 11 tsp of added sugars. The *Guidelines* leave it to the individual to decide how to consume these calories, including whether to allocate them to the consumption of food and beverages with added sugars.

Using data from 1999-2004 NHANES, we found that the average American consumed 22.5 tsp of added sugars per day (table 1)–essentially exhausting the 362 discretionary calorie allowance for a 2,400-calorie diet following the *Guidelines,* leaving no allowance for other foods. American adults consumed 21.6 tsp of added sugars per day and children (ages 2–19) consumed 24.9 tsp. Caloric sweetened sodas and fruit drinks (containing less than 100 percent juice by volume) are major sources of added sugars in American diets, contributing an average of 10.58 tsp of added sugars each day. Children consumed 11.96 tsp of added sugars from sodas and fruit drinks per day (47 percent of their total intake of added sugars).

The excessive intake of added sugars from sodas and fruit drinks, and its correlation with weight gain, has been receiving attention in the fight against obesity. Recognizing the role of caloric sweetened beverages in American children's diets, the Institute of Medicine (2009) recommended that local

Table 1
Added sugar consumption, 1999-2004
Caloric sweetened soft drinks and fruit drinks account for almost half of added sugars in the American diet

	Average consumption							
Population	Sodas	Fruit drinks	Other drinks	Desserts	Ready-to-eat cereals	Sweets	Other foods	Total added sugars
	Teaspoons per day							
United States (age 2 and older)	8.2	2.4	0.8	3.7	0.8	3.3	3.2	22.5
Children (ages 2-19)	8.4	3.6	0.6	3.6	1.5	3.9	3.4	24.9
Adults (age 20 and older)	8.1	2.0	0.9	3.7	0.6	3.1	3.1	21.6

Notes: Desserts include dairy foods (e.g., ice cream, custards, and puddings) and sweetened grains (e.g., cakes, cookies, pies, and pastries). Sweets include candies, jams, jellies, sugar, honey, and other sweeteners. Totals may not sum due to rounding.

Source: ERS calculations based on National Health and Nutrition Examination Survey (NHANES) 1999-2004 data.

governments implement a tax strategy for calorie-dense, nutrient-poor foods and beverages to discourage consumption. Earlier this year, the White House Task Force on Childhood Obesity recommended that Federal and State/local governments analyze the effects of taxes on less healthy, energy-dense foods, such as caloric sweetened beverages (White House Task Force on Childhood Obesity, 2010). The Institute of Medicine and other beverage tax advocates (IOM, 2009; Brownell et al., 2009; Brownell and Frieden, 2009) suggest that the generated tax revenues could be used to promote healthier eating and reduce or prevent obesity.

Potential Tax-Induced Changes in Calorie Intake From Beverages

Using grocery purchase data reported by Nielsen Homescan panelists between 1998 and 2007 (Nielsen, 2007), we estimated a beverage demand system. Household grocery purchases were aggregated into 120 national monthly observations. Beverage purchases were grouped into eight categories using product descriptions provided by Nielsen as shown in table 2. We also present the average daily calorie intake for adults and children in each beverage category.

For caloric sweetened beverages, we found the own-price elasticity of demand to be -1.26 (see, “Appendix: Beverage Demand Model” for full econometric details and demand elasticity estimates). Thus, a 10-percent increase in price is predicted to reduce grocery store purchases of caloric sweetened beverages by 12.6 percent (see box, “Effect of Beverage Tax May Differ in the Away-From-Home Market”). Faced with a higher price for caloric sweetened beverages, consumers would purchase more bottled water, juice, and milk. Bottled water was found to be the strongest substitute for caloric sweetened beverages (cross-price elasticity of 0.75), while skim and whole milk were the weakest substitutes (cross-price elasticity of 0.2). Fruit and vegetable juices containing 100 percent juice were also found to be substitutes for caloric sweetened beverages with a cross-price elasticity of 0.56, falling between that of water and milk. A complementary effect for diet beverages was found (cross-price elasticity of -0.46), suggesting a higher price for caloric sweetened beverages would decrease grocery purchases of diet drinks. Given that our estimates are based on household-level grocery purchases, the complimentary effect is possibly the result of a diverse set of preferences within a household for diet and nondiet sweetened beverages.

We use the demand elasticities to estimate changes in individuals’ daily beverage consumption reported in 2003-06 NHANES in response to a tax-induced price increase of caloric sweetened beverages. Individual daily beverage consumption and the corresponding caloric contents are aggregated into eight categories, as specified in table 2, using USDA’s nutrient database

Table 2
Beverage categories and daily calorie consumption, 2003-06

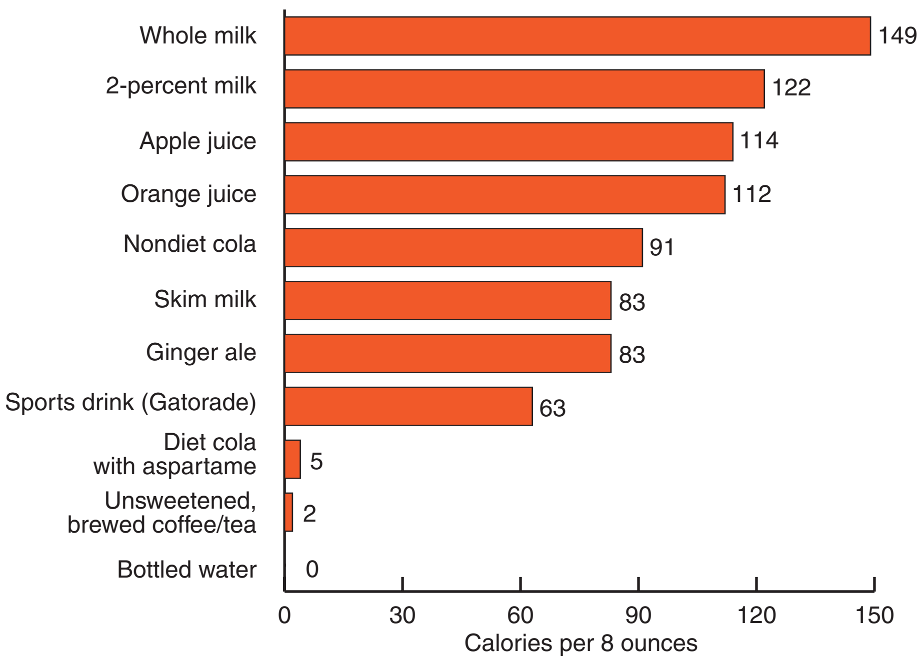
Beverage category	Types of beverages included	Calories per day	
		Adults	Children
Caloric sweetened beverages	Sodas, fruit drinks, sports and energy drinks, and powdered mixes with added sugars	153	193
Diet (low-calorie) beverages	Low- or no-calorie versions of sodas, fruit drinks, sport and energy drinks, and powdered mixes	3	1
Skim milk	Milk labeled as skim or nonfat	11	11
Low-fat milk	Milk labeled as low-fat or reduced fat	37	76
Whole milk	Milk labeled as whole	22	57
Juices	All fruit and vegetable juices containing 100 percent juice	36	55
Coffee/tea*	Liquid coffee and teas, excludes dry beans and leaves	25	10
Bottled water	Bottled water, excludes tap water	0	0

* Nielsen does not provide information to distinguish caloric and noncaloric coffees/teas.

Source: Beverage categories based on authors’ definitions. Daily calorie consumption based on 2003-06 National Health and Nutrition Examination Survey (NHANES).

(USDA/ARS, 2010). Certain juices and milk drinks are more energy dense than sodas (fig. 3). Because we expect consumers to adjust their consumption of alternative beverages when a tax is levied on caloric sweetened beverages (cross-price elasticity), failure to incorporate alternative bever-

Figure 3
Calorie content varies widely across beverages



Source: USDA, Agricultural Research Service's Nutrient Data Laboratory.

Effect of Beverage Tax May Differ in the Away-From-Home Market

Our results are based on a few assumptions typically found in demand studies. Like many other beverage demand studies, we used data from household purchases at grocery stores and did not include beverage purchases from other commercial outlets, such as restaurants and vending machines. One cannot ignore, however, the large amount of beverages purchased in eating establishments, such as fast food and full-service restaurants, ball games, movie theaters, and other away-from-home eating occasions. According to 2003-06 NHANES, about 50 percent of caloric sweetened beverages were consumed away from home.

In fast food and full-service restaurants, consumers often pay for a meal combo that includes beverages. Likewise, some restaurants offer free refills, creating a disconnect between quantity purchased and price. Because of these marketing conditions, consumers are likely to react differently to a price increase at home than away from home. While we acknowledge this potential problem, we note the difficulty in estimating the away-from-home demand for beverages due to data deficiencies. In this study, at-home elasticities are applied to total at-home and away-from-home consumption. This assumption has been made, but not pointed out, in past studies that estimate the impact of a tax on beverage consumption.

ages would bias an assessment of the calorie-reduction effect from a tax. Furthermore, not including alternative beverages to estimate a beverage demand system would result in model misspecification and bias estimates of demand elasticities.

Assuming that a tax raises caloric sweetened beverage prices at retail food stores and restaurants by 20 percent for consumers, the average daily calorie intake from caloric sweetened beverages is estimated to fall by 38.8 calories for adults and by 48.8 calories for children (table 3). To calculate the net change in calorie consumption from shifting beverage choices in response to a tax, we apply the cross-price effects to individual beverage intake data found in NHANES. Led by increased consumption of calorie-containing juices and milk after the tax is imposed, average daily calorie intake from all beverages other than caloric sweetened beverages increased an estimated 1.9 calories for adults and 6.1 calories for children. Subtracting these calorie increases from the calorie savings from lower consumption of the taxed beverages results in a net decline of 36.9 calories per day for adults and 42.7 calories per day for children[3] (see box, "Calculating Changes in Calorie Consumption and Weight Status").

[3]Using the own- and cross-price elasticities and corresponding standard errors reported in appendix table 4, a 95-percent confidence interval was constructed: Net decline of [28.2 – 45.3] calories/day for adults, and [29.8 – 55.3] calories/day for children.

Our findings are based on a historical snapshot of household beverage purchases linked with individual beverage intake surveys. From these historical purchase transactions, we have estimated the price elasticity of demand—how consumers would react to a price change in caloric sweetened beverages. Price elasticities are generally used to simulate the effects of a "small" change in price because, like our estimates, they are typically derived with data on small price changes observed in retail settings. The 20-percent soda tax considered here is large in comparison to typical retail price variation. From appendix table 3, we can see that a 20-percent increase in the mean price of caloric sweetened beverages is larger than the observed range in our data.

When price increases or taxes are large, elasticities may underestimate actual consumer reactions. This may be particularly true if large taxes are fortified by complementary consumer education policies. For example, large State and Federal cigarette taxes (on average 85 percent of the average before-tax

Table 3

Changes in daily beverage consumption

A tax-induced 20-percent increase in the price of caloric sweetened beverages could produce an overall reduction in calorie intake from beverages

	Changes in daily consumption			
	Adults		Children	
Beverage categories	Ounces	Calories	Ounces	Calories
All beverages	-3.63	-36.9	-3.78	-42.7
Caloric sweetened beverages	-3.63	-38.8	-4.45	-48.8
Diet beverages	-0.11	0.0	-0.05	0.0
Skim milk	0.01	0.1	0.02	0.2
Low-fat milk	0.03	0.4	0.08	1.2
Whole milk	0.03	0.6	0.10	1.7
Juices	0.13	1.7	0.27	3.6
Coffee/tea	-0.58	-0.9	-0.13	-0.5
Bottled water	0.48	0.0	0.37	0.0

Source: ERS calculations based on 2003-06 National Health and Nutrition Examination Survey (NHANES) (8,460 adults and 7,365 children).

price or 46 percent of the average after-tax price (Campaign for Tobacco Free Kids, 2010)) combined with government and private tobacco control campaigns have been credited with the large reductions in U.S. cigarette use (Chaloupka, 2010). Using the National Health Interview Survey, the CDC estimates that the share of adults who smoke fell from 42.4 percent to 20.6 percent between 1965 and 2008—a result that many would not have predicted given economists' shortrun estimates of inelastic cigarette demand (average estimate -0.48 (Gallet and List, 2003)). (See Chaloupka 2010; Engelhard et al., 2009 for reviews of the tobacco-tax literature.)

Calculating Changes in Calorie Consumption and Weight Status

The figure below represents a hypothetical individual's intake and the calculations used to derive changes in calorie intake and body weight. This method is carried out for all individuals in 2003-06 NHANES who drank caloric-sweetened beverages. Those who did not drink caloric sweetened beverages were unaffected by the tax.

We need only to consider the elasticities presented in the first column of appendix table 4. These elasticities reflect the percentage change in purchases from each beverage category due to a 1-percent change in the price of caloric sweetened beverages (A). Under our scenario, the price of caloric sweetened beverages increases by 20 percent due to a tax and must be reflected in the percentage change in purchases (B). To translate changes in consumption from purchase decisions, we must assume a one-to-one translation—the percentage change in purchases is equivalent to the percentage change in consumption. Multiplying column B by each individual's calorie intake from each beverage category (C) yields that individual's change in daily calorie intake (D). Averaging these changes in calorie intake (D) over the entire population yields the average change in daily calorie intake found in table 3. Assuming that 1 pound of body weight has about 3,500 calories, we calculate each NHANES respondent's weight reduction over 1 year (E). Each individual's new, hypothetical weight can be used to recalculate overweight and obesity prevalence for the U.S. population.

	(A) Elasticity	(B) Elasticity multiplied by 20 percent	(C) Individual daily intake[1]	(D) Change in individual daily intake
Beverages		**Percent**	**Calories/day**	**Calories/day**
Caloric sweetened	-1.264	-25.28	216	-54.6
Diet	-0.457	-9.14	0	0
Skim milk	0.198	3.96	0	0
Low-fat milk	0.115	2.30	122	2.8
Whole milk	0.222	4.44	0	0
Juices	0.557	11.14	112	12.5
Coffee/tea	-0.383	-7.66	2	-0.2
Bottled water	0.749	14.98	0	0.0

(E) Reduction in calories and weight

-39.5 calories/day

-4.1 pounds/year

[1]Example individual: Adult male, 5 foot 10 inches, weighing 175 pounds would have a BMI of 25.1—overweight. The calorie contents represent the following: 12 ounces of cola, 8 ounces of fruit drink, 8 ounces of 2 percent milk, 8 ounces of orange juice, and 8 ounces of unsweetened brewed tea. After the tax, assuming elasticities and all else constant, the adult male would lose 4.1 pounds of body weight over 1 year, reducing his BMI to 24.5—normal weight.

What Happens to Overweight and Obesity Prevalence?

NHANES respondents' body weight and height were measured during the survey. The body weight and height data were used to determine an individual's BMI, which is the basis for classifying weight status. For adults, *overweight* and *obesity* thresholds are a BMI score of 25 and 30, respectively. For children, the Centers for Disease Control and Prevention (CDC) child growth charts are used, and the 85th and 95th percentiles are the thresholds to classify children (ages 2-19) as *at risk for overweight* and *overweight*, respectively (Kuczmarski et al., 2002).

The dynamic relationship between calorie intake and body weight is quite complex. Weight loss is the result of an energy imbalance (excessive calorie expenditure over intake), and maintaining such an imbalance will lead to long-term changes in weight. When an individual loses weight, he/she will need fewer calories to maintain the lower body weight—given a fixed reduction in daily energy intake, an individual's weight will decrease but then saturate to a new steady state, which can take several years to achieve (Chow and Hall, 2008). One frequently used relationship in textbooks (e.g., Whitney et al., 2002) and scientific articles (e.g., Duffey et al., 2010) is that a pound of fat tissue has about 3,500 calories, which we use to predict the tax-induced weight loss and the resulting changes in the overweight and obesity prevalence.

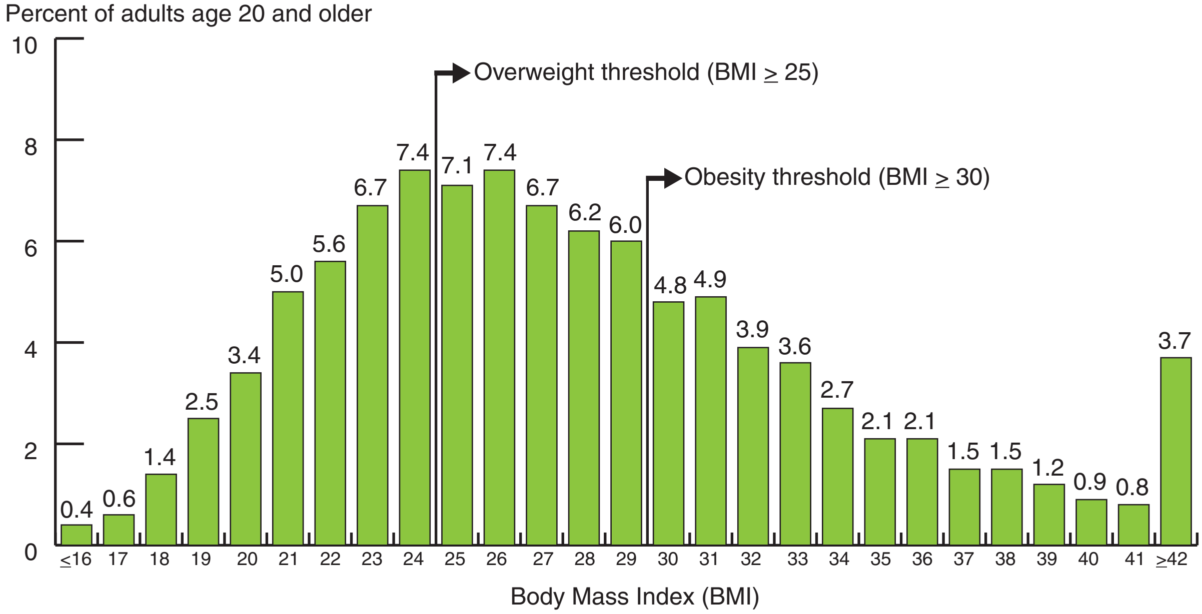
Assuming that everything else remains equal (e.g., constant physical activity level and no shift to foods other than beverages), a reduction of 3,500 calories leads to a 1-pound loss in body weight (Whitney et al., 2002). Individuals' body weight reductions can be used to compare the associated before- and after-tax prevalence of overweight and obesity in the United States. We predict that the overweight prevalence among adults could decline from 66.9 to 62.4 percent, and the prevalence of obese adults could decline from 33.4 to 30.4 percent. For children, the at-risk-for-overweight prevalence could decline from 32.3 to 27.0 percent, and the prevalence of overweight children could decline from 16.6 to 13.7 percent.

These reductions in overweight and obesity prevalence are the result of two factors. First, a large group of adults and children are overweight or obese by only a few pounds. A small reduction in calorie intake could change the weight classification among these individuals. Second, many overweight adults and children consume large quantities of caloric sweetened beverages. Under our assumptions, individuals with a higher consumption of taxed beverages would be affected more by the tax than those who consume less. For example, the overweight adults who would shift to a healthy weight after the 20-percent tax consumed 496 calories a day from caloric sweetened beverages compared with 100 calories consumed by those who remain overweight under the tax. Obese adults who would become nonobese consumed 474 calories a day from caloric sweetened beverages compared with 127 calories consumed by those who remain obese.

Figure 4

Share of adults at each BMI level

Over 14 percent of American adults straddle the overweight threshold



Note: Each BMI value is inclusive (e.g., BMI of 25 includes those with a BMI of 25 to 25.9)

Source: ERS calculations based on 2003-06 National Health and Nutrition Examination Survey (NHANES) data.

In addition, many individuals are just a few pounds below the BMI cutoffs for overweight and obesity (fig. 4). Reduced consumption of caloric sweetened beverages triggered by the tax could prevent them from joining the ranks of the obese or overweight.

Discussion

The use of economic incentives or disincentives to encourage healthful food choices has received heightened attention among policymakers in an effort to improve the American diet. The rich food-demand literature suggests that many foods are generally own-price inelastic—that is, the percentage change in consumption is smaller than the percentage change in price (Andreyeva et al., 2010). Under inelastic demand, price manipulations alone will not induce large consumer responses. This finding is echoed in analyses examining the effects of taxing salty snacks and fat in dairy products (Kuchler et al., 2004; Chouinard et al., 2007), as well as subsidizing fruit, vegetable, and dairy consumption (Lin et al., 2010). Our results in the present study suggest that the demand for caloric sweetened beverages is own-price elastic, suggesting consumers are relatively responsive to price changes—a 10-percent price increase is estimated to reduce purchases by 12.6 percent.

To promote healthier food choices, alternative strategies to taxing caloric sweetened beverages exist—subsidizing healthier beverage choices, restricting supply of unhealthy beverages, or improving informational campaigns. Many of these types of policies have been implemented for children in schools. For example, 31 States had policies limiting access to and/or setting nutrition standards for competitive foods in schools in 2009, including caloric sweetened beverages (Trust for America's Health, 2009). Likewise, the National School Lunch Program offers subsidized milk and requires milk as a menu component. Consequently, school meals are found to be calcium rich, compared with meals eaten by children elsewhere (Lin et al., 1999). If the objective is to reduce the obesity prevalence, however, it is important to note that some juices and reduced-fat milk contain more calories than sodas.

Children have also responded positively to lowering the price of healthy snacks and raising the price of less healthy snacks in school settings (French et al., 2001; Jeffrey et al., 1994). The same pricing strategy could be considered to encourage healthier beverage choices at school. It is important to point out, however, that results from in-school experiments may not apply to retail food markets because children have unique utility functions, partly due to their limited resources and the restricted variety of snacks available in schools.

Type of Tax Matters

Economists are often tasked with calculating consumers' responsiveness to price signals. For a consumer to respond to a tax, he or she must be aware of the tax-induced price change. In this analysis, we assumed that consumers would be cognizant of the 20-percent price increase in caloric sweetened beverages as a result of a tax. But would this be true in the marketplace?

A sales tax is applied as items are rung up at checkout and not displayed on the grocery store shelf. Consumers are often not aware of the tax burden from a particular item or may not consider a sales tax when making food purchase choices at grocery stores or restaurants (McLaughlin, 2009), possibly explaining previous findings that BMI was not associated with State-level taxes (e.g., Fletcher et al., 2009; Powell et al., 2009; Sturm et al., 2010; Fletcher et al., 2010). In addition, grocery purchases of beverages and other eligible foods within USDA's Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program) are exempt from sales taxes (USDA/FNS, 2010). Thus, SNAP recipients would not be subject to the higher price in grocery stores that result from a sales tax.

Caloric sweetened beverages could also be taxed through an excise tax on drink manufacturers based on the quantity of the beverage produced or on the amount of sugar and syrups used in their products. If the tax is then passed on to retailers, who, in turn, incorporate it into a higher retail price, the price increase is displayed on the supermarket shelf or restaurant menu. An excise tax will be more likely to affect food choices, including grocery purchases for SNAP benefit recipients.

Reactions of Beverage Companies and Retailers Affect Impact of Tax

Manufacturers' and retailers' responses to taxes—both sales and excise taxes—affect the size of the tax-induced price increase paid by consumers. If the higher cost from an excise tax is not passed through to the consumer or partially absorbed by the manufacturer or retailer, the effect of the tax is dampened. For example, manufacturers could fully absorb an excise tax and not raise the prices of the taxed beverages, or they could raise prices by less than the full tax rate. If only a portion of the excise tax is passed on to the consumer, then an excise tax greater than 20 percent would be required to cause a 20-percent price increase. Similarly, retailers have freedom to set shelf prices; they could adjust prices to compensate for a tax.

The market structure of the beverage industry can also make it difficult to predict how manufacturers and suppliers of caloric sweetened beverages would change their competitive strategies, if at all, in reaction to a tax on their products. Beverage manufacturers could spread the cost of the excise tax across their products by raising prices of both taxed and nontaxed beverages, creating a situation where the relative price of caloric sweetened beverages versus alternative beverages would essentially remain unchanged. Under this scenario, consumers would be less likely to choose alternative beverages, again, dampening the effect of the tax. For the same reasons, it is also difficult to predict the influence that a tax on caloric sweetened beverages would have on the employment and local economy.

Using taxes or other disincentives to influence consumption is a complicated undertaking with many unknowns. Modeling consumers' responsiveness to higher prices resulting from a tax on caloric sweetened beverages is just one step in predicting the impact of the tax. Responsiveness at the individual or household level could vary across other elements, such as personal preference and income level. The ultimate outcome would depend on many factors, including the size of the tax, the type of tax, and the competitive strategies of beverage manufacturers and food retailers.

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Appendix 1

State Beverage Taxes

Appendix table 1

State-level sales taxes of general food and sodas, effective January 2009

State	Food sales	Soda sales	Soda vending	State	Food sales	Soda sales	Soda vending
	---- *Tax rate (percent)* ----				---- *Tax rate (percent)* ----		
Alabama	4.0	4.0	4.0	Missouri	1.225	1.225	1.225
Alaska	0.0	0.0	0.0	Montana	0.0	0.0	0.0
Arizona	0.0	0.0	0.0	Nebraska	0.0	0.0	5.5
Arkansas	3.0	3.0	3.0	Nevada	0.0	0.0	0.0
California	0.0	6.25	6.25	New Hampshire	0.0	0.0	0.0
Colorado	0.0	0.0	0.0	New Jersey	0.0	7.0	7.0
Connecticut	0.0	6.0	6.0	New Mexico	0.0	0.0	5.0
Delaware	0.0	0.0	0.0	New York	0.0	4.0	4.0
District of Columbia	0.0	0.0	5.75	North Carolina	0.0	4.5	4.5
				North Dakota	0.0	5.0	5.0
Florida	0.0	6.0	6.0	Ohio	0.0	5.5	5.5
Georgia	0.0	0.0	4.0	Oklahoma	4.5	4.5	4.5
Hawaii*	4.0	4.0	4.0	Oregon	0.0	0.0	0.0
Idaho	6.0	6.0	6.0	Pennsylvania	0.0	6.0	6.0
Illinois	1.0	6.25	6.25	Rhode Island	0.0	7.0	7.0
Indiana	0.0	7.0	7.0	South Carolina	0.0	0.0	6.0
Iowa	0.0	6.0	6.0	South Dakota	4.0	4.0	4.0
Kansas	5.3	5.3	5.3	Tennessee	5.5	5.5	5.5
Kentucky	0.0	6.0	6.0	Texas	0.0	6.25	6.25
Louisiana	0.0	0.0	0.0	Utah	1.75	1.75	1.75
Maine	0.0	5.0	5.0	Vermont	0.0	0.0	0.0
Maryland	0.0	6.0	6.0	Virginia	1.5	1.5	4.0
Massachusetts	0.0	0.0	0.0	Washington	0.0	6.5	6.5
Michigan	0.0	0.0	0.0	West Virginia	3.0	6.0	6.0
Minnesota	0.0	6.5	6.5	Wisconsin	0.0	5.0	5.0
Mississippi	7.0	7.0	8.0	Wyoming	0.0	0.0	4.0

* Hawaii does not levy a specific soda sales tax, but rather a general excise tax.

Source: Compiled from Bridging the Gap, 2010.

Appendix table 2

State-level nonsales taxes placed on sodas, effective January 2009

State	Tax
Alabama	1. License tax placed on manufacturers of soda bottles based on bottling machine output—from $40 for machines with 16 bottles per minute of output to $500 for 150 bottles or more per minute. 2. Annual license fee placed on retailers ($2.50; waived if retailer also sales soda by means of a tap) and wholesalers ($50; waived if wholesaler has a bottling license) of soda bottles. 3. Annual license fee place on retailers of soda sold via a dispensing device or tap based on number of residents—$10 for less than 5,000; $15 for 5,000 to 15,000; $20 for 15,000 to 20,000; and $25 for over 25,000—in addition to an additional $2.50 annual tax.
Arizona	1. Privilege tax of $0.21 per gallon placed on manufacturers, distributors, wholesalers, or retailers of soda bottles; waived for retailers if purchased from a licensed manufacturer, distributor, or wholesaler. 2. Privilege tax of $2 per gallon placed on manufacturers, distributors, wholesalers, or retailers of syrup used in sodas; waived for retailers if purchased from a licensed manufacturer, distributor, or wholesaler. 3. Privilege tax of $0.21 per gallon of soft drinks made from a powder mix according to manufacturer's directions placed on manufacturers, distributors, wholesalers, or retailers; waived for retailers if mix is purchased from a licensed manufacturer, distributor, or wholesaler.
Rhode Island	1. Excise tax of $0.04 per case (24, 12 ounce cans) of sodas placed on manufacturers.
Tennessee	1. Privilege tax of 1.9 percent of gross receipts of sodas placed on manufacturers and retailers.
Virginia	1. Excise tax placed on distributors and wholesalers of sodas varying from $50 to $33,000 depending on gross receipts
Washington	1. Excise tax of $1 per gallon of syrup placed on wholesalers and retailers of soda syrup, unless previously taxed.
West Virginia*	1. Excise tax of $0.01 per half liter of soda placed on manufacturers, distributors, wholesalers, or retailers of soda. 2. Excise tax of $0.80 per gallon of soda syrup place on manufacturers, distributors, wholesalers, or retailers of soda syrup. 3. Excise tax of $0.84 per 4 liters of soda syrup place on manufacturers, distributors, wholesalers, or retailers of soda syrup.

* West Virginia has two provisions for an excise tax on syrups based on a gallon and 4 liters, although they are technically the same, because the statutes cannot be reconciled.
Source: Bridging the Gap, 2010.

Appendix 2

Beverage Demand Model

In this study, we estimated a beverage demand system in which beverage categories are distinguished by calorie content. A complete food demand system was not estimated, but rather separability between beverages and other food items was assumed in food budgeting and a sub-system of the eight beverages was estimated (caloric-sweetened beverages, diet drinks, skim milk, low-fat milk, whole milk, juice, coffee/tea, and bottled water).

The Almost Ideal Demand System (AIDS, Deaton and Muellbauer, 1980) is used for the empirical estimation of a beverage demand system. The AIDS can be specified as:

(1) $$w_i = \alpha_i + \sum_i \gamma_{ij} \ln p_j + \beta_i \ln(m/\boldsymbol{P^*}) + e_i \qquad i = 1, \ldots, n,$$

where w_i is the beverage expenditure share for beverage i; p_j is the price for beverage j; m is the total expenditure for all beverages; α_i , γ_{ij} , and β_i are the parameters to be estimated; and e_i is the disturbance term. $\boldsymbol{P}$ is a price index defined by:

(2) $$\ln\boldsymbol{P} = \alpha_0 + \sum_i \alpha_i \ln p_i + 1/2 \sum_i\sum_j \gamma_{ij}^* \ln p_i \ln p_j$$

and $\gamma_{ij} = (\gamma_{ij}^* + \gamma_{ij}^*)/2$. Equation 1 can be considered as the first-order approximation to the general unknown relation between w_i and $\ln m$, and the $\ln p$'s. Shift variables, such as the average U.S. monthly temperature and a time trend, are incorporated into the AIDS using a specification suggested by Alston et al. (2001). According to the Alston et al. specification, these demand shifters can be incorporated into equation 1 as

(3) $$w_i = \alpha_i^* + \sum_i \gamma_{ij} \ln p_j + \beta_i \ln(m/\boldsymbol{P^*}) + e_i \qquad i = 1, \ldots, n,$$

where $\alpha_i^* = \alpha_i + \varphi_{1i}$ (temperature) + φ_{2i} (time trend); $\ln\boldsymbol{P^*} = \alpha_0^* + \sum \alpha_i^* \ln p_i + 1/2 \sum_i\sum_j \gamma_{ij}^* \ln p_\mathrm{i} \ln p_j$; and $\alpha_0^* = \alpha_0 + \upsilon_{1i}$ (temperature) + υ_{2i} (time trend). Adding-up conditions are given by:

(4) $$\sum_i \alpha_i = 1, \sum_i \beta_i = 0, \sum_i \gamma_{ij} = 0, \sum_i \varphi_{1i} = 0, \sum_i \varphi_{2i} = 0$$

Homogeneity and symmetry conditions require:

(5) $$\sum_j \gamma_{ij} = 0 \text{ for all } i \text{ and } \gamma_{ij} = \gamma_{ji} \text{ for all } i, j\ (i \neq j)$$

The price index $\boldsymbol{P}^*$ is scaled to unity at the sample means of prices and the constant term in equation 2 and α_0 was restricted to be zero (Moschini, 1998). Conditional expenditure (ε_i) and uncompensated price (ε_{ij}) elasticity estimates at sample means can be calculated as:

(6) $$\varepsilon_i = 1 + \beta_i/\mathrm{w}_i \text{ and}$$

(7) $$\varepsilon_{ij} = (\gamma_{ij} - \beta_i (\mathrm{w}_j - \beta_j \ln (m/\boldsymbol{P^*}))/\mathrm{w}_i - \delta_{ij}$$

where δ_{ij} is the Kronnecker delta that is unity if $i = j$ and zero otherwise.

Variable definitions and summary statistics can be found in appendix table 3. The iterative seemingly-unrelated-regression technique (TSP, version 5.0) was used to estimate the model represented by equation 3 with homogeneity and symmetry conditions (equation 5) imposed. As the data add up by construction, the error covariance matrix was singular and an arbitrary equation was excluded (the model estimates are invariant to the equation deleted as shown by Barten 1969). The parameters of the excluded equation can be obtained from the adding-up conditions (equation 4) or by re-estimating the model, omitting a different equation.

By estimating the conditional AIDS for beverages shown by equation 3, first-order autocorrelation was found to exist, which required estimating an additional parameter ρ (Berndt and Savin, 1975). In this model, each equation included only the lagged error for that equation, but to satisfy adding up, the seven autocorrelation parameters were constrained to be equal. The 120-month time-series data were fitted by the nonlinear AIDS model, and demand price elasticities were derived using equations 6 and 7. For brevity, the parameter estimates are not reported, and the demand elasticities are reported in appendix table 4. The estimated autocorrelation coefficient, ρ, had a value of 0.71 with a likelihood ratio test statistic of 267.78.

Appendix table 3

Variable definitions and summary statistics, 1998-2007

Variable	Definition	Mean	St. Dev.	Minimum	Maximum
p_1	Nominal price for caloric sweetened beverages, $/gal	2.62	0.17	2.32	3.04
p_2	Nominal price for diet beverages, $/gal	2.00	0.16	1.69	2.35
p_3	Nominal price for skim milk, $/gal	2.80	0.26	2.46	3.72
p_4	Nominal price for low-fat milk, $/gal	2.77	0.28	2.43	3.70
p_5	Nominal price for whole milk, $/gal	2.98	0.31	2.61	3.96
p_6	Nominal price for juice, $/gal	4.36	0.44	3.68	5.55
p_7	Nominal price for coffee/tea, $/gal	4.03	0.33	3.17	4.76
p_8	Nominal price for bottled water, $/gal	1.40	0.16	1.04	1.63
w_1	Beverage budget share for caloric sweetened beverages	0.34	0.03	0.28	0.40
w_2	Beverage budget share for diet beverages	0.16	0.01	0.14	0.20
w_3	Beverage budget share for skim milk	0.06	0.01	0.04	0.07
w_4	Beverage budget share for low-fat milk	0.14	0.01	0.12	0.16
w_5	Beverage budget share for whole milk	0.06	0.01	0.05	0.07
w_6	Beverage budget share for juice	0.16	0.01	0.13	0.19
w_7	Beverage budget share for coffee/tea	0.02	0.01	0.01	0.04
w_8	Beverage budget share for bottled water	0.06	0.02	0.03	0.11
φ_1	Average U.S. monthly temperature	54.37	14.93	28.68	77.26

St. Dev.=Standard deviation.
$/gal=Dollars per gallon.

Sources: Prices and budget shares are ERS calculations based on Nielsen Homescan (1998-2007). Temperature is measured in Fahrenheit (NOAA, 2009).

Appendix table 4

U.S. beverage demand elasticities, 1998-2007

Beverage	Uncompensated price elasticities ε_{i1}	ε_{i2}	ε_{i3}	ε_{i4}	ε_{i5}	ε_{i6}	ε_{i7}	ε_{i8}	Expenditure elasticities ε_{i}
Caloric sweetened beverages	-1.264***	-0.192***	0.023	0.015	0.028	0.233***	-0.027	0.131***	1.054***
	(0.089)	(0.048)	(0.016)	(0.036)	(0.023)	(0.045)	(0.019)	(0.035)	(0.041)
Diet beverages	-0.457***	-0.753***	0.042	0.064	-0.165***	0.096	-0.020	-0.044	1.238***
	(0.103)	(0.106)	(0.026)	(0.052)	(0.042)	(0.071)	(0.031)	(0.057)	(0.051)
Skim milk	0.198**	0.184**	-0.830***	-0.015	0.371***	-0.432***	-0.061*	-0.296***	0.880***
	(0.097)	(0.076)	(0.166)	(0.190)	(0.149)	(0.084)	(0.033)	(0.058)	(0.046)
Low-fat milk	0.115	0.144**	-0.003	-0.707***	0.055	-0.277***	0.037	-0.187***	0.822***
	(0.088)	(0.061)	(0.076)	(0.138)	(0.105)	(0.064)	(0.025)	(0.045)	(0.047)
Whole milk	0.222*	-0.371***	0.332***	0.119	-1.122***	-0.253**	-0.049	0.281***	0.841***
	(0.126)	(0.108)	(0.133)	(0.231)	(0.243)	(0.113)	(0.044)	(0.077)	(0.059)
Juices	0.557***	0.159**	-0.151***	-0.248***	-0.102**	-1.012***	0.006	-0.087*	0.878***
	(0.095)	(0.071)	(0.029)	(0.055)	(0.044)	(0.090)	(0.028)	(0.051)	(0.048)
Coffee/tea	-0.383	-0.103	-0.149**	0.179	-0.139	0.011	-0.451***	-0.018	1.053***
	(0.264)	(0.207)	(0.075)	(0.141)	(0.115)	(0.188)	(0.121)	(0.155)	(0.125)
Bottled water	0.749***	-0.088	-0.284***	-0.460***	0.282***	-0.255*	-0.007	-0.969***	1.032***
	(0.196)	(0.153)	(0.053)	(0.102)	(0.080)	(0.135)	(0.062)	(0.157)	(0.100)

Notes: ***, **, and * indicate a level of significance of 1, 5, and 10 percent, respectively. Standard errors are in parentheses. Highlighted numbers indicate uncompensated own-price elasticities; all other uncompensated elasticities are cross-price estimates.

Source: ERS calculations based on Nielsen Homescan data, 1998-2007.