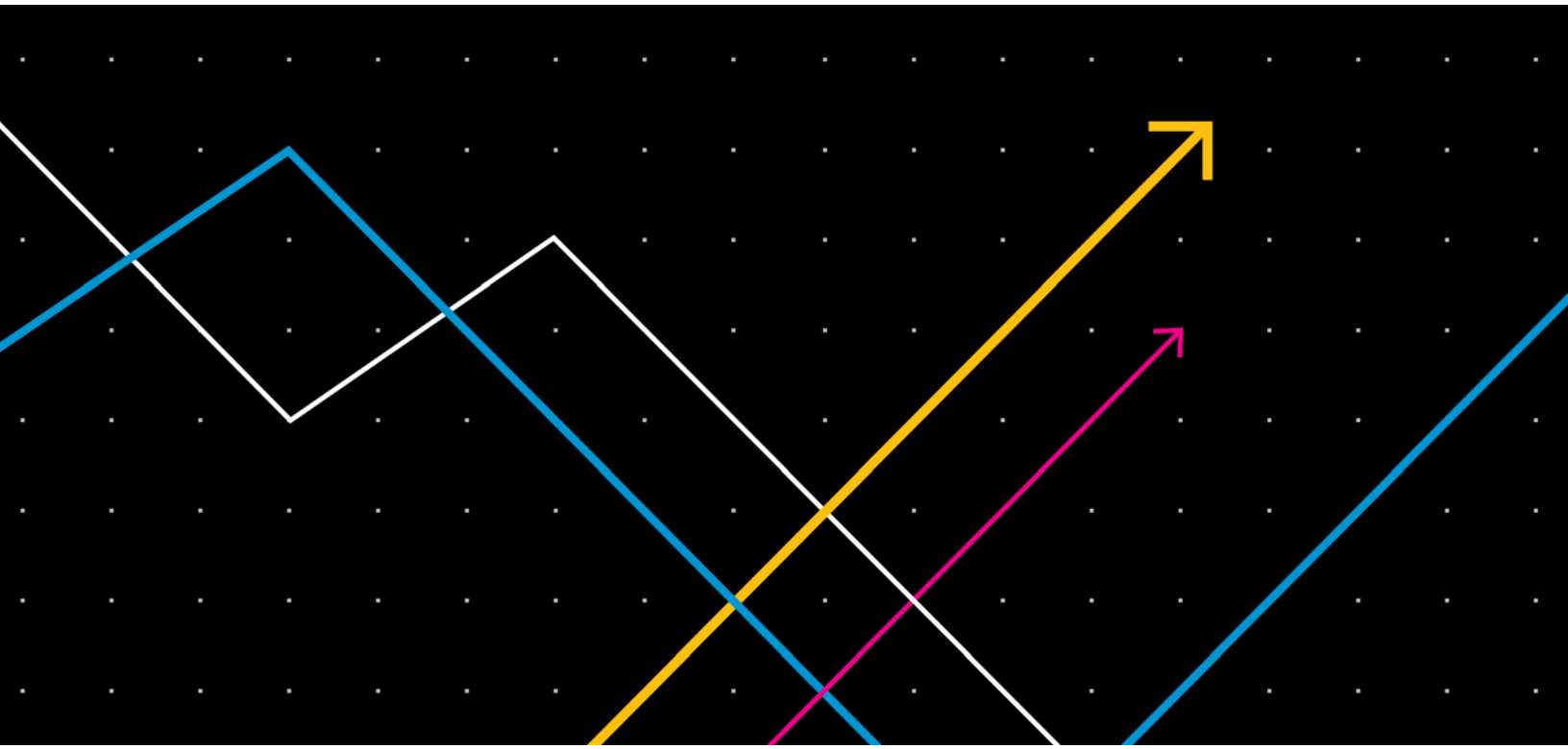

RESEARCH REPORT

The Pros and Cons of Taxing Sweetened Beverages Based on Sugar Content

Norton Francis *Donald Marron* *Kim Rueben*

December 2016

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Acknowledgments

This report was funded by the American Heart Association with additional funds from other general support funders of the State and Local Finance Initiative. We are grateful to them and to all our funders, who make it possible for Urban to advance its mission.

The views expressed are those of the authors and should not be attributed to the Urban Institute, its trustees, or its funders. Funders do not determine research findings or the insights and recommendations of Urban experts. Further information on the Urban Institute's funding principles is available at www.urban.org/support.

We thank Maeve Gearing and John Iselin for contributing to our research, Michael Marazzi for editing, Ann Cleven and Sarah Gault for formatting, and Frank Chaloupka, Carter Headrick, Rachel Johnson, Martin O'Flaherty, Barry Popkin, Mark Schoeberl, Jonathan Pearson Stuttard, and Laurie Whitsel for comments on earlier drafts.

Abstract

The amount of added sugar in sweetened drinks varies greatly. If policymakers decide to use taxes on sweetened beverages to discourage consumption of added sugar, they should therefore consider basing those taxes on the amount of sugar drinks contain rather than their volume. In this report, we analyze the potential policy benefits of taxing sugar content; document how content-based taxes have been used to discourage consumption of sugar, alcohol, and tobacco; and examine the legal and practical challenges of implementing such taxes at the federal, state, and local level. We conclude that taxing based on the amount of added sugar a drink contains, either by taxing sugar content directly or by levying higher volume taxes on drinks with more sugar, is feasible in many jurisdictions and reduces sugar consumption more effectively than comparable taxes on drink volume. Broad-based volume or sales taxes on all soft drinks, however, raise revenue more efficiently. Federal, state, and local policymakers thus face trade-offs between using sweetened-beverage taxes to raise revenue and to discourage consumption of added sugars.

The Pros and Cons of Taxing Sweetened Beverages Based on Sugar Content

The rise in obesity and diabetes rates has prompted many proposals to reduce consumption of sugary drinks. The idea of taxing sugary drinks has received particular attention. In recent years, France, Hungary, Mexico, the United Kingdom, and other countries have adopted sugary drink taxes. In the United States, soft drinks taxes have been enacted by four cities in California (Albany, Berkeley, Oakland, and San Francisco) as well as Boulder, Colorado, Philadelphia, Pennsylvania, Cook County, Illinois, and the Navajo Nation, and more jurisdictions are considering them.

In this report, we examine the pros and cons of basing soft drink taxes on how much sugar a drink contains rather than its volume or retail value.[1] The vast majority of the sugar in drinks is added sugar. Our analysis thus applies equally to taxes on added sugar, which will become feasible once nutrition labels are updated in 2018 and 2019. We make eight main points:

- Sweetened drink taxes are often based on drink volume, thus taxing high- and low-sugar drinks equally. But soft drinks differ greatly in their sugar content. Some have less than two teaspoons of added sugar in each eight-ounce serving, for example, while others have more than seven. From a public health perspective, volume taxes thus do too little to discourage high-sugar drinks and too much to discourage low-sugar drinks. Focusing taxes on drinks with the most sugar would do more to reduce sugar consumption for any given level of taxation.[2]

- Taxes based on sugar content may also encourage manufacturers, distributors, and retailers to redesign their product lineups and marketing plans to favor drinks with less sugar. Such incentives are more pronounced for taxes levied by jurisdictions with large beverage markets than by small ones.

- The federal government has both the authority and the capability to tax soft drinks based on their sugar content. The federal government has long taxed spirits based on their alcohol content and has experience applying different tax rates to different groups of products, such as spirits, wine, and beer. It could pursue either approach with sugary soft drinks.

- Other nations have already enacted drink taxes based on sugar content. Hungary has a one-tier levy that taxes drinks with relatively high sugar levels. The United Kingdom recently announced a two-tier levy that taxes moderate-sugar drinks at one amount and high-sugar drinks at a higher amount. And South Africa plans to tax the added sugar content of beverages.
- State and local governments, as well, often have the ability to implement taxes based on sugar content, but they face more constraints in implementing their tax policies. The tools available to a city or county can differ from those available to a state or nation because of legal limitations (e.g., statutory or constitutional limits on the taxes a jurisdiction can levy) and administrative constraints. The magnitude of taxes they can levy may be limited by the ability of consumers and noncompliant businesses to shift purchases to neighboring jurisdictions. When taxing manufacturers based on sugar content is infeasible, local governments can consider tiered volume taxes collected from distributors. Several states apply tiered taxes to wine and beer based on alcohol content or divide alcoholic beverages into different categories for taxing. Many states include soft drinks in their sales tax base even when food for consumption at home is excluded, applying the general retail sales tax to purchases.
- If policymakers are more focused on raising revenue than reducing sugar consumption, however, they may prefer broader taxes that spread the tax burden more evenly. Philadelphia's decision to tax all sweetened beverages, rather than just sugar-sweetened beverages (SSBs), is a good example.
- Policymakers thus face trade-offs among policy goals. Taxes that target high-sugar drinks provide the most sugar reduction relative to the economic burden placed on consumers. Taxes based on sugar content minimize the cost of reducing sugar in soft drinks. But taxes based on volume or price minimize the cost of raising revenue by taxing sweetened beverages.
- As soft-drink taxes become more common, individual jurisdictions may find the easiest path is to adopt the same design as neighboring jurisdictions. Such coordination will reduce the administrative burden on both governments and businesses. But it also raises the importance of identifying and implementing good tax designs early on, lest ad hoc choices lead jurisdictions to miss out on better tax designs.

In the remainder of this report, we present an economic analysis of different tax designs, document that taxing soft drinks based on sugar content is feasible for the federal government, and argue that although taxing soft drinks based on sugar content may face challenges at the state and local level, it is generally feasible as well.

Taxing Sugar Content Is the Least Costly Way to Reduce Sugar Consumption

Taxes on sweetened beverages are often based on drink volume. But sugar content varies greatly among beverages. A volume tax will increase the price of a high-sugar drink by the same amount as a low-sugar drink. Taxes linked to sugar content may therefore be a better way to discourage sugar consumption because the price will increase as sugar content increases. To explore that possibility, we document the wide variation in sugar content in drinks, review previous research examining different tax designs, develop and use a new model to examine the implications of different ways of taxing sweetened beverages, consider how concerns about consumers with low-income should inform tax design, and discuss the potential for taxes based on sugar content to inspire businesses to shift their product lines toward drinks with less sugar.

Sugar Content

Sugar content varies greatly both across beverage categories and within them (table 1). A typical sugar-sweetened soda, for example, contains almost 30 grams of sugar (about 7 teaspoons) per eight-ounce serving. A typical sweetened iced tea contains about half as much, and a typical flavored water contains one–third as much. Even within those categories, sugar content varies greatly. Some regular sodas have less than 10 grams, while others have almost 50. And some sweetened teas have as much sugar as a sugar-sweetened soda, while others have almost none. Basing a tax solely on drink volume thus ignores the diversity in sugar content and potential health effects.

TABLE 1

Sugar Content of Sugar-Sweetened Beverages, 2014

Grams per eight-ounce serving

	Minimum	Maximum	Mean
Regular soda	8	48	29
Fruit drinks	1	57	22
Sports drinks	5	14	12
Ready-to-drink tea	5	28	15
Energy drinks	1	33	19
Flavored water	4	13	10
Ready-to-drink coffee	2	28	16

Source: Rudd Center for Food Policy and Obesity, 2014, *Sugary Drink FACTS 2014;* authors' calculations.

Many public health experts believe that added sugars in foods and drinks pose particular risks. Nutrition labels, however, currently report total sugar, combining added and naturally occurring sugars. For practical purposes, drink taxes linked to sugar content must therefore be based on total sugar. That will change, however, when added sugars are reported separately on nutrition labels. That reporting is scheduled for mid-2018 for major brands and mid-2019 for smaller ones. At that point, policymakers will have the option of basing drink taxes on added sugar, with a fallback of taxing total sugar if added sugar is for any reason not reported separately. Our analysis of the pros and cons of different tax designs applies almost identically to taxes on added sugar as to taxes on total sugar. The only slight difference is that the base of a tax on added sugar would be slightly smaller because it would omit naturally occurring sugars, such as from the milk in some sweetened drinks.

Previous Studies

Most studies of taxing sweetened beverages focus on uniform taxes on volume or on taxes that raise SSB prices by a specific percentage, usually 10 or 20 percent (Zhen et al. 2011, 2014; Dharmasena and Capps 2012; Lin et al. 2011; Finkelstein et al. 2013). In fact, we are aware of only one study that does a head-to-head comparison of volume and sugar taxes on sweetened beverages. Zhen, Brissette, and Ruff (2014) compared a volume tax (0.5 cents per ounce) to a calorie tax (0.04 cent per kilogram calorie, equivalent to 0.15 cents per gram of sugar).[3] They calibrated these tax rates so the levy on regular Coca-Cola, the most popular sweetened beverage, would be the same under both approaches. They found that taxing sugar would reduce sugar intake 8 percent more, impose 5 percent less of a burden on consumers, and collect 5 percent less revenue than would taxing volume.[4] Taxing sugar content thus delivers more sugar reduction than a volume tax relative to the burden placed on consumers. In short, taxing sugar content is more efficient than taxing volume if the goal is reducing sugar consumption.

Modeling Different Tax Approaches

Using a simple model of consumer purchases of soft drinks, we explored how different tax designs affect the amount of sweetened beverages consumers buy, the amount of sugar they consume from those beverages, the revenue collected by the government, and the economic burden on consumers (appendix A). The model groups sweetened soft drinks into six broad categories: zero-calorie sweetened drinks; regular soda; energy drinks; and noncarbonated sweetened beverages with high, medium, and low sugar content. These six categories keep the model relatively small and tractable while

capturing important variation in sugar content and price. The three categories of noncarbonated soft drinks capture the particularly large variation in sugar content among fruit drinks, sports drinks, ready-to-drink iced tea, ready-to-drink coffee, and flavored waters. Separating carbonated soft drinks into regular soda and energy drinks captures the large price difference between expensive energy drinks and other sweetened beverages.

We calibrated the model to conventional estimates of the price-responsiveness of consumer demand for soft drinks and then simulated the effects of different tax designs. Consistent with many previous analyses, we focused on cases in which excise and sales taxes are both fully borne by consumers; allowing for incomplete pass-through would change the magnitude of some effects, but would not change the qualitative results.[5]

The best tax design depends on the relative importance policymakers place on discouraging sugar consumption, raising revenue, and minimizing new economic burdens on consumers.

- If policymakers want to reduce sugar consumption from sweetened beverages as efficiently as possible, taxing sugar content is the best approach. Taxes on drink volume or sales are less efficient because they do not reflect the wide variation in sugar content among sweetened beverages. For a given level of overall taxation, taxes on volume or price do too little to discourage consumption of high-sugar drinks and too much to discourage relatively low-sugar ones.
- If policymakers want to reduce sugar consumption from sweetened beverages with as little economic burden on consumers as possible, taxing drinks with relatively high sugar content is the best approach. Focusing the tax on high-sugar drinks maximizes the sugar reduction relative to the consumer burden from higher prices.
- If policymakers are focused on raising revenue rather than reducing sugar consumption, a sales tax on all sweetened beverages, including diet ones, is the best approach. Chicago has had a tax on the gross receipts of soft drink vendors since 1994. A close second is an excise tax on soft drink volume, similar to what Philadelphia recently approved. By including diet drinks in the tax base, these broader taxes spread the tax burden, allow lower tax rates, and reduce the consumer burden from higher prices. But they also do less to reduce sugar consumption than taxes on sugar content.

Distributional Considerations

People with lower incomes consume more sweetened drinks, on average, than those with higher incomes. Lin and colleagues (2011) find, for example, that lower-income adults consume about 40 percent more sugary drinks each day than do higher-income adults. For children, the difference is more extreme: kids in lower-income households consume two-and-a-half times as many sugary drinks as their higher-income counterparts.

That pattern has mixed implications for sweetened drink taxes. On the one hand, it implies that policies that reduce sweetened drink consumption may especially help vulnerable populations. On the other hand, it means that sweetened drink taxes are economically regressive, falling more heavily on families with lower incomes than those with higher incomes (Marron, Gearing, and Iselin 2015).

From a distributional perspective, therefore, the most attractive sweetened drink tax designs would be those that maximize the reduction in sugar consumption relative to the economic burden they place on families, particularly families with low incomes. Our modeling results suggest that concern about consumers with low incomes should lead policymakers to prefer taxes that particularly target high-sugar drinks and thus deliver particularly large sugar reductions relative to the economic burden they place on consumers.

Business Responses and Reformulation

Almost all quantitative studies of sweetened beverage taxes focus on how consumers respond. But business responses matter as well. With a volume tax, businesses have some incentive to design and market smaller packages, such as eight-ounce cans. With a tax linked to sugar content, however, they also have an incentive to reduce sugar content or to shift their marketing and promotion efforts to lower-sugar alternatives.

Unfortunately, little systematic evidence exists on such responses. Hungary reports that its one-threshold tax prompted some companies to reduce the amount of sugar in their drinks to get below the threshold (European Competitiveness and Sustainable Industrial Policy Consortium 2014). Moreover, proposed tax levels are very large relative to the price of sweeteners; high fructose corn syrup, for example, costs about 0.1 cents per gram (USDA 2016), while the sugar content taxes we analyzed would be about three times larger, around 0.3 cents per gram. Such a tax would be a meaningful incentive to reformulate products. And major beverage manufacturers have indicated that reducing average sugar content in their products is already part of their overall strategies.[6]

On the other hand, brand formulas are often determined at the national level by manufacturers, limiting the degree to which taxes by state and local governments may prompt reformulation. It is likely that reformulation incentives would be more important for large states and the nation as a whole than for individual localities. But even local taxes may encourage lower-sugar formulations used by regional generic or craft brands.

Taxing Based on Sugar Content Is Feasible at the National Level

The US federal government clearly has the authority and capability to tax sweetened beverages based on their sugar content. The federal government already taxes spirits based on their alcohol content, and it has long experience applying differential tax rates to categories of alcoholic drinks, motor fuels, and tobacco. Applying either approach to sugary drinks would be straightforward: the government would collect the tax from drink manufacturers and importers.

The feasibility of taxing drinks based on their sugar content is reinforced by the fact that several other nations already do so. Hungary taxes SSBs at the equivalent of roughly 2 cents per liter if they contain more than 8 grams of sugar per 100 milliliters, or about 19 grams per eight-ounce serving. The United Kingdom recently announced that it would start taxing sugary drinks at the equivalent of 0.75 cents per ounce if they contain at least 5 grams of sugar per 100 milliliters and about 1 cent per ounce if they contain more than 8 grams per 100 milliliters (those thresholds are equivalent to 12 and 19 grams per eight-ounce serving, respectively). And South Africa recently announced a tax on sweetened beverages equivalent to about one-tenth of US cent per gram of added sugar.

Together, those governments have enacted the three most promising ways to tax beverages based on their sugar content: a single-tier tax (Hungary), a two-tier tax (United Kingdom), and a sugar content tax (South Africa), all levied on manufacturers or importers. Other content-oriented nutrition taxes include Hungary's single-tier taxes on products with other potentially harmful ingredients, including sugar, salt, and caffeine; Mexico's single-tier tax on energy-dense processed foods; and Denmark's now-repealed tax on the saturated fats used in food production.

Taxing Based on Sugar Content Raises More Issues at the State and Local Level but Is Generally Feasible as Well

State and local governments often have less financial and administrative resources than the federal government, must operate within limits imposed by higher levels of government, and are constrained by the fact that many businesses and some consumers produce, distribute, sell, or buy sweetened drinks beyond their borders. These realities can limit the size of potential taxes state and local governments can effectively enforce on sweetened drink taxes. They also may affect the form these taxes can take, as it is likely that taxes will need to be based on information that is known or reported. On balance, however, state and local governments should find it feasible to base drink taxes on sugar content. Many of the issues faced by state and local governments are not very different for a tax based on sugar content versus one based on volume, assuming the information needed to calculate the tax is easy to obtain.

Collection Points

In principle, soft-drink taxes can be collected from manufacturers (and importers), distributors, or retailers. Administration is usually easiest when taxpayers are few and large. For that reason, Mexico, South Africa, and the United Kingdom all apply their national sugary drink taxes to manufacturers. The national government knows who they are, and because they control the borders, collection from both domestic and foreign manufacturers is easier. Compliance checks are restricted to a few large taxpayers rather than hundreds of distributors or thousands of retailers.

At the state and local level, however, taxing manufacturers will not work because many are located outside the taxing jurisdiction. A single Coca-Cola bottler, for example, might serve more than a dozen states.[7] Manufacturers sell through distributors and may not have the necessary legal or practical nexus to the jurisdiction to make a tax feasible.

Although there are more distributors than manufacturers, distributers are more connected to a specific community, so they can be identified more readily by local government officials. If they are located within a city, the city would have authority to tax them, and physical proximity makes identification easier and reduces possible recordkeeping and compliance burdens. Because of space and accessibility, however, distributors often operate warehouses near cities but not always within the city borders. In Philadelphia, for example, this geography includes southern New Jersey. Distributors would have to know which product goes to the taxable jurisdiction and have incentives to be willing to accept

the burden of collecting and remitting taxes to a specific jurisdiction even if they are not legally bound by the jurisdiction (because of not being located within the geographic space). As with Philadelphia and New Jersey, this becomes an interstate issue and it may be difficult to collect the tax from an out-of-state vendor.[8]

Collecting taxes at retail (whether framed as a tax on retailers or a tax on consumers) would be transparent and would ensure that all taxed businesses have a clear nexus with the taxing jurisdiction.[9] However, this would require collecting the tax from a large number of businesses, thus imposing relatively large record-keeping and compliance burdens. Moreover, experience with other products suggests that small retailers might be less able or willing to comply with the new rules. In the fiscal note for a Texas proposal to impose a retail sugary drink tax in 2011, the analysis specifically mentions the compliance difficulties retailers would face.[10]

Berkeley and Philadelphia address this problem by requiring retailers to collect and remit the tax if it is not collected from distributors. For example, Berkeley's sugary drink tax is on the distributor with careful language to ensure that the tax is only collected once (in some cases there may be more than one distributor in the transaction chain). A retailer must show proof of tax paid or collect the tax itself. Because some retailers are exempt (those with gross receipts of less than $100,000), one administrative issue is that distributors need to identify those exempt customers.[11]

Given these concerns, the most administratively practical approach for most cities and states would be to follow Berkeley and Philadelphia's lead and collect soft-drink taxes from licensed distributors to the extent possible, holding retailers ultimately responsible if they purchase from noncompliant distributors, warehouse stores outside the jurisdiction, or other untaxed sources.[12] This recommendation holds for any excise tax, whether based on volume, sugar content, or both. This approach addresses the administration and compliance issue by having a smaller number of taxpayers and addresses the nexus issue by having a "backstop" of being able to collect from the retailer if the distributor is out of reach. As is currently the case for cigarette sales, such an approach likely will involve some enforcement costs to the government to conduct random audits or checks of retailers.

Legal Authority

There are both federal and local legal issues related to sweetened drink taxes. At the federal level, constitutional issues could arise regarding due process or equal protection (14th amendment) because of the singling out of sweetened drinks over other beverages. But courts have generally given states

wide latitude in tax authority under the 14th amendment (assuming it doesn't violate interstate commerce provisions) as long as a rational basis for the tax exists and a clear distinction exists between a taxable good and one that is not taxable. For example, alcoholic beverages are distinguishable by ingredient content (alcohol) and have long been taxed separately from other beverages. The rationale behind this, the desire to reduce alcohol consumption, is similar to the motivation behind sweetened drink taxes.

At the local level, the issues are authority to tax and uniformity of taxable classes. State governments have wide latitude over how and what they tax. Each state, however, establishes the taxing authority available to local governments. Maryland, for example, allows counties to levy a tax on income up to a maximum rate but not on sales. Alaska does not have a state sales tax but allows local governments to tax sales in their jurisdictions. California allows local governments to authorize some additional taxes but only with direct approval of voters. And New York generally limits what local governments can tax although sometimes gives special taxing authority to some large governments. For example, New York City and Yonkers are allowed to levy a local income tax, and New York City is allowed to have an additional cigarette tax.

The legality of a recent sweetened drink proposal in Chicago was questioned.[13] Opponents suggested Chicago had reached the statutory limit on the amount of tax it could levy because the city already levies the maximum 3 percent surtax on bottled soda. Whether the cap refers to all taxes on sodas or just the soft drink occupational tax will undoubtedly be litigated if a future proposal succeeds.

Several states also have uniformity clauses either by constitution or by statute that stipulate that like transactions have to be taxed equally. A good example is the tax on real property: some states allow property taxes to be different for commercial and residential properties, while some states with uniformity clauses may only allow one class. The definition and interpretation of a "class," however, is left to the courts. Pennsylvania has a uniformity clause in its constitution, and that clause has already been raised by opponents of Philadelphia's newly passed sweetened beverage tax.[14] California has a uniformity clause, but excise taxes are specifically exempted from it.[15]

A tax on sugar content may be on stronger legal ground than a tax on volume for sweetened drinks. Basing a tax on the amount of an ingredient in a beverage does not create separate classes if there are no exceptions, whereas taxing based on natural versus added sugars creates beverage classes, as do tiered tax levels.

Cross-Border Coordination

The challenges of levying excise taxes grow as the taxing jurisdiction gets smaller. If a tax is high or difficult to comply with, consumers and retailers have an incentive to acquire soft drinks outside the jurisdiction to avoid taxation. At the national level, tightly controlled borders make this difficult: entry points are few and monitored, and shipment sizes are often large and hard to conceal. Within a country, however, borders are usually open, and the United States has constitutional protections for interstate trade, making it more difficult to monitor flows of goods between areas. At the city level, borders are extremely porous with many entry points. As yet, we have little evidence on the degree to which consumers and businesses will shift drink purchases across borders; such behavior will be relatively more important for jurisdictions that are geographically small and levy high taxes.

When setting local taxes, it is useful to use definitions of products set by another level of government. The handful of local governments that have local excise taxes on tobacco usually use the product definitions of their state and adjust only the rate charged. Most of the local governments that tax cigarettes leave the administration and collection to the state. Having multiple jurisdictions levy and administer taxes increases the compliance burden for taxpayers. For example, Alabama counties collect their own cigarette tax; a package of cigarettes in Mobile County thus has two stamps: one for the state tax and one for the county and city tax.[16] Other states that allow local governments to assess a tobacco tax are Illinois, Missouri, Tennessee, and Virginia. New York City also has a local cigarette tax, although other New York local governments do not.

One feature of the major excise taxes is that the federal government levies similar taxes on manufacturers and importers. This means that one major burden of compliance—the definition of products—is partially determined at the national level with federal resources coming to bear. For example, because the federal government taxes similar tobacco product categories as states, manufacturers don't have an incentive to alter mixes or sizes to avoid state taxes. However, the federal government can be slow to adapt to new technologies, products, and concerns.

The same lack of coordination is happening with proposed sweetened drink taxes. In the absence of any federal tax, lower levels of government are developing their own definitions of both tax systems and what products are included. The coordination issues faced across 50 states are amplified when considering thousands of local jurisdictions. Figuring out appropriate sweetened drink taxes, however, can build on federal requirements for nutritional labeling. Today, that includes labels reporting sugar content and calories; added sugars will be separately reported for major brands by mid-2018 and smaller brands by mid-2019. This federally required information means that local governments can use

sugar content to both determine which products will be covered by a tax and, if desired, to calibrate taxes to sugar content.

By taxing based on the amount of the ingredient, the cliff effect of the categorical tax is avoided. However, greater trust in the measurement overall is required. The US Food and Drug Administration has for years required food manufacturers to inform consumers of the sugar content of many products. These data haven't been used for tax purposes and, if these measures are self-reported, their accuracy may need to be monitored. For taxes on ingredients to be feasible, especially for small local jurisdictions, the information on the ingredient must be readily available. Thus, because sugar content is reported but added sugar is not, any design would currently need to be based on sugars. If a product is subject to the tax, all sugar would contribute to the tax price.

South Africa's new sweetened-drink tax is based on added sugar as determined by the label, but nutritional labeling is not yet mandatory. To address the possible compliance problems, the nation will levy an assumed minimum amount on beverages without labels, providing an incentive for producers to voluntarily apply nutritional labels until the mandatory labeling catches up (South Africa National Treasury 2015). A similar approach could be taken by the US government but is not currently practically available to state and local governments, however jurisdictions could pass an added sugar based tax that reverts to collection based on total sugar content if added sugar isn't reported.

The need for coordination also highlights the possible advantages to being an early adopter of sweetened drink taxes. It is likely that distributors would strongly prefer consistent, easily administered definitions when collecting new taxes.

The question of coordination also raises additional questions if a precedent is set that might not meet the goals of additional jurisdictions. For example, Philadelphia has broadened the class of covered products to include all sweetened beverages whether sugar is included or not. A neighboring jurisdiction would be ill-served to follow Philadelphia's lead if their primary goal is to reduce sugar consumption rather than to maximize tax revenue.[17] However, by using a similar taxing system but limiting what products are included through a simple rule (e.g., by setting a minimum calorie-content threshold for tax coverage), a neighboring jurisdiction can use the basic infrastructure put into place after passage of Philadelphia's tax while maintaining the ability to not tax sugar-free products.

Experience with Taxes Based on Content or Categories

Some state and local governments have experience levying taxes based on product content.

- Berkeley exempts drinks with less than 2 calories per ounce from its sugar-sweetened-beverage tax. This threshold is very low but does affect some drinks with very low sugar content, such as some flavored waters.
- Several states vary their tobacco taxes based on the specific product. For example, cigarillos or little cigars are now taxable as cigarettes in most states, while regular and premium cigars are not. Loose tobacco, snuff, and chewing tobacco are commonly taxed by weight or value. Electronic cigarettes can be taxed by volume of liquid nicotine or by cost. Only four states (Kansas, Louisiana, Minnesota, and North Carolina) and the District of Columbia have enacted taxes on electronic cigarettes.[18]
- States often tax spirits, wine, and beer at different rates,[19] and some state taxes take alcohol content into account. The tax on wine may be the most directly comparable to a tiered sweetened-drink tax based on sugar levels. Many states tax low-alcohol-content wine and high-alcohol-content wine differently. The tax on wine in Kansas with alcohol content less than 14 percent is 30 cents per gallon versus 75 cents per gallon for higher-content wine (fortified). A few states have different tax levels for beer based on alcohol content. Kansas, Minnesota, and Oklahoma use a reduced rate for low-alcohol-content beer (less than 3.2 percent alcohol). Utah controls the sale of all alcohol through government stores with the exception of low-alcohol beer, which is taxed at $11 per barrel in addition to the retail sales tax.[20] One consequence of taxing categorically based on the percentage of an ingredient is the creation of a cliff effect, where very similar products are taxed differently. This creates additional pressure on the reliability of the measurement at the threshold.

Conclusion

As more attention is paid to both the negative effects of sugar and SSBs, more governments are examining the most appropriate way to limit consumption. In the United States, efforts at taxing SSBs are largely underway at the local level. Six cities (Albany, Berkeley, Boulder, Oakland, Philadelphia, San Francisco) and one county (Cook County) have enacted such taxes, and several other municipalities are considering following suit.

As systems are developed, the formats of early-adopted drink taxes are likely to influence the development of these taxes throughout the United States. Local governments should consider their policy goals as they develop these taxes. If policymakers are proposing taxes on sweetened beverages

to discourage sugar consumption, they should give close consideration to basing those taxes on sugar content, which is feasible and legal in many jurisdictions. If, however, their primary goal is revenue collection, taxes on drink volume or sales value might be preferred because of their efficiency.

Appendix A. Modeling Policy Trade-Offs in Designing Sweetened-Beverage Taxes

Model

Strategy

Analysts have used a broad range of models to analyze taxes on soft drinks. Some estimate how much taxes reduce sweetened-beverage purchases based on a single parameter: the own-price elasticity of demand for sweetened beverages (Rudd Center for Food Policy and Obesity 2014; Long et al. 2015). Others use scanner data to estimate highly disaggregated demand models with numerous own-price and cross-price elasticities. Zhen, Brissette, and Ruff (2014), for example, estimated more than 7 million own- and cross-price elasticities for individual soft drinks and other products.

Our goal is a simple model that illustrates the basic trade-offs policymakers face in designing soft-drink taxes. We have limited our categories to highlight the trade-offs and effects of different taxing strategies, focusing on groups that contain products with different sugar content and with different pricing profiles. To that end, we group sweetened soft drinks into six broad categories: zero-calorie sweetened drinks; regular soda; energy drinks; and noncarbonated sweetened beverages with high, medium, and low sugar content. These six categories keep the model relatively small and tractable while capturing important variation in sugar content and price. The three categories of noncarbonated soft drinks capture the particularly large variation in sugar content among fruit drinks, sports drinks, ready-to-drink iced tea, ready-to-drink coffee, and flavored waters. Separating carbonated soft drinks into regular soda and energy drinks captures the large price difference between expensive energy drinks and other sweetened beverages.

To categorize noncarbonated soft drinks as low, medium, or high sugar, we use the thresholds that Britain recently announced for its sweetened-beverage tax. Britain will tax soft drinks that contain at least 5 grams of sugar per 100 milliliters and will levy a higher rate on those with at least 8 grams of

sugar per 100 milliliters. Those cutoffs work out to about 12 and 19 grams of sugar per eight-ounce serving.

Consumer Demand

We model consumer purchasing using a simplified version of the Almost Ideal Demand System. We assume consumers dedicate a fixed portion of their budget to purchasing sweetened beverages.[21] The share of this budget allocated to each of the six product categories is given by

$$w_i = a_i + \sum_j b_{ij} \ln(p_j),$$

where w_i is the share of consumers' soft drink budget spent on category i, p_j is the average price per ounce of drink category j, the a_i are constants, and the b_{ij} determine how responsive budget shares are to price.[22]

We estimate the a_i parameters by calibrating the model to observed market prices and quantities. We estimate the b_{ij} parameters by calibrating the model to estimates of sweetened beverage price sensitivity. Following Powell and colleagues (2013), we assume the own-price elasticity of sweetened beverages overall is -1.2 and of regular sodas is -1.25. These parameters imply the own-price elasticities for other categories vary from −1.4 to -1.9, depending on their initial budget shares. We choose the cross-price terms to be consistent with overall elasticities and to allow plausible degrees of substitution, but previous research provides little compelling evidence about how consumers substitute across product categories, and this is an area where further research would be useful.

Soft Drink Volumes, Prices, and Sugar Content

We base our quantity and price estimates (table A.1) on data from Beverage Digest Fact Book (Beverage Digest 2016). We disaggregate the carbonated soft drink category into regular soda and energy drinks using the quantity data in that report. To estimate the average price of energy drinks, we combine the overall carbonated soft drink price in that report with the energy drink versus regular soda prices reported by Powell and colleagues (2014). Because we do not have separate price information for the non-carbonated drink category we assume the same price across all products irrespective of sugar content. To estimate average sugar content in each category, we combine market share data from the Fact Book with the sugar content data reported by Rudd Center on Food Policy and Obesity (2015).

TABLE A.1

Sweetened-Beverage Market Shares, Prices, and Sugar Content

	Volume share (%)	Price (cents per ounce)	Sugar content (grams per eight ounces)
Sugar-sweetened beverages	**79%**	**4.8**	**24**
Regular soda	52%	4.1	27
Energy drinks	3%	17.3	21
Noncarbonated:			
High sugar	8%	4.8	26
Medium sugar	12%	4.8	15
Low sugar	4%	4.8	8
Diet sweetened beverages	**21%**	**4.5**	**0**
Total	**100%**	**4.8**	**19**

Source: Beverage Digest (2016), Rudd Center on Food Policy and Obesity (2014), and authors' calculations.

Pass-Through

Like many previous analyses (for example, Zhen, Brissette, and Ruff 2014), we assume sweetened-beverage taxes are completely passed through to consumers in the retail prices of taxed products. In reality, the degree of pass-through will depend on market conditions, the size and geography of taxing jurisdictions, and other considerations. Lower (or, under some circumstances, higher) degrees of pass-through would affect our specific estimates, but would not affect our qualitative comparison of tax designs as long as the degree of pass-through is the same for each tax design. Similar pass-through occurs in markets that are sufficiently competitive. The degree to which businesses pass excise taxes on to consumers depends on supply and demand conditions in the same way as the degree to which they absorb sales taxes collected from consumers. Pass-through may differ, however, if markets are not competitive, see Marron, Gearing, and Iselin (2015) and references therein.

Outcomes of Interest

We compare tax designs along four main outcomes: sweetened beverage consumption, sugar consumption from sweetened beverages, revenue, and consumers' economic well-being. The first three of these are straightforward. All the taxes we consider raise revenue for the taxing government and reduce the volume of sweetened beverages that people buy. The degree to which the taxes reduce

sugar from sweetened beverages depends on the volume reduction as well as the relative change in each product category. Taxes that particularly reduce consumption of high-sugar drinks, for example, will generate more sugar reduction for a given volume reduction than do other taxes.

Taxes place an economic burden on consumers directly (through their financial costs) and indirectly (by changing what they buy). The financial cost is straightforward: taxes raise retail prices, so paychecks don't go as far. The indirect costs may not be as visible but are often as real. Consumers may avoid the tax by switching to what were previously more expensive products. If soda costs 5 cents per ounce and juice costs 5.5 cents per ounce, for example, a penny per ounce tax on soda but not juice might lead the consumer to switch to juice. The higher price is a real financial cost, but it does not show up as tax revenues. In addition, consumers experience nonfinancial costs if they get less enjoyment from their new purchases or invest time and effort in purchasing in less convenient ways.

There is some controversy about whether and how to include economic well-being in evaluations of sweetened-beverage taxes. Economists generally include both the direct and indirect costs of taxes in measuring costs (see, e.g., Lovenheim and Harding 2014 and Zhen et al. 2014). Some public-health researchers, however, question whether indirect costs should be recognized (Long et al. 2015). We favor the economists' side and include measures of indirect costs from changed behavior in our analysis. We believe, however, that more research is needed on how to measure such costs for cases, like sweetened-beverage consumption, where consumers may be systematically making suboptimal choices.

Tax Designs

We analyze seven ways of taxing soft drinks. Five tax only SSBs:

- **Sales tax on SSBs:** Like the retail sales taxes that already exist in many states, a retail sales tax on SSBs is based on the retail value of SSBs purchased. Expensive SSBs, such as energy drinks, face a higher tax than less expensive drinks, such as many regular sodas. Previous studies have often analyzed a 20 percent sales tax on SSBs, so we use that as a benchmark for our analyses.
- **Volume tax on SSBs**: A volume tax applies to SSBs based on their fluid volume, usually measured in ounces. Berkeley, for example, charges 1.0 cent per ounce. To raise the same revenue as a 20 percent SSB sales tax in our model requires a volume tax of 1.0 cent per ounce. To achieve the same reduction in SSB sugar requires a volume tax of 0.9 cents per ounce.

- **One-tier tax on SSBs:** This volume tax applies only to drinks whose sugar content exceeds a specified level. Hungary uses this approach, applying its tax to drinks with at least 19 grams of sugar per eight-ounce serving.[23] To raise the same revenue as the benchmark sales tax requires a tax on high-sugar drinks of 1.3 cents per ounce. To achieve the same sugar reduction requires a one-tier tax of 1.0 cent per ounce.
- **Two-tier tax on SSBs:** This volume tax applies to drinks whose sugar content exceeds a specified level, and a higher rate applies if sugar content exceeds a second threshold. Britain recently announced such a tax, with one rate applying to drinks with at least 12 grams of sugar per eight-ounce serving and a higher rate applying to drinks with at least 19 grams of sugar per eight-ounce serving.[24] To raise the same revenue as the benchmark sales tax requires taxes of 0.6 and 1.2 cents per ounce. To achieve the same sugar reduction requires rates of 0.5 and 0.9 cents per ounce.
- **Sugar content:** Taxes vary proportionately with a drink's sugar content. South Africa recently announced such a tax, charging about a tenth of a US cent per gram of added sugar. The US federal government taxes spirits based on their alcohol content, for example, and more governments are beginning to discourage greenhouse gas emissions by taxing the carbon content of fossil fuels. To raise the same revenue as the benchmark sales tax requires a tax on sugar content of 0.34 cents per gram, and to achieve the same sugar reduction requires a tax of 0.27 cents per gram.

We also consider two ways of taxing all sweetened beverages, including zero-calorie drinks as well as sugar-sweetened ones. Sales taxes on all soft drinks already exist in many states, and Philadelphia recently approved a volume tax. Taxes on all sweetened drinks of 15 percent or 0.7 cent per ounce would raise the same revenue as the benchmark sales tax. Taxes of 25 percent or 1.1 cents per ounce would achieve the same sugar reduction.

Results

Taxes That Raise the Same Revenue

We first compare seven taxes that raise the same amount of revenue, which we normalize to be 100 (table A.2). For a given revenue level, taxes targeted at high-sugar drinks are the most effective way to

reduce sugar consumption, but taxes on all sweetened beverages are the most efficient way to raise revenue.

TABLE A.2

Taxes Raising the Same Revenue as a 20 Percent Sales Tax on SSBs

	Sugar-Sweetened Beverages			Consumer Economic Well-Being		
	Volume (%)	Sugar content (%)	Sugar (%)	Taxes paid	Changed behavior	Total
Taxing sugar-sweetened beverages						
Sales	-20	0	-20	-100	-13	-113
Volume	-22	0	-22	-100	-14	-114
Sugar Content	-22	-2	-24	-100	-15	-115
Two-tier	-22	-2	-24	-100	-16	-116
One-tier	-22	-4	-25	-100	-20	-120
Taxing all sweetened beverages						
Sales	-13	0	-13	-100	-7	-107
Volume	-14	0	-14	-100	-8	-108

Source: Authors' calculations.

Our benchmark 20 percent sales tax on SSBs would reduce SSB consumption about 20 percent. The tax would have no effect on the average sugar content of SSBs, so sugar consumption from SSBs would decline by the same percentage. Higher SSB prices would place two burdens on consumers, the tax revenue they effectively pay to the government through higher prices (100) and the loss from changing their behavior (13).

The other four SSB taxes would reduce SSB consumption by slightly more, 22 percent. The reduction is larger than under a sales tax because drink prices vary. A sales tax places more burden on high-price energy drinks and less on other soft drinks. The other taxes track volume or sugar content and thus do more to discourage consumption of cheaper products.

The effects on sugar content, however, differ significantly. Like the sales tax, a volume tax does not encourage consumers to favor lower-sugar products over higher-sugar ones. A sugar content tax, however, does encourage consumers to switch to lower-sugar options, reducing average sugar content about 2 percent. A two-tier tax exempts low-sugar drinks and thus reduces average sugar content, also about 2 percent. A single-tier tax on SSBs with high sugar content reduces sugar content even more, by 4 percent. The single-tier tax thus reduces overall sugar consumption by more than a uniform volume tax (25 percent versus 22 percent).

The economic burden on consumers, however, runs the other way. Sales taxes have long been recognized as one of the most efficient ways to raise revenue because they spread the tax burden widely across consumer spending and do not change the relative prices that guide consumer choices. A volume tax is almost as efficient, imposing relatively little consumer burden relative to the revenue collected. That consumer burden rises, however, for taxes that target sugar content. The consumer burden is most pronounced for the single tier tax on high-sugar drinks because it places the highest tax rate on the narrowest base and thus does the most to change behavior. The burden from changing behavior in that case is 20 percent of the revenue consumers pay through higher prices.

Taxing all sweetened beverages, rather than just sugar-sweetened ones, reduces both the cut in sugar consumption and the efficiency burden on consumers. A volume tax on soft drinks, for example, reduces sugar consumption just 14 percent rather than the 20 to 25 percent caused by taxes that target just SSBs. The burden on consumers from changing behavior, however, is only 8 percent of revenue rather than 13 to 20 percent of those other taxes.

Taxes That Achieve the Same Reduction in Sugar

Our second comparison considers taxes that reduce SSB sugar consumption by the same amount, again taking a 20 percent sales tax on SSBs as the benchmark (table A.3). For a given sugar reduction, taxes based on sugar content are the most efficient way to reduce sugar consumption, but taxes targeted at high-sugar drinks minimize the consumer burden of cutting back sugar consumption from SSBs.

TABLE A3

Taxes Reducing SSB Sugar as Much as a 20 Percent Sales Tax on SSBs

	Sugar-Sweetened Beverages			Consumer Economic Well-Being		
	Volume (%)	Sugar content (%)	Sugar (%)	Taxes paid	Changed behavior	Total
Taxing Sugar-Sweetened Beverages						
Sales	-20	0	-20	-100	-13	-113
Volume	-20	0	-20	-90	-11	-101
Sugar Content	-19	-2	-20	-85	-10	-95
Two-tier	-18	-2	-20	-84	-11	-95
One-tier	-17	-3	-20	-79	-11	-91
Taxing All Sweetened Beverages						

Sales	-20	0	-20	-172	-21	-193
Volume	-19	-1	-20	-141	-17	-158

Source: Authors' calculations.

This comparison reflects the same fundamental trade-offs as the one holding revenue constant. From consumers' perspective, the least burdensome way of reducing sugar consumption is to target taxes on products with the highest sugar content. A single-tier tax on high-sugar drinks, for example, can achieve the same sugar reduction as a uniform volume tax while imposing about 10 percent less economic burden (91 versus 101).

From a broader societal perspective, taxing sugar content is the least costly way of reducing sugar consumption. A content tax minimizes the economic loss from changed behavior for any level of sugar reduction.

Taxes that include zero-calorie drinks are an especially burdensome way to reduce sugar consumption. To achieve the same sugar reduction as a volume tax on SSBs, a volume tax on all sweetened drinks would have to impose half again as much burden on consumers (158 versus 101).

Discussion and Limitations

Policymakers face important trade-offs in designing taxes on sweetened drinks. The goal of the policy will in part determine the design. The most efficient way to raise revenue from soft drinks is to levy a broad-based sales or volume tax on all sweetened beverages including zero calorie ones. However, if the primary goal is to reduce sugar content then the most efficient way is to tax drinks based on their sugar content. And the most consumer-friendly way to reduce sugar consumption is to only tax drinks with high sugar content.

We have illustrated these trade-offs using a simple, stylized model of the soft drink market, but they reflect long-standing insights from tax policy research. We thus expect that they would continue to hold in analyses using more complex modeling approaches. However, our results do come with several important limitations. First, as discussed, detailed information about how consumers respond to drink taxes is limited. Our model, built on what we consider plausible assumptions, is meant to illustrate the economic behaviors of consumers for a variety of designs, but it is simplified and the parameters are uncertain. This is an area where more research is needed. We expect that using more disaggregated data will show larger differences between tax designs. Zhen and colleagues (2014), for example, find a

bigger effect with their more sophisticated analysis but limit their study to a volume and a content tax. Because individual products vary in their sugar content, volume, and price per ounce, we felt that a simplified model could better illustrate how each of these characteristics interacts with the tax structure proposed to affect consumer choice and utility.

The simple model likely understates the potential advantages of taxing sugar content for two reasons. First, the model accounts for substitution between categories but does not reflect any sugar reductions that may occur from consumers switching to lower-sugar products within the same category. Second, the model does not account for any efforts by manufacturers, distributors, and retailers to favor products with lower sugar levels. As noted, these adjustments are most likely from a tax imposed nationally or by a populous state.

Our analysis implicitly assumes that consumers do not avoid the tax by switching to untaxed sources of these drinks. This assumption may be problematic for local governments, where crossing boundaries is easy. Such substitution would not change the relative attractiveness of the different taxes, but it could limit the overall impact any specific tax could have. It would also affect the importance of consumers lost welfare relative to other features and a more complete model could include a measure of the transportation or evasion costs. For example, if a consumer lives equidistant between two grocery stores, one in the taxing jurisdiction and one in a tax-free jurisdiction, changing location may provide a smaller loss in consumer welfare, yet the revenue raised by the jurisdiction would be smaller and the effect on sugar consumed would be negligible.

Our analysis focuses on sugar in sweetened beverages, but it does not account for any increased sugar consumption from products that consumers substitute toward.

Finally, our measures of consumer economic welfare assumes there is no preexisting tax system. In reality, there is an existing tax system that already distorts income and consumption choices. As a result, the incremental welfare costs of taxation are larger than reported here.

Given these considerations, our results likely understate the advantages of basing sweetened-beverage taxes on sugar content.

Notes

1. For this analysis, we suppose that a government has already decided to tax sweetened beverages and is considering how to do so. Whether taxing such beverages would be good policy is beyond our scope. Marron, Gearing, and Iselin (2015) examine the pros and cons of using taxes to discourage consumption of unhealthy foods and drinks.
2. Throughout this paper, we often compare different tax designs that achieve similar levels of overall taxation. Focusing taxes on high-sugar drinks will do more to reduce sugar consumption than spreading the tax over drinks with high and low sugar content, for example, if the overall tax level is the same. In some cases, policymakers make comparisons across taxes that differ in both level and design. In those cases, the insights from our analysis should be supplemented with an analysis of the implications of differing overall tax levels.
3. Their volume tax applies only to drinks with more than 10 calories in an eight-ounce serving. That threshold is equivalent to about 2.6 grams of sugar per serving and thus captures the vast majority of SSBs.
4. Two other studies compare product and nutrient taxes more generally. Harding and Lovenheim (2014) consider taxes on particular groups of products (soda, sweetened beverages, packaged foods, etc.) as well as on specific nutrients (sugar, fat, and salt). They generally find that targeting nutrients directly is significantly more efficient than taxing them indirectly through product categories; for reasons that are unclear, however, this result does not hold for sugar in their model. Miao, Beghin, and Jensen (2014) also compare different tax designs, comparing a tax on sweetened products (a final product) to ones on sugar and high-fructose corn syrup (inputs). They find that taxing sugary inputs is much more efficient at reducing sugar. They also consider a soda tax, finding it less efficient still.
5. Previous studies have documented cases of incomplete pass-through of excise taxes (e.g., Cawley and Frisvold 2015). Incomplete pass-through also happens for retail sales taxes, which may be absorbed by retailers, distributors, and manufacturers. As long as markets are sufficiently competitive, excise taxes and sales taxes of comparable magnitude should have similar effects on the after-tax price consumers pay. If markets are not competitive, pass-through may differ (see Marron, Gearing, and Iselin 2015 and references therein). Sales taxes and excise taxes may also differ in their salience to consumers; excise taxes are passed through into shelf prices, while sales taxes are collected at the point of sale.
6. American Beverage Association, "Alliance for a Healthier Generation and America's Beverage Companies Announce Landmark CGI Commitment to Reduce Beverage Calories Consumed across the Nation," news release, September 23, 2014, http://www.ameribev.org/news-media/news-releases-statements/more/334/.
7. Swire Coca Cola website, accessed September 2, 2016, http://www.swirecc.com/News.
8. In Chicago, suppliers of soft drinks are compensated for collecting the soft drink sales tax.
9. Nexus defines the minimal connection a taxpayer must have to be subject to a taxing authority.
10. Texas Legislature Budget Board's "Fiscal Note, 82nd Regular Session," on Senate Bill 01004, accessed September 2, 2016, http://www.capitol.state.tx.us/tlodocs/82R/fiscalnotes/html/SB01004I.htm.
11. City of Berkeley, California Berkeley Municipal Code 7.72.090, accessed September 2, 2016, http://www.codepublishing.com/CA/Berkeley/?Berkeley07/Berkeley0772/Berkeley0772090.html.
12. City Council of Philadelphia Bill 160176 (2016), https://phila.legistar.com/LegislationDetail.aspx?ID=2595907&GUID=36060B21-D7EE-4D50-93E7-8D2109D47ED1&Options=ID|Text|&Search=sugar.

13. John Byrne, "Chicago Soda Tax Fizzles at City Council Hearing," *Chicago Tribune*, September 9, 2015, http://www.chicagotribune.com/news/local/politics/ct-chicago-sugary-drink-tax-hearing-met-0910-20150909-story.html
14. Ronald D. Castille, "Commentary: Mayor, Council Pushing Unconstitutional Soda Tax," *Philly.com*, June 16, 2016, http://articles.philly.com/2016-06-16/news/73798563_1_8-percent-sales-tax-similar-tax-proposed-tax.
15. California State Board of Equalization Annotations, California Constitutional Provisions, Article XIII Revenue and Taxation, http://www.boe.ca.gov/lawguides/property/current/ptlg/ccp/art-XIII-all.html.
16. Alabama Department of Revenue, "Tobacco Tax Frequently Asked Questions," accessed October 3, 2016, http://www.revenue.alabama.gov/tobaccotax/faqtt.cfm.
17. While neighboring Pennsylvania jurisdictions do not have authority to pass excise taxes, the argument would hold for New Jersey based localities considering SSB taxes. In addition, Pennsylvania law can also change and allow other local governments to pass similar taxes. Indeed, Pennsylvania's commuter tax adoption followed such a pattern with initial adoption by Philadelphia and Pittsburgh then leading to broader adoption.
18. Richard Auxier, "States Should Answer a Few Questions before Taxing e-Cigarettes," *TaxVox*, May 18, 2016, http://www.taxpolicycenter.org/taxvox/states-should-answer-few-questions-taxing-e-cigarettes.
19. The Urban-Brookings Tax Policy Center, "Statistics: Alcohol Rates 2000–2010, 2013–2015 ," accessed October 3, 2016, http://www.taxpolicycenter.org/statistics/alcohol-rates-2000-2010-2013-2015.
20. Utah Beer Tax, Utah Code 59-15, http://le.utah.gov/xcode/Title59/Chapter15/59-15.html.
21. This assumption implies that the own-price elasticity of demand for soft drinks is -1.0, consistent with empirical estimates. Powell et al. (2013), for example, report the price elasticity of demand for soft drinks to be about -0.9.
22. This model typically includes a third term relating budget shares to the size of consumer budgets. For this simplified model, we assume budget shares are unaffected by the size of consumer budgets.
23. Hungary's threshold is 5 grams per 100 milliliters, which is approximately 19 grams per eight-ounce serving.
24. Britain's thresholds are 5 and 8 grams per 100 milliliters, which are approximately 12 and 19 grams per eight-ounce serving.

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About the Authors

Norton Francis is a senior research associate in the Urban-Brookings Tax Policy Center at the Urban Institute, where he works on the State and Local Finance Initiative. He is an expert in state and local tax policy and revenue forecasting. Francis has held senior economist positions in the District of Columbia and New Mexico, and has written about and presented on revenue estimating and state tax policy.

Donald Marron is an Institute fellow and director of Economic Policy Initiatives at the Urban Institute. From 2010 to 2013, he led the Urban-Brookings Tax Policy Center.

Before joining Urban, Marron served in senior government positions, including as a member of the President's Council of Economic Advisers and acting director of the Congressional Budget Office. He has also taught at the Georgetown Public Policy Institute and the University of Chicago Graduate School of Business; consulted on major antitrust cases; and served as chief financial officer of a health care software startup. He has broad experience in economic policy issues, including America's fiscal challenges, tax reform, energy and environment, and the financial crisis. He testifies frequently before congress; appears often at conferences and in the media to discuss economic policy; and works to popularize economics through his blog and writings. He is the editor of *30-Second Economics*, a short book that introduces readers to 50 of the most important theories in economics.

Marron studied mathematics at Harvard College and received his PhD in economics from the Massachusetts Institute of Technology.

Kim Rueben, a senior fellow in the Urban-Brookings Tax Policy Center at the Urban Institute and also directs the State and Local Finance Initiative. Her research examines state and local tax policy, fiscal institutions, state and local budgets, issues of education finance, and public-sector labor markets. Rueben currently serves on a review commission for the DC Department of Revenue and on an advisory board for the DC State Superintendent of Education. She is an adjunct fellow at the Public Policy Institute of California (PPIC) where she was a research fellow before joining the Urban Institute.

Rueben served on a Council of Economic Advisors for the Controller of the State of California, as a member on the DC Tax Revision Commission in 2013 and on National Academy of Sciences panel on the economic and fiscal consequences of immigration.

Rueben received a BS in applied math-economics from Brown University, an MS in economics from the London School of Economics, and a PhD in economics from the Massachusetts Institute of Technology.

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