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Should We Tax Sugar-Sweetened Beverages? An Overview of Theory and Evidence

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Sin taxes" are imposed to discourage individual behaviors, such as smoking or drinking alcohol, that are thought to harm the individual and possibly others in society. This article provides an economic framework for evaluating an increasingly popular class of sin taxes: those on sugar-sweetened beverages. As of mid-2019, seven US cities and thirty-nine countries around the world have implemented sugar-sweetened beverage taxes, mostly in the past few years (Global Food Research Program 2019).

Proponents of these taxes point to a range of policy goals, including improving public health and raising revenues that can be used to reduce budget deficits or to fund social programs. Opponents often express concerns about paternalistic government intervention in individual decisions and point out that sugar-sweetened beverages are consumed most heavily by the poor, which could make taxes regressive. How do economists evaluate these arguments? Should we tax sugar-sweetened beverages? If so, how high should the tax be?

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Table 1
Sugar-Sweetened Beverage Taxes in the United States

Location	*Date enacted*	*Tax rate (¢ per ounce)*	*Includes diet drinks?*
Albany, CA	November 2016	1	No
Berkeley, CA	November 2014	1	No
Boulder, CO	November 2016	2	No
Oakland, CA	November 2016	1	No
Philadelphia, PA	June 2016	1.5	Yes
San Francisco, CA	November 2016	1	No
Seattle, WA	June 2017	1.75	No
Cook County, IL	November 2016 (repealed October 2017)	1	Yes

Source: Data obtained through the authors' research via municipal and county websites and Ballotpedia.

In the first part of the article, we provide background on sugar-sweetened beverage consumption patterns and the resulting health harms. This section helps to explain why sugary drinks have come to be seen as a "sin" worthy of taxation. In the second part of the article, we draw on our recent work (Allcott, Lockwood, and Taubinsky 2019) to present the economic principles that determine the optimal level of taxes on sugar-sweetened beverages. We discuss how the price elasticity of demand, externalities, "internalities," distributional concerns, and the incidence on producers all shape the optimal tax on sugar-sweetened beverages. In the third part of the article, we summarize the growing empirical literature that estimates these key parameters.

We end with seven concrete suggestions for policymakers. First, focus on counteracting externalities and internalities, not on minimizing sugary drink consumption. Second, target policies to reduce consumption among people generating the largest externalities and internalities. Third, tax grams of sugar, not ounces of liquid. Fourth, tax diet drinks and fruit juice if and only if they also cause uninternalized health harms. Fifth, when judging regressivity, consider internality benefits, not just who pays the taxes. Sixth, if possible, implement taxes statewide. Finally, the benefits of sugar-sweetened beverage taxes probably exceed their costs.

Background: Taxes, Consumption, and Health Harms

Existing Sugar-Sweetened Beverage Taxes

Table 1 presents the seven current city-level sugar-sweetened beverage taxes in the United States, all of which have been enacted since 2014. Cook County, Illinois, which contains the city of Chicago, passed a tax and then repealed it a year later. The modal tax rate is 1 cent per ounce, although Boulder, Philadelphia, and Seattle have higher rates. In addition to these explicit taxes, 23 states plus the District of Columbia exempt or partially exempt groceries from sales taxes but do not define sugar-sweetened beverages as "groceries," thereby taxing these drinks at a higher

Table 2
Sugar-Sweetened Beverage Taxes around the World

Europe	*Western Pacific*	*Africa, Eastern Mediterranean, and Southeast Asia*	*Americas*
Estonia (2018)	Philippines (2018)	Morocco (2019)	Colombia (2019)
Ireland (2018)	Brunei (2017)	South Africa (2018)	Bermuda (2018)
United Kingdom (2018)	Vanuatu (2015)	Bahrain (2017)	Peru (2018)
Portugal (2017)	Kiribati (2014)	India (2017)	Barbados (2015)
Belgium (2016)	Cook Islands (2013)	Maldives (2017)	Dominica (2015)
France (2012)	Tonga (2013)	Sri Lanka (2017)	Chile (2014)
Hungary (2011)	Fiji (2007)	Saudi Arabia (2017)	Mexico (2014)
Latvia (2004)	Nauru (2007)	Thailand (2017)	
Norway (1981)	Palau (2003)	United Arab Emirates (2017)	
Finland (1940)	French Polynesia (2002)	St. Helena (2014)	
	Samoa (1984)	Mauritius (2013)	

Source: Based on data from the Global Food Research Program (2019).
Notes: The table lists countries with taxes on sugar-sweetened beverages, grouped by region; year of implementation is given in parentheses.

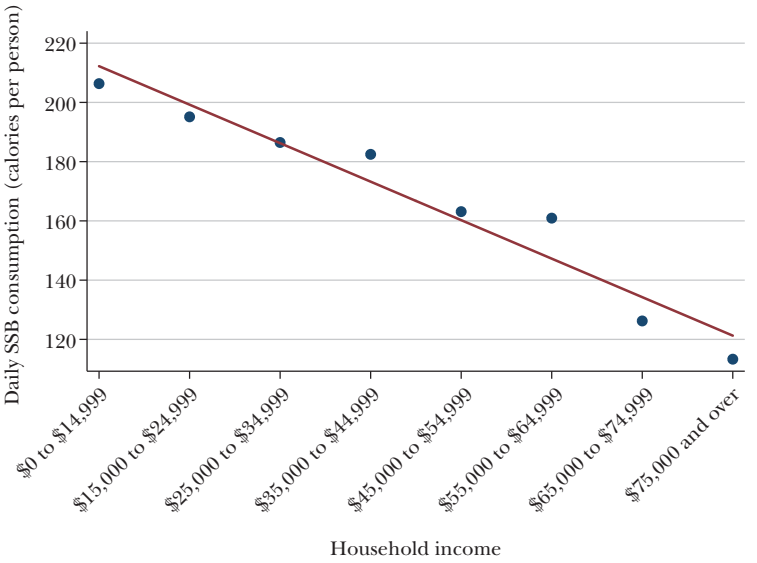
rate (Loughead 2018). Table 2 lists the 39 other countries around the world with sugar-sweetened beverage taxes.

A sugar-sweetened beverage is any drink with caloric sweeteners, including carbonated soft drinks, sports drinks, energy drinks, fruit drinks, chocolate (or otherwise sweetened) milk, and sweetened coffee and tea, but not including 100 percent fruit juice or "diet" drink alternatives with noncaloric sweeteners. The beverage categories included in sugary drink taxes depend on both political calculations and judgment calls by public health experts. All the city-level taxes in Table 1 cover all sugar-sweetened beverages except for sweetened milk products, and they do not include 100 percent fruit juice, on the grounds that the vitamins and nutrients such as calcium in these drinks provide some additional nutritional value. The Philadelphia tax and the repealed Cook County tax additionally include diet drinks. As we discuss below, it is not clear that these coverage decisions are socially optimal.

Sugar-Sweetened Beverage Consumption

Americans consume a remarkable amount of calories from sugar-sweetened beverages. A typical 12-ounce soft drink might contain 35 to 40 grams of sugar and about 140 calories, representing about 7 percent of a benchmark diet of 2,000 calories per day. Using data from the National Health and Nutrition Examination Survey (NHANES) for the period 2009–2016, we calculate that the average American adult consumes 154 calories per day from sugar-sweetened beverages, which represents 6.9 percent of actual total calorie intake. Almost all of these calories are from added sugars. As a benchmark, the US Dietary Guidelines recommend limiting added sugars from all food and drinks to no more than 10 percent of total calorie intake, or around 200 calories per day, while the World Health Organization is even more conservative. In the NHANES data, sugar-sweetened beverages account for 23 percent of the average American adult's total sugar consumption.

Figure 1
Sugar-Sweetened Beverage Consumption by Income



Source: Authors, using data from the National Health and Nutrition Examination Survey.
Notes: Figure shows average daily sugar-sweetened beverage (SSB) consumption by household income for the period 2009–2016. Consumption varies substantially by income; on average, people with higher household income consume fewer calories from sugar-sweetened beverages, which raises concerns that taxes on such drinks could be regressive.

Sugary drinks are broadly popular: about 50 percent of American adults consume at least one sugar-sweetened beverage on any given day. However, Figure 1 shows that consumption varies substantially by income. People with household income below $25,000 per year consume 200 calories per day of sugar-sweetened beverages, while people with household income above $75,000 per year consume only 117 calories per day. This generates the concern that taxes on sugar-sweetened beverages could be regressive. There is also substantial within-group variation: in a large nationwide survey carried out by Nielsen for Allcott, Lockwood, and Taubinsky (2019), the 90th percentile of individual consumption is 2.7 times as large as the mean, and 6.5 times as large as the median.

Perhaps due to rising public awareness of the health effects of sugar-sweetened beverages, consumption is falling over time in the United States and many other Western countries. In the National Health and Nutrition Examination Survey data, the average American consumed 205 calories per day from sugar-sweetened beverages in 2003–2004, compared with 154 calories in 2009–2016. Popkin and Hawkes (2016) find that sugar-sweetened beverage calorie consumption per capita declined from 2009 to 2014 in North America, Australasia, and Western Europe but increased in the rest of the world. They also report that North Americans consume 3 to 4 times more calories from sugar-sweetened beverages than the world average.

Health Harms from Sugar-Sweetened Beverage Consumption

Sugar-sweetened beverage consumption harms health through three main channels: weight gain, type 2 diabetes, and cardiovascular disease. (We do not discuss other health effects, such as tooth decay.) For these main channels, we briefly discuss evidence on the magnitude of the effects. Some of this evidence comes from nonrandomized epidemiological studies that correlate sugar-sweetened beverage consumption with health outcomes, while attempting to control for confounding variables. Although this is sometimes the only evidence available, correlation doesn't imply causation: additional unmeasured confounders such as eating patterns, exercise, and social conditions could mean that these conditional correlations are inaccurate measures of the causal effect of sugar-sweetened beverage consumption on health. Moreover, most quantitative studies report only an average effect, though the effects may be concentrated on particular groups or heavy users.

The first main health harm is weight gain. Some evidence suggests that sugary drinks cause more weight gain than equally sugary foods because calories are less satiating in liquid form (Pan and Hu 2011). A randomized experiment by Mourao et al. (2007) found that when people consume the same amount of calories from solid foods instead of liquids (say, jelly beans instead of soda, or cheese instead of milk), they eat less later in the day, resulting in significantly lower overall calorie intake. Other experiments have found that when people are provided with the same foods and either caloric or noncaloric beverages, they consume the same amount of calories from food regardless of the beverage provided and report no difference in feelings of satiety (DellaValle, Roe, and Rolls 2005; Flood, Roe, and Rolls 2006).

Both field experiments and nonexperimental analyses have estimated the weight gain effects. Randomized trials with children and adolescents find that substituting diet drinks for sugar-sweetened beverages for 12 to 18 months reduces weight by 2 to 4 pounds (de Ruyter et al. 2012; Ebbeling et al. 2012). In observational analysis of three adult cohort studies, Mozaffarian et al. (2011) find that one additional serving per day of sugar-sweetened beverages is conditionally associated with weight gain of 1 pound per four-year follow-up period, after controlling for a variety of biological and lifestyle factors.[1]

The second main health harm is type 2 diabetes. Sugar-sweetened beverages have high "glycemic loads," meaning that they contain large amounts of rapidly digestible sugars. Sugars are digested more quickly when they come from drinks than when they are eaten with food. When foods or drinks with high glycemic loads are digested, they prompt a quick release of glucose into the bloodstream and the secretion of a corresponding amount of insulin in response. Over time, these states of elevated blood glucose and insulin can cause insulin resistance, often a precursor

[1] For a review of additional randomized experiments on the effects of sugar-sweetened beverages on weight gain, see Mattes et al. (2011). For reviews of cohort studies, see Vartanian, Schwartz, and Brownell (2007) and Malik et al. (2013). Weight gain is thought to have an independent effect on diabetes and cardiovascular disease in addition to the mechanisms described below, and weight mediates the statistical relationships between sugar-sweetened beverage consumption and those conditions (for example, Schulze et al. 2004; Fung et al. 2009).

to diabetes (see description in Ludwig 2002; Raben et al. 2011). A meta-analysis of 17 cohort studies found that drinking one more serving of sugar-sweetened beverages per day was associated with a 13 percent higher risk of developing type 2 diabetes (Imamura et al. 2015; see also Malik et al. 2010).

The third main health harm is cardiovascular diseases, such as heart attack and narrowing of the arteries. Randomized trials show that diets high in sugar and other refined carbohydrates increase blood pressure and cholesterol; high blood pressure and high cholesterol are precursors to cardiovascular disease (Santos et al. 2012; Te Morenga et al. 2014). A meta-analysis of four studies found that consuming one additional serving of sugar-sweetened beverages per day is associated with a 17 percent higher risk of coronary heart disease (Xi et al. 2015).

This background helps explain why the public health community has focused on taxing sugary drinks instead of a broader sugar tax that includes sugar in foods: sugar consumed through drinks is more harmful.

Quantifying Health System Costs

By combining estimates of the price elasticity of demand for sugar-sweetened beverages, the effect of sugar-sweetened beverages on diabetes, cardiovascular disease, and obesity, and the costs of treating these diseases, it is possible to estimate the effects of a sugar-sweetened beverage tax on health-care costs. The necessary parameters are often estimated from correlation studies and are thus subject to the same important caveat that correlation does not imply causation. However, Wang et al. (2012) estimate that over 10 years, a 1 cent per ounce tax would save $17.1 billion in health-care costs. Using a separate model, Long et al. (2015) estimate the ten-year savings to be $23.6 billion.

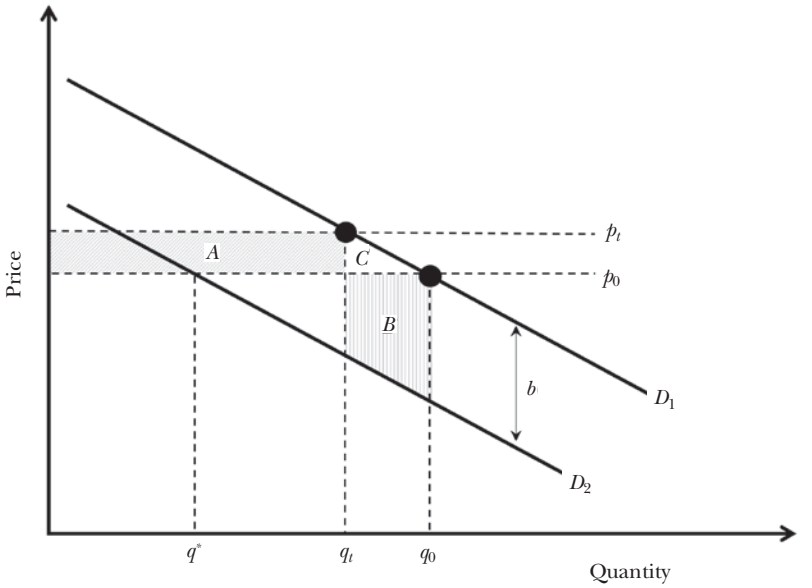
An Economic Framework for Evaluating Sugar-Sweetened Beverage Taxes

The economic logic behind a tax on sugar-sweetened beverages builds from the classic principles of externality-correcting taxes (Pigou 1920): if consuming a good harms others, then people will consume too much if the market is not regulated. Thus, a tax imposed on a good with negative externalities can raise welfare by reducing consumption toward the efficient level at which marginal social cost equals marginal social benefit.

Additionally, a growing body of research in behavioral economics indicates that people sometimes ignore harmful or beneficial effects to *themselves*—for example, because they are misinformed, or because they do not fully consider future health consequences due to "present focus." These costs are sometimes called "internalities," and we view their presence as a key distinction in the rationale for "sin taxes" on goods like cigarettes and alcohol.

It is important to emphasize that externalities and internalities are not the same as "health harms." A consumer might rationally drink something (or take any

Figure 2
Effect of a Sugar-Sweetened Beverage Tax on Individual Consumption



Source: The authors; see Allcott, Lockwood, and Taubinsky (2019) for a formal treatment.
Notes: The figure illustrates the effect of a sugar-sweetened beverage tax on demand from a single consumer. D_1 plots the individual's demand curve for sugar-sweetened beverages at various prices. The vertical distance b represents the per unit externality or internality cost (see text for details).

other action) despite the health risks, because enjoyment of the drink outweighs the health harms. What matters for sin taxes is whether consumers' choices impose harms on others (externalities) or harms on themselves that they do not correctly internalize (internalities).

Although internality and externality costs operate somewhat similarly, there are important differences between the two, and we consider each in turn. Figure 2, which illustrates the effect of a sugar-sweetened beverage tax on demand from a single consumer, can be used to discuss both concepts. In Allcott, Lockwood, and Taubinsky (2019), we provide a formal treatment of the issues this section.

Welfare Effects Due to Externalities

Some sin goods generate direct consumption externalities—cigarettes create second-hand smoke, for example. In the context of sugar-sweetened beverages, probably the most important externalized cost is in the form of financial health-care costs, which are shared through public or private insurance. Strictly speaking, these are moral hazard costs, or "fiscal externalities" (in the case of public insurance), which arise due to preexisting information frictions in a second-best world. We will call all such externalized costs "externalities," however, to emphasize that they are borne by people other than the consumer of sugar-sweetened beverages.

In Figure 2, to illustrate the role of externalities, D_1 plots the individual's demand curve for sugar-sweetened beverages at various prices (or, equivalently, the consumer's marginal private benefit from sugary drinks at each quantity). The vertical distance b represents the per unit externality cost, so that D_2 plots the marginal social benefit from consumption, net of externalities, as a function of quantity consumed. (In practice, b may vary with the level of consumption; here we plot it as a constant marginal externality for simplicity.) A tax that raises the price from p_0 to p_t then has three distinct effects on welfare. (For simplicity here we assume the tax is fully passed through to consumers—we relax that assumption below.) The area $A = t \times q_t$ is transferred from the consumer to the government, in the form of tax revenue. The area $C = \Delta q \times t/2$ represents a further decrease in the consumer's welfare from foregone sugary drink consumption due to the tax. The area $B + C = \Delta q \times b$ represents an increase in welfare for those bearing the externality. In the context of sugar-sweetened beverages, a natural benchmark assumption is that the externality reduction accrues to the government's budget (in present value terms)—for example, due to reduced Medicare expenditures on treatments for conditions such as heart disease and diabetes. Therefore, the net effect of the tax is twofold: a transfer of $A + C$ from the consumer to the government, and a further increase in government funds of B.

The total welfare effects of an externality-based sugar-sweetened beverage tax depend on aggregating these components across individuals. Because the tax involves transfers between parties, something must be assumed about the social value of resources in the hands of the government relative to consumers, and across consumers of different types. A common assumption is that the marginal utility from consumption is decreasing with consumers' incomes—the same assumption that is often used to justify progressive income tax schedules. One way to capture such distributional implications is to assign "social marginal welfare weights" (as in Saez and Stantcheva 2016) to different households depending on their income (or possibly other attributes), so that a weight of, say, 1.5 on household x implies that society places the same value on \$1 in the hands of household x as on \$1.50 in the hands of the government. Then the transfer $A + C$ from the consumer to the government generates a net social gain if the weight on the consumer in question is less than 1, and a social loss otherwise.

Putting these pieces together, we aggregate these effects by summing the externality benefit B and the transfer $A + C$ across consumers, weighted appropriately. The area B scales with its width (proportional to the individual elasticity of demand for sugary drinks) multiplied by its height (the externalized health costs of sugary drink consumption). Therefore, the average value of B across all consumers is proportional to the average demand elasticity times the average externality, plus the *covariance* of the two. This covariance term reflects the fact that if consumers who generate the largest externalities are most responsive to a tax, then the externality benefits of a corrective tax are larger.

The transfer $A + C$ has the same height for all consumers $(p_t - p_0)$, but its width depends on the quantity of sugary drinks consumed by each consumer. Moreover,

this summation across consumers is weighted by the difference between their welfare weight and the value of public funds. In theory, the sign of this welfare effect can be either positive or negative, but it will tend to be negative if poorer consumers (those with high welfare weights) tend to purchase more of the externality-producing good, as is the case for sugar-sweetened beverages. The welfare effect of this transfer depends on the level of sugary drink consumption across the income distribution, and not on sugary drink consumption as a share of consumers' income. Thus, this approach accounts for the common concern that sugar-sweetened beverage taxes may be regressive.

Welfare Effects Due to Internalities

In the context of sugar-sweetened beverages, there are two main reasons why consumers might not act in their own best interest. First, consumers may have imperfect information, and thus they may not know how sugar-sweetened beverages can harm their health. Of course, information provision, such as educational campaigns and disclosure requirements, is the direct way to address imperfect information (as studied by, for example, Bollinger, Leslie, and Sorensen 2011; Cantor et al. 2015; Moran and Roberto 2018; Grummon, Taillie, et al. 2019). However, unless these policies fully inform all consumers, there is a role for taxes as a complementary policy tool.

Second, consumers may face problems of self-control and time-inconsistency and thus might underweight the future health costs of consumption of sugar-sweetened beverages relative to how they would like, in the future, to have weighted those costs. There is disagreement as to whether policymakers should respect consumers' "long-run" or "short-run" preferences (Bernheim and Rangel 2009; Bernheim 2016; Bernheim and Taubinsky 2018). A social planner who uses the long-run criterion for welfare analysis might want to help people implement their long-run preferences by reducing consumption of sugar-sweetened beverages.

We can reinterpret Figure 2 to illustrate internalities (assuming away externality costs for the moment), with D_1 representing the consumer's observed demand curve and D_2 representing the latent demand curve that would arise if consumers did not suffer from internalities. Then the vertical distance b represents an ignored internality cost, measured in money units.

Internalities operate similarly to externalities, with one important difference: the area $B + C$ accrues to the *consumer*, rather than to the bearer of the externality (the government in our example above). This does not change the interpretation of the transfer A, from the individual to the government, which will again take on a more negative value if poorer consumers purchase more sugar-sweetened beverages. And the area C can be regarded as a transfer from consumers affected by the tax to themselves, so for social welfare purposes, it can be ignored. However, it does change the interpretation of B, which (unlike in the case of externalities) is multiplied by the individual's welfare weight. As a result, for a given *average* size of the internality, the internality correction benefits from the tax are larger to the extent that poorer consumers have larger areas of B. This will be the case either if

internalities are larger for poor consumers (for example, due to poorer access to information or more exposure to settings that demand and deplete self-control) or if their demand response Δq is higher (for example, if the elasticity of demand is constant across consumers, since the poor consume a higher level). In other words, internality benefits from a sugary drink tax are theoretically likely to be progressive, even if the financial costs are regressive.

In a context with both externalities and internalities, one must add the externality and (welfare-weighted) internality benefits, netted against any welfare effects due to the transfer of resources from consumers to the government. Externality benefits depend (positively) on the aggregate elasticity of demand for sugar-sweetened beverages, the average externalized health cost from consumption, and their covariance. Internality benefits similarly depend on the aggregate elasticity and average uninternalized health costs, as well as the extent to which uninternalized health costs and demand responses are higher among poor consumers. Finally, the welfare cost of the resource transfer is larger to the extent that poor households consume more sugary drinks.

Are Sugar-Sweetened Beverage Taxes "Regressive"?

A common concern about sugar-sweetened beverage taxes is that they may hurt poor households, since low earners tend to purchase more sugary drinks. The concepts of externalities, internalities, and transfers from Figure 2 illustrate the basic forces at work.

To understand who is helped and hurt by a sugar-sweetened beverage tax, we need to draw a distinction between *who pays the most in taxes* and *who is benefited or harmed, all things considered*. While it is true that poorer consumers will pay more in taxes on average (due to their higher sugary drink consumption), if there are internality costs from consuming sugary drinks, the beneficial reductions of health conditions such as heart disease and diabetes will also accrue to low-income households, as highlighted by Gruber and Kőszegi (2004). In terms of Figure 2, although poorer consumers incur more costs due to area *A* on average, those may be offset (partially, or more than fully) by the gained area *B*. As a result, the fact that poorer consumers purchase more sugar-sweetened beverages does not necessarily imply that they are made worse off by the tax. The extent of this offset depends on the price elasticity of demand: if consumers substantially reduce sugar-sweetened beverage consumption in response to a tax, then the corrective benefits are large relative to the financial burden, making the tax less regressive. On the other hand, if a tax has little effect on consumption, then the corrective benefits are relatively small.

A related question is how the profile of consumption by income affects the optimal *size* of the tax. This depends on why consumption varies with income. Do people have the same underlying preferences, so differences in consumption across incomes are due to the causal effect of more or less income? Or do people at different income levels have systematically different preferences, so that they would consume different amounts even if their incomes were all reset to the same level? A classic principle of optimal taxation (Atkinson and Stiglitz 1976) holds

that if differences in consumption of sugary drinks (or any other good) are driven by causal income effects, then they should not be taxed or subsidized for redistributive purposes—such redistribution is more efficiently carried out through the income tax. In contrast, if differences in sugary drink consumption are driven by between-income preference heterogeneity, then that consumption serves as a "tag," which is useful for redistribution, reducing the optimal sugary drink tax. In Allcott, Lockwood, and Taubinsky (2019), we find that preference heterogeneity appears to be the reason why low-income people drink more sugar-sweetened beverages.

Finally, the total regressivity of a sugar-sweetened beverage tax may depend on how the resulting revenues are allocated. Some existing policies have earmarked revenues toward causes that primarily benefit low-income households—sometimes called "progressive revenue recycling." In Philadelphia, for example, a portion of sugar-sweetened beverage tax revenues is pre-allocated to expanding prekindergarten education services within the city. Although earmarking may be useful for building popular support for sugary drink taxes, from a theoretical perspective the practice does not alter the size of the optimal tax. To the extent that it is beneficial to target funds toward prekindergarten programs—or to make the income tax-and-transfer schedule more progressive generally—then that should be done regardless of whether a sugar-sweetened beverage tax is implemented. As a result, revenue recycling and earmarking may be better interpreted as questions of political expediency, rather than optimal taxation. Moreover, pre-allocation may create challenges for policymakers if the tax turns out to be more effective than expected at reducing sugary drink consumption, resulting in a budget shortfall for popular or progressive programs.

Substitution and Leakage

So far, we have assumed that sugar-sweetened beverages can be modeled as one homogeneous good with no substitutes or complements. In reality, this is not the case, which generates additional important considerations.

First, there are many thousands of different sugar-sweetened beverages, each with different sugar content. Theoretically, the optimal structure would be to impose separate taxes on each good, depending on the parameters described above (internalities, externalities, demand elasticities, and between-income preference heterogeneity). In practice, these parameters are difficult to estimate for each specific good, and such heterogeneous taxes would be prohibitively difficult to administer. Most existing sugar-sweetened beverage taxes therefore use a simplified structure of a constant tax rate per ounce of drink. However, since the externalities and internalities from sugary drinks come from the sugar, not the liquid, the externalities and internalities are likely to be proportional to the sugar content of beverages. An alternative simple tax structure of a constant tax rate per gram of sugar in the drink would much more closely approximate the theoretical optimum.

Second, when consumers cut back on sugar-sweetened beverages due to the tax, they may also raise or lower their consumption of other (untaxed) sugary goods.

To the extent that they do, the resulting change in externalities and internalities from those goods should be considered when setting the tax on sugar-sweetened beverages. The sign of this effect is ambiguous. For example, consumers may view sugary snacks as a substitute for sugar-sweetened beverages—an alternative way to get a desired "sugar kick"—in which case some of the internality and externality reductions from a tax on sugar-sweetened beverages may be offset by increased internalities and externalities from substitution to other sugary goods. On the other hand, sugar-sweetened beverages and unhealthy foods may be complements, and if consumers tend to purchase or consume such snacks together, then the analysis above will *understate* the benefits of a sugary drink tax.

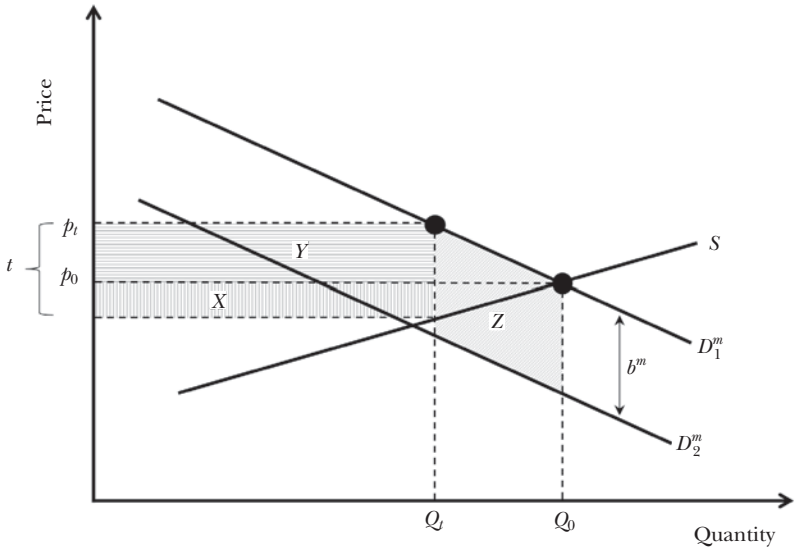
A third reason substitution may matter is that consumers may adjust their behavior to evade or avoid a sin tax—for example, through black market cigarette or drug purchases or, in the case of city-level beverage taxes, through cross-border shopping. This so-called tax "leakage" creates costs for consumers without reducing externalities and internalities from sugar-sweetened beverage consumption. As a result, although some local tax experimentation is useful for estimating the effects of a tax, in the long run there is a benefit from harmonizing tax rates to reducing avoidance by setting them at the state or regional level.

Pass-Through and Producer Surplus

The exposition so far accounts only for the consumer side of the market and therefore leaves out two key issues: the question of tax pass-through (what portion of the tax is borne by consumers in the form of a price increase) and the phenomenon of producer surplus (which accrues to firm owners, in the form of profits, or to employees). To illustrate these forces, Figure 3 depicts a simple supply-and-demand model of the market for sugar-sweetened beverages. D_1^m represents observed market demand for sugar-sweetened beverages, while b^m represents the average marginal externality (weighted by elasticities of demand) plus average marginal internality (weighted by elasticities of demand and welfare weights), so that D_2^m represents market demand less the uninternalized social cost of consumption (normalized by the marginal value of public funds) at each quantity. For illustrative purposes, the pictured tax is a little lower than the optimal level, b^m.

In a simple model like this one, the conventional explanation for incomplete tax pass-through is that some of the tax incidence falls on producers rather than consumers. To account for this possibility, we allow for a market supply curve S that slopes upward, due, for example, to rising marginal costs. The share of the tax that is passed through to consumers is $\frac{p_t - p_0}{t}$, a quantity that rises with the elasticity of sugary drink supply and falls with the (absolute) elasticity of demand. The tax then has three distinct effects on welfare: a transfer from producer surplus to the government, represented by the vertically hatched area X; a transfer from consumers to the government, represented by the horizontally hatched area Y; and a beneficial reduction in externalities and internalities (now combined), represented by the diagonally hatched area Z.

Figure 3
Effect of a Sugar-Sweetened Beverage Tax on Market Consumption



Source: The authors; see Allcott, Lockwood, and Taubinsky (2019) for a formal treatment.
Notes: The figure depicts a simple supply-and-demand model of the market for sugar-sweetened beverages. D_1^m represents observed market demand for sugar-sweetened beverages and b^m the average marginal externality (weighted by elasticities of demand) plus average marginal internality (weighted by elasticities of demand and welfare weights), so that D_2^m represents market demand less the uninternalized social cost of consumption at each quantity. The pictured tax is a little lower than the optimal level, b^m. The area X represents a transfer from producers to the government; the area Y, a transfer from consumers to the government; and the area Z, a beneficial reduction in externalities and internalities (now combined).

Relative to a model with infinitely elastic supply of sugary drinks (corresponding to full pass-through to consumers), the key difference is that some of the costs of the tax are borne by producers rather than consumers. If marginal resources are valued equally in the hands of producers and (welfare-weighted) consumers of sugar-sweetened beverages, the issue of pass-through is irrelevant: in this case, the tax should be adjusted to maximize the welfare gain from the internality and externality benefit Z, and the weighted transfer of resources $X+Y$. But if resources are valued more in the hands of consumers than producers of sugar-sweetened beverages—for example, if marginal resources accrue to firm shareholders who have a lower average welfare weight than consumers of sugar-sweetened beverages (perhaps because they have higher incomes)—then a lower pass-through will imply a larger net welfare benefit from the tax and a higher tax at the optimum. Conversely, if a higher welfare weight is placed on producers, then partial pass-through calls for a lower optimal sugar-sweetened beverage tax.

Other explanations for partial pass-through, such as discrete pricing policies by grocers or an inability to separately price regular and diet soda fountain sales

at fast-food restaurants, might generate different implications. In particular, if a portion of the tax is absorbed by producers with no reduction in quantity supplied, then the optimal tax may need to be larger than b^m to achieve the efficient reduction in sugary drink consumption. However, this possibility depends on understanding the reason for partial pass-through, in addition to quantifying the pass-through rate itself.

Empirical Estimates of Key Parameters

In this section, we review the empirical estimates of the key parameters identified in the previous section, with an eye to the strengths and weaknesses of different estimation strategies.

Demand Elasticities

When estimating demand for any good, not just sugar-sweetened beverages, perhaps the most basic challenge is to isolate quasi-random price variation in order to estimate the demand curve. Conceptually, a demand curve reflects the causal effect of prices on quantity purchased, not just the correlation between prices and quantity purchased. The ideal way to estimate a demand curve would be to run an experiment in which different consumers are offered different prices and then to measure the share of consumers that buy at each price. When market data do not include randomized pricing experiments, several factors will mean that correlation doesn't imply causation. For example, measurement error in prices can also incorrectly make demand appear to be less responsive to price than it actually is. As another example, retailers naturally charge higher prices for higher-quality goods, as well as higher prices for the same good in periods of high demand. This "simultaneity bias" can sometimes even generate positive correlations between price and quantity demanded, whereas the true causal relationship is negative.

There are two types of strategies for isolating quasi-random variation in nonexperimental data. The first is to attempt to control for product quality and demand fluctuations, in hopes that the remaining price variation is quasi-random. For example, Dubois, Griffith, and O'Connell (2017) include brand, time, and other fixed effects, thereby identifying the demand elasticity only off of variation in prices of the same product across retailers and variation in the slope of nonlinear pricing (the relative prices of small versus large containers) across brands. The second strategy is to find a useful instrumental variable for exogenous price movements. In Allcott, Lockwood, and Taubinsky (2019), we create an index of the price households pay for the specific sugar-sweetened beverages they buy at the specific stores where they shop, and we instrument for that price with the time-varying prices that the same retailer charges for the same beverages at other stores in other counties. Finkelstein et al. (2013) instrument for a household's price paid with prices paid by other households in the same city and quarter, excluding households living in the household's Census tract.

For sugar-sweetened beverages, data availability is a particular challenge. There are two common types of datasets. The first is household-level scanner data, such as the US National Consumer Panel (also known as Nielsen Homescan) or Kantar Worldpanel. Participating households are asked to scan the bar codes of all groceries that they bring home, but they do not record consumption away from home, such as purchases at restaurants, vending machines, and ballparks. This unobserved consumption can be substantial: in Allcott, Lockwood, and Taubinsky (2019), we estimate that total consumption exceeds Homescan grocery purchases by 39 percent. If sugar-sweetened beverage taxes are imposed on all consumption, then the relevant demand elasticity is for all consumption, including away from home. Consumption away from home could be more or less price elastic, and there may also be bias due to substitution if households respond to higher grocery prices by consuming more away from home. The second type of dataset is self-reported consumption from beverage frequency questionnaires or dietary recall studies such as the National Health and Nutrition Examination Survey, in which people record food and drink consumed over the past 24 hours or some other recent period. Self-reports may have more measurement error and do not track the same individuals over time, making it difficult to use the two strategies detailed above for isolating quasi-exogenous price variation.

There are several reviews of the literature estimating the price elasticity of demand for sugar-sweetened beverages. Andreyeva, Long, and Brownell (2010) report that across 14 studies, the mean price elasticity is −0.79, with a range from −0.13 to −3.18. Powell et al. (2013) review 12 studies and find a mean price elasticity of −1.21, with a range from −0.71 to −3.87. In Allcott, Lockwood, and Taubinsky (2019), we estimate an elasticity of about −1.4. This relatively elastic demand implies that the internality and externality reduction benefits from a tax are meaningful relative to the burden of the tax payments.

A separate but related parameter is the elasticity of sugar-sweetened beverage consumption with respect to a *tax*. As illustrated in Figure 3, the tax elasticity depends on both the supply and demand elasticities. The tax elasticity is of interest because it determines the public health effect of a tax. Fletcher, Frisvold, and Tefft (2010) study how consumption of sugar-sweetened beverages responds to changes in whether they are included in state sales and excise taxes, but this variation is very limited: among states with a nonzero tax during their sample period, the average tax rate was no more than about 5 percent. Bollinger and Sexton (2017), Cawley, Frisvold, et al. (2018b), Silver et al. (2017), Seiler, Tuchman, and Yao (2019), and others study responses to the Berkeley and Philadelphia taxes. While these tax rates are higher than the taxes studied by Fletcher, Frisvold, and Tefft (2010), having only one or two cities limits the sample size and requires the strong assumption that no factors other than the tax change affected sugar-sweetened beverage demand. Tax elasticity estimates may also capture how interest groups' advertising campaigns and public debates about sin taxes could affect demand over and above the effect of a price increase (Taylor et al. 2016; Rees-Jones and Rozema 2018).

Externalities

Sugar-sweetened beverage consumption generates two main types of externalities: health cost externalities and other fiscal externalities. Estimating the size of these externalities involves a series of challenges in measurement and causal inference.

Health cost externalities result because most Americans have health insurance, typically through their employers, Medicare, or Medicaid, and thus most of the health costs caused by sugar-sweetened beverage consumption are paid for by others. Wang et al. (2012) and Long et al. (2015) both estimate that the health system costs of sugar-sweetened beverages are approximately 1 cent per ounce of sugar-sweetened beverage consumed. The US Department of Health and Human Services estimates that for people with employer-provided insurance, about 15 percent of health costs are borne by the individual, while 85 percent are covered by insurance (Yong, Bertko, and Kronick 2011). Cawley and Meyerhoefer (2012) estimate that 88 percent of the total medical costs of obesity are borne by third parties. Putting these numbers together suggests that the average health cost externality from sugar-sweetened beverage consumption might be 0.8 to 0.9 cents per ounce.

This figure might overstate the true externality, because the results of Bhattacharya and Bundorf (2009; see also Bhattacharya and Sood 2011 in this journal) suggest that obese people who have employer-sponsored health insurance face the full health costs of obesity through lower wages. However, it is not clear whether these labor market effects also exist for less easily observable diseases such as diabetes and cardiovascular disease, and the results do not apply to people with government-sponsored health insurance through Medicare or Medicaid.

In addition to health cost externalities, sugar-sweetened beverage consumption imposes other fiscal externalities, like positive or negative effects on the government's budget. As one tragic example, obesity appears to cause people to die earlier, reducing the amount of Social Security benefits that obese people will claim (Fontaine et al. 2003; Bhattacharya and Sood 2011).

As described in the previous section, the key statistic is the average externality from sugar-sweetened beverage consumption for people who respond to a small change in the tax. While we have estimates of average externalities and overall demand elasticity, one additional important but unknown statistic is the covariance across people between the demand elasticity and the marginal health damages of sugar-sweetened beverage consumption. For example, low-income people are thought to be more price elastic, and their health cost externalities may be higher (if their health costs are not offset by wage reductions because they are on Medicaid) or lower (if they are more likely to be uninsured). Dubois, Griffith, and O'Connell (2017) argue that sugar-sweetened beverage consumption by young people might generate larger health harms, and they show that young people are more price elastic. Sugar-sweetened beverage consumption by people who are prediabetic—that is, just below the threshold for receiving diabetes treatment—may generate larger health cost externalities, since additional consumption may result in high health costs from managing type 2 diabetes. This covariance is one of many questions for future research.

Internalities

As with externalities, there are multiple challenges to measuring internalities.[2] First, there is a mechanical tension in evaluating policies to address internalities, which are predicated on the idea that consumers *do not* act in their own best interest, using revealed preference techniques, which are predicated on the idea that consumers *do* act in their own best interest. Following Bernheim and Rangel (2009), behavioral welfare analyses must somehow establish a "welfare-relevant domain"—that is, a subset of consumer choices that are assumed to be unbiased—versus another subset of "suspect" choices that may be affected by bias. This requires assumptions. Second, measuring internalities often involves the same type of causal inference challenges that arise when estimating price elasticities, health effects, and other parameters. Third, internalities must be measured in units of dollars, as highlighted by the fact that the internality and/or externality b is a vertical distance separating the demand curves in Figures 2 and 3. While much of the behavioral economics literature has focused on simply establishing the presence of some behavioral bias, behavioral welfare analysis requires that internalities be quantified in units of dollars.

As discussed above, imperfect information and lack of self-control are two primary reasons why consumers might not act in their own best interest. Different empirical strategies are often required to quantify different types of internalities. For imperfect information, researchers can estimate the effects of information provision, as in Allcott and Taubinsky (2015) and others. For self-control, researchers can compare choices made for consumption now versus in the future, as in Read and van Leeuwen (1998), Augenblick, Niederle, and Sprenger (2015), and others. For example, Sadoff, Samek, and Sprenger (2015) take advance orders for grocery delivery and allow people to re-optimize their choices at the time that the groceries are delivered, finding that people tend to re-optimize toward less-healthy options and that one-third of people would like to restrict their own future ability to re-optimize. However, standard "preference reversal" experiments cannot directly quantify the effects of limited self-control in dollar units.[3]

Alternatively, a "counterfactual normative consumer" approach can be used to measure multiple biases simultaneously, and to quantify their effects in dollar terms. As an example of this approach, Bronnenberg et al. (2015) show that sophisticated shoppers—in their application, doctors and pharmacists—are more likely to buy generic instead of branded drugs, and they conduct welfare analysis assuming that only sophisticates' choices are welfare relevant. Bartels (1996), Handel and Kolstad

[2] A growing literature in behavioral economics attempts to measure bias in various settings: for overviews, see Allcott and Sunstein (2015), Bernheim and Rangel (2009), Bernheim and Taubinsky (2018), DellaVigna (2009), Handel and Schwartzstein (2018), and Mullainathan, Schwartzstein, and Congdon (2012).

[3] Another approach to quantifying self-control problems is to combine an outside estimate of time-inconsistency from another domain with an estimate of the future private costs of sugar-sweetened beverage consumption. However, it is difficult to assess those future private costs, and the extent of time-inconsistency can vary across domains.

(2015), Johnson and Rehavi (2016), and Levitt and Syverson (2008) similarly compare informed to uninformed agents to identify the effects of imperfect information.

In Allcott, Lockwood, and Taubinsky (2019), we use this counterfactual normative consumer approach to measure the effect of both imperfect information and self-control on sweetened beverage consumption. Specifically, we survey Nielsen Homescan panelists to measure nutrition knowledge and perceived overconsumption of sugar-sweetened beverages, and we find that soda consumption is higher among consumers who are less informed about nutrition and who profess less self-control, even after controlling for demographic variables and survey-based measures of health preferences and tastes for different drinks. The key weakness of this approach is that it requires the assumption that the conditional correlation between bias and consumption equals the causal effect of bias on consumption. Under this assumption, we predict that the average American household would consume 31 to 37 percent less sugar-sweetened beverage if they had perfect self-control and had the nutrition knowledge of dietitians and nutritionists. Translated into dollar terms, the estimated average marginal internality from sugar-sweetened beverage consumption is 0.91 to 2.14 cents per ounce.

Regressivity

The progressivity or regressivity of a sin tax depends on how the internality-reduction benefits and the burden of tax payments vary across the income distribution. In Allcott, Lockwood, and Taubinsky (2019), we find that internality-reduction benefits are highly progressive. Lower-income people have systematically less nutrition knowledge and are more likely to self-report that they consume more sugary drinks than they think they should. While not dispositive, these facts suggest that lower-income people have larger internalities than higher-income people. Our estimated average marginal internality is about one-third larger at household incomes below $10,000 per year compared with at household incomes above $100,000 per year. Furthermore, low-income households reduce sugar-sweetened beverage consumption much more than high-income households when prices rise. Specifically, we find very similar price elasticities, so high-income and low-income households reduce consumption by similar *proportions* in response to a price increase. But because low-income households consume much more, the absolute amounts of their reductions are much larger. Putting these facts together implies that internality-reduction benefits are highly progressive. Under conventional degrees of inequality aversion used in models of optimal income taxation, this progressivity magnifies the internality correction in the optimal tax formula by about 20 percent.

On the other hand, because low-income households consume more sugar-sweetened beverages, they pay more in tax payments. Combining the progressivity of internality-reduction benefits with the regressivity of the tax payments, we find that the net benefits of a sugar-sweetened beverage tax are reasonably flat across the income distribution, and are possibly highest for the lowest-income consumers. More importantly, we find that low-income people benefit substantially from sugar-sweetened beverage taxes, regardless of whether they benefit more than high-income people.

Substitution and Leakage

As described above, the welfare effects of sugar-sweetened beverage taxes depend on whether they affect consumption of other untaxed goods that generate externalities or internalities. Various papers estimate demand systems that capture these substitution patterns between sugar-sweetened beverages and other foods and beverages. Possibly due to the challenges in data quality and variation in identification strategies, there is very little agreement in this literature. For example, Duffey et al. (2010) find that pizza is a strong substitute for sugar-sweetened beverages. Finkelstein et al. (2013) find no substitution to pizza, but statistically significant substitution to canned soup. Zhen et al. (2014) find that canned soup is a complement to carbonated soft drinks but a substitute for sports drinks, energy drinks, and juice drinks. Aguilar et al. (2019) use the implementation of beverage and food taxes in Mexico to estimate substitution to untaxed goods. These conflicting and sometimes counterintuitive results highlight the difficulties in estimating substitution patterns. They may also reflect false positives from multiple hypothesis testing, as there is not an obvious reason for why pizza and canned soup are substitutes for sugary drinks.

In Allcott, Lockwood, and Taubinsky (2019), we find that diet drinks are moderate substitutes for sugar-sweetened beverages. Across a comprehensive range of other drink categories, sugary foods, and even alcohol and cigarettes, we find close to zero net substitution from sugar-sweetened beverages to other possible "sin goods." This would imply that welfare evaluations and optimal tax calculations could safely ignore substitution to other goods, unless one believes that diet drinks have material health harms.

In addition to substitution to other goods, evaluations of local taxes also need to account for substitution to sugar-sweetened beverages purchased outside of the taxed jurisdiction. Bollinger and Sexton (2017) find that approximately half of purchase reductions of sugar-sweetened beverages within Berkeley appear to be substituted to retailers just outside of Berkeley. Roberto et al. (2019) and Seiler, Tuchman, and Yao (2019) also detect substitution to purchases outside of Philadelphia in response to the Philadelphia tax. This leakage reduces the welfare gains from the city-level taxes and reduces the optimal tax rate.

Pass-Through and Producer Surplus

To ease administration and to increase tax salience, city-level sugar-sweetened beverage taxes in the United States are generally collected from beverage distributors that sell to retailers. A number of recent papers have estimated the extent to which these taxes are passed through into higher retail prices. Two papers studying the Philadelphia tax conclude that the tax was approximately fully passed through (Cawley, Frisvold, et al. 2018a; Seiler, Tuchman, and Yao 2019). Six papers studying Berkeley and Boulder find less than full pass-through, implying that at least some of the incidence of these taxes is on suppliers (Falbe et al. 2015; Bollinger and Sexton 2017; Cawley and Frisvold 2017; Rojas and Wang 2017; Silver et al. 2017; Cawley, Crain, et al. 2018).

Bollinger and Sexton (2017) also document how retailers' overall pricing strategies interact with a local tax on a small subset of products. First, as documented by DellaVigna and Gentzkow (2017) and Hitsch, Hortacsu, and Lin (2017), large retail chains often set uniform prices across many stores in many cities. This limits the extent to which a local cost increase from a local tax is passed through to retail prices in that area. Second, retailers often use "category pricing": for example, all two-liter bottles of regular *and* diet soda might have the same price. If retailers maintain equal prices for regular and diet soda and if consumption of diet soda involves lower internalities or externalities because it does not contain sugar, this reduces the welfare gains from a tax on sugar-sweetened beverages. This intersection between industrial organization and optimal taxation is an interesting area for further research.

Putting It Together

In Allcott, Lockwood, and Taubinsky (2019), we estimate that the socially optimal sugar-sweetened beverage tax is between 1 and 2.1 cents per ounce. One can understand this as coming from the correction needed to offset the negative externality (about 0.8 cents per ounce) and internality (about 1 cent per ounce, inflated by 20 percent due to the progressivity of internality correction), with a further reduction due to the regressive incidence of the financial costs of a tax (reducing the tax by about 0.5 cents per ounce). Together, these rough estimates suggest an optimal tax of about 1.5 cents per ounce. While there is considerable uncertainty in these optimal tax estimates, the optimal tax is not zero and may be higher than the levels in most US cities to date. However, for policymakers who are philosophically opposed to considering internalities in an optimal tax calculation, the optimal tax considering only externalities is around 0.4 cents per ounce.

Guiding Principles for Policymakers

Although uncertainty remains about some empirical parameters, economic theory and existing data suggest seven guiding principles for designing sugar-sweetened beverage taxes. The first four principles are all motivated by one deeper principle: that sin taxes should be designed to offset uninternalized harms.

1. Focus on Counteracting Externalities and Internalities, Not on Minimizing Sugary Drink Consumption

Many public health advocates explicitly or implicitly take the perspective that the goal of policymakers should be to maximize health or minimize unhealthy behaviors. It's easy to see why this can't be the right social objective. The way to maximize health is to ban any sugary or fatty food or drink, including sugary drinks, red meat, and dessert. Such a ban would preclude any enjoyment that people get from eating steak or dessert, and it's not clear where to draw the line on what foods or drinks to ban.

The economic framework presented in this article instead focuses on maximizing social welfare and provides a principled approach that trades off

health-related externalities and internalities with consumer surplus, producer surplus, and government revenues. The framework highlights that unhealthy behaviors do not necessarily merit policy intervention, as they could simply reflect the fact that people enjoy eating steak and dessert. Sin taxes are justified only to the extent that they offset uninternalized externalities or internalities.

2. Target Policies to Reduce Consumption among People Generating the Largest Externalities and Internalities

Consumption by different people may involve larger or smaller externalities and internalities, perhaps due to differences in self-control, nutrition knowledge, and health insurance coverage. Ideally, policies would be targeted to reduce consumption more among people with larger externalities and internalities. For example, if internalities and externalities are largest among children—perhaps due to limited self-control, or because their consumption generates lifelong habits—then very high taxes or bans on sugar-sweetened beverages in schools may be justified.

3. Tax Grams of Sugar, Not Ounces of Liquid

Most sugar-sweetened beverage taxes are structured as a per-ounce tax on any drink with added sugar. That means that drinks with high and low amounts of added sugar are taxed at the same rate. From the perspective of the theoretical rationale for sugary drink taxes, this structure makes little sense. It's the sugar in the drinks, not the amount of liquid, that harms our health. Therefore, drinks containing more sugar generate greater externalities and probably greater internalities.

Scaling the tax with the amount of sugar instead of the amount of liquid that comes with the sugar encourages consumers to switch to lower-sugar drinks and also encourages producers to reduce sugar content. Using economic and epidemiological models, we estimate that taxing sugar-sweetened beverages based on sugar content instead of volume would boost a tax's health benefits by 43 percent, helping people around the world to lose nearly 200 million pounds (Grummon, Lockwood, et al. 2019). Other research arrives at qualitatively similar conclusions about the gains from taxing sugar content instead of volume (Francis, Marron, and Reuben 2016; Zhen, Brissette, and Ruff 2014).[4]

4. Tax Diet Drinks and Fruit Juice If and Only If They Also Cause Uninternalized Health Harms

Even if restricted to 1 cent per ounce volumetric taxes, policymakers must decide what drinks should be included in sugary drink taxes. The Philadelphia and erstwhile Cook County taxes also include diet drinks, on the grounds that this raises more revenues and also makes the tax less regressive because higher-income people buy more diet drinks. However, the Philadelphia diet drink tax is an inefficient way

[4]The United Kingdom and several other countries approximate sugar taxes through tiered systems that impose a higher volumetric tax for drinks with higher sugar content, but this still falls short of the ideal of setting taxes proportional to uninternalized harms.

to raise revenue, and as we discuss below, the regressivity argument is misguided. Including diet drinks would be justified only if the externalities and internalities from diet drinks are as large as those from nondiet drinks, but the evidence presented above suggests that diet drinks are less harmful.

All existing sugary drink taxes exclude 100 percent fruit juice, despite arguments by Wojcicki and Heyman (2012), Gill and Sattar (2014), and some other public health experts that the naturally occurring sugar in fruit juice may be as harmful as the added sugar in soft drinks. Exempting fruit juice from a beverage tax is justified only if the positive externalities and internalities from the additional vitamins and nutrients offset the negative externalities and internalities from the sugar.

5. When Judging Regressivity, Consider Internality Benefits, Not Just Who Pays the Taxes

Some people argue that sugar-sweetened beverage taxes are regressive, because low-income people buy more of these beverages and will thus pay more in taxes. As we discussed above, however, what matters is not just how much low-income people would pay in this kind of tax but how much this tax benefits or harms them overall. In Allcott, Lockwood, and Taubinsky (2019), we estimate that low-income people enjoy a disproportionate share of the internality-reduction benefits, because they both have larger internalities in this domain and reduce consumption more in response to a tax. Overall, our results suggest that low-income people benefit substantially from sugar-sweetened beverage taxes, and they may even benefit more than high-income people.

6. If Possible, Implement Taxes Statewide

All of the current sugar-sweetened beverage taxes in the United States have been implemented by individual cities. Evidence suggests that the benefits of city-level taxes are diminished because consumers avoid these taxes by purchasing outside of the city. To reduce this leakage, sugar-sweetened beverage taxes would ideally be implemented over larger geographic areas, such as at the state level. Such geographic integration can also help to reduce the importance of compliance and administrative costs. However, the existence of externalities and internalities suggests that city-level taxes may be better than no taxes at all.

7. The Benefits of Sugar-Sweetened Beverage Taxes Probably Exceed Their Costs

Our read of the evidence is that sugar-sweetened beverage consumption likely imposes externalities on the health system and internalities due to imperfect nutrition knowledge and self-control problems. In Allcott, Lockwood, and Taubinsky (2019), we estimate that the social welfare benefits from implementing the optimal tax nationwide (relative to having zero tax) are between $2.4 billion and $6.8 billion per year. These gains would be substantially larger if the tax rate were to scale with sugar content.

Of course, such calculations require strong assumptions and depend on uncertain empirical estimates, in particular with respect to internalities and externalities.

We therefore emphasize that much more empirical work is needed. Furthermore, sugar-sweetened beverage taxes are not a panacea—they will not, by themselves, solve the obesity epidemic in America or elsewhere. But sin taxes have proven to be a feasible and effective policy instrument in other domains, and the evidence suggests that the benefits of sugar-sweetened beverage taxes likely exceed the costs.

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