POLICY FORUM

HEALTH ECONOMICS

Designing better sugary drink taxes

Tax the sugar, not the liquid

By **Anna H. Grummon[1], Benjamin B. Lockwood[2,3], Dmitry Taubinsky[3,4], Hunt Allcott[3,5,6]**

Taxes on sugar-sweetened beverages (SSBs), such as soda and bottled iced tea, are an increasingly popular approach to reducing obesity, diabetes, and other health harms (*1*). As of mid-2019, 42 countries and seven U.S. cities have implemented SSB taxes (*2*). A basic economic principle is that such corrective taxes should be proportional to the harm caused. The harm from sugary drinks comes from the sugar, and SSBs vary substantially in sugar per unit volume. Yet SSB taxes typically set constant rates per unit volume; only three SSB taxes worldwide are proportional to sugar content. For example, the seven U.S. cities that tax SSBs use volumetric taxes of 34 to 68 cents per liter of liquid (1 to 2 cents per ounce) instead of, say, 0.5 cents per gram of sugar. These volumetric SSB taxes are poorly targeted to the actual health harms from SSBs. We estimate that a simple design change—taxing the amount of sugar in a drink, not the volume of liquid that accompanies the sugar—could boost a SSB tax's health benefits and overall economic gains by roughly 30%.

HARMS FROM SUGARY DRINKS

The two most well-established health consequences of SSB consumption are weight gain and type 2 diabetes (*3*, *4*). SSBs cause weight gain primarily by increasing calorie intake (*3*), and a drink's calorie content is directly proportional to its sugar content. SSBs are thought to cause type 2 diabetes both by causing weight gain and because they have high glycemic load, meaning that they rapidly and substantially raise blood sugar levels. Glycemic load also depends directly on a drink's sugar content (*5*, *6*). Thus, the health harms from SSBs are closely proportional to their sugar content. Because the glycemic load and weight effects are larger when we consume sugar in drinks than in solid food, public health experts (and our analyses) focus on taxing sugar only in drinks (*7*).

Despite their different sugar content and resulting different harms, all SSBs are taxed at the same rate per liter under a volumetric tax. This tax structure gives consumers no incentive to substitute from high-sugar to low-sugar SSBs, even though the latter are less harmful. Thus, although a volumetric tax reduces consumption of SSBs in general, it does not provide the maximum possible health benefits.

BENEFITS OF A SUGAR TAX

Although it is impossible to predict the exact gains from a sugar tax in any given city or country, standard economic and health models can provide a rough estimate. The estimate depends on three main factors. First, the variation in sugar content matters: If most SSB products have fairly similar sugar content per liter, then volumetric and sugar taxes can generate fairly similar tax rates on most products. Second, the price elasticity of demand matters: If demand is inelastic—that is, if consumers do not shift their purchases away from high-sugar SSBs in response to a sugar tax—then the sugar tax makes little difference. Third, the health effects of sugar consumption matter: The more harmful is sugar, the more beneficial it is to reduce consumption. In theory, the extent to which an SSB tax causes consumers to substitute to other unhealthy foods and drinks also matters, but recent evidence suggests that this is negligible overall (*8*).

Using the variation in sugar content and empirical estimates of demand elasticities and health impacts, we quantified how sugar taxes and volumetric taxes affect SSB consumption patterns and resulting health outcomes. We ran Monte Carlo simulations to capture uncertainty in the empirical estimates. Because the most reliable empirical estimates of elasticity and health effects tend to use U.S. data, we focused our estimates on U.S. adults. We compared a volumetric SSB tax of 34 cents per liter (1 cent per ounce) to an "economically equivalent" sugar tax on SSBs, which is 0.37 cents per gram of sugar. By "economically equivalent," we mean that the tax rates are the same on the product with average sugar content, and the two taxes have approximately the same effect on total SSB consumption. (See the supplementary materials for details, and see the table for results.)

First, we considered the benefits of a standard volumetric SSB tax compared with no tax. In our average Monte Carlo simulation, a 34-cent-per-liter volumetric tax causes the average U.S. adult to drink 2.9 fewer ounces of SSBs per day, a 22% reduction. This equals about 8 g of sugar per day, which is about one-quarter of the American Heart Association's recommended limit for daily added sugar intake from all sources (*9*). This reduction in sugar intake would help the average adult to lose 2.3 pounds. A nationwide volumetric SSB tax would reduce obesity rates by 2.0%, implying 2.1 million fewer adults with obesity, and would reduce the number of new type 2 diabetes cases by 2.3%, or 36,000 new cases per year. These calculations are broadly consistent with other studies that predict large health benefits from volumetric SSB taxes (*10*, *11*).

Weighing against these health benefits, we must account for the lost "consumer surplus" from taxing SSBs—that is, the amount of money that consumers pay in taxes plus the monetary value of the enjoyment lost when we drink fewer tasty drinks (*12*). The total economic efficiency gain from a volumetric tax in the United States—accounting for the health care system cost savings, consumer surplus losses, and tax revenues—would be about $5 per adult per year, or about $1.4 billion per year nationwide.

Next, we considered the incremental benefits of a sugar tax compared with a volumetric tax. Because the sugar tax naturally imposes higher taxes on higher-sugar SSB products, it induces consumers to substitute to lower-sugar SSBs, even though overall reductions in SSB consumption remain approximately the same as under a volumetric tax. In our average Monte Carlo simulation, a sugar tax causes U.S. adults to consume 2.3 fewer grams of sugar per day from SSBs than they would under a volumetric tax. This sugar reduction would help the average adult to lose another 0.7 pounds. Scaled across the United States, a sugar tax instead of a volumetric tax would reduce obesity rates by 0.6%, or 630,000 adults, and would reduce the number of new type 2 diabetes cases by another 0.7%, or 11,000 people per year. The additional annual economic efficiency gain would be about $1.55 per adult, or about $400 million. By each of these measures of health effects and economic gains, a sugar tax would generate about 30% more benefits than would a volumetric tax.

[1]*Harvard Center for Population and Development Studies, Harvard TH Chan School of Public Health, Cambridge, MA, USA.* [2]*Department of Business Economics and Public Policy, University of Pennsylvania Wharton School of Business, Philadelphia, PA, USA.* [3]*National Bureau of Economic Research, Cambridge, MA, USA.* [4]*Department of Economics, University of California Berkeley, Berkeley, CA, USA.* [5]*Microsoft Research, Cambridge, MA, USA.* [6]*Department of Economics, New York University, New York, NY, USA. Email: hunt.allcott@nyu.edu*

There are about 240 million adults worldwide living in cities or countries that currently have volumetric SSB taxes. After adjusting for the differences in SSB consumption across countries, our average Monte Carlo estimates suggest that implementing sugar taxes in place of volumetric taxes in these places could help adults around the world lose about 100 million pounds. Of course, it is important to be cautious when generalizing the price elasticity and other relevant parameters across countries, and the diabetes, obesity, and economic efficiency calculations cannot be plausibly extrapolated outside the United States because of differences in health care costs and the distributions of diabetes and obesity risk.

Our calculations involve various caveats. First, one could make alternative assumptions about parameters such as the effect of SSB consumption on health care costs or the extent to which retailers raise prices in response to SSB taxes. Second, our primary approach uses a simplifying assumption that substitution between SSBs does not depend on sugar content. This could cause us to overstate the gains from a sugar tax. Third, our calculations do not account for the possibility that sugar taxes encourage SSB producers to make drinks with less sugar, providing healthier options for consumers. This could cause us to understate the gains from a sugar tax. Although there is substantial uncertainty in our estimates, two other analyses using different approaches also find meaningful benefits from sugar taxes relative to volumetric taxes (*13*, *14*).

These benefits are notable given that they come from a simple change in tax design. By contrast, nontax interventions aimed at reducing SSB consumption—which often involve nutrition education conveyed through workshops, text messages, written materials, and meetings with dietitians—have material costs and, on average, generate only modest reductions in SSB intake among children and no reductions in SSB intake among adolescents or adults (*15*).

In most places, a sugar tax is not materially more difficult to implement than a volumetric tax. SSB taxes are typically collected from producers or distributors on the basis of how many SSBs they sell. Consumers never have to calculate the SSB tax themselves; they simply see a higher posted price in the store. To calculate tax payments, sellers and tax authorities use a spreadsheet or similar software that multiplies the units of each SSB sold by its volume, price, or sugar content and then applies the tax rate. If the spreadsheet does not already have a field for sugar content, those data would have to be imported from nutrition facts labels. Policymakers can weigh the cost of inputting and validating sugar content data against the financial and personal burdens from diabetes and obesity. Sugar taxes and volumetric taxes on SSBs both require similar other implementation decisions, such as how they apply to fountain beverages and powdered drinks and whether we are concerned with naturally occurring sugars (for example, in milk and fruit juice) in addition to added sugars. Perhaps the clearest evidence on the feasibility of sugar taxes is that the three countries that already have them—Mauritius, South Africa, and Sri Lanka—are not especially wealthy and do not otherwise have unusual expertise in counting grams of sugar.

The United Kingdom and some other countries approximate sugar taxes through tiered systems that impose a higher volumetric tax for SSBs with higher sugar content. Although this is closer to the ideal of a sugar tax, it still provides no incentive for consumers to substitute to lower-sugar SSBs within a tier and no incentive for producers to reduce the sugar content of their drinks within a tier.

Once there is agreement to tax SSBs, it seems natural to tax the harmful sugar instead of the liquid that comes with the sugar. Our calculations suggest that this idea offers valuable low-hanging fruit for improving public health. ■

A simple design change, a boost in health and economic benefits

Monte Carlo Simulations of effects of volumetric or sugar taxes on sugar-sweetened beverages (SSB)

	VOLUMETRIC TAX compared to no tax			SUGAR TAX compared to volumetric tax		
UNITED STATES	**10TH PERCENTILE**	**MEAN**	**90TH PERCENTILE**	**10TH PERCENTILE**	**MEAN**	**90TH PERCENTILE**
SSB consumption decrease (ounces/person-day)	1.4	2.9	3.8	0	0	0
SSB sugar consumption decrease (grams/person-day)	3.7	7.8	10.2	1.1	2.3	3.0
SSB calorie consumption decrease (calories/person-day)	15.9	33.4	43.9	4.8	10.0	13.1
Steady-state obesity prevalence decrease (percent change)	0.8	2.0	3.7	0.2	0.6	1.1
Type 2 diabetes incidence decrease (percent change)	1.0	2.3	3.3	0.3	0.7	1.0
Economic efficiency gain (Dollars/person-year)	1.0	2.3	3.3	0.3	0.7	1.0
GLOBAL						
Steady-state weight loss (millions of pounds)	147.0	324.0	463.0	44.0	97.0	139.0

REFERENCES AND NOTES

1. In economic language, SSB consumption causes two classes of harms: "externalities," when a consumer's health care costs are paid by others, and "internalities," when people consume too much because of self-control problems or imperfect nutrition knowledge. See the supplementary materials and (*8*) for details.
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SUPPLEMENTARY MATERIALS

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