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# HOW TO

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# NOTES

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## How to Apply Excise Taxes to Fight Obesity

Fiscal Affairs Department

# How to Apply Excise Taxes to Fight Obesity

Prepared by Patrick Petit, Mario Mansour, and Philippe Wingender

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Fiscal Affairs Department  
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## The Rise of Obesity-Related Diseases

As income per capita increases, more countries are faced with a gradual shift from communicable to non-communicable diseases, most of which are related to four main risk factors: tobacco, alcohol, physical inactivity, and unhealthy diets (Jamison and others 2013). Given its unambiguous positive health impact, encouraging physical activity has gathered strong support, while curbing tobacco consumption has been a core objective of national and international efforts for the opposite reason (WHO 2019a). Although its health impact is somewhat less straightforward—notwithstanding large overall externalities—alcohol consumption has also followed some positive trends in many countries. Concerns over poor diet, however, follow growth in income, and some of its main consequences are obesity-related health conditions.<sup>1</sup> It is now estimated that obesity and overweight are directly responsible for at least 2.8 million deaths annually (WHO 2019b), and that the share of obesity-related diseases in total deaths is rapidly increasing (Table 1).<sup>2</sup> The economic burden of obesity is also significant and in the United States alone, represented \$147 billion (1 percent of GDP) in 2008.<sup>3</sup>

Fighting the obesity epidemic<sup>4</sup> has so far proven a difficult challenge, given the diversity of natural and

processed foods, the complexity of food supply chains,<sup>5</sup> and the fact that targeting *excessive* caloric consumption is far trickier than reducing overall consumption (as for tobacco). Nevertheless, efforts to curb caloric intake are gearing up and the experience from tobacco control has drawn much attention on a potential role for excise taxes in fighting obesity (Brownell and Frieden 2009, Jamison and others 2013, Petit and others 2014, World Bank 2020).

Many related questions have therefore been raised as part of the IMF's capacity development work: Should excises on unhealthy food be used to fight obesity? If so, under what conditions? What are the product and market characteristics that would help identify the relevant tax bases and the rates at which to tax them? While acknowledging that the scientific evidence keeps evolving, this note summarizes the ongoing debate and practice on food excises and on their potential role as a policy tool to fight the obesity epidemic, with a view to assist policymakers in deciding whether to go forward, and if so, how.

## The Case for Excise Taxes to Fight the Obesity Epidemic

Modern tax systems rely on broad-based taxes such as income and consumption taxes to finance government budgets. The case for narrow-based taxes on specific goods or services in addition to generally applicable ones, therefore, usually rests on other objectives and a careful balancing act between these objectives and the standard principles of tax policy making—that is, administrative simplicity, equity, and efficiency. Despite the rise of broad-based consumption taxes, such as the value-added tax (VAT), excise taxes remain an important feature of most tax systems around the world for many reasons, including: (1) addressing negative externalities (that is, the impact

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<sup>1</sup>Poor diet is also related to a host of other conditions, such as tooth decay, hypertension, etc., which are not the immediate focus of this How-to Note.

<sup>2</sup>In the USA, 30.3 million people had diabetes in 2015, and 84.1 million prediabetes (CDC 2017).

<sup>3</sup>This represented 9.1 percent of health care expenditures – see Finkelstein (2009). For the USA, see also Cawley, (2010); and Cawley and others (2015), who provide a higher estimate of USD 315.8 billion for 2010. Shekar and Popkin (2020) provide estimates for a group of 13 middle- and high-income countries. Burden of disease estimates generally vary widely, depending on data and methodology.

<sup>4</sup>Although “epidemic” has traditionally been used for infectious diseases, it is here given its modern meaning, that is, occurring in

numbers in excess of normal expectancy, as compared to endemic or sporadic.

<sup>5</sup>See for example the debate on the role of High Fructose Corn Syrup in the obesity epidemic (Lustig and others 2012; Bray and others 2004; and White 2009).

**Table 1. Total Number of Deaths Linked to Obesity-Related Diseases (In million cases, unless otherwise specified)**

	2000		2012		2030 (proj.)	
	Cases	Share (%)	Cases	Share (%)	Cases	Share (%)
Communicable diseases <sup>1</sup>	16.3	30.9	12.8	23.0	12.0	17.1
Noncommunicable diseases	31.5	59.6	37.9	67.8	51.8	73.9
. . . of which (obesity-related <sup>2</sup> ):	14.6	27.6	18.0	32.2	23.7	33.9
Breast cancer	0.4	0.8	0.5	1.0	0.8	1.1
Corpus uteri cancer	0.1	0.1	0.1	0.1	0.1	0.2
Colon and rectum cancers	0.6	1.1	0.7	1.3	1.1	1.5
Diabetes mellitus	1.0	2.0	1.5	2.7	2.5	3.5
Hypertensive heart disease	0.8	1.6	1.1	2.0	1.5	2.1
Ischaemic heart disease	6.0	11.3	7.4	13.2	9.2	13.2
Stroke	5.7	10.7	6.7	11.9	8.6	12.2
Injuries	5.0	9.5	5.1	9.2	6.3	9.0
Total number of deaths in the world	52.8	100.0	55.9	100.0	70.1	100.0

Source: World Health Organization, and authors' calculations.

<sup>1</sup>Communicable diseases include "Communicable, maternal, perinatal and nutritional conditions".

<sup>2</sup>Main conditions only - this list is not exhaustive. Many of these conditions have additional risk factors, some of which could be more important than obesity.

on an individual's welfare from consumption by others [Pigou 1918]), externalities (time inconsistency resulting from differences between immediate and long-term preferences [Gruber and Koszegi 2001 and Gruber 2003]), and imperfect information; (2) revenue-raising; and (3) the pursuit of other objectives not primarily motivated through their economic dimension, notably public health.

### Externalities and Internalities

The main economic justifications for excise taxes are externalities, internalities, and imperfect information. In the case of food, despite the significant work on the health and economic burden of obesity, identifying what part of these costs are, in fact, externalities remains a conceptual and empirical challenge that has attracted relatively few contributions. In the absence of a direct externality, such as smoke in the case of tobacco, the obesity externality is mainly channeled through the (public or private) health insurance system and related pooling of risk,<sup>6</sup> which brings three main methodological issues. First, the size of the externality will depend on several institutional factors. For example, a pure out-of-pocket health care system<sup>7</sup> would entail no externality since there is no pool-

<sup>6</sup>Positive externalities through the pension system – if obese people die sooner, there could be higher benefit for non-obese people – have not been discussed as much as in the case of tobacco externalities.

<sup>7</sup>While non-insured USA citizens are a clear example of this, it is also useful to remember that in many middle- and low-income countries, despite a nominally universal health care system, the lack of resources often leads to a variety of sometimes large out-of-pocket

ing of risk across agents. Second, and importantly, as suggested by Bhattacharya and Sood (2005 and 2011), it is not because obese individuals pay less in premium than they receive in healthcare that an externality exists—this could be something inherent to risk pooling, regardless of weight. In fact, they argue that an externality would exist if (1) there is pooling of risk between non-obese and obese individuals, and (2) if the insurance induces change in behavior (that is, a moral hazard, such as eating more or exercising less without having to pay for the consequences, or adverse selection, such as non-obese people dropping from the insurance pool in response to the obesity-related increase in premiums). In other words, the economic burden is not a measure of the externality, which would be better assessed by the difference between the economic burden of obesity between a pure out-of-pocket system and the specific insurance-based system being evaluated. Regardless, and third, even if one assumes that the burden of disease (or a part of it) is a good measure of the externality, the tax should, in principle, be set equal to the marginal cost of the externality, which has never been assessed. Finally, if not all high-caloric food consumption results in an externality—which is certainly the case for sugar consumption, especially taking into account individual physiological and behavioral differences—an excise targeting this externality (or "Pigouvian tax") becomes an inefficient instrument (Fleischer 2015), as it also reduces efficient consumption to economically sub-optimal levels.

payments, such as for drugs and other supplies or for faster and better treatment with completely private providers.

Interestingly, in the case of private insurance systems, Bhattacharya and Bundorf (2009) compare wages between employer-insured workers and others without employer health insurance, and their findings suggest that for employer-insured obese workers, lower wages roughly compensate for the additional health benefits (which is not the case for jobs without health insurance), so that there is no pooling and therefore no externality.<sup>8</sup> Pooling does exist for public insurance though, but the impact on behavior is mixed. Based on this approach and individual level survey data, Bhattacharya and Sood (2005) further calculate that obesity had per capita externality costs of \$149 in 1998, which is much lower than Finkelstein's (2009) more recent estimate for the burden of obesity for 2008 (that is., \$488 per person, or \$147 billion in the United States).<sup>9</sup> Other authors, such as Rashad and Markowitz (2007), find little evidence of such an externality (albeit based on data with limitations), while Allcott and others (2019a) propose a 0.41 cents tax per ounce of sugar-sweetened beverages (SSBs), such as soft drinks, to cover costs borne by third parties (externalities only—roughly 10 to 20 percent of the sale price). Overall, more conceptual and empirical research is probably needed on the topic, including on intergenerational externalities through diets imposed by parents on children, habit formation, genetics, and epigenetics.

Measuring internalities also involves numerous conceptual and empirical challenges (see Allcott and others 2019b) and have only attracted a small number of contributions, which, so far suggest that internalities—and the related “paternalistic” tax rationale—could demand higher corrective taxes than externalities.<sup>10</sup> O’Donoghue and Rabin (2006) explore the theoretical implications of low self-control (time inconsistency) and show that even with a small number of people with low self-control, optimal taxes can in principle still be large. Griffith and others (2018) propose a theoretical framework and conjecture on the prevalence and importance of internalities without estimating their magnitude. Finally, Allcott and others (2019a) bundle imperfect information and self-control into a single

measure of SSB internalities and arrive at roughly 1.1 cents per ounce for an optimal tax based on internalities alone, which is higher than many policy proposals (see Appendix 1).

### Revenue-Raising

Despite the lack of strong evidence for externalities and internalities, the imperatives of revenue raising have led many governments to use excise taxes on various goods with low own-price elasticity as a source of *convenient and stable* revenue, regardless of efficiency and equity considerations. Yet, well-designed excise taxes on clearly identified tax bases generally entail minimal administrative and compliance costs and therefore need to remain simple. This is notably the case for excise taxes on fuel, tobacco, alcohol, cars, and telecoms services, which can provide a significant share of overall revenue, especially in countries with low tax administration capacity.

The simplicity of an excise tax on high-calorie food or beverages is less straightforward given the complexity of the tax base, their wide variety, use as inputs in various products, and often complex production and distribution chains. Sugar, for example, is conceptually an attractive tax base to fight obesity, but it can occur naturally in food or can be added to it as an ingredient. Non-natural (processed) sugar can, in turn, come from sugarcane (which can be sold under various forms), beetroot, corn (syrup), fruits, and various other sources. All of these can then be used as direct food intake or as inputs into a wide variety of food products that can have final sugar contents ranging from very low to very high—hence necessitating differentiated taxation if the objective is to tax proportionally to sugar content. The administrative feasibility of an excise tax on a comprehensive set of high-calorie food items is therefore a key concern (especially in a low-capacity environment) and may suggest a narrower focus on a smaller subset of carefully chosen goods.

Food excise taxes also raise many questions on equity grounds, as there is no evidence that high-calorie food items are consumed in greater proportion by higher-income individuals (as opposed to fuel, for example). In fact, there is ample evidence that cheap, highly-processed, high-calorie food is consumed more among low-income individuals, although the likely stronger long-term negative impact on consumption among low-income individuals, and thus the reduction in internalities for those persons, will offset

<sup>8</sup>Such findings may raise additional equity concerns though, which are not covered here or by Bhattacharya and Bundorf (2009).

<sup>9</sup>Comparing their results to earlier studies, Bhattacharya and Sood (2005), point to a similar difference.

<sup>10</sup>Interestingly, this literature points to links between internalities, corrective taxes and redistributive policies, given the relationship between internalities, imperfect information, self-control and education levels and socio-economic status.



**Table 2. Food Products Own-Price Elasticities in Two Systematic Reviews of the Literature<sup>1</sup>**

Relevant categories	Andreyeva and others (2010)	Cornelsen and others (2014) (38 countries) <sup>2</sup>		
	(USA)	Low-income	Middle-income	High-income
Food away from, home	-0.81	-	-	-
Soft drinks	-0.79	-0.74	-0.68	-0.56
Sweets/sugars	-0.34	-	-	-
Juice	-0.76	-	-	-
Dairy	-0.65	-0.78	-0.72	-0.60
Milk	-0.59	-	-	-
Cheese	-0.44	-	-	-

<sup>1</sup>Categories are grouped for ease of comparison but are not necessarily identical between the two studies.

<sup>2</sup>Income categories refer to groups of countries, not to population groups within the countries.

(to some extent) the otherwise regressive aspect of the tax.<sup>11</sup> In any event, though, it remains that increasing equity is not a *prima facie* strong rationale for such a tax. Last, but not least, the economic efficiency of these excise taxes, which demands complementarity with leisure (see Corlett and Hague 1953; Atkinson and Stiglitz 1976; and Crawford, Keen, and Smith 2010) remains an unexplored property of food excise taxes and highlights the need for further research.

The own-price-elasticity<sup>12</sup> of high-calorie food is the topic of a vast, but scattered amount of literature, which somewhat reflects the diversity of products and economic environments. In a review of 160 such studies in the United States, Andreyeva and others (2010) looked at own-price elasticities for 16 groups of food products (Table 2). Soft drinks and juice topped the list with average elasticities of  $-0.79$  and  $-0.76$ , respectively, but these estimates vary widely, as soft drinks also showed the widest confidence interval ( $-0.33$  to  $-1.24$ ) and range of individual estimates ( $-0.13$  to  $-3.18$ ). Sweets/sugars were much less sensitive to own-price, with an average elasticity of  $-0.34$  (range of  $-0.14$  to  $-0.53$ ), and essential food items (for example, cereals, fats, and oils) generally had even more inelastic demands.<sup>13</sup> Cornelsen and others (2014) expanded the coverage in a review of 78 studies covering 38 low-, middle-, and high-income countries (Table 2) and found comparable results, notably for dairy and sweets,

which in their case includes soft drinks, hence the higher elasticity. They also found that changes in food prices had the largest own-price effects in low-income countries. More recent or narrowly focused reviews tend to provide higher elasticities: Powell and others (2013) estimate that own-price elasticity of SSB and fast-food are  $-1.21$  and  $-0.52$ , respectively; Nakhi-movsky and others (2016) find own-price SSB elasticities ranging from  $-0.6$  to  $-1.2$  in 9 middle-income countries; and Allcott and others (2019a) estimate an elasticity of about  $-1.4$  for SSBs. Overall, it therefore appears that the case for *convenient and stable* revenue-raising by taxing obesity-related food is weak.

### Improving Health

The flip side of high own-price elasticity is obviously that taxes could help decrease the consumption of unhealthy products and reduce obesity—revenue and health objectives are in this sense somewhat antagonistic. Although the link from tax to obesity and health is indirect<sup>14</sup> and may vary from person to person (see Taubes 2013), the literature (see Appendix 1<sup>15</sup>) does suggest that it is real and operates through identifiable types of food and that the ultimate impact of excise taxes on obesity and health outcomes is uncertain and likely small, with no studies yet documenting a link from an excise tax to a health outcome given that most health-motivated initiatives are recent (Shekar and Popkin 2020).

<sup>14</sup>Products that can cause obesity must be identified to define a controllable tax base, taxes on these products must then be passed into higher prices, which in turn must significantly decrease overall consumption of unhealthy products (that is, considering substitution effects), and the decrease in consumption must be large enough to impact calorie intake.

<sup>15</sup>Given the vast literature reviewed for this section, most texts used for this section are referenced and summarized in Appendix 1 to ease the reading.

<sup>11</sup>In low-income countries, processed food or soft drinks are more likely to be consumed by the higher-income groups, and hence have a stronger equity rationale.

<sup>12</sup>A part or more than the tax amount can be passed on to the consumers, depending on many factors, notably the price elasticity, the type of excises and industry structure, etc. This is an important topic that is not covered here, but that should be part of policy design.

<sup>13</sup>Besides perhaps “Food away from home” Andreyeva and others (2010) does not have a category that could have been closely associated with consumption of excess fat, such as chips or fast food.

Medical research (for now largely based on US evidence) provides strong evidence that obesity can be caused by small dietary imbalances (a 5- to 10-percent increase in daily caloric intake—for example, one or two cans of soft drinks)<sup>16</sup> that are sustained over long periods of time, and that the increased final consumption of identifiable key food items has been responsible for most of these extra calories, including soft drinks, chips and potatoes, unprocessed red meat, and processed meat.<sup>17</sup> SSBs have notably been the focus of much research and have been repeatedly linked to obesity and obesity-related conditions, accounting for up to half of dietary imbalances in the United States. It follows that fighting obesity might not require a moderate reduction in widely used difficult-to-control inputs (such as sugar or fat in general) but rather by drastically reducing the consumption of the specific retail-level food items that cause the small imbalances through high taxes. However, even with the recent health-driven movement toward higher taxes in the United States and elsewhere (mainly excise taxes and general sales taxes on SSBs), current rates fall well below such levels and the literature generally suggests that they have only a small impact, except perhaps on specific subgroups (children and adolescents, low-income individuals). Nakhimovsky and others (2016) report similar conclusions for nine middle-income countries.

Yet, if current SSB taxes do decrease consumption of the taxed good, as expected and widely documented in the literature (see, notably, Teng and others 2019), why not significantly increase them? In fact, the literature also suggests that significant substitution effects could lead to increased consumption of other high-calorie food items (for example, juices, flavored milks, and high-calorie snacks), and that international differences in consumer behavior need to be better understood. For example, Edward (2011) finds that studies considering substitution effects simulate a much lower impact of higher taxes on the Body-Mass Index. Cornelsen and others (2014) also notes that cross-price elasticities tend to be significantly lower than own-price elasticities on a product-by-product basis, but rightly suggests

<sup>16</sup>As made clear by Taubes (2013), the link between obesity and caloric intake can also be complex to the point of challenging commonly held views on the nature of obesity as an imbalance between caloric intake and use.

<sup>17</sup>This raises a series of additional questions on environmental tax on meat from beef and other grazing animals, given their large carbon footprint.

that it is the combined effect on many products that should be relevant for policy and that substitution effects are very heterogeneous across products, income levels, and countries—see also Briggs and others (2013), who documents international differences in substitution patterns (the United States vs. the United Kingdom).

Other studies suggest that substitution effects are significant for tax policy and need to be better understood. In a comprehensive model of consumer choices, Harding and Lovenheim (2017) estimate that considering substitution effects, a 20 percent tax on SSBs (soda) reduces purchases by 10.35 percent, but related caloric intake by only 4.84 percent.<sup>18</sup> Dubois and others (2019), while documenting a significant reduction in overall caloric intake, also measure a strong mitigating impact of increased consumption of non-taxed sugary drinks and food. Others, like Dharmasena and Capps (2012), document significant cross-substitution patterns on narrower baskets of goods, such as liquids, with taxes on SSBs impacting the sales of juices, low-fat milk, coffee, and tea, and, hence, weakening the impact of the tax. The recent experience of Mexico's excise taxes also seems to confirm these findings, with uncertain substitution patterns and health impacts despite a significant drop in sales of taxed products, as expected (see Box 1). Finding the right basket of goods to tax and ensuring that the operation remains administratively feasible may still pose some policy and research challenges, both of which will benefit from currently accumulating evidence.

## Policy Guidance and Country Experiences

With a weak revenue-raising rationale, a still evolving debate on externality/internality, potential implementation difficulties linked to the definition of a comprehensive base and ensuing focus on a narrower set of goods, as well as doubts on the ultimate health impact related in large parts to still uncertain substitution effects, it might be tempting to conclude that excise taxes on unhealthy food are not the best way to reduce obesity. Yet, the sheer magnitude and costs of the obesity epidemic in the absence of a simple and straightforward solution increases the relative social and political benefit of available solutions, even if

<sup>18</sup>Relatedly, they also calculate that a tax on nutrients (sugar) has a larger impact, but administrative considerations of taxing nutrients are not discussed.

### Box 1. A Tax on Sugar-Sweetened Beverages in Mexico

Facing some of the highest obesity and diabetes mellitus prevalence rates in the world (respectively 71 and 10.8 percent of adult population), as well as one of the highest soft drink consumption levels (163 liters per person per year), the Mexican authorities adopted on 31 October 2013 an excise tax of 1 Mexican peso per liter of SSB, equivalent on average to about 10 percent of the sales price. It covers a wide range of drinks, including energy drinks and all non-alcoholic beverages prepared by dissolving sugars in water, whether carbonated or not. The tax was accompanied by a large-scale media campaign on healthy habits and a further 8 percent tax on 9 categories of non-staple high-calorie processed foods (snacks, confectionery, chocolate products, flan/pudding, fruit & vegetable-derived sweets, peanut & hazelnut spreads, dulce de leche, cereal-based processed foods, ice cream and popsicles) with more than 275 calories per 100 grams (PAHO 2015). This specific tax also has an imbedded regulatory adjustment process related to cumulative inflation.

Compared to a baseline consumption scenario, taxed products (of which soda and non-soda SSBs) saw a decline in sales volume of 5.5 percent in 2014 and 9.7 percent in 2015, thus suggesting stronger

long-term price elasticity (Arantxa Colchero and others 2017). However, the impact was much stronger on non-soda taxed products (–16.2 and –29.4 percent in 2014 and 2015, respectively) than on soda taxed products (–0.8 and –0.3 percent for the same years, respectively). The effect of the tax was also significantly higher among lower socio-economic classes. While sales of non-taxed products increased by 2.1 percent on average over the study period, there remains some uncertainty regarding the exact nature of the substitution patterns, notably because of possible switching from non-soda to soda products (also taxed, but cheaper and with a less elastic demand), as well as to smaller package sizes (badly measured given data source). The impact on untaxed dairy products (for which data series were shorter) also probably requires additional research, given a strong decline (14.4 percent on average over 2014 and 2015) that stands in sharp contrast with the modest fall in taxed dairy products (2.5 percent on average) – other factors might be at work. In 2014, tax revenue from sweet beverages were 0.1 percent of GDP and about 0.08 percent of GDP for the non-staple high-calorie processed foods (PAHO 2015).

they appear to be relatively ineffective, at least in their current form. In that respect, and if governments are going to move forward anyway, the debate has provided much evidence to guide policy and better shape expected results.

It has notably become clearer under which conditions health-motivated excise taxes could have some impact on obesity. First, despite the wide variety of products initially considered for excess calories (including fatty products), the issue of tax base definition is less acute than initially thought: added sugar, especially in SSBs, is in many countries a core problem. More generally, linking obesity to one or few clearly identifiable food items leading to excessive caloric intake is therefore a necessary condition for policy feasibility and effectiveness (even if some countries have showed that taxing a wide variety of products or a basic ingredient can also be administratively feasible, within limits—see Boxes 2 and 3, as well as Bird and Bahl 2020). Second, substitution

away from high-calorie food is essential for long-term policy efficiency, but it is still largely undocumented. Documenting small (large) substitution effects toward unhealthy (healthy) food would provide a strong health rationale for excise taxes on food.<sup>19</sup> Third, the impact of excise taxes on consumption is complex and is influenced by the presence of other non-tax policy measures, and vice-versa—hence, the importance of an inclusive approach that notably involves varied ministerial bodies and nongovernmental organizations. In Mexico, for example, awareness of the tax was linked to significantly lower consumption (Álvarez-Sánchez 2018). In that respect, it is not surprising that recent health-motivated tax increases and proposals have revolved around moderate hikes (for example, one cent per ounce of soft drinks, that is, 15 to 20 percent of the value), on a few well-selected high-calorie products

<sup>19</sup>Documenting a strong complementarity between leisure and unhealthy food would in addition make the tax economically efficient.

### Box 2. A Tax on Saturated Fat in Denmark

The short-lived Danish tax on saturated fat introduced in October 2011 remains the only excise to have been based on the fat content of food as opposed to being levied on specific food categories. Consumers paid 16 kroner (EUR 2.15) per kilogram of saturated fat on food with fat content above 2.3 percent (Smed 2012). This threshold effectively excluded drinking milk from the tax (Jensen and Smed 2013), but included a host of “fatty” foods such as meat, cheese, butter, edible oils, spreads, snacks, etc. This specific rate was roughly equivalent to a 30 percent ad valorem rate for butter, 8 percent for a bag of chips, and 7 percent for a liter of olive oil for example. The tax was remitted by wholesalers and importers in addition to other excises on sweet products and soft drinks, and the usual 25 percent VAT.

The tax proved highly unpopular and was repealed after only 15 months, because of high administrative costs for producers, loss of competitiveness related to alleged cross-border shopping, and disputed effects on consumption habits. Subsequent econometric analysis indicated however that the tax had been successful in changing consumption habits, with a 10 to 15 percent decline in the consumption of the targeted food items, but also for some types of oil and fat a shift in purchases from high price supermarkets towards low-price discount stores (Jensen and Smed 2013). The government and the Danish Chamber of Commerce’s claim that the tax also led to an increase in cross-border shopping has apparently not yet been confirmed by independent econometric evidence (Sassi and others 2013).

### Box 3. A Tax on Food with Sugar, Salt, and Caffeine in Hungary

Hungary introduced the Public Health Product Tax (PHPT) on selected manufactured foods with high sugar, salt or caffeine content in September 2011. It does not cover basic food stuffs and only affects products that are deemed to have healthier alternatives such as soft drinks and energy drinks, confectionery, salted snacks, and fruit jams among others. The law was amended several times to ensure the broadest coverage of all alternative foods, and rates were also updated. The rates are specific and depend on sugar, salt or caffeine content as well as on the specific type of consumer goods. For example, as of January 1, 2019, rates from HUF 240 (85 US cents) per liter for soft drinks syrups with total sugar content exceeding 8 g per 100 ml, to HUF 600 (USD 2.15) per kg for fruit jams containing total sugar in excess of 35 percent.

The PHPT is payable upon first sale in Hungary, either by the producer, wholesaler or importer (exports are exempt from the tax). The government’s objective in introducing the tax was to “limit the consumption of foods that have no benefit from a public health perspective” and to raise additional revenue to finance growing health spending needs (ECSIP 2014). In this respect, the tax generated HUF 40.6 billion in 2018 (close to USD 150 million), or 0.1 percent of GDP.

According to private sector studies, the introduction of the tax led to an increase in the price of the taxed products of 10 to 30 percent and a decrease of 10 to 15 percent in the consumption of taxed goods (ECSIP 2014). A study by the National Institute for Health Development also found that “26–35 percent of the people consuming products subject to the PHPT currently consume less of the products subject to the PHPT than one year ago.” Among those who reported consuming less of the taxed goods, 80 percent reported that their decreased consumption was due to higher prices. One in five respondents indicated however that they had become aware that the foods were unhealthy (NIHD 2013). According to a survey conducted after the introduction of the tax, it appears that manufacturers also changed recipes of several final pre-packaged goods either by reducing or removing completely the targeted ingredients (ECSIP 2014). No analysis of the actual public health impact of the tax have been conducted so far, but the Hungarian example suggests that tax policy might have played a role in raising public awareness and in improving food quality.

#### Box 4. France's Soft Drink Tax

In January 2012, France started imposing an excise tax on all beverages with added sugar or artificial sweetener. The tax was initially meant to only apply to sodas but was eventually extended to all beverages with added sugar or sweetener. Taxable items must meet the following four criteria: (1) fall under the customs tariff codes NC 2009 (non-fermented fruit and vegetable juices) and NC 2202 (water, including sparkling and sweetened products); (2) contain any amount of added sugar or artificial sweetener; (3) be packed into containers destined for retail; and (4) have an alcohol level less than 1.2 percent (Ministère du Budget, 2015). In 2015, the specific rate is €7.50 per hectoliter of

product. The tax is remitted by suppliers, whether producers, importers or wholesalers or retailers. Exports are exempt (ECSIP, 2014). Interestingly, a reduced VAT rate of 5.5 percent is applied to SSB instead of the standard 20 percent VAT rate, which raises important questions on the coherence of tax policy. The government indicated that the tax was meant to improve dietary habits by reducing the consumption of SSBs, with revenues from the tax earmarked for the national health insurance. In 2013, the tax generated €375 million in revenue against an initial objective of €280 million.

such as beverages with added sugar, as one part of a multi-pronged strategy to fight obesity (see also Box 5 on the legal constraints to excise tax policy that could affect the policy mix).

Relatedly, the debate has also shed a new light on other policy issues, one of which is the coherence between VAT and excise tax policy and earmarking. With VAT rates in the range of 15 to 20 percent in several countries (and higher than 20 percent in several EU countries), the blanket food exemptions found in certain VAT legislation may have a more negative impact on health than any realistic excise tax could correct for, as suggested by Lakdawalla and Philipson (2002) (who also emphasize the impact of falling food prices on obesity<sup>20</sup>). Furthermore, removing VAT reduced rates and exemptions is a much more conventional and easy tax policy recommendation than multiplying the number of excise taxes (a simple amendment to the list of exempt goods would generally do). Properly applying the VAT to all unhealthy food items (that is, not just SSBs) is more likely to rally both finance and health officials and thus represent in many cases a lower-hanging fruit than higher excises. On the other hand, and beyond common exemption on basic food, reducing the VAT burden on healthy food through zero-rating has also been pro-

posed, although more controversial.<sup>21</sup> It would notably involve a parallel debate on the nature and definition of healthy food, and make the tax system more complex, with goods either subject to VAT, exempt or zero-rated and also potentially subject to excise taxes. The health impact would also depend on the price elasticity of healthy food items, which appears to be low (Andreyeva and others 2010).

The use of the revenue from the food excise taxes has added another dimension to the much-discussed relative merits of earmarking. On this issue, while the ultimate use of the resource (for example, general budget, support for cheaper prices for healthy food, awareness campaigns, and so on) remains an open question, there has been a growing acknowledgment that a parallel commitment to increase taxes and to fund health-related initiatives through the standard budget process—"soft earmarking"—proved much more flexible, efficient, and transparent than out-of-budget mechanisms channeling the resources to externally-managed dedicated funds—"hard earmarking"—(Cashin and others 2017), notably because it fosters broader and more durable political support for higher funding in a context where financial resources are fungible.

Very importantly, and contrary to widespread perceptions, the current debate has made it clear

<sup>20</sup>Lakdawalla and Philipson (2002) notably emphasize the long-term impact of technological change, lifestyle and overall food prices on obesity, and estimate that lower food prices account for 43 percent of increase in the Body-Mass Index.

<sup>21</sup>Zero-rating is usually reserved for exports in the standard destination-based consumption VAT systems. The input VAT in zero-rated products is fully credited, and reimbursed if necessary (see Ebrill, Keen, Bodin and Summers, 2001).

### Box 5. Legal Constraints to Excise Policy Design

Constitutional and legal constraints can sometimes play an important role in excise policy design and may significantly alter the overall approach to fighting obesity. For instance in 2011, France’s Constitutional Council upheld the French soft drinks tax imposed on both sugary and artificially sweetened drinks (see Box 4), despite there being weaker scientific evidence of the negative health effects of the latter—raising concerns about the tax being discriminatory. However, because the legislator had in the final stages of adoption added a broader revenue-raising objective to the bill’s initial sole health-based objective, the Council was able to sidestep this constitutional issue and upheld the tax on revenue rather than health grounds. Likewise, while a manufacturer level excise tax is generally favored from an administrative and efficiency standpoint, this may not always be legally feasible. For example, in a US case in which a local sales tax

appeared to duplicate a statewide sales tax (barred by state-level statutes), the court upheld the local tax as it applied to the local distribution of sugary drinks rather than their local manufacture or retail sale. Indeed, given that local communities lack jurisdiction to tax manufacturers based outside their jurisdiction and often also lack authority to levy a sales tax, they may be constrained to taxing distribution instead (Shoked, 2018; Kearns and others 2019). Conversely, while New York City’s ban on the sale of large size sodas of 16 oz or more (the so-called “portion cap rule”) was struck down by the state’s Supreme Court in 2014 because the NYC Board of Health was found to have overstepped its regulatory authority, a well-designed city tax on sugary drink could have withstood legal scrutiny—but would also have required a majority vote in the City Council.

that excise taxes on unhealthy food do not represent a sharp departure from the current international practice. Indeed, despite the recent hype around health-motivated excise taxes in Denmark, France, Hungary, Mexico, and others (see Boxes 1 to 4), dozens of countries have long taxed SSBs (fruit juices as well as sugared carbonated and noncarbonated drinks) at similar rates, albeit not necessarily for health reasons (see Table 3—in a separate initiative, WHO has notably inventoried 75 countries with taxes on SSBs). In most low-income countries, for example, SSBs are produced in easily controllable facilities<sup>22</sup> and have been associated with luxury items,<sup>23</sup> for a long time. Hence, they have encouraged opportunistic and equitable revenue raising through mostly ad valorem taxes.<sup>24</sup>

Three important lessons can be drawn from this. First, although the argument of convenient and stable revenue raising can hardly be invoked in high-income countries with already high revenue, other factors could offset this for low-income countries. There, revenue from unhealthy food excise taxes could rep-

resent a larger share of GDP (see notably Cambodia, Rwanda, and Uganda in Table 3), and consequently a much higher share of total revenue, given the lower tax-to-GDP ratio. In a context where the marginal value of government spending is high, excise taxes on easy-to-tax unhealthy food (notably bottled drinks) can therefore significantly impact population welfare through the spending side of the budget, with health as a side effect (whereas revenue is more like a side-effect of health policy in countries that aim to reduce sugar consumption). Second, countries that pursue health objectives seem to use specific taxes, since damage to health is proportional to the quantity of sugar. By contrast, ad-valorem taxes seem to be more common in countries where the revenue rationale might be more immediate. Lastly, the overall revenue from excise taxes on unhealthy food nevertheless remains low in all countries compared to other excise taxes (including alcohol) and their benefits, including health-related, need to be carefully balanced against their administrative costs, added complexity to the tax system, and likely economic inefficiency (deadweight loss).

Finally, the many rationales for taxing SSBs, as well as country practices also have implications for the design of these excise taxes. Although revenue considerations can lead to either specific or ad-valorem taxes depending on the context, the fact that such

<sup>22</sup>In fact, in some countries, local breweries will also manufacture other bottled beverages (under license), hence the easy step of extending an existing excise system to other production lines among the same taxpayers.

<sup>23</sup>Perhaps even more so in countries, where religious practices prohibit or restrict alcohol consumption.

<sup>24</sup>Excises often extend to bottled water for the same reasons.

**Table 3. SSB and Similar Taxes in Selected Countries**

Country	Base and Rate	Revenue (% GDP)
Algeria	0.5% tax on soft drinks	0.002
Bahrain, Qatar, U. A. E., and S. Arabia	Regional agreement: Soft drinks: 50% of retail sale price <sup>1</sup> Energy drinks: 100% of retail sale price <sup>1</sup>	NA
Barbados	Sweetened beverages: 10% of production costs or CIF value	NA
Belgium	0.068 euro per liter ( $\pm 4\%$ of grocery retail price)	0.01
Benin	Non-alcoholic beverages: 7% of ex-factory price or CIF value Non-alcoholic energy drinks: 10% of ex-factory price or CIF value	NA
Burkina Faso	Non-alcoholic beverages: 10% of ex-factory price or CIF value	NA
Cambodia	10% rate on certain carbonated and similar non-alcoholic drinks	0.16
Cameroun	Carbonated beverages, imported mineral water, fruit juices: 25% of ex-factory price or CIF value and all applicable taxes excluding VAT	NA
Cent. Afr. Rep.	Non-alcoholic beverages: 10% of ex-factory price or CIF value	NA
Chad	Bottled water carbonated or sweet beverages: 5% of ex-factory price or CIF value	NA
Chile	Beverages with more than 6.25g of sugar per 100 ml: 18% Beverages with less than 6.25g of sugar per 100 ml: 10%	0.07
Congo DR	Bottled water (carbonated or not): 10% of reference price Lemonades and other sweet beverages: 5% of reference price Fruit juices containing chemical preservers: 5% of reference price Fruit juices containing chemical preservers and other substances: 10% of reference price	0.03
Côte d'Ivoire	Non-alcoholic beverages: 14% of ex-factory price or of CIF value incl. all applicable taxes excluding VAT, augmented by 25%	NA
Croatia <sup>2,3</sup>	0.533 euro per liter ( $\pm 50\%$ of grocery retail price)	0.07
Dominica	Non-alcoholic drinks (except fruit juices): 10%	NA
Equ. Guinea	Non-alcoholic drinks (except fruit juices): 20%	NA
Fiji	35 cents per liter if sweetened and carbonated drinks	NA
Finland	0.22 euro per liter ( $\pm 17\%$ of grocery retail price)	0.02
France	0.075 euro per liter ( $\pm 5\%$ of grocery retail price)	0.02
Gabon	Non-alcoholic beverages: 5% of ex-factory price or CIF value	NA
Kiribati	20–55% tax on sugar, sugar confectionary, cocoa, and sweetened drinks not including fruit or vegetable juices	NA
Lao PDR	Soft drinks: 5–10%	NA
Latvia <sup>2</sup>	0.074 euro per liter ( $\pm 10\%$ of grocery retail price)	0.06
Mali	Non-alcoholic beverages: 12% of ex-factory price or CIF value	0.05
Mexico	1 peso per liter ( $\pm 10$ percent of retail price)	0.1
Peru	Beverages with less than 6g of sugar per 100 ml: 17% Beverages with more than 6g of sugar per 100 ml: 25%	NA
Philippines	Beverages sweetened with caloric or non-caloric sweeteners: 6.00 PHP (0.12 USD) per liter Beverages sweetened with high-fructose corn syrup: 12.00 PHP (0.25 USD) per liter	NA
Rwanda	Soft drinks: 39% of ex-factory price or CIF value	0.16
Samoa	SAT 0.51 per liter of soft drinks	NA
Senegal <sup>4</sup>	Soft drinks and juices: 5% of ex-factory price or CIF value	0.01
South Africa	SSB tax of 0.0221 ZAR (0.13 US cents) per gram of sugar content that exceeds 4 grams per 100 ml.	0.06
Tajikistan	Soft drinks: 0.03 euros per liter	NA
Thailand	Soft drinks: 14% tax with specific rate depending on sugar content	NA
Togo	Non-alcoholic beverages: 2% of ex-factory price or CIF value	0.001
Uganda	Soft drinks: max. of 12% of ex-factory price or 200 UGX per liter Juices: max of 13% of ex-factory price or 300 UGX per liter	0.14
United Kingdom	Beverages with 5 to 8 g of sugar per 100 ml: 18 p per liter ( $\pm 12\%$ of grocery retail price) Beverages with more than 8 g of sugar per 100 ml: 24 p per liter ( $\pm 17\%$ of retail price)	NA

Source: Authors' compilations, and country authorities.

<sup>1</sup>Retail prices based on mutual agreement between traders and tax administration.

<sup>2</sup>Per 100 Kg (that is, roughly 1 hl).

<sup>3</sup>Revenue includes excise tax on coffee.

<sup>4</sup>Rate and base as of 2019; revenue figure is for 2017 and for soft drinks only.

consumer products are regularly produced domestically in the large-scale formal sector (and hence with an easily observable retail price and a local annual tax declaration that can support ex-factory price controls) and that sugar content might vary greatly and present some measurement challenges (especially for imported products) suggest that ad valorem might be easier to implement than specific taxes in the absence of an explicit health rationale.<sup>25</sup> Revenue-based specific taxes could nevertheless be based on volume (regardless of sugar content) for administrative simplicity. A health rationale, however, inevitably leads to a specific excise preferably based on sugar content. A further twist down that path could also lead to sugar-based tiers of specific excises, with the explicit aim to incentivize reformulation. In the United Kingdom, Portugal (Goiana-da-Silva and others 2018), and South Africa, for example, tiered excise tax categories based on increasing sugar content have triggered changes in the composition of products and have therefore had an effect not unlike that of regulation (see also Box 3 on a similar pattern in Hungary, and Allais (2020) on reformulation in French desserts).<sup>26</sup>

## Conclusion

Although more time will likely be needed to witness a health impact (if any), the policy debate on the use of excise taxes to fight the obesity epidemic is evolving and the growing empirical evidence that comes with new tax initiatives will continue to enrich that debate, notably regarding substitution effects and the ensuing ultimate impact on health. Based on the existing geographically limited and incomplete evidence, this note concludes that although defining a relevant, comprehensive, and administratively feasible tax base remains a core challenge, a cautious case can be made for such taxes under specific circumstances.

SSBs may provide an easy tax handle in low-income countries, where the feasibility of more productive but complex taxes is limited by administrative capacity, and where the marginal social value of government spend-

ing is high. SSBs also provide a relatively well-defined tax base that significantly contributes to obesity in high-income countries, hence a potential role for excise taxes in improving health. In this context, the impact of the tax could be larger in the presence of complementary policies, and a broader policy package should be considered.

Current evidence also highlights many risks, such as people switching to other unhealthy food and the still relatively low revenue yield (which may matter less if pursuing health objectives). In this respect, inducing the right kind of substitution will likely be a key factor in determining whether these taxes are here to stay, as well as their revenue yield. Regardless, there must be policy coherence in the taxation of foods; as such, removing VAT exemptions, reduced and zero-rates on unhealthy food items, is a first easy step on the path to better health.

<sup>25</sup>For a more complete discussion, see Keen (1998), as well as Crawford, Keen and Smith (2010).

<sup>26</sup>This deserves a broader reflection on the relative merits of regulation and taxation. For example, banning trans-fats has been a much more efficient solution than taxing them would have been, and similar solutions might be explored regarding sugar, for which there are non-caloric substitutes, although their long-term effects remain to be further investigated.



**Appendix 1. Excises on Unhealthy Food: A Brief Overview of the Health Literature**

Author	Type of study and main findings
<b>Cause of obesity and definition of the tax base</b>	
Vartanian and others (2007)	Meta-analysis based on 88 studies. Strong statistical relationship between soft-drink consumption, body weight and diabetes, as well as a negative impact on milk consumption.
Johnson and others (2009)	American Heart Association Scientific Statement. Small daily dietary imbalances ( $\pm 125$ calories, or 4 to 5 percent of daily caloric intake) cause long term effects on weight. Imbalances are brought by a few final consumption products with high concentration of specific base ingredient, most notably sugar (high-fructose corn syrup) in soft drinks. "Over the past 30 years, total calorie intake has increased by an average of 150 to 300 calories per day, and approximately 50% of this increase comes from liquid calories (primarily sugar-sweetened beverages)"
McGranahan and others (2011)	SSBs are a significant contributor to weight gain and discretionary caloric intake, they represented on average only 5.6 percent of total caloric intake among all Americans in 2007/08 (albeit with significant differences between population subgroups).
Mozaffarian and others (2011)	Cohort study of 120,877 non-obese (baseline) women and men from the USA. Weight gain was on average 3.35 lbs. per person per 4-year interval, and that weight gain was statistically associated with (in descending order): potato chips (1.69 lbs.), potatoes (1.28 lbs.), SSBs (1.00 lbs.), unprocessed red meat (0.95 lbs.), and processed meat (0.93 lbs.). Vegetables, whole grain, fruits, nuts and yogurt were associated with weight losses, as well as physical activity (21.76 lbs.).
Woodward-Lopez and others (2011)	Review of the literature. One-fifth of the weight increase in the US population between 1977 and 2007 is due to sweetened beverages.
Chriqui and others (2013)	Review of tax practices and policy options. The inclusion/exclusion of various products from the tax base is most likely going to require very granular understanding of market dynamic for a range of products, such as aspartame and saccharin-based drinks, less than 100% fruit juices, sports and energy drinks, lightly sweetened fizzling water, etc.
Bes-Rastrollo and others (2016)	Review of systematic reviews on: (1) SSBs and obesity; (2) metabolic adverse effects of fructose and SSB, and (3) the impact of SSB taxation on weight control. SSBs represent half of the added sugar intake in America (fruit drinks for children and sodas for adolescents and adults) and most studies conclude that they are a risk factor for obesity. The effect of taxes on weight gain is unclear, notably because of product substitution. Taxes on all SSBs could have a role as part of a multi-component strategy.
Drewnowski and Rehn (2014)	Cross-sectional study among 31,035 children, adolescents, and adults based on US surveys (2003–2004, 2005–2006, 2007–2008, and 2009–2010) to identify the source and form of consumed added sugar. Purchases in stores account for 65 to 76 percent of added sugar. Soda, energy and sports drinks account for 34.4 percent of added sugar, and fruit juices for 8 percent.
<b>Impact of current taxes</b>	
Smed and others (2007)	Estimation of a demand system for food in Denmark, using household-level panel data. Price sensitivity of various unhealthy food items changes with age and socio-economic conditions.
Powell and Chaloupka (2009)	Review of the literature on the impact of food and restaurant prices on weight outcomes. Small taxes and subsidies are unlikely to significantly affect Body Mass Index or prevalence of obesity. Higher taxes could have an impact on specific subgroups, such as children, adolescents, individuals with low socio-economic status, as well as for those at risk of obesity and overweight.
Powell and others (2009)	Individual-level panel data regression analysis. SSB taxes have no effect on adolescent Body Mass Index.
Fletcher and others (2010a)	Individual-level regression analysis on the effect of taxes on Body Mass Index. There is a significant but negligible effect of current soft drink taxes on adult weight. The effect is stronger for low-income individuals and Hispanics.
Fletcher and others (2010b)	Individual-level regression analysis on the effect of taxes on Body Mass Index and soft drink consumption. The effect of existing soft drink taxes on consumption is very small for children and adolescent and is fully offset by substitution towards other products (notably milk), hence no impact on obesity. Nevertheless, a 16 percent ad valorem tax on soft drinks could reduce consumption by 100 calories.
Sturm and others (2010)	Individual-level regression analysis on the effect of taxes on Body Mass Index and soft drink consumption. Taxing SSBs at current levels has very little impact, but sub-groups of at-risk children (overweight, low-income, African-American) are more sensitive.
Tiffin and Arnoult (2011)	Estimation of a demand system based on United Kingdom household food survey data, and simulation of the impact of a subsidy to fruits and vegetables combined with a tax on saturated fat. The impact of the tax on health is negligible.
Jou and Techakehakij (2012)	Review of obesity prevalence, tax rates and SSB consumptions in various countries. Various factors that could determine the impact of new taxes on weight, including the obesity rate itself (that is, how acute the problem is), the level of SSB (and other unhealthy food) consumption (that is, the scope for dietary improvement) and baseline tax rates (that is, potential to raise the current tax level).
Powell and others (2013)	Systematic review of the effects of price on consumption and weight outcomes. The studies that link soda taxes to weight outcomes show very little impacts on weight.
Chriqui and others (2014)	Compilation of taxes on unhealthy food in the USA, as of January 2014. Taxes were on average 5.2 percent among the 35 states that applied a sales tax on soft drinks (whether general sales tax or excise).
Cornelsen and others (2014)	Review of literature and meta-analysis on own- and cross-price elasticity in low-, middle-, and high-income countries. Own-price elasticities are larger in low-income countries. Cross-price elasticities vary widely and are highest in high income countries (see also Table 2).

*(Continued)*

Author	Type of study and main findings
Finkelstein and others (2014)	Review of the literature. Little evidence that targeted food taxes or subsidies alone could have a major effect on individual weight or obesity prevalence.
Batis and others (2016)	Use of consumer-level purchasing data to assess the impact of Mexico's 8% tax on high-energy non-essential foods and 1 peso-per-liter tax on SSBs (that is, $\pm 10\%$ ad valorem) after one year of implementation. The impact of the tax on consumption was significant, but marginal (25 g per month per capita, or 70 to 110 calories), and substitution patterns and weight impact remain unclear.
Arantxa-Colchero and others (2017)	Use of consumer-level purchasing data to assess the impact of Mexico's 1 peso-per-liter tax on SSBs (that is, $\pm 10\%$ ad valorem) after two years of implementation. Sales decreased by 8.2 percent for taxed beverages and increased by 2.1% for untaxed beverages. The impact was strongest among low socio-economic groups. Substitution patterns, impact on health and effects of other factors (concurrent information campaign) remain unclear.
Teng and others (2019)	Systematic review and meta-analysis of real-world sugar-sweetened beverage tax evaluations and related impact on purchases and dietary intake, based on 17 study outcomes. A hypothetical 10 percent tax on SSBs is associated with an equivalent average decrease in consumption and dietary intake, but there are considerable variations, which likely depend on the local context. The impact of the tax on non-taxed drink is not statistically significant.
<b>Simulations for tax policy proposals</b>	
Mytton and others (2007)	Use of elasticity, expenditure and consumption data from the United Kingdom's 2000 National Food Survey and of meta-analysis-based biometric estimates to estimate the effect of extending the 17.5% United Kingdom VAT to various food categories. Applying the tax to three ever wider subsets of unhealthy food, authors concluded that a tax on a narrow subset of principal sources of saturated fat would decrease the intake of such fats, but that an increase in salt intake would offset the health benefits. Wider tax bases would bring the modest but tangible benefits of saving 2100 to 3200 deaths per year.
CBO (2008)	Use of existing price elasticity estimates to calculate the impact of a 0.25 cents tax per ounce on SSBs. Annual revenue would amount to USD 4 to 5 billion.
Brownell and others (2009)	Use of existing price elasticity and consumption estimates to calculate the impact of a 1 cent per ounce tax on SSBs (equivalent to 15 to 20 percent of the price of a 20-ounce bottle, or 12 cents on a standard size soft drink can). Calorie consumption would be reduced by 10 percent and estimated tax revenue increase by USD 14.9 billion.
Allais and others (2010)	Use of scanner data to estimate the demand for food in France and derive price- and "nutrient elasticities". A tax-induced price increase of 10 percent for a wide range of unhealthy food would result in a small decrease in caloric intake (for example, less than 20 calories per day per individual for cheese, butter and cream). However, the cumulative effect of small changes in calorie intake could amount to significant long-term gains, and a 10 percent tax could amount to a weight reduction of 2 to 3 kilograms after a decade.
Smith and others (2010)	Estimation of a demand system with individual-level and industry data. The decrease in SSBs induced by a 20 percent tax would be partly compensated by increased intake of juice, milk (among children), and mostly bottled water. The resulting weight loss would be on average 3.8 pounds after a year among adults, and 4.5 pounds among children.
Andreyeva and others (2011)	Use of existing price elasticity and consumption estimates to calculate the impact of a 1 cent per ounce tax on SSBs. The tax would generate USD 13.5 billion and reduce consumption by 24 percent (roughly 50 calories per day), hence a reduction of 5 pounds per year in body mass.
Edwards (2011)	Selective review of the literature to emphasize the importance of considering cross-price elasticities. The simulated impact on Body-Mass Index of a given tax using price elasticity estimates found in the literature is much lower for studies that take substitution pattern into account.
Dharmasena (2012)	Use of scanner data to estimate a demand system for various beverages. There are significant substitution patterns from SSBs towards fruit juices, low-fat milk, coffee and tea. Nevertheless, a 20 percent tax on SSB would reduce bodyweight by 1.54 to 2.55 pounds over a year.
Jensen and Smed (2013)	Use of household level data to assess the impact of the Danish tax on saturated fat on the level and place of purchase of taxed items. Tax-induced price changes in the range of 18–22 percent for butter, butter blends and margarine were associated with a 10 to 20 percent decline in consumption. Consumers appear to have shifted to discount stores.
Wang and others (2012)	Use of various existing estimates to calculate the impact of a 1 cent per ounce tax on SSBs. The tax would decrease health care cost by an average of USD 1.7 billion annually, in addition to raising USD 13 billion in revenue.
Briggs and others (2013)	Estimation of a demand system for sweetened drinks in the United Kingdom using individual data and simulation of the impact of a 20 percent tax. The tax would decrease prevalence of obesity in the United Kingdom by 1.3%. The effect would be only half of that in the USA, and substitution patterns appear to be widely different: whereas diet drinks and SSBs are complements in the USA, they are substitute in the United Kingdom.
Finkelstein and others (2013)	Use of scanner data to estimate a demand system for various food items. Increasing the price of SSBs by 20 percent would have little impact on consumed quantities of other products, except for fruit juice and to a lesser extent fat intake (for example, ice cream). The related average weight loss would be 1.6 pounds in the first year and 2.9 pounds over 10 years.
Dubois and others (2019)	Use of individual-level survey and household data to model "on-the-go" purchases of sugary and non-sugary drinks. A United Kingdom-style 25 p. per liter tax on sugary soft drinks would lower "on-the-go" soft-drink-related sugar intake by 195 g per person per year. The impact is stronger among youth and low-income individuals, but individuals with strong sugar preferences are relatively price insensitive. The reduction in caloric intake is mitigated by an increased consumption of non-taxed sugary drinks (125 g) and by food sources of sugar of a similar amount.

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