Health and Distributional Effects Taxing Sugar-Sweetened Beverages: the case of Kazakhstan

Alan Fuchs, Kate Mandeville, Ana Cristina Alonso-Soria

Consumption of sugar-sweetened beverages (SSBs) has been linked to a range of noncommunicable diseases (NCDs), including diabetes, obesity, cardiovascular disease, and over 12 types of cancer (Singh, et al. 2015). Increasingly, governments around the world are taxing SSBs to curb sugar consumption. However, especially in low and middle-income countries, concern is growing over the apparent regressive character of consumer taxes. This note contributes to the literature on the effect of taxes on unhealthy products. The extended cost-benefit analysis (ECBA) methodology is applied to assess distributional effects of an increase of SSB taxes on household expenditures, out-of-pocket (OOP) medical expenses, and productivity in Kazakhstan. Results suggest that the long-term net income effect of an increase in SSB taxes is progressive: lower-income deciles benefit relatively more than higher-income deciles.

Mounting evidence links consumption of SSBs to a variety of negative health effects, as well as economic costs from health care expenditures, forgone productivity, disability, and premature death. SSBs—drinks containing added caloric sweeteners, such as sucrose, high-fructose corn syrup, or fruit juice concentrates—including carbonates, fruit beverages, sports beverages, energy and vitamin water beverages, sweetened iced tea, and lemonade (WCRF 2018). SSB consumption has been linked to ischemic heart disease, hypertension, type 2 diabetes (GBD 2018; WCRF 2018), hypertension (Xi, et al. 2015), long-term weight gain (Hu 2013), tooth decay, and 12 types of cancer, including esophageal, colon, pancreatic, breast, uterine, kidney, and gall bladder (Singh, et al. 2015).

Taxes to increase the prices of SSBs by at least 20 percent is one of the most effective tools for reducing obesity rates and related NCDs, according to the World Health Organization (WHO 2017a). Epidemiological models indicate that taxing SSBs by sugar content could result in 200 million pounds (90.7 million kilograms) of weight reduction worldwide (Grummon, et al. 2019).

Over 85 percent of premature deaths from NCDs occur in low- and middle-income countries. Promotion of healthy diets to control NCDs worldwide target SSBs. The achievement of the Sustainable Development Goal (SDG) target of a one-third reduction in premature deaths from NCDs by 2030 requires immediate actions to reduce dietary risks, especially sugar consumption.

As of 2019, more than 37 countries had implemented tax policies on sugary drinks, including Ecuador, India, Ireland, Mexico, Peru, the Philippines, South Africa, and Thailand (Cawley, et al. 2019). While price increases from taxes on unhealthy products represent a large short-term burden on low-income households, studies have also shown that the largest longer-run economic and health benefits also accrue to low-income consumers because of their stronger response to price changes (Sassi, et al. 2018).

This note summarizes the first use of the extended cost-benefit analysis (ECBA) to examine the income distribution effects of taxes on SSBs. The main outcome of interest is the net effect of taxing SSBs on more price-responsive, low-income consumers, bigger tax increases result in bigger welfare gains.

1 Allcott, Lockwood, and Taubinsky (2019) also developed a novel model incorporating internality (misperception of long-term costs) and externality costs from the consumption of SSBs, to show that taxing these goods is welfare-enhancing. Similarly, they also show that for

2 The ECBA has been applied and adapted to the analysis of tobacco taxation in several countries by Fuchs and Meneses
household income via 3 channels: (a) larger household budget expenditure on SSBs, (b) savings in out-of-pocket (OOP) spending on health care because of lower disease incidence, and (c) higher labor income resulting from increased life-expectancy.

**Methodology**

Our ECBA model (Equation 1) calculates the aggregate effect of taxing SSBs.

**Equation 1: Aggregate Effect on SSB Taxes**

$$\text{Net Income Effect} = \text{Change in SSB expenditure} + \text{Change in OOP spending on health care} + \text{Change in years of productive life}$$

**SSB Expenditure:** We estimate the effect of SSB price increases on household expenditures using the change in prices resulting from the tax, the price elasticity of SSBs by income decile, and the share of household spending on SSBs. The model assumes a price increase of 20 percent. We aggregate changes in household expenditures at the decile level.

**OOP Spending:** Based on a simple static model, we estimate the long-term change in OOP spending on health care that would result from a reduction in the consumption of SSBs. We distribute the cost of treating diseases related to SSB consumption across income deciles according to the share of households that consume SSBs in each decile.

**Years of Productive Life:** We derive the effects of reducing SSB consumption on labor income from the reduction in workers’ years of life lost (YLL) because of premature mortality (deaths before age 70). We estimate the increase in years of productive life by distributing the YLL lost across deciles proportionally with the number of households that consume SSBs in each decile.

**Net Income Gains:** We estimate net income gains by decile by adding the price effects, the savings in OOP spending, and the gains in years of productive life.

**Data**

We use data on household consumption and expenditures on SSBs in Kazakhstan from 11 waves of the Household Budget Survey (HBS), from 2007 to 2017. The survey includes disaggregated consumption information on a range of products, including carbonated drinks and fruit juices. We obtain unit prices by dividing total quantities consumed by the amounts paid, a common practice in the literature. We use HBS information on the ages of family members, gender, educational attainment, and urban versus rural residence to control for household characteristics.

Around 60 percent of households consume SSBs, and this share does not vary significantly with income. Annual average household consumption of SSBs in liters is higher among higher-income households (28.7 versus 21.9 total annual liters in the top versus the bottom decile in 2017). In 2018, total consumption of carbonated drinks and juices in Kazakhstan was approximately 1,206.3 million liters (Euromonitor International 2019). HBS estimates show that households in the richest deciles pay a slightly higher average unit price than households in the poorest deciles, presumably because of quality preferences.

The proportion of household expenditures on SSBs has increased over time, from under 1 percent of total household expenditures to a little over 1 percent, on average (Figure 1). The share of expenditures on SSBs out of total expenditures is lower among richer households.

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3 The model assumes that the reduction in SSB consumption has an immediate effect on health and, hence, on employment-related income.

4 Our analysis aggregates carbonated drinks and fruit juices, as both types of products are broadly SSBs. The survey also does not allow the distinction between artificially and non-artificially sweetened beverages.

5 An important caveat associated with the elasticity estimates derived from unit prices is that the lack of direct price information may result in biased estimates, because quality differentials are not directly identifiable from unit prices.

6 Average unit prices from HBS data differ from market price data because of recall error, brand and quality effects, and survey design.
The average price elasticity of SSBs is -0.70, in line with the results found in the literature. We estimated price elasticities using average annual unit prices. After eliminating quantity and unit value outliers outside 3 standard deviations, we estimated elasticities for the total population using a simple equation. An average price elasticity of demand of -0.70 implies that a tax that increases the price of SSBs by 20 percent would result in a 14 percent drop in quantity demanded. We evaluated 3 elasticity scenarios: medium-bound elasticity estimate with average of -0.70; and lower- and upper-bound elasticity scenarios of 0.20 above and 0.20 below the medium-bound, respectively.

Approximately 8.2 percent of total deaths could be attributable to SSB consumption (Table 1). We collected data from the Global Burden of Disease (GBD) database on SSB-related diseases, including mortality associated with diabetes mellitus type 2, ischemic heart disease, hypertensive heart disease, and stroke in Kazakhstan. 8 And we multiplied the total mortality in 2016 for each disease by the corresponding population attributable fraction (PAF)—the contribution of a risk factor to a disease or a death—associated with each type of SSB-related disease. The incidence of diseases associated with SSB consumption (number of newly diagnosed cases) reached 2.16 million cases in 2016. The largest share of cases corresponded to dental care and obesity.9

Table 1: Deaths by Gender, Diseases Related to Consumption of SSBs, Kazakhstan, 2016

<table>
<thead>
<tr>
<th>Disease</th>
<th>Rel. Risk</th>
<th>PAF %</th>
<th>Death: women</th>
<th>Death: men</th>
<th>Total</th>
<th>% Total death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>1.18</td>
<td>10.4</td>
<td>59</td>
<td>41</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>1.16</td>
<td>9.3</td>
<td>1,803</td>
<td>1,763</td>
<td>3,566</td>
<td>9</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.1</td>
<td>6.0</td>
<td>639</td>
<td>536</td>
<td>1,175</td>
<td>6</td>
</tr>
<tr>
<td>Hypertensive heart disease</td>
<td>1.12</td>
<td>7.1</td>
<td>62</td>
<td>50</td>
<td>112</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>2,562</td>
<td>2,390</td>
<td>4,953</td>
<td>8</td>
</tr>
</tbody>
</table>


Annual OOP expenditures attributable to the management of diseases related to SSB consumption add up to US$10.7 million, with close to 49 percent of the costs corresponding to treatment of cardiovascular disease and the rest to endocrine and metabolic diseases (including diabetes).10 We used data on total medical costs in 2016 from the National Health Accounts of Kazakhstan. Expenditures by disease were not available; thus, we substituted the share of medical expenditures by disease group from Belarus, a country with comparable OOP attributable fraction (PAF). Thus, we could be underestimating the total benefits of the tax in health and welfare of the population.

9 We used 2016 because this was the latest year with available information on total medical spending.

10 Lack of disaggregated data on treatment costs for specific diseases could potentially result in overestimation of the total costs, as groupings contain non-SSB–related diseases. However, this effect

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7 $\ln(Q_{id}) = \beta_0 + \beta_1 \ln \bar{P} + \beta_2 D_i + \beta_3 X_{id} + \mu_{id}$: where $Q_{id}$ represents the quantity of SSBs consumed per year by household $i$ in decile $d$, measured in liters; $\bar{P}$ the average price of SSB liter; $D_i$ the consumption decile of household $i$; and $X_{id}$ a vector of household characteristics (urban versus rural, household size, ages of household members, educational level, and gender of the household head).

8 We did not include data on cancer mortality because of lack of suitable parameters to estimate the corresponding population

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![Figure 1: Share of Expenditures on SSBs in Total Household Consumption](chart1.png)

Source: Estimates based on the Household Budget Survey

![Figure 2: Price Elasticities of SSBs, by Decile](chart2.png)

expenditures as a share of total health care costs (35.80 percent in 2015) and a similar disease burden.\textsuperscript{11} We estimated the share of total medical expenditures in Kazakhstan for 2 groups of diseases: (a) endocrine and metabolic diseases (including diabetes) and (b) cardiovascular disease. We then multiplied total costs per disease group by the PAF to estimate costs corresponding to diseases linked to SSB consumption (Table 2).

Table 2: Out-of-Pocket Expenditures on the Treatment of Diseases Related to the Consumption of SSBs in Kazakhstan (2016)

<table>
<thead>
<tr>
<th>Total out-of-pocket expenditures (tenge)</th>
<th>Total out-of-pocket expenditures (2011 PPP$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular disease</td>
<td>T 1,797,629,151</td>
</tr>
<tr>
<td>Endocrine and metabolic diseases</td>
<td>T 1,721,707,343</td>
</tr>
<tr>
<td>Total</td>
<td>T 3,519,336,494</td>
</tr>
</tbody>
</table>

Source: Estimates based on National Health Accounts of Kazakhstan 2016, the Household Budget Survey 2016, Kontsevaya et al. (2018), and relative risks estimates review of Shim et al. 2019.

Approximately 8.1 percent of total Years of life lost (YLL) are due to diseases associated with the SSB consumption. We estimated the YLL by multiplying the PAF of each disease associated with SSB consumption by the total YLL-by-disease data obtained from the Global Burden of Disease database. We interpret the YLL as a proxy for income forgone because of worker premature mortality.

**Incorporating the price elasticities of demand reduces the negative impacts of higher SSB expenditures.** The medium- and lower-bound elasticity scenarios result in negative income shocks across all deciles. Only the upper-bound elasticity scenario results in positive income gains for deciles 1 to 9. Overall, the lower-, medium-, and upper-bound elasticity scenarios show progressivity, that is, poorer households show relatively smaller income losses (or relatively larger gains) compared with richer households.

**Savings in OOP expenses are proportionally higher for lower-income deciles, making the tax effect progressive.** Income gains from reduction in OOP spending are positive, but small, across scenarios. Income gains from the change in years of productive life are positive across all income deciles, but negligible. Wealthier households receive higher income gains from working life years as income gains per year of working life are higher for them.

**In the long run, lower-income deciles benefit more than higher-income deciles from the tax.** The net income effect is negative for all income deciles under lower and medium-bound elasticity scenarios, but positive for the upper-bound, long-term elasticity scenario.

**Figure 3: Total Income Effect: Direct and Indirect Effects of Sugary Beverages Taxes**

With no behavioral changes—assuming a complete pass-through scenario—increases in the price of SSBs are completely passed on to consumers spending in SSBs, affecting lower-income deciles relatively more. These households spend a larger proportion of their incomes on consumption of food and beverages. The immediate effect of a 20 percent price shock would be a larger share of the household budget allocated to purchasing SSBs (that is, a negative income effect) among all deciles. Such income effects might be offset by the exclusion of treatment costs for other, related diseases, including various types of cancer.

\textsuperscript{11} The prevalence of diabetes, overweight, and obesity in Kazakhstan was 11.5 percent, 58.7 percent, and 23.5 percent of the population in 2016, compared with 9.5 percent, 61 percent, and 25.2 percent in Belarus, respectively (WHO 2016).
These results add to substantial other benefits of taxing SSBs. These include additional tax revenue that governments could redistribute back to the poor in public goods, including alternatives to SSBs, such as clean water. Other benefits of taxes targeted to reduce SSB consumption include substantial improvements in health, quality of life, and longevity.

Despite lack of important data and other limitations, the results of the ECBA model are in line with results from other models, such as the behavioral redistributive model of Allcott, Lockwood, and Taubinsky (2019).

Among the limitations of this approach, is the assumption of immediate (that is, zero discount rate) health-related income benefits. The coverage of diseases and treatment costs incorporated into the model is incomplete due to data limitations. This includes certain cancers associated with SSB consumption.

More research is necessary to understand the SSB taxation effects on consumption and health. As more developing countries tax SSBs, the benefits of taxation in more resource-constrained environments should become clear.

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