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## Support for Sugary Drinks Taxes

Health and Distributional Impacts of a Tax on Sugar-Sweetened Beverages in Kazakhstan

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# Health and distributional impacts of a tax on sugar-sweetened beverages in Kazakhstan

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## [Abstract]

Excessive consumption of sugar-sweetened beverages (SSBs) has been linked to the development of a wide 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 implementing especial taxes on SSBs to curb excessive sugar consumption. However, especially in low- and middle-income countries, there is a growing concern over the apparent regressive character of consumer taxes applied to unhealthy products. This note contributes to the literature on the effect of taxes on unhealthy products such as tobacco, alcohol, and SSBs by applying the extended cost-benefit analysis methodology to assess the distributional effects of an increase in taxes on SSBs on household expenditures, out-of-pocket (OOP) medical expenses, and productivity by income deciles in Kazakhstan. Results suggest that the net income effect of an increase in taxes on SSBs is progressive in the long run, with lower-income deciles benefiting more in relative terms than higher-income deciles.

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## [Executive summary]

The promotion of healthy diets is at the center of many strategies to prevent and control noncommunicable diseases (NCDs) worldwide. Sugar-sweetened beverages (SSB) are the target of many of these strategies given their contribution to obesity and related diseases. In addition to detrimental health effects, overconsumption of SSBs can result in economic costs derived from health care expenditures, forgone productivity, permanent disability, and premature death. The World Health Organization (WHO 2017a) has concluded that one of the most effective tools for reducing obesity rates and other related NCDs is the implementation of taxes to increase the prices of SSBs by at least 20 percent. Epidemiological models indicate that taxing SSBs by sugar content could result in a 200 million pound (90.7 million kilogram) weight reduction worldwide (Grummon, et al. 2019).

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 resulting from taxes on unhealthy products represent a large short-term burden on low-income households, the largest longer-run economic as well as health benefits also accrue to individual low-income consumers because of their stronger response to price changes (Sassi, et al. 2018). Allcott, Lockwood, and Taubinsky (2019), in a novel model incorporating internalities (misperception of long-term costs) and externality costs resulting from the consumption of SSBs, show that taxing these goods is welfare-enhancing. Similarly, they also show that for more price responsive low-income consumers bigger tax increases result in bigger welfare gains.

This report represents the first adaptation of the extended cost-benefit analysis methodology to examine taxes on SSBs.<sup>1</sup> The main outcome of interest is the net effect of the taxes on household income via three channels: (1) larger amount of household budget expenditure on SSBs, (2) savings in out-of-pocket (OOP) spending on health care because of lower disease incidence associated with reduced SSB consumption, and (3) higher labor income resulting from an increase in life-expectancy. The model uses the simplified assumption that a reduction in the consumption of SSBs has an immediate effect on health and so on employment-related income.

We estimate average price elasticity for SSBs in Kazakhstan as  $-0.70$ , in line with the estimates found in the literature (see section 2 of the report). 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 the quantity demanded. 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. Income gains from a reduction in OOP spending are positive, but small across the three elasticity scenarios of price responsiveness used in the analysis: lower bound, or low-price responsiveness; medium bound, and upper bound). Savings in OOP spending are proportionally higher among lower-income deciles, showing that the effect of the tax is progressive. Income gains from increases in working life years are positive across all income deciles, but negligible in size. Wealthier

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<sup>1</sup> Fuchs and Meneses (2017a, 2017b, 2018), based on Pichón-Riviere et al. (2014) and Verguet et al. (2015).

households exhibit slightly higher income gains from working life years under the three elasticity scenarios, as income gains per year of working life are higher among high-income individuals.

The net income effect that incorporates the effects on expenditures on SSBs, OOP spending, and increases in working-life years is negative among all income deciles under the lower-bound and the medium-bound elasticity scenarios and positive for the upper-bound (long-term) elasticity scenario. In the long run, independent of the scenario used, lower-income deciles benefit more than higher-income deciles from the tax in relative terms.

Finally, the results of this study add to the substantial other benefits of taxing SSBs. These include additional tax revenue that could be used for health and social programs and, most importantly, the intrinsic value of substantial improvements in the health, quality of life, and longevity of those who reduce SSB consumption.

## [Literature]

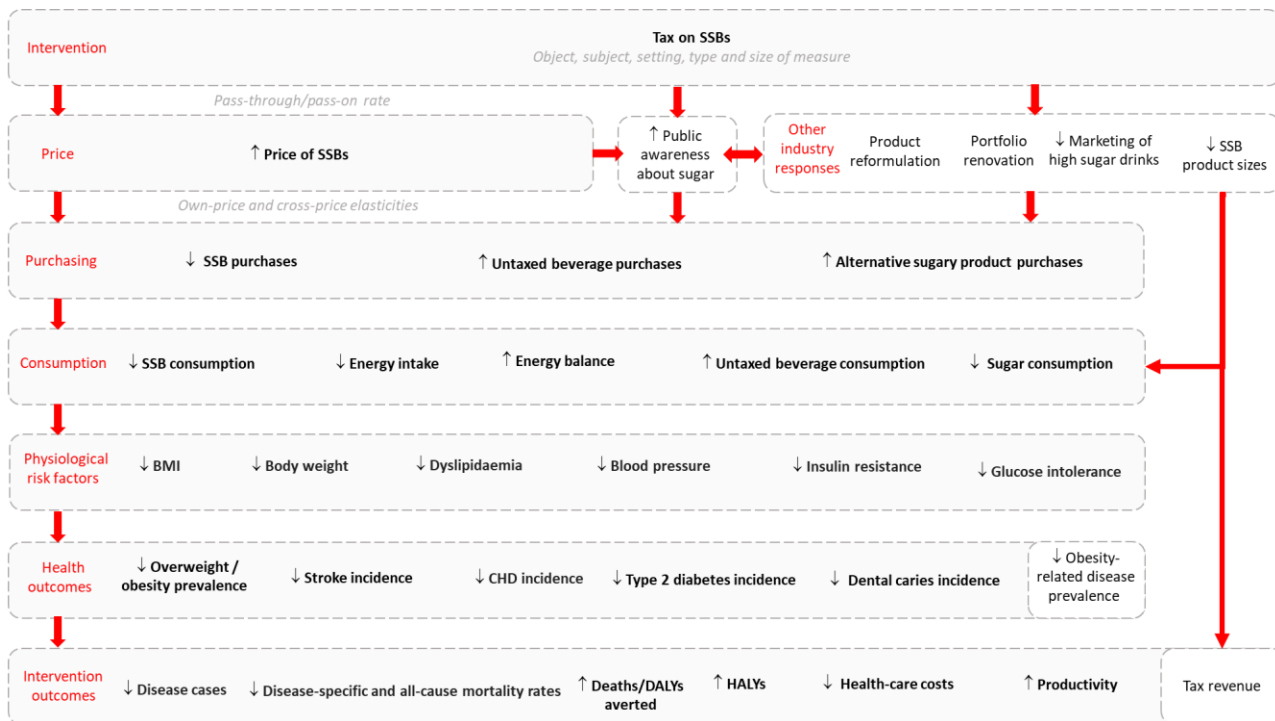
### Sugar-sweetened beverages and health

Sugar-sweetened beverages (SSBs) are drinks containing added caloric sweeteners, such as sucrose, high-fructose corn syrup, or fruit juice concentrates. They include carbonates, fruit beverages, sports beverages, energy and vitamin water beverages, sweetened iced tea, and lemonade (WCRF 2018). There is mounting observational evidence linking excess consumption of SSBs with ischemic heart disease and type 2 diabetes (GBD 2018; WCRF 2018). One serving per day of SSBs is associated with an 18 percent greater incidence of type 2 diabetes (25 percent for artificially sweetened beverages) (Imamura, et al. 2015). An individual who consumes one more SSB per day relative to another person is 17 percent more likely to develop coronary heart disease and 8 percent more likely to develop hypertension (Xi, et al. 2015).

Robust prospective cohort studies have demonstrated a significant direct association between SSB consumption and long-term weight (Hu 2013). Drinking two sugar-sweetened beverages per day for six months induces features of metabolic syndrome and fatty liver (Bray and Popkin 2013), and the consumption of even one SSB per day is associated with the likelihood of overweight by 27 percent among adults and by 55 percent among children (Te Morenga, Mallard and Mann 2012). The consumption of SSBs is also associated with tooth decay among children and adults. Every additional reported serving of SSB consumed per day among children ages 8–9 is associated with an increase of 22 percent in caries (Wilder, et al. 2016). Adults drinking one to two or over three servings of SSBs daily had, respectively, 31 percent and 33 percent greater net decayed, missing, and filled teeth increments relative to adults not drinking any SSB (Bernabé, et al. 2014). Additional negative effects on health resulting from the effect of SSB consumption on the body mass index include diabetes, cardiovascular disease, and 12 types of cancer, including esophageal, colon, pancreatic, breast, uterine, kidney, and gall bladder cancer (Singh, et al. 2015).



Figure 1. Theory of Change: Tax on SSBs



The achievement of the Sustainable Development Goal target of a one-third reduction in premature deaths from noncommunicable diseases (NCDs) by 2030 requires immediate preventive actions to reduce dietary risks, especially those associated with sugar consumption. Over 85 percent of premature deaths resulting from NCDs occur in low- and middle-income countries. Cardiovascular disease, cancer, and diabetes are among the top four leading causes of NCD-related deaths worldwide (WHO 2018). From 2007 to 2017, the estimated number of deaths associated with SSB consumption as an underlying risk factor increased by 30.4 percent, from 105 million to 135 million annual deaths, and estimated deaths from Type II Diabetes with SSB consumption as an underlying risk factor increased by 50.5 percent (GBD 2017 Risk Factor Collaborators 2018). The estimated surge in mortality rates has been accompanied by increasing consumption of SSBs. In the United States, consumption of soft drinks has increased fivefold since 1950 (Bray and Popkin 2013), accounting for at least one-fifth of the weight gained between 1977 and 2007 among the population (Woodward-Lopez, Kao, and Ritchie 2011).

Worldwide, the increasing consumption of SSBs, especially among children and adolescents, has contributed to the obesity epidemic, tooth decay and increasing risks of coronary heart disease (WHO 2017). From 1975 to 2016, the prevalence of obesity worldwide nearly tripled, while the number of obese children and adolescents rose 10-fold (NCD-RisC 2017). In 2010, 0.7 percent of global disability-adjusted life years (8,526,456) were attributable to SSB consumption associated diseases. Of these, 49.5 percent were attributable to cardiovascular disease, 41.4 percent to diabetes mellitus, 4.5 percent to body mass index–related cancers, and 4.9 percent to musculoskeletal disorders (Singh, et al. 2015). Average trends in body mass index among boys and girls have flattened in high-income countries in northwestern Europe and other relatively

affluent regions, in contrast to the increasing prevalence of overweight among preschool-age children in low- and lower-middle-income countries, especially in East and South Asia (Bentham, James and NCD Risk Factor Collaboration 2017). In 2016, close to 50 percent of all overweight children ages under 5 were living in Asia, and 25 percent in Africa (UNICEF/WHO/World Bank Group 2017).

#### Economic costs associated with the consumption of sugar-sweetened beverages

NCDs associated with the consumption of SSBs impose a large economic burden on individuals, families, and health care systems around the world. In addition to health care, economic costs stem from disability, lost work productivity, premature death, and forgone economic growth (Tremmel, et al. 2017). Low- and middle-income countries account for 83 percent of the global NCD burden as measured by disability-adjusted life years (World Economic Forum and the Harvard School of Public Health 2011). From 2016 to 2031, the projected economic loss attributed to NCDs in these countries is estimated to reach \$7 trillion, with 51 percent attributed to cardiovascular diseases, 6 percent to diabetes, and 21 percent to cancer (CDC 2016). The International Diabetes Federation (IDF 2017) estimates that, between 2006 to 2017, total health care expenditures by people with diabetes increased from \$232 billion to \$727 billion, and low- and middle-income countries are expected to carry a larger proportion than high-income countries of the future expenditure burden on diabetes (WHO 2016).

At the household level, costs associated with the treatment of chronic NCDs have important implications for poverty and equity. NCDs affect spending patterns and reduce nonmedical-related spending on food and education and may induce households into distress patterns such as borrowing and selling important assets to finance out-of-pocket (OOP) expenses on health care (Engelgau, et al. 2011). Research in 35 developing countries found that people with diabetes had a significantly greater chance of incurring catastrophic medical expenditures relative to similar individuals without diabetes (WHO 2016). More than 40 percent of NCD deaths occur during the most productive period of life (before age 70) (CDC 2016), affecting the ability of households to cope if one productive member dies or becomes disabled as a result of NCDs.

#### Taxes on sugar-sweetened beverages

The World Health Organization (WHO) has encouraged the adoption of comprehensive action plans to reduce sugar consumption to combat the obesity and diabetes epidemics (WHO 2017). Comprehensive action plans include a combination of taxation, restrictions on the marketing of sugary products to children, and campaigns to promote healthy diets and physical activity. Taxes are now one of the preferred policy tools to address the increasing consumption of unhealthy products, including tobacco, alcohol, and SSBs. Extensive cost-benefit analyses of the application of taxes on tobacco products show a reduction in tobacco consumption, coupled with long-run benefits that outweigh the costs of the price increase.<sup>2</sup> The potential benefits of SSB taxation include reduced consumption, disease prevention, savings on health

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<sup>2</sup> See the World Bank reports on tobacco taxation in Bosnia and Herzegovina (2019), Indonesia (2018), Bangladesh (2018), Moldova (2018), Russia (2018), South Africa (2018), Chile (2017), and Ukraine (2017).

care costs, revenue generation, reformulation of SSBs by manufacturers, and increased public awareness about the effects of sugar overconsumption (WCRF 2018).

While price increases resulting from taxes on unhealthy products might represent a larger burden to low-income households, the largest benefits also accrue to low-income consumers who respond strongly to price changes (Sassi, et al. 2018). Obesity and diet-related NCDs affect lower-income populations disproportionately, and the overall effect of SSB taxation are likely to be progressive because of savings on health care costs (WCRF 2018). Additionally, low-income households are more likely to report lower levels of nutritional knowledge and self-control in the consumption of SSBs relative to higher-income households (Allcott, Lockwood and Taubinsky 2019). To the extent that externalities—the harmful effects of SSB consumption derived from misperceiving or paying insufficient attention to future effects of SSBs on health—are greater among poorer consumers, SSB taxes might prove progressive (Allcott, Lockwood and Taubinsky 2019).

The types of taxes applied on SSBs vary substantially across countries. World Cancer Research Fund International and WHO recommend the implementation of specific excise taxes based on sugar content or volume, as they create a higher relative price increase and discourage substitution for cheaper but equally unhealthy options, while promoting reformulation by producers (WCRF 2018). As of 2019, 37 countries had applied taxation policies on sugary drinks, including Ecuador, India, Ireland, Mexico, Peru, The Philippines, South Africa, and Thailand (Cawley, et al. 2019). An analysis of Mexico's 2014 tax on SSBs showed a 5.5 percent decrease in purchases in 2014 and a reduction of 9.7 percent in 2015, with an average reduction of 7.6 percent over the study period (Colchero, Rivera-Dommarco, et al. 2017). Reductions in SSB consumption in Mexico were coupled with a 16.2 percent increase in water purchases (Colchero, Molina and Guerrero-López 2017). In Barbados, a 10 percent excise tax on sugary drinks implemented in 2015 resulted in a price increase of 5.9 percent in the two quarters following the tax implementation relative to the previous year (WCRF 2018).

SSB taxation has also been implemented at the subnational level, as in the cases of Catalonia, in Spain, the United Kingdom, and various cities and states in the United States. In Berkeley, California, the first U.S. city to implement a tax on SSBs, results from a cross-sectional survey showed a 52 percent reduction in the consumption of SSBs in the first three years of the tax (Lee, et al. 2019). An evaluation of the soda tax in Philadelphia revealed an average rate of pass-through (the rate at which producers pass a tax increase to prices) of 97 percent, resulting in a 46 percent drop in soda sales after the tax came into effect; however, the evaluation also documented a sharp increase in SSB sales in shops in the city's periphery, for a final total demand reduction of 22 percent, and no significant reduction in calorie and sugar intake (Seiler, Tuchman and Song 2018). Roberto, et al. (2019) found a 51.0 percent decrease in total volume sales of taxed beverages in Philadelphia after tax implementation, 24.4 percent of which was offset by sales in bordering zip codes. Almost-complete pass-through rates were also found in microdata evaluations of excise soda taxes in France after six months of implementation (Berardi, et al. 2016) and in Mexico (Colchero, et al. 2016). While the results in Berkeley point to an increase in water consumption since the application of the tax, the results in Philadelphia show no significant substitution for untaxed beverages (water and natural juices) (Seiler, Tuchman and Song 2018).

Evidence of an impact on health outcomes mostly comes from modeling studies. Modeling of a 20 percent price increase on SSBs in the United Kingdom showed a potential reduction of 0.5 percent in obesity among children and adults, 17.7 percent fewer incident cases of diabetes per year, and 2.4 percent fewer decayed, missing, or filled teeth annually (Briggs et al. 2017). In South Africa, a simulation of a 20 percent tax on SSBs estimated a gain of 688,719 life-years (Stacey et al. 2018). In Mexico, simulation of a 10 percent reduction in SSB consumption as a result of the tax, accounting for a 39 percent calorie compensation, led to an estimated 189,300 fewer incidents of type 2 diabetes, 20,400 fewer incidents of stroke and myocardial infarctions, and 18,900 fewer deaths in 2013–22, with potential savings of \$983 million international U.S. dollars (Sánchez-Romero, et al. 2016). An examination of the potential impact of a nationwide penny-per-ounce excise tax on SSBs in the United States found a potential reduction in consumption of 15 percent among adults ages 15–64, with the consequent prevention of 2.4 million diabetes person-years, 95,000 coronary heart events, 8,000 strokes, and 26,000 premature deaths, with over \$17 billion savings in medical costs and an additional \$13 billion in annual tax revenue over 2010–20 (Wang, et al. 2012).

#### Price elasticities of sugar-sweetened beverages

The extent to which a potential tax will be effective in reducing SSB consumption depends on the price elasticity, a measure of the sensitivity of demand to a change in prices. A systematic review of 12 U.S. studies showed an estimated average price elasticity of demand of SSBs of  $-1.21$ , with estimates ranging from  $-0.71$  to  $-3.87$ , implying that a tax that raised the prices of SSBs by 20 percent would reduce overall consumption by 24 percent (Powell, et al. 2012). A meta-analysis of international studies conducted in the Brazil, France, Mexico, and the United States found an average price elasticity of SSBs of  $-1.29$  (Cabrera Escobar, et al. 2013). In South Africa, analysis of SSB consumption among urban households resulted in an estimated own-price elasticity of  $-1.18$  and a predicted 23.6 percent reduction in the consumption of carbonated soft drinks under a 20 percent tax scenario, assuming complete pass-through (Stacey, Tugendhaft and Hofman 2017). Elasticity estimates for SSBs in the United Kingdom were close to  $-0.92$  for concentrated drinks and  $-0.81$  for nonconcentrated drinks (Briggs, Mytton, et al. 2013), meaning that demand for concentrated drinks is more price elastic than the demand for nonconcentrated drinks.

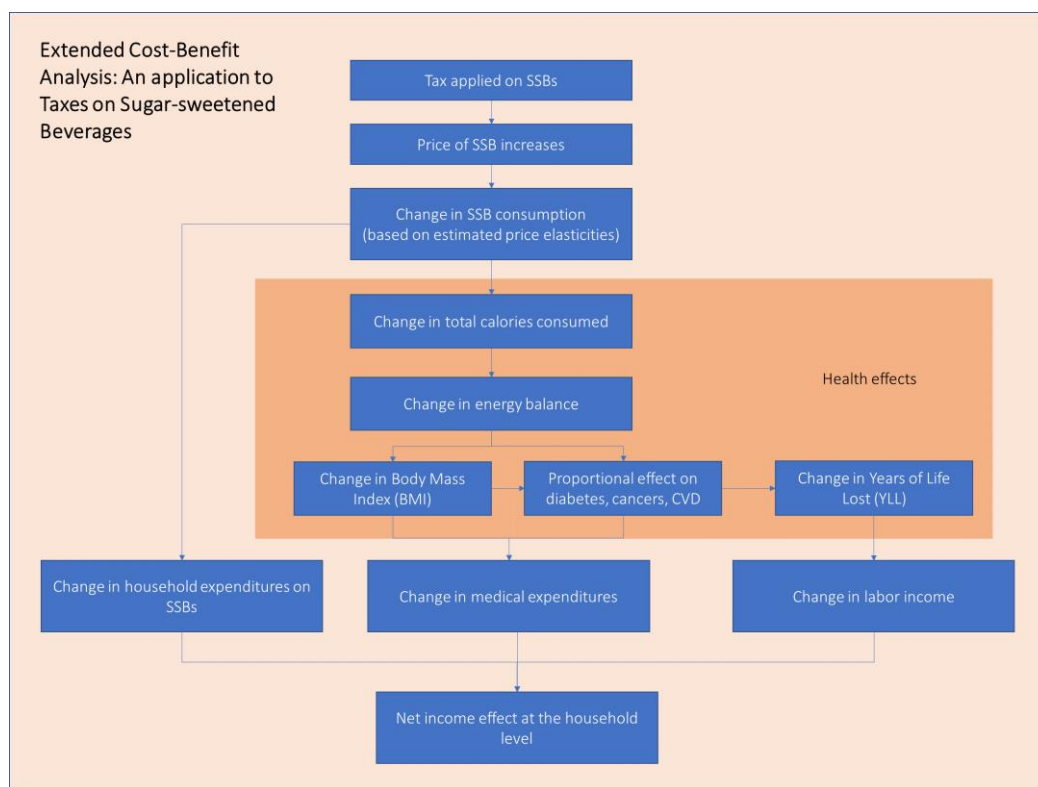
Using data on the United States, Finkelstein, et al. (2010) found a total estimated own price elasticity of calories from SSBs of  $-0.87$ , with an estimated elasticity of  $-0.49$  for households in the 50 percent to 75 percent income quartiles to  $0.06$  for the 76 percent to the 100 percent income quartiles. A review by the World Cancer Research Fund found that a minimum 10 percent price increase would result in purchasing behavior changes in the countries reviewed, but a price increase of at least 20 percent would be more effective in reducing consumption of SSBs (WCRF 2018). In Mexico, the estimates of price elasticities for SSBs were between  $-1.06$  and  $-1.16$ , indicating that a 10 percent price increase would result in a 10.6 to 11.6 percent reduction in quantity consumed (Colchero, .Salgado, et al. 2015). Households living in rural areas, in more marginalized areas, and with lower income showed higher elasticities in Mexico (Colchero, .Salgado, et al. 2015). In Chile, estimates of the own-price elasticity of soft drinks were close to  $-1.37$  (Guerrero-López, Unar-Munguía and Colchero, 2017).

The literature also analyzes cross-price elasticities of potential substitutes of SSBs, such as milk and other beverages not subject to the tax, but this is beyond the scope of this paper.

## [Model]

The extended cost-benefit analysis methodology developed by Fuchs and Meneses (2017a, 2017b, 2018) based on Pichón-Riviere et al. (2014) and Verguet et al. (2015) has been applied to estimate the effects of an increase in tobacco taxes in Bangladesh (2018), Bosnia and Herzegovina (2019), Chile (2017), Indonesia (2018), Moldova (2018), the Russian Federation (2018), South Africa (2018), Ukraine (2017), and Vietnam (2019) (box 1). This report is the first adaptation of the methodology to taxes on SSBs. The main outcome of interest is the net effect of the tax on household income over three channels: direct spending on SSBs, OOP spending on health care because of SSB consumption-related diseases, and labor income because of productive years lost to SSB consumption-related deaths. The model assumes that a reduction in consumption of SSBs will immediately translate into positive health effects, accompanied by a reduction in medical costs.

Box 1. Extended Cost-Benefit Analysis: An Application to Taxes on SSBs



Source: Adapted from Fuchs and Meneses (2017); Manyema et al. (2014); Singh et al. (2015).

The aggregate effect of a tax on SSBs is as follows:

$$\text{Net Income Effect} = \text{Change in SSBs expenditure (A)} + \text{Change in OOP spending on health care (B)} + \text{Change in years of productive life (C)} \quad (1)$$

1. Change in SSB expenditures

The effect of the SSB price increase on household expenditures is estimated 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 shock of 20 percent. The change in household expenditures is aggregated at the decile level based on the following formula:

$$\Delta Expenditure_{ij} = [(1 + \Delta P)(1 + \varepsilon_{ij} * \Delta P) - 1] * \frac{\omega_{ijt}}{Total\ Expenditure_{jt}} \quad (2)$$

where  $\Delta P$  refers to the change in price,  $\varepsilon_j$  to the price elasticity of product  $i$  (SSBs) for decile  $j$ , and  $\omega_{ijt}$  to the share of expenditures on product  $i$  for period  $t$  and decile  $j$ .

## 2. Change in OOP expenses on health care

Based on a simple static model, equation (3) estimates the long-term change in OOP spending on health care that would result from a reduction in the consumption of SSBs. The cost of treating diseases related to the consumption of SSBs is obtained from National Health Accounts and distributed across income decile  $i$  according to the share of households that consume SSBs in each decile.

$$\Delta Medical\ Expenditure_{ij} = [(1 + \varepsilon_{ij} * \Delta P) - 1] * \frac{\text{Cost of Treatment of Diseases related to the consumption of sugary beverages}}{Total\ Expenditure_{jt}} \quad (3)$$

The main assumption behind this equation is that a reduction in the consumption of SSBs will have a direct impact on health outcomes and thus on the treatment costs of the related diseases.

## 3. Increase in years of productive life

The impact of a reduction in the consumption of SSBs on labor income is derived from the reduction in years of life lost (YLL) because of premature mortality, that is, deaths before the age of 70. The increase in working years is estimated by distributing the YLL lost across deciles ( $j$ ) proportionally with the number of households that consume SSBs in each decile. Income increases as fewer years of productive life are lost to diseases related to SSB consumption, as follows:

$$Working\ years_j = \frac{YLL_j * \text{Share of households consuming sugary beverages}}{Population_i} \quad (4)$$

$$\Delta Income_j = [(1 + \varepsilon_j * \Delta P) - 1] * \frac{Working\ years_j * Total\ Expenditure_j}{Total\ Expenditure_j} \quad (5)$$

In the final step, net income gains by decile are estimated by adding the price effects, the savings in OOP spending, and gains in years of working life.

## [Data and Descriptive Statistics]

Data on household consumption and expenditures on SSBs in Kazakhstan are taken from 11 waves of the Household Budget Survey (HBS), from 2007 to 2017. The survey includes disaggregated consumption information on a wide range of products, including carbonated drinks and fruit juices. The following analysis presents the results of the model for carbonated drinks and fruit juices taken together, as both types of products could be broadly classified as SSBs (see annex B for sensitivity analyses). The survey does not allow for the distinction between artificially and non-artificially sweetened beverages, nor does it include price information. The unit prices used in the analysis are obtained by dividing the total quantities consumed by the amounts paid, a common practice in the literature. 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.

HBS information on the ages of family members, gender, educational attainment, and urban versus rural residence was used to control for household characteristics. Price elasticities are estimated using average annual unit prices. After eliminating quantity and unit value outliers outside the three standard deviation range, elasticities for the total population were estimated using the following equation:

$$\ln Q_{id} = \beta_0 + \beta_1 \ln P * D_i + \beta_3 X_{id} + \mu_{id} \quad (6)$$

where  $Q_{id}$  represents the quantity of SSBs consumed per year by household  $i$  in decile  $d$ , measured in liters;  $P$  the average price of a liter of SSBs;  $D_i$  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).

Table 1 presents summary statistics from the 2017 HBS. The proportion of households that consume SSBs is approximately 60 percent, and this share does not vary significantly with income decile. 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). This consumption pattern is consistent across years. In contrast, consumption data on the United States show that average purchases of SSBs measured in liters per adult equivalent are higher among lower-income deciles (Allcott, Lockwood and Taubinsky 2019).

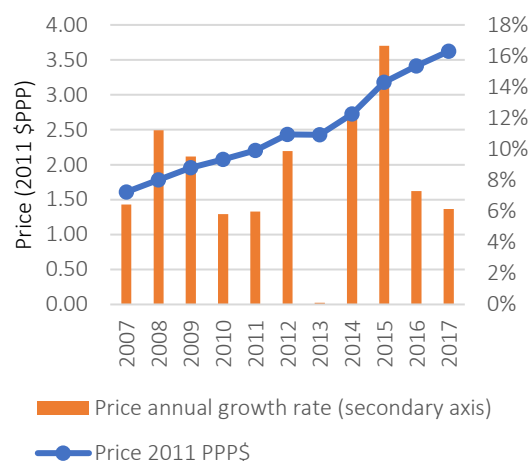


| Table 1. Descriptive Statistics, 2017                  |               |       |       |       |       |       |       |       |       |        |         |
|--|---------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|---------|
|  | Income decile |       |       |       |       |       |       |       |       |        |         |
| Indicator  | 1             | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10     | Average |
| Average household per capita annual expenditures (PPP) | 1,009         | 1,316 | 1,538 | 1,757 | 1,986 | 2,249 | 2,578 | 3,010 | 3,686 | 6,011  | 2,514   |
| Household total annual expenditures (PPP)              | 5,766         | 6,888 | 7,499 | 7,971 | 8,355 | 8,616 | 8,796 | 9,064 | 9,192 | 11,307 | 8,345   |
| Proportion of HH consuming SSBs                        | 0.58          | 0.62  | 0.62  | 0.63  | 0.63  | 0.62  | 0.63  | 0.61  | 0.59  | 0.63   | 0.61    |
| Annual average HH consumption of SSBs (liters)         | 21.9          | 23.6  | 23.9  | 24.6  | 24.6  | 25.2  | 25.8  | 26.5  | 26.9  | 28.7   | n/a     |
| Proportion of HH expenditures on SSBs                  | 0.012         | 0.011 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.009  | 0.01    |
| Amount spent on SSB (PPP\$/year)                       | 71            | 78    | 82    | 83    | 86    | 90    | 91    | 95    | 98    | 107    | 88      |
| Household size   | 5.30          | 4.69  | 4.32  | 3.91  | 3.53  | 3.18  | 2.83  | 2.44  | 2.16  | 1.76   | 3.41    |
| Proportion of HH with female head                      | 0.34          | 0.39  | 0.40  | 0.44  | 0.46  | 0.48  | 0.51  | 0.56  | 0.60  | 0.68   | 0.49    |
| Proportion of HH with higher educational attainment    | 0.15          | 0.20  | 0.23  | 0.25  | 0.27  | 0.31  | 0.31  | 0.31  | 0.38  | 0.44   | 0.28    |
| Proportion of HH in urban areas                        | 0.33          | 0.38  | 0.44  | 0.49  | 0.51  | 0.57  | 0.57  | 0.58  | 0.64  | 0.70   | 0.52    |

Source: Estimates based on the 2017 Household Budget Survey.

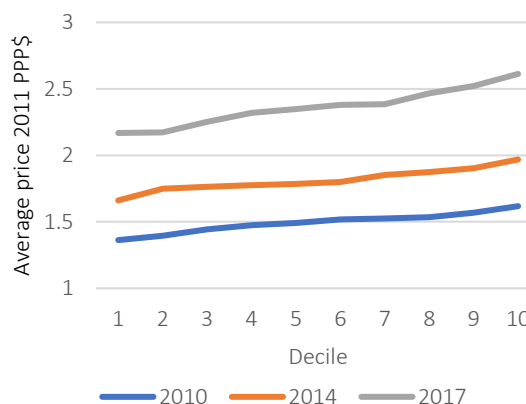
In 2018, the total consumption of carbonated drinks and juices in Kazakhstan was approximately 1,206.3 million liters (Euromonitor International 2019). Figure 2 presents average market prices for carbonated drinks and juices obtained from the Euromonitor Passport Database, and figure 3 shows the average price of a generic SSB (carbonated drink or fruit juice) by income decile obtained from the HBS. Average unit prices obtained from HBS data differ from market price data because of recall error, brand and quality effects, and survey design. Estimates based on the HBS 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.

**Figure 2. Average Price of Carbonated Drinks and Juices, Kazakhstan**



Source: Euromonitor International 2019.

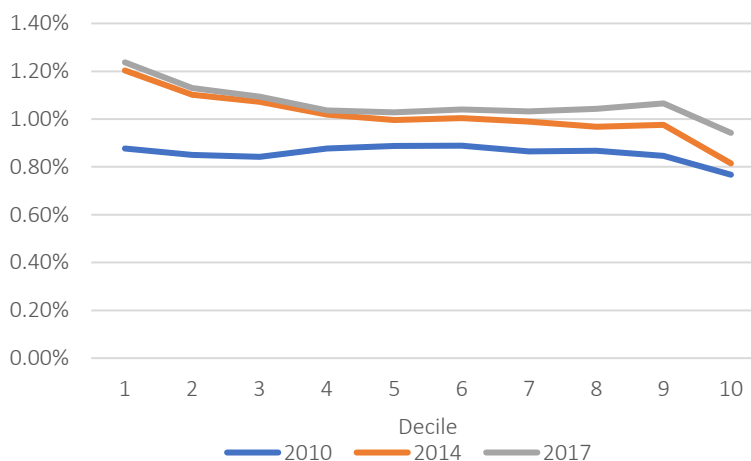
**Figure 3. Average Price Paid by Households for a Generic Sugary Beverage, Kazakhstan**



Source: Estimates based on data of the Household Budget Survey.

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 4). The share of expenditures on SSBs out of total expenditures is lower among richer households.

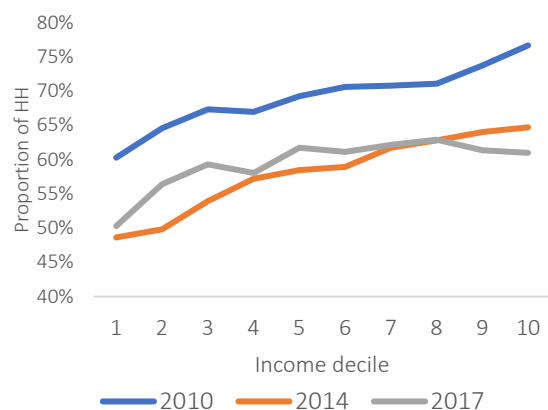
**Figure 4. Share of Expenditures on SSBs in Total Household Consumption**



Source: Estimates based on the Household Budget Survey.

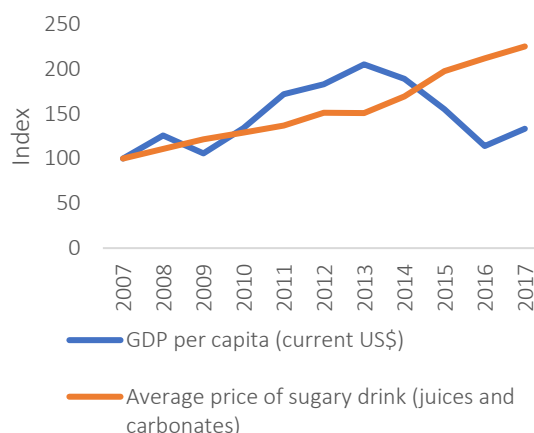
Figure 5 shows a reduction in the number of households that report a consumption of SSBs over time, especially in the richest end of the distribution. The reduction in the share of households consuming SSBs with respect to 2010 might be a result of the economic slowdown that hit Kazakhstan in 2013. Since then, the economy has struggled to recover, and gross domestic product (GDP) per capita has fallen with respect to 2012, while the prices of SSBs have continued to increase (figure 6).

**Figure 5. Proportion of Households That Consume SSBs**



Source: Estimates based on data of the Household Budget Survey.

**Figure 6. Affordability of SSBs, Kazakhstan, 2007-17, 2007 = 100**



Source: World Development Indicators and Euromonitor data, constant prices.

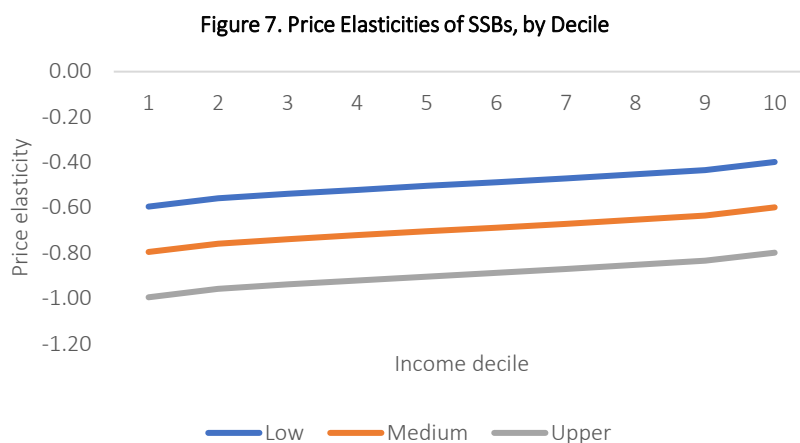
### 1. Price elasticity of sugar-sweetened beverages, by decile

Price elasticities by income decile were calculated using 11 waves of Kazakhstan's HBS (2007–17) (table 2; figure 7). The average price elasticity of SSBs is  $-0.70$ , which is in line with the results found in the literature (see section 1). 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 the demand quantity. We have used three scenarios in this report: a medium-bound average elasticity estimates of the average elasticity of  $-0.070$ ; and lower and upper-bound elasticities of  $-0.020$  lower and higher. Lower-bound estimates may represent individuals with more rigid consumption patterns or a lag in effect before taste preferences evolve. Upper-bound estimates can be interpreted as a long-term scenario, whereby higher prices might discourage younger individuals from creating a habit of SSB consumption, and taste preferences across the population adjust to lower sugar consumption. Households in the richest end of the distribution show smaller elasticities with respect to households in the poorest end of the distribution.

**Table 2. Price Elasticities of SSBs, by Decile**

|                     | Income decile |       |       |       |       |       |       |       |       |       |          |
|---------------------|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| <i>Elasticities</i> | 1             | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | National |
| Lower bound         | -0.60         | -0.56 | -0.54 | -0.52 | -0.50 | -0.49 | -0.47 | -0.45 | -0.43 | -0.40 | -0.50    |
| Medium bound        | -0.80         | -0.76 | -0.74 | -0.72 | -0.70 | -0.69 | -0.67 | -0.65 | -0.63 | -0.60 | -0.70    |
| Upper bound         | -1.00         | -0.96 | -0.94 | -0.92 | -0.90 | -0.89 | -0.87 | -0.85 | -0.83 | -0.80 | -0.90    |

Source: Estimates based on data of the Household Budget Survey 2007–17.



## 2. SSB consumption–related mortality and morbidity

Data on mortality associated with diabetes mellitus type 2, ischemic heart disease, hypertensive heart disease, and stroke in Kazakhstan were obtained from the Global Burden of Disease database. Data on cancer mortality were not included because of the lack of suitable parameters to estimate 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 cancer, and thus we could be underestimating the total effect of the tax in health and welfare of the population. The prevalence of SSB consumption is estimated based on the 2016 HBS because information on total medical spending was only available for 2016. According to the survey, 64 percent of the population consumed SSBs in 2016 (11.3 million in a total population of 17.7 million). The PAF of SSBs was derived from the relative risks associated with the consumption of more than one serving of SSBs per day for diabetes, obesity, ischemic heart disease, and stroke from the review of Shim et al. (2019) and the share of exposed subjects in the entire study population (the proportion of the population that reports consumption of SSBs) ( $P_{pop}$ ) in Kazakhstan in 2016, obtained from the HBS, according to the following formula:

$$PAF = \frac{P_{pop} * (RR - 1)}{P_{pop} * (RR - 1) + 1} \quad (7)$$

Total mortality data for 2016 for each disease were multiplied by the corresponding PAF to estimate the deaths corresponding to the consumption of SSBs. According to the estimates, 8.2 percent of total deaths from these diseases could be attributable to the consumption of SSBs (table 3).

| Table 3. Deaths by Gender, Diseases Related to Consumption of SSBs, Kazakhstan, 2016 |               |        |               |             |       |                              |
|--|---------------|--------|---------------|-------------|-------|------------------------------|
|  | Relative risk | PAF, % | Deaths, women | Deaths, men | Total | % of total deaths by disease |

|                            |      |      |       |       |       |    |
|----------------------------|------|------|-------|-------|-------|----|
| Diabetes mellitus type 2   | 1.18 | 10.4 | 59    | 41    | 100   | 10 |
| Ischemic heart disease     | 1.16 | 9.3  | 1,803 | 1,763 | 3,566 | 9  |
| Stroke                     | 1.1  | 6.0  | 639   | 536   | 1,175 | 6  |
| Hypertensive heart disease | 1.12 | 7.1  | 62    | 50    | 112   | 7  |
| Total                      |      |      | 2,562 | 2,390 | 4,953 | 8  |

Source: Estimates based on Global Burden of Disease data, the 2016 Household Budget Survey, and the relative risk estimates review in Shim et al. 2019.

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 caries and obesity (table 4).

| Table 4. Incidence, Disease Cases Related to the Consumption of SSBs, Kazakhstan, 2016 |           |
|--|-----------|
| Disease  | Incidence |
| Obesity (prevalence)   | 687,119   |
| Diabetes mellitus type 2   | 5,800     |
| Ischemic heart disease   | 3,164     |
| Stroke   | 1,673     |
| Dental caries  | 1,464,217 |

Source: Estimates based on Global Burden of Disease and WHO data (for obesity prevalence), the 2016 Household Budget Survey, and the relative risk estimates review in Shim et al. 2019.

### 3. Medical costs derived from the consumption of sugar-sweetened beverages

Data on total medical costs in 2016 were obtained from the National Health Accounts of Kazakhstan (see annex A). Total OOP expenditures according to the classification of health care providers reached T 580,529,743,920 in 2016, the equivalent of 35.56 percent of total health care costs. Expenditures by disease were not available. The share of medical expenditures by disease group were therefore obtained from Belarus, a country with comparable OOP expenditures as a share of total health care costs (35.80 percent in 2015) and a similar disease burden profile.<sup>3</sup>

The share of total medical expenditures in Kazakhstan was estimated for two groups of diseases related to the consumption of SSBs: (1) endocrine and metabolic diseases (including diabetes) and (2) cardiovascular disease. The total costs per disease group were then multiplied by the PAF to obtain the costs corresponding to diseases linked to the consumption of SSBs (table 5). Annual OOP expenditures attributable to the management of these groups of diseases amount to approximately \$10.7 million, with close to 49 percent of the costs corresponding to the treatment of cardiovascular disease and the rest to endocrine and metabolic diseases (including diabetes). The lack of disaggregated data on treatment costs for specific

<sup>3</sup> 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).

diseases could potentially result in overestimation of the total costs, as groupings contain non-SSB–related diseases. However, this effect might be offset by the exclusion of treatment costs for other, related diseases, including various types of cancer.

| <b>Table 5. Out-of-Pocket Expenditures on the Treatment of Diseases Related to the Consumption of SSBs in Kazakhstan (2016)</b> |   |  |
|---|---|--|
|   | <b>Total out-of-pocket expenditures (tenge)</b> | <b>Total out-of-pocket expenditures (2011 PPP\$)</b> |
| Cardiovascular disease  | T 1,797,629,151                                 | \$21,499,758   |
| Endocrine and metabolic diseases (including diabetes)   | T 1,721,707,343                                 | \$20,591,728   |
| <b>Total</b>  | <b>T 3,519,336,494</b>                          | <b>\$42,091,486</b>                                  |

*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.

#### 4. Estimation of years of life lost (YLL) associated with the consumption of SSBs

The YLL was estimated by multiplying the PAF of each disease associated with the consumption of SSBs by the total YLL by disease obtained from the Global Burden of Disease database (table 6). Approximately 8.1 percent of the total YLL related to the diseases listed are associated with the consumption of SSBs in Kazakhstan. The YLL could be interpreted as a proxy for the income forgone because of premature mortality among the population consuming SSBs.

| <b>Table 6. Years of Life Lost Attributable to the Consumption of SSBs, Kazakhstan, 2017</b> |                  |               |                                    |
|--|------------------|---------------|------------------------------------|
| <b>Disease</b>   | <b>Total YLL</b> | <b>PAF, %</b> | <b>SSB-attributable YLL (2017)</b> |
| Diabetes mellitus type 2   | 21,915           | 10            | 2,269                              |
| Ischemic heart disease   | 697,925          | 9             | 64,974                             |
| Stroke   | 376,540          | 6             | 22,702                             |
| Hypertensive heart disease   | 35,294           | 7             | 2,523                              |
| <b>Total</b>   | <b>1,131,675</b> | <b>N/A</b>    | <b>92,468</b>                      |

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

## [Results]

The World Cancer Research Fund recommends implementing a tax on SSBs that would result in at least a 20 percent price increase to promote a reduction in consumption (WCRF 2018). The model here estimates the direct effect of a 20 percent price increase on household expenditures on SSBs, OOP spending on health care, and the YLL. Changes in household income are estimated for each decile under a complete price pass-through scenario and lower-, medium-, and upper-bound elasticity scenarios.

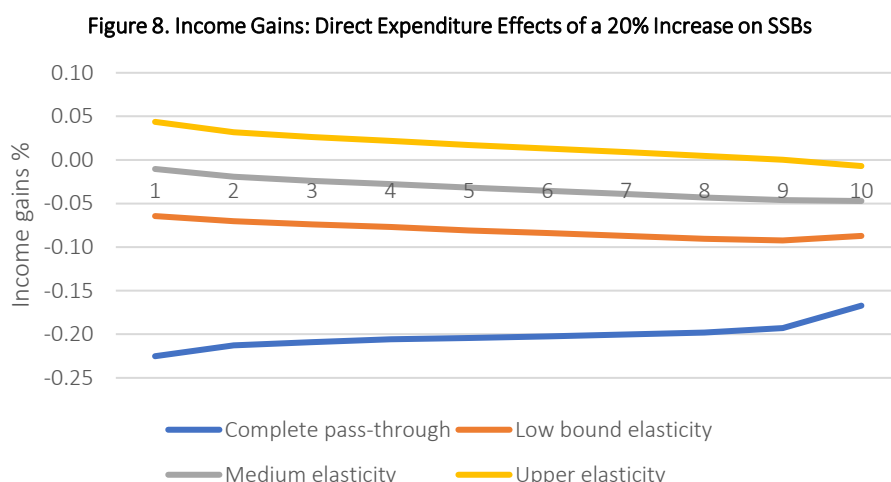
#### 1. Household expenditures on SSBs

Under a scenario of no behavior change, the price increase is completely passed on to consumers without a change in consumption, thereby affecting lower-income deciles relatively more because a larger proportion of the expenditures of these households is devoted to the consumption of food and beverages. The medium- and lower-bound elasticity scenarios

result in negative income shocks across all deciles. Only the upper-bound elasticity scenario results in enough declines in consumption to yield increases in income for deciles 1 to 9 (table 7). The income gains are proportionately lower among high-income deciles, given the comparatively lower price elasticities among these deciles. All scenarios show progressivity: that is, poorer households show relatively smaller income loses (or relatively larger gains) compared with richer households (figure 8).

| Table 7. The Direct Effect on Household Income (%) of Price Increases through Taxes, by Decile (20% price shock) |               |       |       |       |       |       |       |       |       |       |
|--|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|  | Income decile |       |       |       |       |       |       |       |       |       |
| Elasticities   | 1             | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
| Complete pass-through  | -0.23         | -0.21 | -0.21 | -0.21 | -0.20 | -0.20 | -0.20 | -0.20 | -0.19 | -0.17 |
| Lower-bound elasticity   | -0.06         | -0.07 | -0.07 | -0.08 | -0.08 | -0.08 | -0.09 | -0.09 | -0.09 | -0.09 |
| Medium-bound elasticity  | -0.01         | -0.02 | -0.02 | -0.03 | -0.03 | -0.04 | -0.04 | -0.04 | -0.05 | -0.05 |
| Upper-bound elasticity   | 0.04          | 0.03  | 0.03  | 0.02  | 0.02  | 0.01  | 0.01  | 0.00  | 0.00  | -0.01 |

Source: Estimates based on Household Budget Survey data 2007–17.



Source: Estimates based on Household Budget Survey data 2007–17.

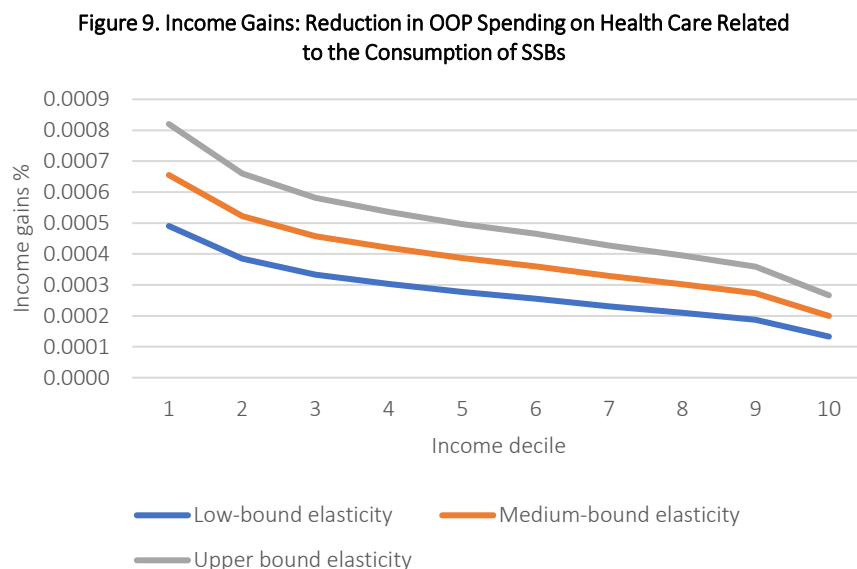
## 2. OOP spending on health care

Table 8 reports the income effect resulting from a reduction in the OOP medical expenses associated with the management of SSB-related diseases (total costs amount to T 75.8 billion, of which 36 percent correspond to OOP expenditures). Income gains from a reduction in OOP spending are positive, but small across all elasticity scenarios (table 8). This is since the diseases for which we have data account for only a modest share of premature mortality. The gains are proportionally higher among lower-income deciles, showing that the reduction in OOP health care spending is progressive, as observed in figure 9. Income gains are higher across all income deciles under the upper-bound elasticity scenario.

| Table 8. Income Gains: Reduction in OOP Spending on Health Care Related to the Consumption of SSBs, by Decile (Percent change in household income from a 20% price shock) |                |   |   |   |   |   |   |   |   |    |
|---|----------------|---|---|---|---|---|---|---|---|----|
|   | Income deciles |   |   |   |   |   |   |   |   |    |
| Elasticity scenario   | 1              | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

|                         |        |        |        |        |        |        |        |        |        |        |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Lower-bound elasticity  | 0.0005 | 0.0004 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0002 | 0.0002 | 0.0002 | 0.0001 |
| Medium-bound elasticity | 0.0007 | 0.0005 | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0003 | 0.0003 | 0.0003 | 0.0002 |
| Upper-bound elasticity  | 0.0008 | 0.0007 | 0.0006 | 0.0005 | 0.0005 | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0003 |

Source: Estimates based on data of the Household Budget Survey 2007–17 and National Health Accounts of Kazakhstan.



Source: Estimates based on data of the Household Budget Survey 2007–17 and the National Health Accounts of Kazakhstan.

### 3. Income gains derived from an increase in working life years

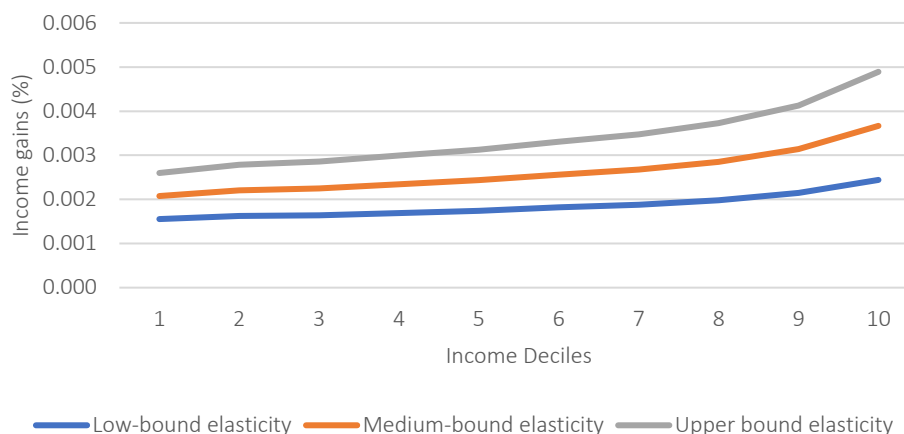
The model assumes that a reduction in the consumption of SSBs has a direct effect on health and on employment-related income. The income effect derived from an increase in working-life years is estimated by dividing the total number of working years lost across income deciles proportionately to the number of households that consume SSBs in each decile. Income gains are positive across all income deciles, but negligible in size (table 9; figure 10). Wealthier households exhibit higher income gains under the three elasticity scenarios, presumably because income gains per year of working life are higher among high-income individuals.

| Table 9. Income Gains under a Reduction of Years of Working Life Lost, by Decile (%) (20% price shock) |   |       |       |       |       |       |       |       |       |       |
|--|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|  | Percent Change in Household Income by Income decile |       |       |       |       |       |       |       |       |       |
| Elasticity   | 1   | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
| Lower-bound elasticity   | 0.002   | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| Medium-bound elasticity  | 0.002   | 0.002 | 0.002 | 0.002 | 0.002 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 |
| Upper-bound elasticity   | 0.003   | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 | 0.005 |

Source: Estimates based on data of the Household Budget Survey 2007–17 and the Global Burden of Disease database.



**Figure 10. Income Gains under a Reduction of Years of Working-Life Lost, by Decile (%)**



Source: Estimates based on data of the Household Budget Survey 2007–17 and the Global Burden of Disease database.

#### 4. Net effects: total distributional impact

The net distributional impact of SSB taxes results from aggregating the income effects of a 20 percent increase in the price of SSBs on SSB spending (table 10), OOP spending on health care, and working-life years. The net income effect is interpreted as the annual effect of the price increase on average annual household consumption (estimated at the decile level). The net income effect is negative across all income deciles under the lower-bound and medium-bound elasticity scenarios and positive in the upper-bound elasticity scenario (figure 11). Only under the upper-bound elasticity scenario are the savings in OOP spending on health care and the increase in working-life income enough to offset the negative price effect of higher taxes. The average upper-bound elasticity of  $-0.90$  is best interpreted as a longer-run scenario, and it is in line with the average elasticities found in the literature.<sup>4</sup> Overall, the net income effect of taxes on SSBs is clearly progressive in the long run, with lower-income deciles benefiting more in relative terms than higher-income deciles.

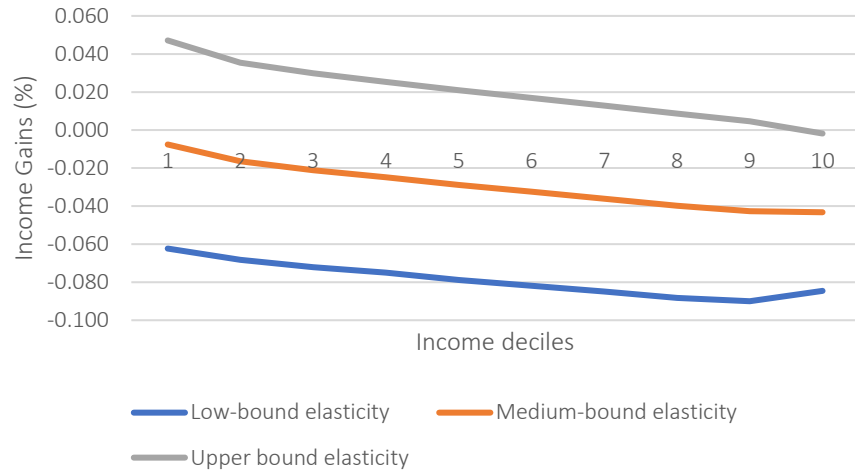
**Table 10. Net Distributional Impact of SSBs Taxes on Household Expenditures, by Decile (%) (20% price shock)**

| Elasticity              | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Lower-bound elasticity  | -0.062 | -0.068 | -0.072 | -0.075 | -0.079 | -0.082 | -0.085 | -0.088 | -0.090 | -0.085 |
| Medium-bound elasticity | -0.008 | -0.016 | -0.021 | -0.025 | -0.029 | -0.032 | -0.036 | -0.040 | -0.043 | -0.043 |
| Upper-bound elasticity  | 0.047  | 0.035  | 0.030  | 0.025  | 0.021  | 0.017  | 0.013  | 0.009  | 0.005  | -0.002 |

Source: Estimates based on data of the Household Budget Survey 2007–17.

<sup>4</sup> A systematic review of 12 U.S. studies showed an estimated average price elasticity of demand of SSBs of  $-1.21$ , with estimates ranging from  $-0.71$  to  $-3.87$  (Powell, et al. 2012).

**Figure 11. Total Income Effect: Direct and Indirect Effects of Sugary Beverages Taxes**



*Source:* Estimates based on data of the Household Budget Survey 2007–17.

## [Policy Discussion]

This report contributes to the discussion on the effects of taxes on unhealthy products by presenting the first application of the extended cost-benefit analysis methodology on taxes on SSBs.<sup>5</sup> The report presents the effects of a 20 percent SSB price increase on productivity and household spending on SSBs and health care in Kazakhstan. The incorporation of savings on the medical costs of diseases associated with the consumption of SSBs and income gains from the extended years of working life offset the regressivity of the tax and result in a net positive income effect among households under an upper-bound elasticity scenario. The upper-bound elasticity scenario is best interpreted as the long-run effect of the taxes.

A tax on SSBs would work as a disincentive to consumption for new generations and encourage manufacturers to reformulate products. For example, companies in the United Kingdom reformulated their products in anticipation of a sugary beverages tax that would enter into force two years after the announcement (Pym 2018). The long-term impact on health and working income might increase if the tax is accompanied by healthy eating promotion campaigns, physical activity programs, and labeling and marketing regulations, along with other policies to transform obesogenic environments.

For better results, the implementation of a tax on SSBs in Kazakhstan should be accompanied by restrictions on the marketing of unhealthy products. For example, a 2019 study of television advertisements in the country showed that the majority of advertised foods and beverages (72.3 percent) were not permissible in advertising and marketing aimed at children according to the WHO model (WHO 2019). Of the total, 22 percent of the advertisements in Kazakhstan were on beverages with added sugar, followed by chocolate, sugar confectionery, and energy bars (WHO 2019).

The specific design of the tax will depend on existing tax structures and regulations, but World Cancer Research Fund International and WHO recommend the implementation of specific excise taxes based on sugar content or volume because they create a higher relative price increase and discourage substitution for cheaper, but equally unhealthy options (WCRF 2018). Additionally, taxes should be applied to a sufficiently large geographical area (nationally or across countries, if possible) to discourage crossborder shopping, which occurred, for instance, in cities in the United States (Seiler, Tuchman and Song 2018).

Despite important limitations because of the lack of data, the results of the extended cost-benefit analysis model presented here are in line with the results of models that combine health survey data with consumption and price data, such as the behavioral redistributive model of Allcott, Lockwood, and Taubinsky (2019). Among the limitations, we can mention the assumption of immediate (i.e. zero discount rate) health related income benefits. On the other hand, as noted above, the coverage of diseases (and the cost of treating them) is incomplete due to data limitations. This includes certain types of cancers that are proven to be associated with SSB consumption. Similarly, the paper does not address the potential use of SSB tax revenues. Governments could redistribute part of these revenues back to the poor in the form of expenditures on

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<sup>5</sup> Fuchs and Meneses (2017a, 2017b, 2018), based on Pichón-Riviere et al. (2014) and Verguet et al. (2015).

public goods and services that not only directly benefit the poor but may also provide them with cheaper alternatives to SSB, such as clean running water availability.

More research is necessary to understand the effects of SSB taxes on consumption habits in the short term and on health effects in the long term. As more developing countries implement taxes on SSBs, the relative benefits of the implementation of the tax in more resource-constrained environments as opposed to more affluent areas should become clear.

Finally, the results of this study add to the substantial other benefits of taxing SSBs. These include not taking account of income benefits from reduction of cancer, additional tax revenue that could be used for health and social programs and, most importantly, the non-income intrinsic value of substantial improvements in health, quality of life, and longevity.

## [Annex A. Estimates of the Medical Costs of SSB-Related Diseases]

Data on total medical costs for t 2016 were obtained from the National Health Accounts of Kazakhstan. Total OOP expenditures according to the classification of health care providers reached T 580,529,743,920 in 2016, the equivalent of 35.56 percent of total health care costs. The share of medical expenditures by disease group was obtained from the System of Health Accounts of Belarus, a country with comparable OOP expenditures as a proportion of total health care costs (35.80 percent in 2015) and a similar disease burden profile (table A.1).<sup>6</sup>

| Table A.1. Medical Costs, by Disease Category, Belarus, 2015 |  |
|--|--|
| Diagnostic Category  | % of current expenditure on health (HP.1-HP.9) |
| Cardiovascular disease                                       | 4.0  |
| Endocrinology and metabolic diseases (including diabetes)    | 0.7  |

Source: (Kontsevaya, et al. 2018).

To obtain the number of SSB-related cases, total prevalence for the year 2016 was multiplied by the PAF of SSB consumption (table A.2). The PAF was calculated based on the relative risks of four diseases associated with consuming more than one serving per day of SSBs, based on data of Shim et al. (2019) and the proportion of exposed subjects in the entire study population ( $P_{pop}$ ) estimated from the consumption data reported in the 2016 HBS (64 percent), according to the formula (LaMorte 2018):

$$PAF = \frac{P_{pop} * (RR - 1)}{P_{pop} * (RR - 1) + 1} \quad (A.1)$$

| Table A.2. Relative Risks and Population Attributable Fractions of Diseases Related to the Consumption of Sugar-Sweetened Beverages, Kazakhstan, 2016 |               |        |
|---|---------------|--------|
| Endocrine and metabolic diseases  |               |        |
| Disease   | Relative risk | PAF, % |
| Diabetes mellitus type 2  | 1.18          | 10.4   |
| Obesity   | 1.31          | 16.6   |
| Cardiovascular diseases   |               |        |
| Disease   | Relative risk | PAF, % |
| Ischemic heart disease  | 1.16          | 9.3    |
| Stroke  | 1.1           | 6.0    |

Source: Calculations based on the relative risk estimates review of Shim et al. 2019 and the 2016 Household Budget Survey.

Endocrine and metabolic diseases include diabetes mellitus type 2 and obesity, while cardiovascular disease groups stroke and ischemic heart disease. The OOP cost of treatment was obtained by dividing the proportion of total OOP costs corresponding to each disease group by total disease prevalence. The cost of disease treatment was multiplied by the

<sup>6</sup> For example, the prevalence of diabetes, overweight, and obesity in Kazakhstan was 11.5 percent, 58.7 percent, and 23.5 percent of total population in 2016, compared with 9.5 percent, 61.0 percent, and 25.2 percent, respectively, in Belarus (WHO 2016).

number of SSB-related events, for a total cost of SSB-related diseases of T 3,519,336,494 or 2011 PPP \$42,091,486 (table A.3).

| Table A.3. Medical Costs Associated with the Consumption of Sugar-Sweetened Beverages, Kazakhstan, 2016 |                  |                   |                                 |                           |                                      |
|---|------------------|-------------------|---------------------------------|---------------------------|--------------------------------------|
| Disease group   | Total prevalence | SSB-related cases | Out-of-pocket cost of treatment | Total out-of-pocket costs | Total out-of-pocket costs (2011 PPP) |
| Endocrine and metabolic diseases (including diabetes)   | 5,272,224        | 804,143           | T 2,141                         | T 1,721,707,343           | \$20,591,728                         |
| Cardiovascular disease  | 655,287          | 50,728            | T 35,437                        | T 1,797,629,151           | \$21,499,757                         |
| Total   | 5,927,511        | 854,871           | N/A                             | T 3,519,336,494           | \$42,091,486                         |

Source: Estimates based on Global Burden of Disease Database, the 2016 Household Budget Survey, Kontsevaya et al. (2018), and Shim et al. 2019.

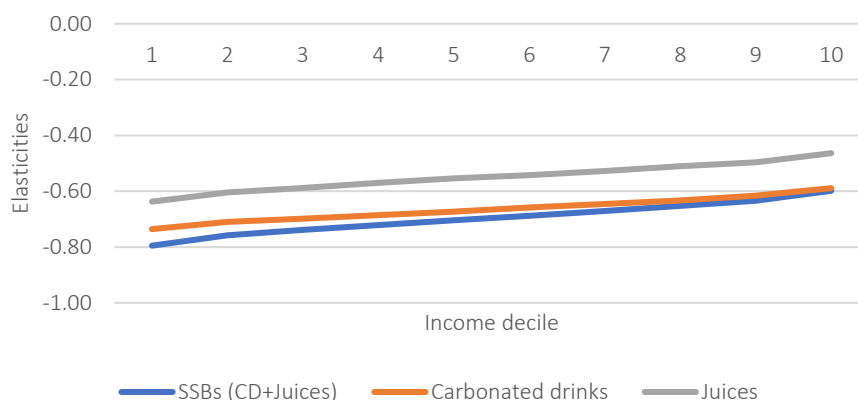
## [Annex B. Sensitivity Analyses: Price Elasticities of Juices and Carbonated Drinks]

The analysis is based on the consumption of carbonated drinks and juices taken together. Additional sensitivity analyses were performed to analyze differences between the price elasticities of carbonated drinks and juices separately. Price elasticity estimations for carbonated drinks and SSBs (carbonated drinks and juices) were similar (–0.66 and –0.70, respectively). The price elasticities for juices were 0.12 smaller in absolute terms, which indicates a somewhat more inelastic demand with respect to price (table B.1; figure B.1).

|                        | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | Avg.  |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| SSBs (CD + juices)     | –0.80 | –0.76 | –0.74 | –0.72 | –0.70 | –0.69 | –0.67 | –0.65 | –0.63 | –0.60 | –0.70 |
| Carbonated drinks (CD) | –0.74 | –0.71 | –0.70 | –0.69 | –0.67 | –0.66 | –0.65 | –0.63 | –0.62 | –0.59 | –0.66 |
| Juices                 | –0.64 | –0.60 | –0.59 | –0.57 | –0.55 | –0.54 | –0.53 | –0.51 | –0.50 | –0.46 | –0.55 |

Source: Estimates based on data of the Household Budget Survey 2007–17.

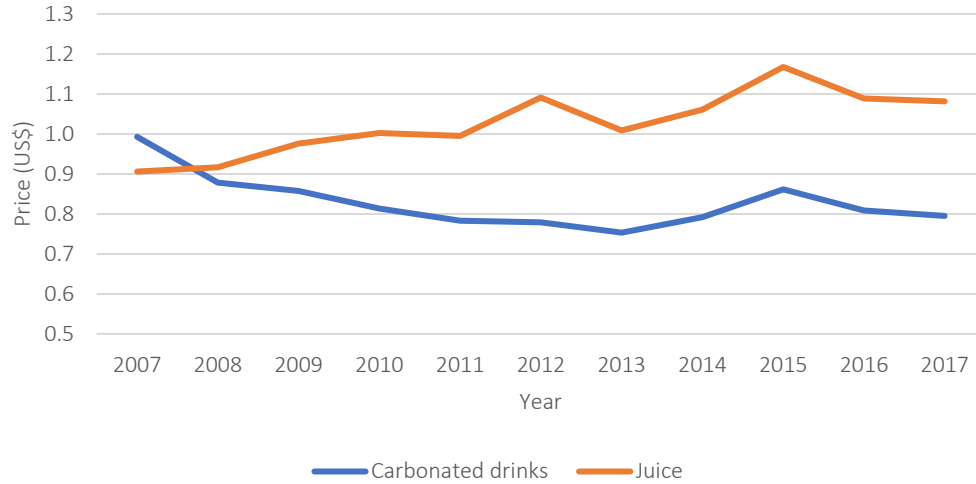
**Figure B.1. Medium-Bound Price Elasticity Estimates, by Beverage Category, Kazakhstan, 2007–17**



Source: Estimates based on data of the Household Budget Survey 2007–17.

The market prices of juices have been consistently higher than the prices of regular carbonated drinks during the period of analysis (2007–17) (figure B.2). Ultimately, the design of the tax on SSBs should reflect the price elasticity differentials as well as the elasticity of substitution between these two product categories.

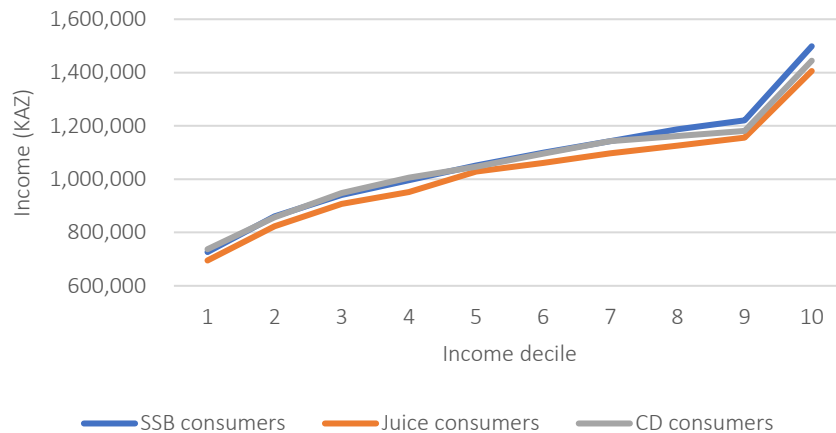
**Figure B.2. Unit Prices, Carbonated Drinks and Juices, US\$\*, Kazakhstan, 2007-17**



Source: Euromonitor International 2019.  
\* Historic fixed 2018 exchange rate.

The income distribution was similar among households consuming only juices, only carbonated drinks, and both, contrary to the expectation that households consuming juices might be more affluent than others (figure B.3). Given the similar income distributions in these consumer subgroups, the main analysis was performed using the broader standard definition of SSBs.

**Figure B.3. Average Annual Household Income, by Decile in Local Currency, 2017**



Source: Data of the Household Budget Survey 2017.

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