The consumption of sugar-sweetened beverages in Jamaica and its association with household expenditure allocation

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Abstract

**Background.** Overweight and obesity are important drivers for the increasing healthcare and other social costs. Apart from present social costs, consumption of SSB may have an effect on future outcomes, from family future wellbeing to national economic growth. If expenditures on SSB decrease expenditures on other goods and services, such as education and healthcare, this “crowding-out” may have a lasting effect. The objective of this article is to estimate the statistical association between the decision of spending in SSB and budget allocation in Jamaica.

**Methods.** Using the Jamaican Household Expenditure Survey 2004-2005 a generalized ordered probit model was estimated to examine the association between socioeconomic variables and the decision to purchase SSB. Seemingly Unrelated Regression Equations (SURE) of all the expenditure groups (except the SSB group) were used to estimate the association between the decision of buying SSB and budget allocation on other goods and services.

**Results.** Purchases of SSB are negatively affected by the size of the household and the area of residence (rural households purchase more SSB than urban ones), while having a larger proportion of children (15 or younger) and having a larger total budget is associated to more expenditures on SSB. Households with positive expenditure on SSB allocate significantly less budget to “Health” and “Education”, when compared to those who did not buy SSB.

**Conclusions.** SSB purchases may crowd-out expenditures in essential goods and services, which implies that decreasing the amount spent on SSB may have important present and future consequences on poorer households’ welfare.

**Keywords:** Jamaica, Sugar-sweetened beverages; Budget allocation
Background

According to a 2018 World Health Organization Global report, obesity has nearly tripled between 1975 and 2016 and, globally, more than 1.9 billion people aged 18 and older were overweight, with more than 650 million considered obese. (1) Among children the overweight/obesity epidemics is also growing: in 2016, 340 million children and adolescents aged 5–19 years, and around 40 million children under the age of 5 years, were considered overweight or obese. (1) The region of the Americas has the highest prevalence of adult obesity in the world, with 28.6%, which is more than double the global prevalence of 13.1%. (1)

In the case of Jamaica, the prevalence of adults with overweight doubled from 27.4% in 1975 to 55.5% in 2016, while the prevalence of obesity among adults increased from 6.9% in 1975 to 24.7% in 2016, nearly a 4-fold increase. (2) For childhood obesity the situation is even worse. Its prevalence increased from 1% in 1975 to 13% in 2016, thirteen times greater, with an average annual increase of 6.3%. (2)

Increases in overweight and obesity have been associated with a number of health conditions, including the most burdensome ones such as cardiovascular diseases, different types of cancer, and diabetes. (3) Prominent experts in public health have signalled the consumption of sugar-sweetened beverages (SSB) as “the single largest driver of the obesity epidemic”, calling for extensive taxation and regulation of such products. (4) In addition to its impact on overweight/obesity, the scientific evidence relating the consumption of SSB to negative health outcomes is vast and has been accumulating over the last decade. A 2007 systematic review found that SSB consumption was associated with an increase in caloric intake, beyond the levels contributed by the said beverages and an increase in body weight. (5) In addition, it found negative associations (moderate but significant) between the consumption of SSB
and certain nutritious foods like milk and essential nutrients like calcium. There is also evidence of a positive relationship between SSB consumption and cardiovascular diseases and type 2 diabetes mellitus.(6-9) These associations points toward a significant increase in future health system costs associated with overweight/obesity and noncommunicable diseases, in relation to SSB consumption.(10, 11)

A recent study measured global, regional and national consumptions of SSB and milk.(12) The study found that the intake of SSB in Jamaica is higher than milk intake for women aged 20-49 years old and for males aged 20-69 years old. It has also demonstrated that the average SSB intake in Jamaica is 3.29 and 3.58 servings/day (serving = 8oz = 237 ml) for female and male (aged 20-30 years), respectively. These figures are more than three times higher than the global average intake for female and male population with similar age range (20-39 years): 0.94 and 1.04 servings/day, respectively. Another, related study, found that, in 2010, more than 380 people (over 20 years old) died in Jamaica from diseases directly attributed to SSB consumption. The vast majority of these deaths were related to diabetes.(13)

As with tobacco and alcohol, taxation has been proposed as an effective tool to decrease SSB consumption.(14) As recent as last year, a high-profile Task Force on Health Taxes, chaired by a former US Secretary of Treasure, concluded that “raising taxes on sugary beverages is prudent because taxes can incentivize healthier diets and address the growing burden of disease from obesity and diabetes”.(15)

Overweight and obesity are also important drivers for the increasing healthcare costs. Direct healthcare costs increase because of the many conditions that are caused by overweight/obesity, but other indirect, usually much higher costs are also present, such as loss of human capital, job absenteeism and presenteeism, disability pension, loss of quality-life years, and premature deaths.(16) Family costs, such as the cost of suffering and loss
earnings for caregivers, can also be significant and greatly increase total social costs, though they are often difficult to measure. Studies measuring such costs for low- and middle-income countries are scarce, though a recent study conducted in Chile, Ecuador and Mexico found that direct and indirect costs for overweight/obesity may range from 0.2% of GDP (Chile) to 1.7% of GDP (Ecuador) with important increases expected in the near future.\footnote{17} In the case of Jamaica and other Caribbean countries, although there are no reasons to expect they would be different from the abovementioned three countries, there are no studies quantifying such costs.

Apart from present social costs, consumption of SSB may have an effect on future outcomes, from family future wellbeing to national economic growth. If expenditures on SSB decrease expenditures on other goods and services, such as education and healthcare, this “crowding-out” may have a lasting effect. Families in such a situation may end up with lower human capital accumulated, which could imply lower earnings and higher healthcare costs in the future.\footnote{18} At the aggregate level, lower human capital is related to permanent lower economic growth.\footnote{19}

Although a number of studies have analyzed the effect that consumption of unhealthy products (e.g. tobacco) has on the allocation of households expenditures,\footnote{20, 21} such analysis has not been conducted for SSB. The objective of this article is to estimate the statistical association between the decision of spending in SSB and budget allocation, in the case of Jamaica. To the best of our knowledge, this is first work to conduct such an analysis for SSB. Two types of analyses were conducted. The first one seeks to shed light on what socio-demographic variables are related to the purchase of SSB according to households’ levels of SSB expenditures. The second analysis seeks to establish the statistical association between expenditure allocation on SSB and on other goods and services. Given their fixed

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budget, households have to decide on how to allocate it and therefore in which goods and services they would spend it on.

Methods

Data for the analyses come from the Jamaican Household Expenditure Survey 2004 – 2005 (HES 2004 – 2005), which was collected between June 2004 and March 2005 by the Statistical Institute of Jamaica.(22) The HES 2004 – 2005 used a two-stage stratified random sample design, where the first stage was the selection of Primary Sampling Units (PSUs). In the second stage, a number of households from each PSUs were selected. A total of 12,012 households were selected to be surveyed over a period of ten months, and the response rate was of 73.8%, totaling 8,865 households with a completed survey.

Data contains information on all categories of expenditures; employment status of all members of the household; household incomes; personal and household characteristics, such as age, gender, area of residence (urban/rural), household size, etc. For the sake of the analyses, household expenditures were classified into 16 categories: 1) Food; 2) Tea, coffee and cocoa; 3) SSB; 4) Non-SSB; 5) Alcoholic beverages; 6) Tobacco; 7) Clothing and Footwear; 8) Housing, water, electricity, gas and other fuels; 9) Furnishings, household equipment and routine household maintenance; 10) Healthcare; 11) Transport; 12) Communication; 13) Recreation and culture; 14) Education; 15) Restaurants and hotels; 16) Others.

Every category, except the first four ones, follows the Classification of Individual Consumption According to Purpose (COICOP) classification.(23) The first group of COICOP classification was further divided into four subgroups "Food", “Tea, coffee and cocoa”, "SSB" (juices, carbonated beverages, nectars, etc.) and "Water" to perform the
Two different models are estimated to characterize households’ decisions related to SSB purchases. First, a generalized ordered probit model (GOPM) was estimated to examine the association between socioeconomic determinants and the decision to purchase SSB. The dependent variable is ordinal and takes four possible values: 0 if the household does not purchase SSB; 1 if household spend a “low amount” on SSB; 2 if they spend a “medium amount” on SSB; and 3 if they spend a “high amount” on SSB. Categories of expenditures on SSB are ad-hoc and constructed using tertiles (33% of the distribution) of the total household expenditure on SSB. GOPM are more parsimonious than probit models when data is ordered,(24) as it is this case. In addition, GOPM do not have to satisfy the parallel lines assumption that ordered probit models (OPM) have to satisfy.(24) A likelihood-ratio test, testing the parallel lines assumption, is conducted to choose between them.(25)

The functional form for these models has been described in detail elsewhere.(25) In our case, the independent variables include the area of residence of the household (urban or rural); the sex, age and age squared of the head of the household; the natural logarithm of the household size; the proportion of women in the household; the proportion of children in the household (younger than 15); a dichotomous variable taking the value of one if there is at least one employed member in the household; and the natural logarithm of total household expenditure.

The second model estimates the statistical association between the decision of buying SSB and budget allocation on other goods and services. This is conducted by estimating a model of Seemingly Unrelated Regression Equations (SURE) of all the expenditure groups (except the SSB group) mentioned above.(26) The SURE estimation allows to estimate a system of
equations where the errors of each equation may be correlated to the errors of the other equations, an assumption that is reasonable in a context where budget allocations are made (almost simultaneously), given a certain budget restriction. (27) Specifically, we estimate a system of 15 equations in which each individual equation, takes the form:

$$w_{ih} = \alpha + \beta \cdot SSB_h + \gamma \cdot X_h + \varepsilon_{ih}$$

where $w_{ih}$ is the share of the household total expenditures allocated to the good/service $i$ by the household $h$, where $i$ can be any of the fifteen categories of goods/services specified (all except SSB); SSB is a dichotomous variable that takes the value of one if the household $h$ has positive expenditure on SSB and $X_h$ are a set of sociodemographic variables for household $h$. These are the same variables included in $X$ for the GOPM. A positive (negative) $\beta$ for category $i$ means that the purchase of SSB is associated to an increase (decrease) in the share of total expenditures devoted to that particular category of goods/services. In the case the coefficient is negative, this indicates that purchasing SSB is related to a decision to spend less in that category of goods/services. Because, as mentioned before, the decision by the household is made simultaneously, this system of equations may result in errors that are correlated ($\varepsilon_{ih}$).

The estimation of both models takes into account the structural information of sample design and sampling weights. Models are estimated using Stata 15.1/MP.

**Results**

Table 1 displays sociodemographic characteristics of the sample according to SSB purchases (no purchases and some purchases), while Table 2 presents the expenditure structure of the households disaggregated by the same groups as Table 1. Assuming households do not make
stocks of SSB neither waste them, SSB purchases are equal to SSB consumption. Table 1 shows that 68% of the households registered positive expenditure on SSB. Households with higher consumption present a higher percentage of urban households (59%) compared to those with lower consumption (50%). Households that did not have SSB expenditures reported a lower percentage of children (26.1%) than those with positive SSB expenditures (27.7%). The average total annual expenditure of households was $478,456 Jamaican dollars; higher in the households that consume SSB ($539,001 versus $349,544).

*Place holder for Table 1.*

Table 2 shows budget shares of each of the 16 groups in which the universe of goods and services purchased by Jamaican households was divided. The category of goods or services that concentrate, on average, most of the total expenditure is “Foods” (36%), followed by “Transport” (12%) and “Housing, water, electricity, gas and other fuels” (12%). These three groups are the ones that concentrate the greatest proportion of the total expenditures in all the SSB consumption groups.

*Place holder for Table 2.*

The likelihood-ratio test to test the parallel lines assumption is rejected at a significance of 1% (results not shown but available from authors). Hence, the GOPM is preferred over the OPM. The marginal effects of the GOPM are presented in Table 3. It shows that living in urban areas, significantly increases the probability of not purchasing SSB: rural households have a 2 percentage points higher probability of purchasing SSB than urban ones, keeping
everything else constant. Larger households also increase such a probability: a 10% increase in the household size increases the probability of not purchasing SSB by 4%. If the proportion of children increases by 10%, the probability of not purchasing SSB decreases by 8% and the proportion of having high SSB purchases increases by 6%. Finally, increasing by 10% the total household expenditures (a proxy for household income) decreases the probability of not purchasing SSB by 17% and increases the probability of having high SSB purchases by 21%.

*Place holder for Table 3.*

Table 4 presents the results of 15 equations of the SURE model. A positive (negative) and statistically significant coefficient for the dichotomous variable showing purchases of SSB means that households in that position increase (decrease) the budget share (i.e. relative allocation) of that category. Hence, a positive and statistically significant coefficient for such a dichotomous variable in the equation of “Food”, for example, implies that households with positive expenditures on SSB allocate a proportionally larger portion of their total expenditures to food purchases, compared to all other considered variables that were kept constant. This is what is shown, for instance, in the first line of Table 4.

*Place holder for Table 4.*

Positive expenditures on SSB are positively and significantly related to a higher share of total expenditures in “Food” (households purchasing SSB allocate, on average, 2.5 percentage points more to food purchases, keeping everything else constant), “Tea, coffee and cocoa” (0.2 extra percentage points), “water” (0.1 extra percentage points), “Alcoholic beverages”
(0.3 extra percentage points), “Tobacco” (0.2 extra percentage points) and “Clothing and footwear” (0.4 extra percentage points), among others.

On the other hand, the purchase of SSB is significantly and inversely related to the budget share in: “Housing, water, electricity, gas and other fuels” (households purchasing SSB allocate 1.7 percentage points less to housing and utilities, keeping everything else constant), “Health” (0.4 percentage points less than households not buying SSB), “Transport” (2 percentage points less than households not buying SSB), “Communication” (0.3 percentage points less than households not buying SSB), “Recreation and culture” (0.3 percentage points less than households not buying SSB), “Education” (0.3 percentage points less than households not buying SSB), “Restaurants and hotels” (0.5 percentage points less) and in the rest of the goods and services not included in the previous categories (0.5 percentage points less than households not buying SSB).

Discussion

The consumption of SSB is associated to the prevalence of obesity, diabetes, cardiovascular diseases, cancers, and other several health conditions. The social and economic costs of SSB consumption include not only direct medical costs, associated with the treatment and care for those illnesses, but crucially, the value of productive and life-quality years lost to diseases and incapacities. Hence, these costs are borne not only by those consuming these goods, but by the society. When this happens (i.e. the consumption of products implies social costs that are larger than the private ones), it is optimal to tax these products in order to decrease their consumption.

In the case of Jamaica, SSB are not taxed, apart from the general consumption tax on all goods and services (16.5% of the value of goods after duties). No other fiscal measure (e.g.
subsidies on water) is in place to disincentivize the consumption of SSB by altering market relative prices. There is no information on the evolution of affordability (i.e. how many hours/days of work-salary are needed to buy one liter of SSB), although it is known that in the region, prices of SSB have suffered a strong decrease when compared to nominal wages.(28) If this is the case for Jamaica (and there are no reasons to believe it is not), it is quite possible that the per capita consumption of SSB has grown strongly over the past years. Therefore, it is highly advisable then to impose taxes that could curb such a consumption.

One of the main arguments usually given against SSB taxation is that taxing SSB may be regressive, as relatively poorer households may spend a higher budget share on these goods.(29) At least two counter arguments can be put forward. First, SSB are non-essential goods, with widely available healthy substitutes (e.g. potable water) and with own-price demand elasticities plausibly above or around 1 (in absolute terms): an increase in SSB prices, would lead to a decrease in consumption more than proportionally.(30-32) This would also decrease the budget share allocated to these products, freeing them to be spent in more essential goods and services (as shown in Table 4). In the case of Jamaica, the results displayed in Table 3 show that purchases of SSB are strongly and directly related to household total expenditures. In other words, richer households have a significantly higher probability of purchasing these products than poorer ones. This would show that, if a tax on SSB is imposed, those mostly affected in absolute monetary terms would be richer households. In addition, the fact that SSB purchases may displace purchases in essential goods and services (e.g, education and healthcare) reflects the fact that decreasing the amount spent on SSB may have important future consequences on poorer households’ welfare, as they may be unable to increase their investment on human capital.
Second, the consumption of SSB has negative health consequences that may have a greater effect on poorer households, as they may put them in situations of financial distress, considering they usually have less access to healthcare. Hence, lower consumption of these products by poorer households (as a consequence of, for instance, higher prices) could imply less negative health consequences and, as a result, a lower probability of incurring out-of-pocket expenditures on health. This is consistent with what has been shown for other non-healthy products, such as tobacco or alcohol.(18, 33)

The second common argument against SSB taxation is related to job losses, as it is argued that taxes destroy jobs in taxed sectors. However, there is strong evidence that this is not the case with taxes on SSB. Money not spent on the taxed SSB will not be destroyed or lost; it will be spent on substitutes (non-taxed beverages) and other products and services. While there would be lower demand for the taxed SSB, as consumers reallocate their spending to non-taxed beverages and other goods and services, new jobs will be created in these sectors, as it has been demonstrated in other countries.(34, 35) Usually, SSB markets are dominated by a few highly capital-intensive firms. Thus, a change in consumption towards more labor-intensive goods could even imply a net creation of jobs. There is no evidence of a decrease in aggregate or even sectoral jobs in countries where taxes on SSB have been applied. A study from Mexico shows,(35) for instance, that while the SSB industry was shedding jobs well before the implementation of the tax (possibly because of automatization), that situation stopped after the tax implementation and jobs in the SSB industry stabilized.

**Conclusions**
The consumption of SSB is associated with overweight/obesity and several diseases, including diabetes, cancers, and cardiovascular diseases. Such diseases increase the costs of medical treatment, loss of human capital and a waste of resources in the form of premature mortality and disability. Such a burden may be excessive, especially for developing countries, undermining their capacity to increase human capital stock and limiting the resources needed to face present and future challenges regarding healthcare.

As demonstrated in this study, SSB purchases displace household expenditures in housing, transport, healthcare and education, which may have a long-run effect on households’ welfare (by decreasing future incomes and/or increasing future healthcare costs) and on society (by diminishing the accumulation of human capital and/or increasing healthcare costs).

Taxing SSB is a strategy that is being increasingly followed by both developing and developed countries around the world. Numerous studies have concluded that, because of the existence of healthy, nearly-free substitutes (plain water), taxing SSB does not constitute a financial burden on poorer households, as they usually are elastic goods. In addition, there is evidence that such taxes do not lead to an economic burden in terms of job losses, as the reallocation of expenditures (away from taxed SSB) imply the creation of jobs in other sectors of the economy.

Taxation can also bring fiscal revenues that can be used to increase resources devoted to healthcare and/or to promote the consumption of healthy substitutes (plain water). A program to, for instance, provide water dispensers or even unsweetened milk at schools, in both rural and urban areas, could be financed with these revenues.

**List of abbreviations**

COICOP: Classification of Individual Consumption According to Purpose
Declarations

Ethics approval and consent to participate

As the study uses publicly available secondary data, no ethics approval or consent to participate is needed.

Consent for publication

Not applicable

Availability of data and materials

Data is available from the Statistical Institute of Jamaica (https://statinja.gov.jm/)

Competing interests

The authors declare that they have no competing interests

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Authors’ contributions

GP: Conceptualization; data curation; formal analysis; funding acquisition; methodology; software; writing - original draft; visualization

FG: Conceptualization; funding acquisition; project administration; supervision; writing - original draft; visualization

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Bibliographic references

1. World Health Organisation. Noncommunicable diseases country profiles 2018. Geneva, Switzerland; 2018.

2. The World Health Organization. Global Health Observatory Data: Overweight and Obesity [Available from: http://www.who.int/gho/ncd/risk_factors/overweight/en/.

3. The World Health Organisation. Report of the commission on ending childhood obesity. Geneva, Switzerland: The World Health Organisation; 2016.

4. Brownell KD, Frieden TR. Ounces of Prevention — The Public Policy Case for Taxes on Sugared Beverages. New England Journal of Medicine. 2009;360(18):1805-8.

5. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. American journal of public health. 2007;97(4):667-75.

6. Imamura F, O’Connor L, Ye Z, Mursu J, Hayashino Y, Bhupathiraju SN, et al. Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: systematic review, meta-analysis, and estimation of population attributable fraction. Bmj. 2015;351:h3576.

7. Wang M, Yu M, Fang L, Hu R-Y. Association between sugar-sweetened beverages and type 2 diabetes: A meta-analysis. Journal of Diabetes Investigation. 2015;6(3):360-6.

8. Yin J, Zhu Y, Malik V, Li X, Peng X, Zhang FF, et al. Intake of Sugar-Sweetened and Low-Calorie Sweetened Beverages and Risk of Cardiovascular Disease: A Meta-Analysis and Systematic Review. Advances in Nutrition. 2020.
9. Narain A, Kwok CS, Mamas MA. Soft drinks and sweetened beverages and the risk of cardiovascular disease and mortality: a systematic review and meta-analysis. International Journal of Clinical Practice. 2016;70(10):791-805.

10. Withrow D, Alter DA. The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. Obesity Reviews. 2011;12(2):131-41.

11. Nugent R. Chronic diseases in developing countries: health and economic burdens. Ann N Y Acad Sci. 2008;1136:70-9.

12. Singh GM, Micha R, Khatibzadeh S, Shi P, Lim S, Andrews KG, et al. Global, Regional, and National Consumption of Sugar-Sweetened Beverages, Fruit Juices, and Milk: A Systematic Assessment of Beverage Intake in 187 Countries. PloS one. 2015;10(8):e0124845.

13. Singh GM, Micha R, Khatibzadeh S, Lim S, Ezzati M, Mozaffarian D. Estimated Global, Regional, and National Disease Burdens Related to Sugar-Sweetened Beverage Consumption in 2010. Circulation. 2015.

14. Summers LH. Taxes for health: evidence clears the air. The Lancet. 2018;391(10134):1974-6.

15. The Task Force on Fiscal Policy for Health. Health Taxes to Save Lives. Employing Effective Excise Taxes on Tobacco, Alcohol, and Sugary Beverages. New York: Bloomberg Philanthropies; 2019.

16. Goettler A, Grosse A, Sonntag D. Productivity loss due to overweight and obesity: a systematic review of indirect costs. BMJ open. 2017;7(10):e014632-e.
17. Comisión Económica para América Latina y el Caribe, Programa Mundial de Alimentos. El costo de la doble carga de malnutrición: impacto social y económico. Santiago de Chile, Chile: Comisión Económica para América Latina y el Caribe, Programa Mundial de Alimentos; 2017.

18. U.S. National Cancer Institute, The World Health Organization. The Economics of Tobacco and Tobacco Control. 2016.

19. Barro R, Sala-i-Martin X. Economic Growth. Massachusetts, USA: The MIT Press; 1998.

20. Paraje G, Araya D. Relationship between smoking and health and education spending in Chile. Tobacco Control. 2017.

21. John R., Chelwa G., Vulovic V., Chaloupka F. Using Household Expenditure Surveys for Research in the Economics of Tobacco Control. University of Illinois at Chicago; 2019.

22. Statistical Institute of Jamaica. Household expenditure survey report 2004 - 2005. Kingston, Jamaica: Statistical Institute of Jamaica; 2010.

23. Nations U. Classifications of expenditure according to purpose. Statistical papers M 84. 2000.

24. Williams R. Generalized ordered logit/partial proportional odds models for ordinal dependent variables. Stata Journal. 2006;6(1):58-82.

25. Johnston C, McDonald J, Quist K. A generalized ordered Probit model. Communications in Statistics - Theory and Methods. 2020;49(7):1712-29.

26. Paraje G, Araya D. Relationship between smoking and health and education spending in Chile. Tobacco Control. 2018;27(5):560.
27. Banks J, Blundell R, Lewbel A. Quadratic Engel Curves and Consumer Demand. Review of Economic and Statistics. 1997;79(4):527-39.

28. Paraje G, Pincheira P. Affordability of beer and soft drinks in 15 Latin American countriesAcessibilidade a cervejas e refrigerantes em 15 países da América Latina. Revista panamericana de salud publica = Pan American journal of public health. 2018;42:e49-e.

29. Ross J, Lozano-Rojas F. Are Sugar-Sweetened Beverage Taxes Regressive? Evidence from Household Retail Purchases. In: Tax Foundation, editor. Washington, DC: Tax Foundation,; 2018.

30. Colchero MA, Salgado JC, Unar-Munguía M, Hernández-Ávila M, Rivera-Dommarco JA. Price elasticity of the demand for sugar sweetened beverages and soft drinks in Mexico. Economics & Human Biology. 2015;19:129-37.

31. Chacon V, Paraje G, Barnoya J, Chaloupka FJ. Own-price, cross-price, and expenditure elasticities on sugar-sweetened beverages in Guatemala. PloS one. 2018;13(10):e0205931.

32. Nakhimovsky SS, Feigl AB, Avila C, O'Sullivan G, Macgregor-Skinner E, Spranca M. Taxes on Sugar-Sweetened Beverages to Reduce Overweight and Obesity in Middle-Income Countries: A Systematic Review. PloS one. 2016;11(9):e0163358.

33. Meier PS, Holmes J, Angus C, Ally AK, Meng Y, Brennan A. Estimated Effects of Different Alcohol Taxation and Price Policies on Health Inequalities: A Mathematical Modelling Study. PLoS medicine. 2016;13(2):e1001963.

34. Powell LM, Wada R, Persky JJ, Chaloupka FJ. Employment Impact of Sugar-Sweetened Beverage Taxes. American journal of public health. 2014;104(4):672-7.
35. Guerrero-López CM, Molina M, Colchero MA. Employment changes associated with the introduction of taxes on sugar-sweetened beverages and nonessential energy-dense food in Mexico. Preventive medicine. 2017;105:S43-S9.
### Table 1: Mean and standard deviation of sociodemographic variables

| Variable                                  | No SSB Consumption$^1$ | Positive SSB Consumption$^1$ | Low SSB Consumption$^1$ | Medium SSB Consumption$^1$ | High SSB consumption$^1$ | Total$^1$ |
|-------------------------------------------|------------------------|-----------------------------|--------------------------|---------------------------|--------------------------|-----------|
| % of households with positive expenditure SSB SD | 0.00% 0.00            | 100.00% 0.00               | 100.00% 0.00             | 100.00% 0.00             | 100.00% 0.00           | 68.04% 0.47 |
| % of households with positive expenditure on water SD | 52.34% 0.50          | 47.66% 0.50                | 53.21% 0.50             | 49.42% 0.50             | 43.07% 0.50           | 12.40% 0.33 |
| % of female head of the household SD | 42.02% 0.49           | 43.47% 0.50                | 44.73% 0.50             | 44.24% 0.50             | 41.42% 0.49           | 43.01% 0.50 |
| % of urban households SD | 50.12% 0.50          | 54.73% 0.50                | 50.39% 0.50             | 54.86% 0.50             | 59.03% 0.49           | 53.25% 0.50 |
| Average age of household head SD | 49.85 16.66          | 46.68 16.15                | 47.54 16.68             | 46.56 15.82             | 45.91 15.87           | 47.69 16.38 |
| Average household Size SD | 3.38 2.26            | 3.50 2.31                  | 3.42 2.24               | 3.46 2.30               | 3.61 2.39            | 3.46 2.30 |
| Percentage of Women in household SD | 46.53% 0.32          | 47.80% 0.31                | 48.48% 0.32             | 47.89% 0.31             | 47.00% 0.30           | 47.39% 0.32 |
| % of children in the household (<18) SD | 26.13% 27.74%        | 27.84% 27.14%              | 27.84% 27.14%           | 27.84% 27.14%           | 28.22% 27.23%        | 27.23% 27.23% |
| SD     | 0.27 | 0.26 | 0.27 | 0.26 | 0.25 | 0.26 |
|--------|------|------|------|------|------|------|
| Number of employed in the household | 1.12 | 1.19 | 1.11 | 1.20 | 1.25 | 1.17 |
| SD     | 0.92 | 0.94 | 0.93 | 0.94 | 0.94 | 0.93 |
| Total annual expenditure | $349,544 | $539,001 | $391,259 | $508,598 | $719,724 | $478,456 |
| SD     | 337,713 | 460,664 | 376,127 | 410,348 | 521,135 | 434,317 |

1: Mean in upper value, standard deviation in lower value

Low, medium and high SSB consumption are tertiles of households grouped according to purchases of SSB physical quantities (excluding households with no purchases)
| Variable | No SSB Consumption | Positive SSB Consumption | Low SSB Consumption | Medium SSB Consumption | High SSB consumption | Total |
|----------|--------------------|--------------------------|--------------------|------------------------|----------------------|-------|
| Budget share in food | 37.81% | 35.06% | 34.63% | 34.93% | 35.61% | 35.94% |
| SD | 0.20 | 0.17 | 0.19 | 0.17 | 0.16 | 0.18 |
| Budget share in tea, coffee and cocoa | 0.66% | 0.75% | 0.67% | 0.76% | 0.82% | 0.72% |
| SD | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Budget share SSB | 0.00% | 2.31% | 0.83% | 1.95% | 4.17% | 1.57% |
| SD | 0.00 | 0.03 | 0.01 | 0.02 | 0.03 | 0.02 |
| Budget share water | 0.02% | 0.13% | 0.07% | 0.13% | 0.19% | 0.09% |
| SD | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| Budget share in alcoholic beverages | 0.67% | 0.87% | 0.64% | 0.79% | 1.18% | 0.81% |
| SD | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 |
| Budget share in tobacco | 0.70% | 0.62% | 0.80% | 0.64% | 0.42% | 0.65% |
| SD | 0.03 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 |
| Budget share in clothing and footwear | 3.08% | 3.53% | 3.59% | 3.64% | 3.37% | 3.39% |
| SD | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Budget share in housing, water, electricity, gas and other fuels | 13.30% | 11.32% | 12.38% | 11.69% | 9.89% | 11.95% |
| SD | 0.12 | 0.10 | 0.11 | 0.10 | 0.09 | 0.11 |
| Budget share in furnishing, household equipment and others | 4.38% | 4.86% | 4.40% | 4.81% | 5.39% | 4.71% |
| SD | 0.06 | 0.06 | 0.05 | 0.06 | 0.06 | 0.06 |
| Budget share in Health | 3.57% | 3.08% | 3.55% | 2.89% | 2.79% | 3.24% |
| SD | 0.08 | 0.07 | 0.08 | 0.06 | 0.05 | 0.07 |
| Budget share in transport | 11.90% | 12.11% | 12.51% | 12.49% | 11.33% | 12.04% |
| SD | 0.12 | 0.12 | 0.12 | 0.12 | 0.11 | 0.12 |
| Budget share in communication | 4.18% | 4.30% | 4.29% | 4.39% | 4.22% | 4.26% |
| SD | 0.05 | 0.05 | 0.05 | 0.05 | 0.04 | 0.05 |
|----|------|------|------|------|------|------|
| Budget share in recreation and culture | 3.83% | 4.01% | 4.13% | 4.08% | 3.81% | 3.95% |
| SD | 0.07 | 0.06 | 0.06 | 0.06 | 0.05 | 0.06 |
| Budget share in education | 1.70% | 2.08% | 2.06% | 2.07% | 2.10% | 1.96% |
| SD | 0.06 | 0.06 | 0.06 | 0.06 | 0.05 | 0.06 |
| Budget share in restaurants and hotels | 4.88% | 5.41% | 5.64% | 5.27% | 5.30% | 5.24% |
| SD | 0.10 | 0.10 | 0.10 | 0.09 | 0.09 | 0.10 |
| Budget share in others | 8.96% | 9.11% | 9.37% | 9.12% | 8.83% | 9.06% |
| SD | 0.09 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |

1: Mean in upper value, standard deviation in lower value

SD: Standard deviation

Low, medium and high SSB consumption are tertiles of households grouped according to purchases of (excluding households with no purchases)
### Table 3: Marginal effects of Generalized Ordered Probit model for SSB consumption

| VARIABLES                                             | (1)          | (2)          | (3)          | (4)          |
|-------------------------------------------------------|--------------|--------------|--------------|--------------|
| No SSB purchase                                      | Urban household (ref: rural household) (SD) | 0.02**       | -0.00        | -0.01        | -0.01        |
|                                                       |              | (0.010)      | (0.009)      | (0.009)      | (0.008)      |
|                                                       | Sex of household head (SD) | -0.01        | 0.01         | 0.01         | 0.00         |
|                                                       |              | (0.010)      | (0.009)      | (0.009)      | (0.008)      |
|                                                       | Age of household head (SD) | 0.01***      | -0.00        | -0.00        | -0.01***     |
|                                                       |              | (0.002)      | (0.001)      | (0.001)      | (0.001)      |
|                                                       | Age squared of household head (SD) | -0.00***     | 0.00         | 0.00         | 0.00***      |
|                                                       |              | (0.000)      | (0.000)      | (0.000)      | (0.000)      |
|                                                       | Log of household size (SD) | 0.04***      | 0.01         | -0.01        | -0.03***     |
|                                                       |              | (0.010)      | (0.009)      | (0.009)      | (0.009)      |
|                                                       | Proportion of women in household (SD) | -0.01        | 0.04***      | 0.00         | -0.03**      |
|                                                       |              | (0.016)      | (0.015)      | (0.015)      | (0.014)      |
|                                                       | Percentage of children in the household (SD) | -0.08***     | 0.00         | 0.01         | 0.06***      |
|                                                       |              | (0.026)      | (0.023)      | (0.023)      | (0.022)      |
|                                                       | Someone employed in the household (ref: no one employed in the household) (SD) | -0.01        | -0.01        | 0.01         | 0.00         |
|                                                       |              | (0.012)      | (0.011)      | (0.011)      | (0.010)      |
|                                                       | Log Total household expenditure (SD) | -0.17***     | -0.08***     | 0.04***      | 0.21***      |
|                                                       |              | (0.006)      | (0.005)      | (0.005)      | (0.005)      |
| Observations                                          | 8,760        | 8,760        | 8,760        | 8,760        |

SD: Standard Errors within parentheses; HH: household; *** p<0.01, ** p<0.05, * p<0.1
| Variable                                          | BS in Food1,2 | BS in Tea, Coffee and cocoa1,2 | BN in water1,2 | BS in Alcoholic Beverages1,2 | BS in Clothing and Footwear1,2 | BS in Housing, Water, electricity, etc.1,2 | BS in Furnishing, household equipment, etc.1,2 | BS in Health1,2 | BS in Transport1,2 | BS in Communication1,2 | BS in Recreation and Culture1,2 | BS in Education1,2 | BS in Restaurants and Hotels1,2 | BS in Others1,2 |
|--------------------------------------------------|---------------|--------------------------------|----------------|-----------------------------|-----------------------------|--------------------------------|--------------------------------|----------------|------------------|-----------------------|----------------------|-------------------|-------------------------|-----------------|
| Positive SSB consumption (ref: No SSB consumption) | 0.025 ***     | 0.002 ***                      | 0.001 ***      | 0.003 ***                   | 0.002 ***                   | -0.017 ***                      | -0.004 ***                      | -0.020 ***       | -0.003 ***       | -0.003 ***                      | -0.003 ***                      | -0.003 ***       | -0.006 ***                      | -0.005 ***       |
| Urban household (ref: rural household)           | -0.014 ***    | -0.002 ***                     | 0.000 ***      | -0.002 ***                  | 0.000 ***                   | -0.006 ***                      | 0.035 ***                      | -0.006 ***       | -0.004 ***       | 0.001 ***                      | 0.001 ***                      | 0.002 ***       | 0.006 ***                      | -0.006 ***       |
| Sex of the head of the household                 | 0.012 ***     | 0.000                          | 0.000 ***      | -0.008 ***                  | -0.007 ***                  | -0.002 ***                      | 0.017 ***                      | 0.001 ***        | -0.009 ***       | 0.001 ***                      | 0.007 ***                      | 0.005 ***       | -0.007 ***                      | 0.000 ***       |
| Age of the head of the household                 | 0.001 ***     | 0.000                          | 0.000          | 0.000                       | 0.000 ***                   | 0.000 ***                      | 0.000 ***                      | 0.000 ***        | 0.000 ***        | 0.000 ***                      | 0.000 ***                      | 0.000 ***       | 0.000 ***                      | 0.000 ***       |
| Log household size                               | 0.011 ***     | 0.000                          | 0.000          | -0.003 ***                  | 0.000                       | 0.002 **                       | -0.007 ***                     | -0.004 ***       | 0.000 **         | -0.001 ***                      | 0.000 ***                      | 0.001 ***       | 0.004 ***                      | -0.004 ***       |
| Percentage of women in the household             | -0.026 ***    | 0.000                          | 0.000          | -0.003 ***                  | -0.003 ***                  | -0.002 **                       | 0.022 ***                      | 0.006 ***        | 0.006 **         | 0.001 ***                      | 0.003 ***                      | 0.004 ***       | -0.004 **                       | -0.009 ***       |
| Percentage of children in the household          | 0.026 ***     | 0.000                          | 0.000          | 0.002                       | 0.000                       | 0.002                           | -0.007                        | -0.001          | -0.012 ***        | -0.009 ***                      | -0.010 ***                     | 0.003 ***       | -0.002 **                       | 0.015 **         |
| Someone employed in the household (ref: no one employed) | -0.001        | 0.000                          | 0.000          | 0.001 **                    | 0.000                       | 0.000                           | -0.001                        | -0.006 ***       | 0.003 **         | 0.013 ***                      | -0.012 ***                     | 0.003 **       | -0.002 **                       | 0.003 **         |
| Log Total expenditure                            | -0.100 ***    | -0.001 ***                     | 0.000 ***      | -0.002 ***                  | -0.004 ***                  | -0.002 ***                      | -0.004 ***                     | 0.007 ***        | 0.005 ***        | 0.002 ***                      | 0.042 ***                      | 0.008 ***       | 0.009 ***                      | 0.013 ***         |
| Constant                                         | 1.562 ***     | 0.019                          | -0.003 ***     | 0.038 ***                   | 0.067 ***                   | 0.075 ***                      | 0.153                         | -0.046 ***       | -0.066 ***       | -0.367 ***                      | -0.053 ***                     | 0.048 ***       | -0.137 ***                      | -0.134 ***       |

*Table 4: SURE estimates for budget shares for total population*
Coefficient is upper value, standard errors in parentheses: *** Significant at 1%; **** Significant at 5%; *** Significant at 10%; BS stands for "budget share"