Taxing Calories in Mexico

(Preliminary and incomplete Draft)

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Abstract

We exploit a unique panel dataset of about 8000 households, including detailed information of their purchases of products at the barcode level to estimate the impact of the introduction of a series of taxes on sugary drinks and other products with high caloric density in Mexico using an "event-study" type methodology. We find almost full pass-through of the taxes to prices. We estimate a price-elasticity for the demand of sugary drinks close to -0.5, and for total calories consumed of -0.3, albeit not statistically significant (all these results are preliminary, estimated with 10% of the sample and the caloric content of 72 percent of food purchases).

Keywords: Obesity, Taxes, Sugar added drinks.

JEL Codes: I18, H23, H51

We would like to thank Kin Gutierrez Olivares for outstanding research assistance and the collaboration of Kantar World Panel México. The current paper sprang from a collaboration with the Consejo Mexicano de la Industria de Productos de Consumo, A.C (ConMéxico) in which they helped us get the data from KWP. ConMéxico did not have any veto power nor influence in the results. Any remaining errors are ours only. Comments welcome.

1. Introduction

Obesity is a growing and costly health problem. It is related to several chronic illnesses that are major causes of death in both developed and the developing countries. Across the OECD, 18 percent of the adult population is obese, with Mexico and the US scoring at the two highest positions, at 35 and 32 percent respectively.[1] This is costly in terms of medical attention, related costs and quality of life. According to Finkenstein et al (2009) "The estimated annual medical cost of obesity in the U.S. was $147 billion in 2008 U.S. dollars; the medical costs for people who are obese were $1,429 higher than those of normal weight''. Similarly, the Mexican Ministry of Health indicates that 7 percent of the government's health budget and 3 out of 4 hospital beds are devoted to patients with obesity related diseases.[2]

Although its high costs are undeniable, there is debate about the extent to which this calls for government intervention, as well as which are the best policy tools to mitigate obesity. Proposals span a wide spectrum: from increasing the availability of drinking water and vegetables, to limiting the serving sizes of certain high caloric density foods or imposing taxes on them. The OECD has strongly recommended taxing high caloric density foods as an essential policy tool to reduce obesity in the population. Some countries have actually implemented such proposals, but little is known about the causal effect of such taxes, and most of the evidence today consists of correlations between food prices and weight (e.g. Duffy et al 2010). During 2011, Denmark implemented a tax on all foods with saturated fat content above 2.3 percent; Finland has extra taxes on candies, ice cream and soft drinks since 2011; that same year Hungary raised a tax on a series of products such as soft drinks, energy drinks, pre-packed sweetened products, salty snacks and condiments; France imposed a tax on all beverages with added sugar in 2012; finally, Berkeley, CA became the first city in the U.S. to pass a tax on sugary drinks of one cent per ounce, which began to be implemented in January 1st, 2015. Similar taxes are being discussed in other countries.

[1] http://www.oecd.org/health/Obesity-Update-2014.pdf
[2] www.salud.df.gob.mx/ssdf/index.php?option=com_content&task=view&id=4034

In this paper we study the effects of the taxes charged on sugary drinks and high caloric density foods, implemented in Mexico in January 1st 2014.[3] The taxes consist on charging one peso[4] per liter of drinks (except milk products with no sugar added) containing any amount of added sugar and an ad-valorem tax of 8 percent on non-basic foods with a caloric density greater than or equal to 275 calories per 100 grams. We measure the effects of these taxes on price and consumption of the taxed products, and estimate price elasticities using the taxes as an instrument for price. To take substitution towards untaxed goods into account, we measure the effect of the taxes on *total* caloric intake at the household level and provide evidence on the evolution of household head's Body Mass Index (BMI) one year before and after the tax's implementation.

An important contribution relies on the use of high-quality and frequency data provided by a leading consumer tracking company. The data spans the period 2010-2014 and contains weekly purchases at the barcode level for more than 25 thousand barcodes for food items in more than 8,000 households. The data also contain BMI as well some demographic information collected yearly. Finally, a group of surveyors recorded nutritional information (including calories) for the products included in the scanner data purchases.

This paper presents an "event-study" analysis that exploits the sharp price increase just as the taxes came into effect. We find almost full pass-through of the taxes to prices[5]. In a context of perfect competition, this would suggest that the demand for these types of products is highly inelastic. Using this tax-induced price change, we estimate a price elasticity of around -0.5 for sugary drinks. We also study the overall effect of the taxes on calories, by considering the possibility of substitution toward non-sugary drinks. We find that although the price of calories increased by close 4 percent, the quantity of calories consumed decreased by about 1 percent only. The resulting price elasticity for calories close to -0.3. Although these "low" elasticities limit the power of taxes to decrease obesity, they imply high tax collection potential for these measures.

[3] "Impuesto a Bebidas Saborizadas con Azúcares añadidos y alimentos no básicos con alta densidad calórica", as a part of the Law "Ley del Impuesto Especial Sobre Producción y Servicios" (LIEPS).

[4] 1peso in 2014 is about 0.06 USD.

[5] Grogger (2015) gets also a similar result using a completely different data source.

Given the nature of the data, it is important to note that these elasticities relate to products that tend to be consumed at home (hereon in-home (IH) consumption) as opposed to those that are consumed elsewhere (hereon out-of-home consumption (OH)). The latter, OH consumption, includes consumption at restaurants and "on-the-go" from products purchased at small convenience stores. This distinction could be important as price elasticities might differ.

There is an extensive literature measuring demand elasticities (not necessarily the effect of taxes). But most of these studies display important identification problems as they use price variation across markets, which conflate supply and demand.[6] These studies find a wide range of elasticities. Andreyeva et al. (2010) survey more than 180 studies and find average elasticities for soda drinks of -0.79, with a range in (-0.33, -1.24); for foods the elasticities lie between -0.27 and -0.81 on average, depending on food items. Fletcher et al. (2010)'s statistical methodology is probably the most credible in the non-experimental literature. They exploit across State variation in soda taxes in the US to estimate a differences-in-difference model of tax level[7] on liters of soda consumed, calories consumed and weight. They found that a 1 percentage point increase in the tax implies a reduction of only 6 soda-calories per day, although they are compensated by increase in calorie consumption of other foods.[8] Lakdawalla and Zeng (2011) survey 13 studies of the effect food price changes on weight and conclude that big changes in prices on a large set of foods are associated with weight loss, while changes in a small set of food prices are not.

The other set of studies that are often cited are randomized control trials varying prices. They have substantial internal validity, but are carried in very specific settings, limiting their external validity. Also, little allowance is made for substitutions and competing products that could actually happen in a supermarket or similar everyday settings. Furthermore, they are focused on

[6] See for instance Powel et al. (2009), Allais et al. (2009). The use of uncontrolled variation may explain the wide range of elasticities found in the survey of 180+ studies in Andreyeva et al. (2010).

[7] In 2006 19 States had soda taxes amounting to 5% of the price on average.

[8] Using data from France, Allais et al (2009) estimate an almost-ideal demand system and conclude that taking into account substitution to other products a tax of 10% on caloric foods would reduce calorie consumption by only 1%. Powel et al (2009) use a cross sectional regressions of BMI against soda prices in the US --with potentially serious concerns of price endogeneity and multiple testing — find a null effect of prices on BMI. They find a negative effect only for a sub-population of overweight adolescents. In this regression they estimate that a 1pp increase in the soda tax is associated to a reduction of only 0.006 points in the BMI.

very restricted types of populations, often with samples of less than 100 individuals.[9] The heterogeneity of the populations may explain the heterogeneity of results: in an extensive meta study of 23 papers with experimental results, Epstein et al. (2012) conclude that the price elasticity of foods oscillates between -0.5 and -3.8 depending on the product and study. There is also disagreement regarding calories: Giesen et al. (2011) find that although changes in price produce changes in consumption, this is not reflected in changes in calories. In contrast, Yang and Chiou (2010) study price changes in sugary drinks and find a price-calorie elasticity of -0.6.

The paper proceeds as follows. Section 2 presents the Mexican obesity outlook and discusses tax policy for food before and after the introduction of the new taxes on sugary drinks and high caloric density foods. Section 3 describes our data sources. Section 4 explains our empirical strategy, while Section 5 presents the main results and a series of robustness checks. The last section concludes.

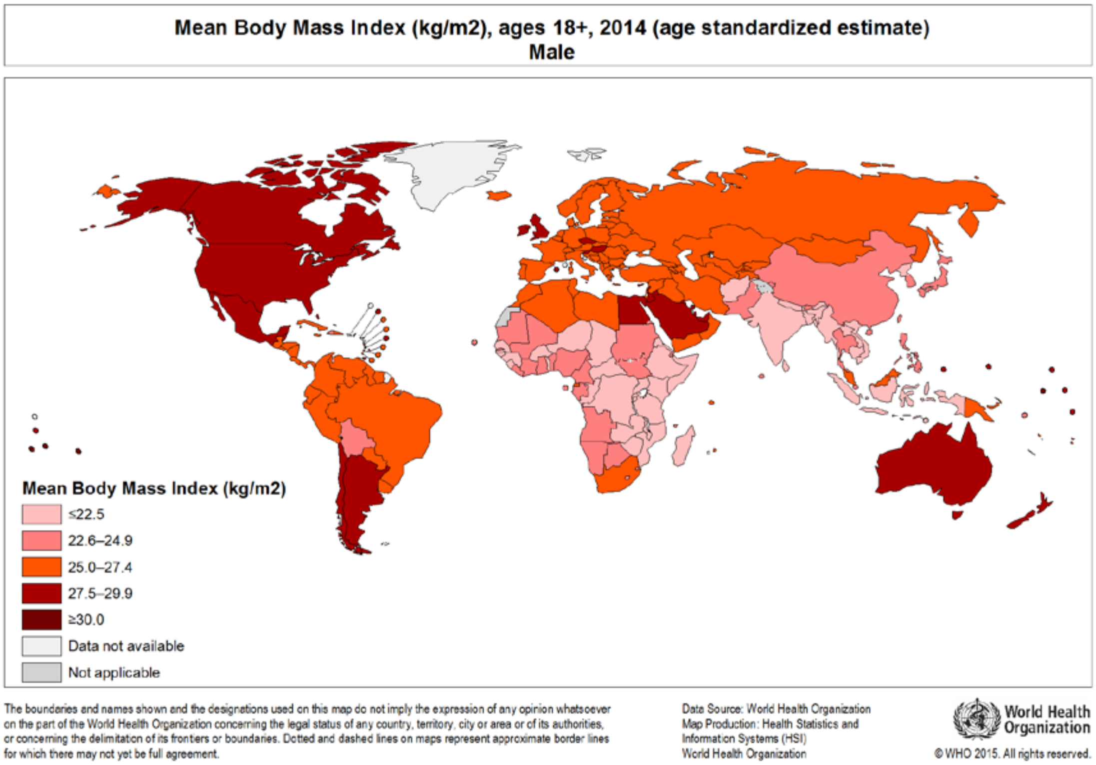
2. Context and description of the tax on calories

The prevalence of adult and childhood obesity has dramatically increased in several countries in the world, including the US and Mexico. Figure 1 shows the average Body Mass Index around the world according to the World Health Organization. Mexico is one of the countries in the world where the problem seems more severe. According to the Mexican Nutrition and Health Survey (ENSANUT), 40 percent of the population aged over 20 years old is overweight, and an additional 30 percent is obese; 35 percent of Mexican children suffer from obesity. According to the Mexican Ministry of Health, 7 percent of the government's health budget and 3 out of 4 hospital beds are devoted to patients with obesity related diseases, and these numbers are likely to increase considerably in the years to come.[10]

[9] See French et al. (2001), Epstein et al. (2012). Estimated elasticities are very different across studies, maybe due to the differences participating populations of the context of the experiment.

[10] www.salud.df.gob.mx/ssdf/index.php?option=com_content&task=view&id=4034

Figure 1



Given all this, in January 1st 2014, the Mexican government introduced a series of taxes on sugar added drinks and caloric dense foods known in Mexico as IEPS, which stands for "Special Tax on Production and Services." IEPS was a tax established in 1980,[11] which imposed specific tax rates to the acquisition or import of products such as alcoholic drinks, tobacco, fuel; and activities such as lotteries and gambling. Before 2014, sugar added drinks were only taxed under a Value Added Tax (VAT) which imposed a 16% tax rate; while high caloric density foods were VAT exempt.

The 2014 IEPS reform taxed sugar[12] added drinks and high caloric density foods. The first got a tax of one peso (6 cents of a dollar) per liter of product in addition to the VAT.[13] Exemptions to

[11] In fact the acquisition or import of sodas were included under the original 1980 IEPS law and taxed at 15.7% ad-valorem. Sodas were later removed from this tax in 1990.
[12] The law establishes that sugars include monosaccharides, disaccharides and polysaccharides employed as sugar substitutes with caloric content.
[13] Sugar added drinks range from sodas, juices, nectars to concentrates and powdered drink mix. In the case of concentrates and powders to prepare drinks, the tax would be calculated based on the amount of liters that, according to the drink instructions, can be prepared. Partial liters would be proportionately taxed. For example, this

IEPS include alcoholic beverages (which are subject to another rate), some milk based drinks, and drinks sweetened with sugar substitutes. As for foods, those non-basic products[14] with a caloric density content greater than or equal to 275 kilocalories per 100 grams of product are to be taxed at 8% ad-valorem. Products subject to this tax include snacks, candies, chocolates, puddings, marmalades, peanut butter, sweets, cereal-based food, ice cream and ice pops.[15] The caloric density is determined using the information from the product's label that details the nutritional information.

During 2014 the IEPS collected Mx$124,493.6 million in tax revenue from non-oil related products, which corresponds to an increase of 52.3% with respect to its 2013 level[16], surpassing the predictions of the tax authorities by 5%.[17] Considering only IEPS applied to foods and beverages, tax collection for sugary drinks was 18,279.7 million pesos and 13,666.1 million pesos. These are 46% and 144% higher than anticipated by the Ministry of Finance respectively.

3. Data sources

Our main dataset is the Mexican chapter of the Kantar World Panel (KWP). The data consists of a weekly panel of more than 8000 households with information on purchases for household consumption at the barcode level, specifying quantities and prices paid in each transaction for 46,000 barcodes. Surveyors visit participating households weekly and require respondents to (a) show ticket receipts for all purchases made in formal establishments, and to (b) keep a notebook for all those purchases made in informal markets, which are then coded into a dataset including the date of each transaction, the barcode of the product bought, the number of units purchased,

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means that a 355ml soda would pay a tax of 35.5 Mexican cents, regardless of the amount of sugar added above zero.

[14] Every year, the Ministry of Finance publishes through a document named "Miscelanea Fiscal" the list of IEPS exempt products. These products include wheat-based food, such as tortilla, bread, and pasta to prepare soup, among others; and maize-based food, such as tortilla, flour, and other food products.

[15] Wheat and maize-based products considered as basic diet products are exempt from this tax. Basic diet products are determined and published every year in an official document

[16] Consulted at the Ministry of Finance webpage (www.shcp.gob.mx)

[17] Predictions based on the document "Criterios Generales de Política Económica 2014" (pp. 126) published by the Ministry of Finance to establish the Federal budget for fiscal year 2014.

its price and presentation (e.g. a six pack or individual cans of soda). We use all weeks in 2013 and 2014.

KWP also administers a yearly questionnaire to all participating households which captures a set of socio-economic characteristics (from which they are classified into different socio-economic categories) along with self-reported information on the weight and height of the household head. This allows us to split the sample into different groups according to their Body Mass Index (BMI). Table 1 presents descriptive statistics for the characteristics of households in our sample.

The characteristics of the household heads match pretty closely the averages in census data and the National Health and Nutrition Survey (Encuesta Nacional de Salud y Nutrición, ENSANUT). On average, household heads are 46 years old, 78 percent are male, and almost 60 percent did not graduate from secondary school. 44 percent of household heads are overweight while 22 percent are obese.

However, while our data seems to match closely the Mexican population in terms of socio-economic status and other characteristics, it does not capture households' total expenditures. In particular, the panel captures information on the purchases of industrialized, packaged products, but excludes fresh meat, fruits and vegetables, expenditures for consumption outside the household, other non-durable goods, such as clothing, and all durable goods. According to the Mexican Income and Expenditure Survey (ENIGH 2012), a Mexican household spends on average 10,780 pesos a month, and 3,218 pesos in food including beverages. The total expenditures in goods in the Kantar World Panel is 1,799 pesos on average. This reflects mostly that only a subset of products are collected by KWP; however the data also shows that within the same categories of products KWP reports 12% higher expenditures that ENIGH. This makes us more confident that within these categories KWP is measuring consumption accurately.

Table 1: Descriptive Statistics

Variable	Mean	Standard Deviation
Household's Head Characteristics		
Age	46	14
Male (Fraction)	78%	0.42
Schooling Level		
Less than Primary (%)	4%	0.2
Primary (%)	55%	0.5
Secondary (%)	24%	0.42
More than Secondary (%)	17%	0.37
Body Mass Index (BMI)	28	4.6
Overweight (%)	44%	0.5
Obese (%)	22%	0.42
Unemployed (%)	1%	0.1
Household Characteristics		
Bathrooms	0.95	0.52
Bedrooms	2.2	1
Household Assets		
TV (%)	90%	0.3
Computer (%)	42%	0.49
Car (%)	42%	0.49
Socio-Economic Status (SES)		
ABC+ (%)	20%	0.4
CD+ (%)	45%	0.5
DE (%)	36%	0.48

We focus first on three outcome variables: (a) total weekly expenditure holding constant the consumption basket. This is a proxy for the impact on prices. We divide expenditures in total expenditures on taxed and untaxed foods, expenditures on taxed foods (including sugary drinks), and expenditures on sugary drinks. (b) expenditure allowing the quantities to change, which allows for substitution across foods and therefore is useful to calculate incidence, (c) calories consumed from all foods.

Table 2 presents descriptive statistics for the content of households' consumption bundle captured in our dataset. The dataset captures, on average, weekly expenditures of 373 pesos in total, which includes packaged food and beverages and home and personal care; 29.5% is on products that we classified as taxable, while about 14% of total expenditures were on sugary drinks (soft and still drinks). Interestingly, the fraction of total expenditures destined to taxable foods and sugary beverages varies very little by Socio-Economic Status and household head's Body Mass Index

Table 2

Descriptive Statistics: Household's Consumption Bundle

	Weekly Expenditures (2014 mxn pesos)	Share of total Expenditures			Share of Total Calories	
		Food	Taxable Goods**	Sugary Drinks	Taxable Goods**	Sugary Drinks
SAMPLE						
Total						
Total	372.8	68.48%	29.51%	13.97%	40.39%	18.79%
By Socio-Economic Status						
ABC+	418.2	68.50%	30.05%	13.69%	41.78%	18.82%
CD+	382.5	68.29%	29.60%	14.01%	40.72%	19.03%
DE	336	68.72%	29.02%	14.12%	39.14%	18.46%
By Body Mass Index						
Not Overweight	357.7	68.12%	28.99%	13.37%	39.59%	16.89%
Overweight	372.93	68.35%	29.32%	13.64%	39.93%	18.10%
Obese	389.43	68.98%	30.14%	14.83%	41.23%	20.35%

*These numbers are preliminary, as they only consider the nutritional information for 72 percent of all food purchases.

**Includes Sugary Drinks

4. Identification strategy

We use an "event-study" strategy that exploits the sharp price increase just as the tax came into effect to estimate consumers' responses to its introduction. We study the tax on sugary drinks and the total effect of the new taxes on caloric intake separately. Since these applied to different types of drinks/food, we need a common quantity standard to measure elasticities. We will use liters when referring to the quantities of drinks and calories when referring to total consumption. We include the consumption of sugary drinks when estimating the effect of the new taxes on total caloric intake. In order to do this we generate some indexes as described below.

Denoting u_{ipt} the number of units of barcode p that household i purchased in week t, and l_p the liters contained in product p, the total liters (L_{it}) of sugary beverages purchased by household i in week t is $L_{it} = \sum_p u_{ipt} * l_p$. Assigning a weekly price per liter of sugary drinks to each household in the dataset is a more complicated task because the price of each barcode is different. It is necessary to determine which sugary drinks consumption bundle should be used to calculate the per-liter price faced by each household every week. For simplicity and ease of interpretation, in the first part of the analysis we choose to calculate a price index for liters of sugary drinks for each household, keeping the bundle of sugary drinks of each household fixed at the average consumption bundle of each household during 2013 (before the tax was introduced). The price per liter of sugary drinks that we assign to household i in week t, P_{it}^{L} is then $P_{it}^{L} = \sum_p \frac{L_{pi,2013}}{L_{i,2013}} p_{pt}$, where $L_{i,2013} = \sum_{t=1}^{52} \sum_p u_{itp} * l_p$ is the liters of sugary drinks consumed by household *i* during 2013, and $L_{pi,2013} = \sum_{t=1}^{52} u_{itp} * l_p$ is the total liters of barcode p consumed by household *i* during 2013, $L_{pi,2013}$, and p_{pt} is the average price per liter of barcode *p* on week *t*, calculated as the simple average of the price paid for that barcode in all purchases, by all households in our dataset. We define the price per calorie to household *i* in week *t* analogously as $P_{it}^{C} = \sum_p \frac{C_{pi,2013}}{C_{i,2013}} p_{pt}$, where $C_{pi,2013} = \sum_{t=1}^{52} u_{isp} * c_p$ are total calories consumed un household i in 2013.

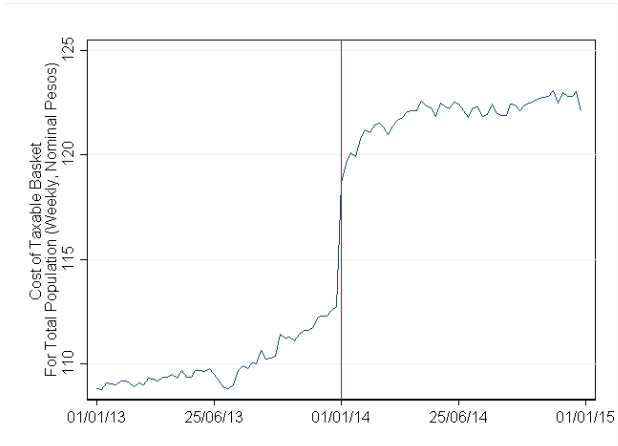
We begin by studying the pass-through of the tax to prices. Several papers[18] have found close to full pass through of these types of taxes. We present the analysis in two parts. First, focusing only on sugary beverages, we estimate the change in price per liter of sugary drinks paid by each household around the introduction of the tax, and relate it to the change in the total liters of sugary drinks purchased. Second, understanding that the main objective of the new taxes was to reduce caloric intake, we measure the price per calorie (including those from sugary drinks) paid by each household in our data around the introduction of the taxes, and the corresponding change in total calories purchased by households around the introduction of the tax. We observe a sharp increase for both the price per liter of sugary drinks and the price per calorie consumed around the introduction of the tax.[19]

Figure 2

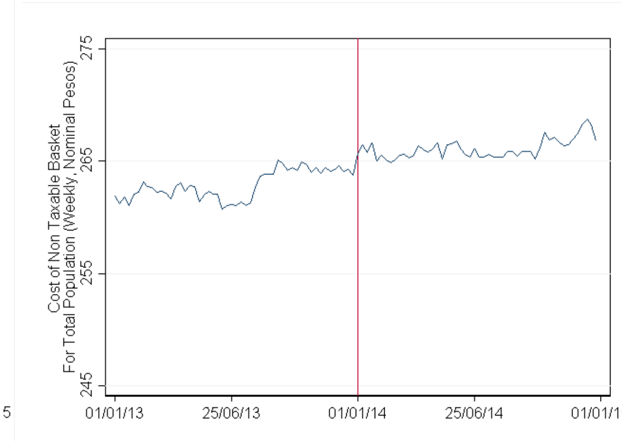
Evolution of prices and cost of average consumption basket

[18] See for instance Grogger (2015) and the papers cited there.
[19] All results are preliminary, as they only include 10 percent of the full sample and the caloric content of 50 percent of the barcodes.

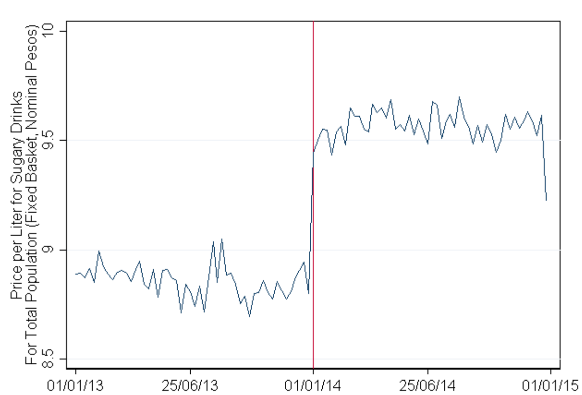
(a) Taxable goods



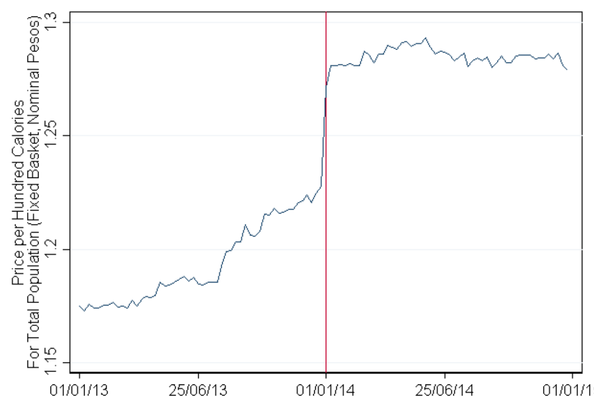
(b) Non-Taxable goods



(c) Price per liter sugary drinks



(d) Price per calorie



Note that we do not observe such increase in prices for non-taxable products; this suggests that the change in the price per liter of sugary drinks and calories observed in January 2014 is attributable to the new taxes.

5. Results

The event study methodology uses only time series variation in order to identify the effect of the tax. It measures breaks from trends just at the time of taxes. In order for the methodology to identify the effect of the tax we need (a) small or no anticipatory responses to the tax, (b) smooth controls of seasonality $f(t)$, (c) sharp price effects that allow estimation of elasticities. Figure 2 above suggest this last condition is met.

Given that these conditions seem to be met, we estimate the effect of the Tax by running specifications of the following form:

$$(1) \quad \ln(P_{it}) = \beta Tax_t + f(t) + \gamma_i + \delta_w + \varepsilon_{it}$$

Where P_{it} is the price per liter of sugary drinks or per calorie paid by household i in week t, as defined above, Tax is a dummy variable taking value of one since the first week of January, 2014, and zero otherwise, $f(t)$ includes linear, quadratic or cubic time trends, γ_i are household fixed effects, δ_w are 52 week of the year fixed effects, which will control for any seasonal changes in the dependent variable over the course of the year; and ε_{it} is an error term. Our coefficient of interest is $\beta,$ which measures the change in the dependent variable around the date the new taxes were introduced.

In order to understand the change in household purchases around the introduction of the tax, we will run the same specification, this time using the log of one plus the total liters of sugary drinks (L_{it}) and the log of one plus the total calories (C_{it}) consumed by each household as dependent variables. As all our dependent variables are defined in log terms, we can approximately interpret our coefficient of interest as the percentage change in the dependent variables around the introduction of the tax. We estimate price elasticities by regressing these log quantities on price, instrumenting the price with the Tax dummy and including all controls listed in equation (1). We understand that these price elasticities are a function of the variety of products and presentations included in both sugary drinks and total calories and substitution among them.

5.A.1 Results for Sugary Drinks

The main results for sugary drinks are presented in Table 3.[20] We present the estimates splitting the sample by socio-economic status (SES) categories and by BMI categories. Column 1 presents regression results adjusting for a linear time trend. Columns 2 and 3 adjust a quadratic and cubic time trends, respectively. The estimated change in prices ranges from 12 to 14 percent, and does not seem to vary considerably across SES or BMI categories (which could be the case if the increase in prices had been different for different products or presentations). Given that the average price per liter of sugary drinks paid by households in our data is approximately 7.8 pesos and that the tax was one peso per liter, the estimates suggest close to 100 percent pass-through of the tax to prices, immediately in the months that followed the tax. The increase in price was about 1 percentage point higher for those with lower SES. The price increase did not differ by BMI.

Table 3: Effect on prices per liter of Sugary Drinks

	Change in Log Price per Liter at the Introduction of the Tax			
Time Trend Adjustment	**Linear**	**Quadratic**	**cubic**	**Obs**
SAMPLE				
Total	0.126***	0.126***	0.141***	72,695
	(0.0015)	(0.0012)	(0.0021)	
By Socio-Economic Status				
ABC+	0.119***	0.119***	0.134***	13,926
	(0.0014)	(0.0011)	(0.0019)	
CD+	0.126***	0.126***	0.141***	33,188
	(0.0016)	(0.0012)	(0.0022)	
DE	0.129***	0.129***	0.145***	25,581
	(0.0016)	(0.0013)	(0.002)	
By Body Mass Index				
Not Overweight	0.125***	0.125***	0.14***	12,658
	(0.0015)	(0.0012)	(0.0016)	
Overweight	0.127***	0.127***	0.143***	29,210
	(0.0016)	(0.0011)	(0.0021)	
Obese	0.124***	0.124***	0.139***	30,827
	(0.0015)	(0.0012)	(0.0022)	

* All results are preliminary, run for 10% of the full sample
All regressions include household and week of the year fixed effects as controls.
Robust standard errors clustered at the household level in parentheses.
*significant at 10%, **significant at 5%, ***significant at 1%

[20] All results are preliminary, as they only include 10 percent of the full sample and the caloric content of 50 percent of the barcodes.

Ultimately, the tax seeks to reduce consumption of high caloric density foods. Table 4 presents estimates of the change in total consumption of sugary drinks. We estimate the following specification:

$$(2)\quad \ln(L_{it}) = \beta Tax_t + f(t) + \gamma_i + \delta_w + \varepsilon_{it}$$

Table 4 presents the results. For the full sample the estimated decrease in purchases of sugary drinks ranges from 6.5 to 7 percent. This specific tax seems to have incentivized consumers to reduce their consumption of sugary drinks, although moderately. Nonetheless, differences arise when comparing these numbers across SES and BMI categories. High SES households' decrease in purchases of sugary drinks is a bit larger across specifications, and households whose head's BMI classifies him as obese respond with a smaller decrease in purchases. That is, the tax has a smaller effect in the population for which it was intended.

Table 4: Effect on Liters of Sugary Drinks Consumed

	Change in Log Liters of Drinks at the Introduction of the Tax			
	Linear	**Quadratic**	**cubic**	**Obs**
SAMPLE				
Total	-0.065***	-0.065***	-0.07***	72,695
	(0.0079)	(0.007)	(0.0178)	
By Socio-Economic Status				
ABC+	-0.07***	-0.07***	-0.101***	13,926
	(0.011)	(0.011)	(0.0257)	
CD+	-0.062***	-0.062***	-0.05*	33,188
	(0.0111)	(0.01)	(0.0269)	
DE	-0.065***	-0.065***	-0.081***	25,581
	(0.0091)	(0.0077)	(0.0204)	
By Body Mass Index				
Not Overweight	-0.092***	-0.092***	-0.08**	12,658
	(0.0118)	(0.0118)	(0.0314)	
Overweight	-0.077***	-0.077***	-0.085***	29,210
	(0.0107)	(0.0106)	(0.0256)	
Obese	-0.055***	-0.056***	-0.067**	30,827
	(0.0147)	(0.0129)	(0.0269)	

* All results are preliminary, run for 10% of the full sample

All regressions include household and week of the year fixed effects as controls.

Robust standard errors clustered at the household level in parentheses.

*significant at 10%, **significant at 5%, ***significant at 1%

An essential input to optimal taxation formulas is the price elasticity of demand. Table 5 presents estimates of this elasticity for different populations. For the full sample the point estimate is -0.5. The elasticity is larger for households with high SES and smaller for those whose head is classified as obese according to his or her BMI. These elasticity estimates are within those estimated in the literature.

Table 5: Price elasticities Liters of Sugary Drinks

	Price Elasticity of Demand of Sugary Drinks			
Time Trend Adjustment	**Linear**	**quadratic**	**Cubic**	**Obs**
SAMPLE				
Total	-0.516***	-0.516***	-0.499***	72,695
	(0.0597)	(0.0542)	(0.1229)	
By Socio-Economic Status				
ABC+	-0.583***	-0.582***	-0.757***	13,926
	(0.0905)	(0.0891)	(0.1892)	
CD+	-0.494***	-0.495***	-0.353*	33,188
	(0.0851)	(0.0777)	(0.1876)	
DE	-0.507***	-0.508***	-0.558***	25,581
	(0.067)	(0.058)	(0.1363)	
By Body Mass Index				
Not Overweight	-0.738***	-0.738***	-0.575***	12,658
	(0.093)	(0.0932)	(0.2212)	
Overweight	-0.607***	-0.607***	-0.598***	29,210
	(0.0809)	(0.0807)	(0.1742)	
Obese	-0.445***	-0.451***	-0.482**	30,827
	(0.114)	(0.1009)	(0.1875)	

* All results are preliminary, run for 10% of the full sample
All regressions include household and week of the year fixed effects as controls.
Robust standard errors clustered at the household level in parentheses.
*significant at 10%, **significant at 5%, ***significant at 1%

It is important to mention again that these are in-home consumption elasticities which could be larger than total consumption if for instance people pay more attention to prices for sodas in supermarket than in restaurants.

5.A.2 Results for foods calories purchased

In the fight against obesity one important indicator of success is the decrease in total calories. Decreases in the liters of sugary drinks may not change total calorie consumption if consumers substitute to other foods or drinks. One way to take into account all substitution patterns is to study total calories consumed of all foods, taxed and untaxed. This is what we do in Tables 6, 7 and 8 where the dependent variables are the log of the price per 100 calories, the log of calories purchased, and the demand elasticity of calories.[21] Again, the empirical strategy involves estimating the mean change in price and quantities while controlling for seasonality using weekly dummies and for household composition using household fixed effects.

Table 6: Effect on Price of Calories

Change in Log Price per 100 Calories at the Introduction of the Tax				
Time Trend Adjustment	**Linear**	**Quadratic**	**Cubic**	**Obs**
SAMPLE				
Total				
Total	0.04***	0.04***	0.045***	75,726
	(0.0011)	(0.0004)	(0.0007)	
By Socio-Economic Status				
ABC+	0.038***	0.038***	0.042***	15,073
	(0.0012)	(0.0004)	(0.0008)	
CD+	0.04***	0.04***	0.045***	35,172
	(0.0011)	(0.0004)	(0.0007)	
DE	0.041***	0.041***	0.047***	25,481
	(0.0012)	(0.0004)	(0.0007)	
By Body Mass Index				
Not Overweight	0.037***	0.037***	0.042***	13,410
	(0.0011)	(0.0004)	(0.0007)	
Overweight	0.042***	0.042***	0.047***	30,784
	(0.0417)	(0.0418)	(0.0467)	
Obese	0.04***	0.04***	0.045***	31,532
	(0.0011)	(0.0004)	(0.0007)	

*All results are preliminary, run for 10% of the full sample

Al regression include household and week of the year fixed effects as controls

Robust standard errors clustered at the household level in parentheses

*significant at 10%, **significant at 5%, ***significant at 1%

[21] All results are preliminary, as they only include 10 percent of the full sample and the caloric content of 70 percent of the barcodes.

Table 6 shows that the introduction of the taxes had a significant impact on the price of calories for all households in our data. For the full sample, we estimate an increase in the cost of calories of about 4%. This increase is pretty homogeneous across socioeconomic levels and levels of BMI. This means that the poorer segments of the population are facing an increase of a similar magnitude than the higher income population. This small increase in price already may suggest a small change in quantity which is what we find in Table 7. Calories consumed decreased by 1 percent per week. With the current sample size this is not statistically distinguishable from zero.

Table 7: Effect on Quantity of Calories*

Change in Log Hundreds of Calories at the Introduction of the Tax				
Time Trend Adjustment	**Linear**	**Quadratic**	**Cubic**	**Obs**
SAMPLE				
Total				
Total	-0.013	-0.013	-0.02	75,726
	(0.012)	(0.0119)	(0.0304)	
By Socio-Economic Status				
ABC+	-0.02	-0.021	-0.05	15,073
	(0.0194)	(0.0189)	(0.0425)	
CD+	-0.007	-0.007	0.034	35,172
	(0.0139)	(0.0138)	(0.0372)	
DE	-0.016	-0.017	-0.075**	25,481
	(0.0158)	(0.0158)	(0.0366)	
By Body Mass Index				
Not Overweight	-0.05**	-0.049**	-0.053	13,410
	(0.0215)	(0.0216)	(0.0517)	
Overweight	-0.008	-0.008	0.007	30,784
	(-0.0081)	(-0.0079)	(0.0074)	
Obese	-0.02	-0.02	-0.05	31,532
	(0.0179)	(0.0179)	(0.0374)	

*All results are preliminary, run for 10% of the full sample
Al regression include household and week of the year fixed effects as controls
Robust standard errors clustered at the household level in parentheses
*significant at 10%, **significant at 5%, ***significant at 1%

In terms of elasticities, Table 8 estimate elasticities between -0.3 and -0.4, depending on the specification. These elasticities are not statistically significant using the current 10% of the sample. Surprisingly, the elasticities are large and statistically significant for the not-overweight population.

Table 8: Price Elasticity of Demand for Calories

Time Trend Adjustment	Linear	Quadratic	Cubic	Obs
SAMPLE				
Total				
Total	-0.32	-0.31	-0.43	75,726
	(0.29)	(0.29)	(0.66)	
By Socio-Economic Status				
ABC+	-0.53	-0.53	-1.17	15,073
	(0.50)	(0.48)	(0.99)	
CD+	-0.17	-0.17	0.73	35,172
	(0.33)	(0.33)	(0.80)	
DE	-0.4	-0.4	-1.6**	25,481
	(0.37)	(0.37)	(0.77)	
By Body Mass Index				
Not Overweight	-1.34**	-1.32**	-1.25	13,410
	(0.57)	(0.57)	(1.20)	
Overweight	-0.19	-0.19	0.157	30,784
	(-0.19)	(-0.18)	(0.15)	
Obese	-0.50	-0.50	-1.11	31,532
	(0.43)	(0.43)	(0.81)	

*All results are preliminary, run for 10% of the full sample
Al regression include household and week of the year fixed effects as controls
Robust standard errors clustered at the household level in parentheses
*significant at 10%, **significant at 5%, ***significant at 1%

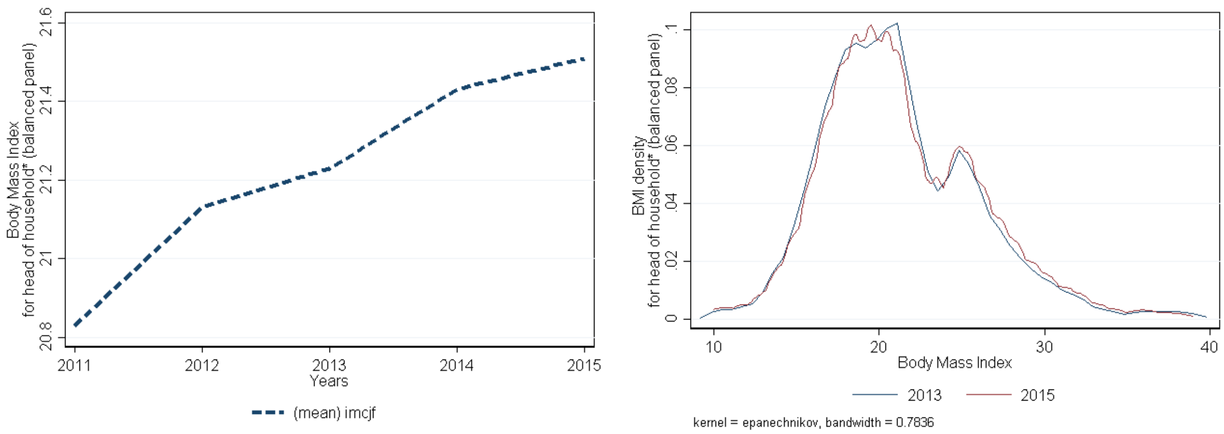
5.A.3 Results for measures BMI

Our data includes measures of BMI for the household head each year, i.e. KWP records for the same person each year the BMI. This allows us to present changes in the distribution of BMI by year and see if the average BMI decreased after the tax.

Figure 3 Panel B presents the kernel density estimate of the BMI for 2013 before the tax, and for 2015 one year after the tax was implemented. The sole graph is very telling: there is no discernible difference across the years in BMI. Panel A plots the mean BMI in time and if anything the tendency has continued to rise, albeit by small quantity. It seems that so far the existing tax has not had a detectable decrease in BMI. This is consistent with the small impact on calories presented above.

Figure 3: Effects of the Tax on BMI

(a) Time trend of mean BMI (b) Distribution of BMI



We only observe information for about 1 year after the tax and one may rightly claim that the tax takes time to show effects. In the future we will update this information with information of 2016. Ideally one would also like to measure the effects of the tax on biometric markers. Unfortunately we lack the financing to carry out these tests.

5. Conclusion

Obesity and its cost are high and rising and we know little about the effectiveness of different policy tools. We measure the short term impact of one such tool: taxing high caloric density foods. The results are still preliminary, but the evidence shows that the effects of the Mexican taxes on calories consumed in-home are very small. Results also show that lower SES may pay a higher percentage of their income from these taxes. This paper does not study health benefits which may impact the different SES differentially.

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