IMPACT OF SSB TAXES ON CONSUMPTION

Judit Vall Castelló

Universitat de Barcelona & Institut d'Economia de Barcelona

Centre for Research in Health and Economics
Universitat Pompeu Fabra

Guillem López-Casasnovas

Department of Economics

Centre for Research in Health and Economics

Universitat Pompeu Fabra

Barcelona

April 2018

CRES-UPF Working Paper #201804-110

IMPACT OF SSB TAXES ON CONSUMPTION

JUDIT VALL CASTELLÓ

UNIVERSITAT DE BARCELONA & INSTITUT D'ECONOMIA DE BARCELONA
CENTRE FOR RESEARCH IN HEALTH AND ECONOMICS
UNIVERSITAT POMPEU FABRA

GUILLEM LOPEZ CASASNOVAS

DEPARTMENT OF ECONOMICS & CENTRE FOR RESEARCH IN HEALTH AND ECONOMICS
UNIVERSITAT POMPEU FABRA

Abstract:

In this paper we analyze a tax on Sugar Sweetened Drinks (SSB) that was introduced in Catalonia on 1st May of 2017. The Bill established the requirement of a 100% pass-through of the tax to the final consumer. This requirement introduces a new element which has not been present in SSB taxes introduced in other countries. Thus, previous literature focusing on the impact of SSB taxes finds small or zero effects on consumption as the pass-through of the tax into final prices is generally lower than 100%. Our paper provides new evidence that when the tax increases prices substantially, the consumption response is also large. In particular we estimate that the new SSB tax in Catalonia reduced SSB consumption by 22% vis-à-vis zero/lights. We document that part of this effect is due to the reduction in SSB consumption while part of it is due to increases in zero/light drinks (substitution effect). Importantly, the reduction in consumption was stronger in non-touristic regions and in areas with a stronger incidence of obesity. We believe that our results are informative for policy-makers that plan to introduce similar taxes in other countries, like the UK, Ireland or South Africa which are set to implement an SSB tax in 2018.

1. Introduction

Overweight and obesity are a growing health problem in most developed countries. 54% of the adult population in OECD countries was overweight in 2015 and around 19.5% of the population was obese (see Figures 1 and 2 below, OECD Health Statistics 2017). These figures are much higher for some countries like the USA where 70% of the adult population is overweight and 38% obese. Furthermore, overweight and obesity are not only a problem for the adult population but it is also affecting children: 23% of boys and 21% of girls are overweight in the OECD (see Figure 3, OECD 2014). High overweight rates among children are worrying because this will entail increases in public health problems in the future. Indeed, OECD projections show a steady increase in overweight rates at least until 2030 (OECD, 2017).

The consumption of sugar is considered to be one of the driving causes of the growing overweight and obesity rates and sugar consumption and excess caloric intake comes to a large extent from the consumption of Sugar-Sweetened Beverages (SSBs from now on[1]). For all these reasons the World Health Organization issued a report in 2016 with a number of recommendations for governments in developed countries, such as the introduction of taxes for products that are harmful for health (with a special emphasis to those inducing non communicable diseases like diabetes, obesity and cardiovascular problems) and encouraging the consumption of fruits and vegetables in individual's diet (WHO, 2016). Following the recommendation of the WHO, governments (either national, regional or municipal) are creating taxes on these products with the aim of reducing their consumption and improving population health in the short and long term. Mexico (in 2014), France (in 2012) and some states in the USA (Berkeley in 2015 and more recently Seattle, Philadelphia, Boulder and Oakland) are examples of this very recent trend and have introduced taxes on sugar sweetened drinks (SSB)[2].

In March 2017 the Parliament of one of the 19 regions in Spain, Catalonia, approved a tax on SSB's that was implemented in Catalonia on May 2017. The aim of the tax, as in the other countries, was to foster the reduction in the consumption of these drinks. The amount of the tax depends on the sugar content of the drink and the law established that the whole increase in price had to be translated to the final consumer (100% pass-

[1] Block G. Foods contributing to energy intake in the US: data from NHANES III and NHANES 1999---2000. J Food Compos Anal. 2004;14(3---4):439---447.
Reedy J, Krebs-Smith SM. Dietary sources of energy, solid fats, and added sugars among children and adolescents in the United States. J Am Diet Assoc. 2010;110(10): 1477---1484.

[2] In Spain, a number of studies have advocated in favour of higher taxes: Lopez Cassanovas 2013; Gil, Lopez-Casasnovas and Mora 2013, and Ortun, Gonzalez and Pinilla 2016 among others.

through to final prices). In this paper, we present the first evaluation of the tax on SSB consumption in Catalonia. We use data from a large supermarket chain which represents 10% of the Catalan market. Using data on final prices, we first show that, indeed, the tax was 100% passed through to the final consumer. We next focus on consumption and show that the new SSB tax in Catalonia reduced SSB consumption by 22% vis-à-vis zero/light drinks. We also document that part of this effect is due to a reduction in SSB consumption while part of the effect is due to increases in the consumption of zero/light drinks (substitution effect). Furthermore, the reduction in consumption was stronger in non-touristic regions and in areas with a stronger incidence of obesity. Our paper provides new evidence that when the increase in prices is substantial the consumption response is also large.

The pass-through rate, that is to say, the extent to which the tax is shifted to final prices paid by consumers, is one of the most relevant aspects for policymakers before being able to assess the effectiveness of the tax in reducing consumption (beyond the secondary goal of obtaining revenues). Pass-through rates vary across products, brands, regions and package sizes.

There are some studies examining different experiences, such as the Mexico case where an excise tax on SSBs was introduced in 2014. A recent study on the SSB tax in Mexico reports that, on average, the tax was entirely passed to final prices but with stronger changes on small packages, over-shifting in carbonated SSBs and under-shifting in non-carbonated SSBs (Colchero *et al* 2015). Another experience that has been quite studied is the case of Berkeley (California), where the government of the city introduced an excise tax on SSBs in 2015. In this case, there is evidence of greater variability in the pass-through of the tax, being the average 43.1%. Factors such as distance to city's border, package size and retailers make this percentage vary substantially (Cawley *et al*, 2017). Similar results are found by Falbe *et al* (2015), studying the Berkeley's case they observe large variations depending on the type of product, brand and retailer, and the average estimated pass-through rate is around 47%. In Europe there are also some examples; in Denmark some changes in taxes on beverages (also alcoholic drinks) were introduced. Focusing on the evolution of prices after those changes, Bergman and Hansen (2016) find that the pass-through is close to one but with differences across products; beer and soda seem to have lower pass-through rates while liquors report higher pass-through rates. Interestingly, the authors find heterogeneous responses in price changes for tax cuts and for tax increases: tax cuts are mostly not translated into

price reductions while tax hikes do increase prices. Distance to German's border also influences the pass-through rate, like in the Berkeley case. The closest example to the Catalan tax is a soda tax set on France in 2012. The tax targeted both beverages containing sugar as well as light beverages containing sweeteners. Berardi et al. 2012 estimate price changes at the product level and find that the tax is completely passed-through for soda drinks, and only partially passed-through (between 60 and 85%) for other types of taxed beverages. They also report important variability depending on the retailer (Berardi *et al* 2012). Different results are found by Etilé *et al* (2017), who also analyze the French soda tax following a different approach: in order to account for substitution effects, they estimate joint index prices for SSBs and NCSBs (Non-Calorically Sweetened Beverages) instead of looking at prices at the product level. Their results are lower than the ones reported by Berardi et al. 2012, as they estimate a pass-through rate of 30% for SSBs and of 32.6% for NCSBs.

The Catalan law obliges retailers to shift the entire tax to final prices so that the pass-through rate is a less important outcome to analyse. In any case, we will also provide evidence that the requirement was fulfilled and that the tax was, indeed, fully transferred to the final consumer. Therefore, the most relevant issue in the Catalan tax is the evaluation of the extent to which the increase in prices affects the consumption of SSBs. Previous literature focusing on changes in consumption after the introduction of taxes on SSBs reports small and ambiguous results. Taxes on sweetened drinks and snacks in Maine (introduced in 1991) and on a wide range of soft drinks in Ohio (introduced in 2003), have been found not to alter the consumption of sugar or fat. In Maine prices remained unchanged (both at the brand as well as at the aggregate level), which would explain the lack of consumption responses. In Ohio prices marginally changed although these changes were small and potentially not attributable to the tax, which can also explain the lack of consumption responses in this case (Colantuoni & Rojas, 2015). On the other hand, Harding & Lovenheim (2017) use a large transaction-level dataset for a representative sample of US consumers to calculate price and expenditure elasticities. They then simulate the demand response to the introduction of product taxes on soda, SSB's, packaged meals, snacks, and nutrient taxes on fat, salt and sugar. They find larger impacts of nutrition rather than product taxes (as they avoid substitution effects) and, in particular, sugar taxes are highlighted for being an important tool in inducing healthier choices among consumers. Finally, Fletcher *et al* (2010a) exploit state variation in the USA in excise taxes, sales taxes and special

exemptions from sales taxes for the case of soft drinks to evaluate their impact on body mass index, obesity and overweight. Their results show that state-level taxes on soft drinks in the United States have a small impact on behaviour and weight (a decrease in overweight and obesity rates of around 0.02% and 0.03%). The authors claim that the small effects of soft drink consumption on weight is reasonable given that soft drinks only represent 7% of total energy intake and tax rates are small.

In a related paper, Fletcher *et al* (2010b) estimate demand functions for soft drinks with US data in order to evaluate the impact of state soft drink sales and excise taxes on child and adolescent consumption of soft drinks. Based on these two types of taxes, they find that soft drink taxation lead to a moderate reduction of soda consumption by children and adolescents. However, they also report that this moderate reduction in soft drinks consumption is completely offset by increases in the consumption of other high-calorie drinks (such as juice and juice-related drinks and whole milk). More specifically, they report that a 1 percentage point increase in soft drinks tax rates increases caloric intake from milk by 13%. The presence of these substitutes offsets the reduction of caloric intake due to less soda consumption, so there is no evidence that a tax on soft drinks reduces overall caloric intake.

As we have revised above, the existing literature on the impact of SSB taxes on consumption is not very extensive as the use of fiscal policies to reduce the consumption of SSBs is a relatively new issue. Of course, some less specific sales and excise taxes already existed in a number of countries but the new taxes targeting specifically SSB products are in place only since the last decade. Therefore, we contribute to this new literature in several dimensions. First, we study the first SSB tax that requires a 100% transfer to the final consumer, which is something not included in previous SSB taxes introduced in France, Mexico or Berkeley. This requirement increases final prices of SSB drinks substantially, especially for the case of big recipients which experience increases in prices of more than 20% as a result of the tax. This price increase is in line with the recommendations of the WHO for SSB taxes to be effective. Therefore, we provide evidence that, when the increase in prices is big enough, consumption responses are also important. Furthermore, we run several heterogeneity tests to understand the type of regions and consumers that proof to be more responsive to the tax. Finally, we also explore the consumption response for potential substitutes. We believe that our results are informative for policy-makers that

plan to introduce similar taxes in other countries, like the UK, Ireland or South Africa, that plan to introduce SSB taxes in 2018.

2. The Catalan Tax on sugar-sweetened drinks

On the 22nd March 2017, the Catalan Parliament enacted a tax on Sugar-Sweetened Beverages, which is included in law (5/2017)[3]. This tax was planned to come into force on the 1st April 2017, but given that its implementation required changes in the receipt systems of the companies, the final introduction of the tax was delayed until the 1st May 2017. The tax affects the consumption of SSB's in the entire Catalan territory independently of the place where the SSB's have been produced.

The aim of this tax is to reduce the consumption of these beverages given the negative effects of excessive sugar consumption on population health. This objective is in line with the recommendation issued by the World Health Organisation (WHO) in a report from October 2016 encouraging governments to tax SSB's to reduce obesity and diabetes problems (WHO, 2016).

According to the law, SSBs are all those beverages containing caloric added sweeteners such as sugar, honey, fructose, sucrose, or several types of syrups (rice, corn, agave…). This includes soda drinks, fruit juices, sport drinks, teas and coffees, energetic drinks, sweetened milks and shakes, vegetal drinks and flavoured waters. Any kind of beverage which does not contain added caloric sweeteners is not taxed. Other beverages excluded from the tax are drinkable yoghourts, drinkable fermented milks, products used for medical reasons and alcoholic drinks (see Table 2).

The Bill establishes that the tax is paid by the person (legal or physical) providing the beverage to the final consumer, that is to say, retailers, bars and restaurants, cinemas, vending machines, etc. However, the distributor may act as the payer of the tax under some circumstances (even the producers can be the payers of the tax in case of direct sales), always under the premise that the tax has to be 100% transferred to the final consumer. This is, in fact, how it generally works in practice; the distributor, which is a much more concentrated market, is the one paying the taxes and transferring it to its clients: retailers, bars and restaurants, etc... In order to do so, the distributor must include the tax in the invoice under the concept "IBEE" (*Impost de Begudes Ensucrades Envasades*), SSB tax in Catalan. The tax must be included in the VAT tax base.

[3] Published in the DOG n. 7340, the 30th of March

In our case, the supermarket chain is the single and direct tax payer. The tax base is the quantity, in litres of SSB, supplied to the consumer. The tax rate varies depending on the quantity of sugar contained in the beverage. For drinks containing between 5 and 8 grams of sugar each 100 millilitres, the tax is 0.08 euros per litre. For drinks containing more than 8 grams per 100 millilitres, the tax is 0.12 euros per litre (see Table 1).
The tax is payable from the moment the consumer has purchased the product.

Table 1. Summary of the price increases regulated by the law.

Grams of sugar per 100ml	Tax per liter
0-5	Exempt
5-8	0.08 €
>8	0.12€

Table 2. Products taxed and non-taxed.

Products taxed	Products not included
-Soda drinks -Fruit juices or fruit nectars -Sport drinks -Teas and coffees -Energetic drinks -Sweetened milks, shakes and juices containing milk. -Vegetal drinks -Flavoured waters	-Natural fruit or vegetable juices -Milk or milk-derived drinks not containing added caloric sweeteners -Drinkable yogurts -Drinkable fermented milks -Alcoholic drinks -Products for medical usage

3. Data

We have data of one big supermarket chain operating in all the Catalan territory that has a 10% of the Catalan market share. We have weekly data on the total number of sales by type of product (at the individual level for 105 products comprising SSB's of different brands, zero/light products from different brands and water from different brands) from 2016 and 2017 for each of the stores that the supermarket chain has in Catalonia (around 160 stores). We also have detailed information on the location of the store,

which will allow us to aggregate the information for groups of stores placed in the same region in order to explore heterogeneous effects by income level, and other characteristics of the region. Thus, we create 18 different income level regions according to the Family Available Gross Income (*RFDB*) data provided by the Catalan Statistical Office (IDESCAT) (for the municipalities and the counties) and by the Barcelona's Town Hall (for the Barcelona Districts), (see Table 1 in the Appendix). Additionally, assuming that the price elasticity demand of the poorest regions could be different from the richest one, we will also explore the existence of heterogeneous responses to the tax along the family income dimension. Thus, we split the sample in supermarkets located in one of the nine richest regions of Catalonia and supermarkets located in one of the nine poorest regions in Catalonia (see Table 4 and Table 1 in the Appendix for more details of this classification).

Moreover, in the robustness text section we analyze the potential heterogeneous response to the introduction of the tax along three additional geographical dimensions. First, we exploit the huge differences in terms of family income that are present in the city of Barcelona in order to explore, in a more accurate way, the way in which the SSB tax affects consumption in terms of income. Using data collected from the Barcelona's City Hall, we split the sample in two groups: the first one includes neighborhoods that have a higher family income than the mean in Barcelona while the second group includes neighborhoods that have a lower family income than the mean in Barcelona (see Table 22).

Second, we study the impact of the tax in more and less touristic regions in Catalonia. Some of the regions in Catalonia are places with a strong presence of tourism, which may potentially be less affected by the tax. Therefore, in order to verify our hypothesis, we split the sample into the three most touristic and the three less touristic areas in Catalonia using data from the Catalan Statistical Office on the percentage of tourist received in each area in 2017. With this purpose, we divide the sample between supermarkets that are located in one of the three most touristic areas[4]: Barcelona, which received 40.8% of all tourist that visited Catalonia in 2017, Costa Brava which received 17.2% of all tourists that visited Catalonia in 2017 and Costa Daurada which received 14% of all tourists, and supermarkets that are located in one of the less touristic areas: Paisatges de Barcelona which received 1.3% of all tourists in 2017, Terres de Lleida

[4] Tourist areas are defined by the Catalan Agency of Tourism that groups territories according their tourist and cultural features.

which received 1.4% of all tourists and Terres de l'Ebre which received 1.5% of all tourists in 2017 (see Table 23 for more details).

Finally, the third geographical division that we use is regions with higher obesity rates and regions with lower obesity rates. As explained above, the main aim of the tax is to reduce SSB consumption in order to improve population health and decrease the negative health consequences associated with an excessive consumption of sugar. Thus, if we find that the tax was most effective in areas with higher obesity rates, we have reasons to think that there could be potentially positive effects of the tax on population health. In order to do that, we use data from the Catalan Health Survey (ESCA) in 2016 and we collect information on the percentage of the population who is obese for the seven sanitary regions in Catalonia. We divide the sample between supermarkets located in regions with a higher obesity rate: Alt Pirineu/Aran with a 16% obesity rate, Camp de Tarragona with a 17% obesity rate and Terres de l'Ebre with a 19% obesity rate, and supermarkets located in areas with a lower obesity rate: Barcelona with a 14% obesity rate, Catalunya Central with a 15% obesity rate, Lleida with a 15% obesity rate and Girona with a 15% obesity rate (See Table 24).

We collect information on the grams of sugar per liter of product for the 105 products and we group them into three groups of products: 1) SSB's if the product has 5 or more grams of sugar per 100ml; 2) zero/lights if the product has less than 5 grams of sugar per 100ml and 3) water if the product is water without added sugar. Only the first group of products, SSB's, are subject to the tax.

We also classify products according to the size of the recipient. That is, products with a recipient of 0,5 liters or less are classified as "small recipient". On the contrary, if the product is stored in a recipient of more than 0,5 liters we classify them as "big recipient". This is important because the size of the recipient is a key variable in explaining the percentage increase in the price due to the law; big recipients are usually cheaper than small recipients (for the same product) and they include the same amount of sugar per 100ml (which determines the increase in the price as dictated by the law). Therefore, this may result in different consumption responses of consumers according to the size of the recipient due to the different percentage increase in prices for small and big recipients.

Additionally, in order to corroborate that the introduction of the tax was fully transferred to the final consumer, as stated by the law, we also have information on prices of each of the products: one observation with the price of all 105 products one

month before the introduction of the reform and one observation with the price of all 105 products one month after the introduction of the reform.

4. Econometric Strategy & Results

4.1. Price changes

As explained above, we only have information of prices in one point in time before the law (one month before) and one point in time after the law (one month after) for the 105 products included in our sample. Therefore, we calculate the increase in prices between these two points in time for these products. Figure 4 shows the increase in price in percentages, by size of the recipient. As we can see, there is no change in prices for zero/light products of any size, which is consistent with those products not being subject to the SSB tax. Similarly, for water products there is no general increase in prices except for small bottles for which we observe a reduction in prices. On the other hand, we can see that, for all sizes, there is an increase in the prices of SSB products. Furthermore, the increase in prices is higher for larger recipients. More specifically, prices increase between 5-10% for smaller recipients (cans) and around 20% for bigger recipients. This is in line with the WHO recommendation which establishes that retail prices should increase by 20% or more in order for the SSB tax to result in proportional reductions in consumption (WHO, 2016). In fact, we can see in Figure 4 that for SSB's in two liters recipients, the price increases on average by around 23%.

In order to understand whether the price increase observed in Figure 4 corresponds to the increase dictated by the law, in Figure 5 we compare the real increase in prices observed in our data with the increase stated by the law. The figure shows a solid line in which we calculate the price change dictated by the tax according to two characteristics: total liters (size of the recipient) as well as grams of sugar that the product contains. The dots, on the other hand, show the real increase in the price of the products observed in our data and we plot them (averaging) also according to these two characteristics (liters and grams of sugar).

Thus, the first thing to highlight is that the real increase in price was almost identical to the price increase dictated by the law. This is true for all products. Again, there is no change in prices for non-taxed products. Therefore, we conclude that the required pass-through rate of a 100% was enforced for most of the products subject to the tax. This requirement in the Catalan law is a unique feature as SSB taxes implemented in other

countries do not establish a pass-through rate by law. In those other cases, the tax is usually only partially transferred to the final consumer, which makes the consumption response smaller.

For the Catalan tax, we present evidence that the pass-through rate was 100% as dictated by law and that, for some products (especially SSB's in big recipients), the increase in the final price was remarkably high. This fact makes us suggest that the change in consumption can also be large.

4.2. Consumption changes

After providing evidence that the change in price was relatively large, particularly so for SSB's in big recipients, and that other non-taxed products did not experience a change in prices, we next explore the potential changes in consumption patterns brought about by the implementation of the tax.

We start by looking at some descriptive evidence on the evolution of consumption patterns for 2017 (from week 7; 12-18 February 2017, to week 32; 6-12 August 2017) for SSB's and zero/light products. We can see in Figure 6 that the consumption of SSB (left-hand axis) in 2017 is higher than the consumption of zero/light products (right-hand axis) although the consumption patterns are pretty similar. However, from week 17 (last week of April 2017) there is a drop in the consumption of SSB's which is much higher than the drop in the consumption of zero/light products. It is also important to note than two weeks before the introduction of the policy, in week 16, there is a strong increase in the consumption of SSB's which is also happening, to a lower extent, for the consumption of zero/light products. From week 25 (18-24 June) onwards there is again an increase in the consumption of both types of products coinciding with the summer months (week 25 is also the last week of school in Spain). The same pattern can be observed for both high and low income regions (Figures 7 and 8) while the drop in SSB consumption following the introduction of the SSB tax is much more pronounced for big recipients than for small recipients (see Figures 9 and 10). We can see the same figures for the evolution of the consumption of SSB and water products in Figures 11 to 15. Water products show a strong increase in consumption from week 19 onwards and this increase is stronger in high income regions (Figure 12) and for small recipients (Figure 15).

Finally, if we compare the individual evolution of each type of product in 2017 versus 2016, we can see in Figure 16 that the consumption of SSB's was higher in 2017 than in

2016. However, after the tax was introduced in week 18 of 2017, the consumption of SSB's dropped and reached the same level than the consumption in 2016. Thus, it seems like the tax equalized the consumption of SSB's in 2016 and 2017. For zero and light products we can see in Figure 17 that the consumption was also higher in 2017 than in 2016 but the introduction of the tax did not change this difference in consumption levels between the two years, which is consistent with the fact that these products were not subject to the tax. If we now turn to the evolution of water drinks we can see in Figure 18 that the consumption was maintained at the same level for 2016 and 2017 for weeks 7-17 but in 2016 the consumption of bottling water decreased from week 18 while in 2017 the consumption of water increased from the same week.

We now turn to the econometric model to estimate the causal effects of the introduction of the tax on consumption behaviour. We start by focusing only in 2017, the year in which the policy was implemented, and comparing the time series evolution of consumption choices for SSB's before and after the introduction of the policy (in week 18) with the consumption patterns of non-taxed drinks. In particular, we select as comparison groups 1) zero and lights drinks and 2) water.

More formally, we estimate the following model:

$$P_{its} = \alpha + \beta_1 SSB_i + \beta_2 Post + \beta_3 SSB_i * Post + \delta_t + \gamma_r$$

Where Ptir represents the purchases of product "i" (105 products) in week "t" and store "s" (around 160 stores). SSB is a dummy variable equal to 1 for taxed sugar sweetened products and zero otherwise and "Post" is a dummy variable that takes the value of 1 for the period after the implementation of the policy (from week 18 onwards which corresponds to the week from 30 April to 6 May, 2017). The model includes week fixed effects and income region fixed effects (18 income regions). Thus the coefficient β_3 identifies the effect of the introduction of the SSB tax on the consumption of SSB products vis-a-vis either zero/light products or water in the year that the policy is introduced. Standard errors are clustered at the income region level.

Table 3 shows that the consumption of SSB products decreased in 1.3 liters per week per product and store vis-à-vis the consumption of zero/light products. The coefficient of the policy when the comparison group is water suggests that the tax decreased the consumption of SSB's by 58 liters per week, product and store. We can see in Table 5

that this effect is stronger for low income regions when compared to zero/lights drinks and the reduction is especially important for big recipients when compared to zero/light products (Table 6).

When we only include information for 2017 we can see that the estimated effect of the policy is quite different depending on whether the control group is light/zero or water.

Thus, this could be due to the existence of seasonal effects specific for each type of product group or other elements (different from the tax) that may affect the consumption behavior of these three types of products in a different way. In order to try to control for these potential confounders, we next include information for the same weeks (7 to 32) for the year 2016, the year before the introduction of the tax. Thus, if there are different seasonal patterns for each type of product, by including the consumption behaviour of 2016 we will be able to control for these patterns.

Thus, we estimate a triple difference model in which we compare the sales of SSB products against zero/light products (or water) before and after the week of May 1st in 2017 against the same change before and after the week of May 1st in 2016. This specification allows us to control for any seasonality in the consumption of SSB, zero/light and water products as we are comparing the behaviour in 2017 against the behaviour in 2016.

In particular the model that we estimate is:

$$P_{its} = \alpha + \beta_1 SSB_i + \beta_2 Post + \beta_3 2017 + \beta_4 SSB_i * Post + \beta_5 SSB_i * 2017 + \\ + \beta_6 Post * 2017 + \beta_7 SSB_i * Post * 2017 + \delta_t + \gamma_r$$

As before P are the purchases of product “i” in week-year “t” and store “s”. SSB is a dummy variable that refers to taxed products (sugar sweetened drinks), “Post” is a dummy variable that takes the value 1 for weeks starting on the 1st May (week 18 onwards) and “2017” is another dummy variable taking the value of 1 for year 2017. We control for fixed effects of week-year and for fixed effects of income region (18 income regions).

We can see in Table 7 that, compared to the purchasing behaviour of zero/light products, the purchases of SSB’s decreased by almost 6 liters per week, product and supermarket establishment. Thus, it is important to include the year 2016 and control for potential seasonal effects by product type as the estimated effect of the policy increases in size with respect to the results including only 2017. As the mean consumption of

SSB's before the reform per establishment, product and week amounts to 26.95 liters, the reduction in consumption of 6 liters represents an impact of the reform of 22.2%. Furthermore, as we have around 160 establishments in our sample and 42 products (out of the 105) are SSB's, we estimate a reduction in SSB's consumption by 40320 liters per week. As our data comes from a supermarket chain that represents almost 10% of the Catalan market, our estimates suggest that the SSB tax reduced consumption of SSB products by 403200 liters per week, which is a non-negligible quantity. If we estimate the same model but using water as a comparison product, we can see that the impact of the policy is larger with a reduction in SSB consumption of 16 liters per week and establishment. Although this coefficient is still larger than the estimated reduction of 6 liters when compared to lights/zero, we can see that the size of the estimated effect of the tax using light/zero is more similar to the size of the effect using water than the results using only data for 2017, which were very unstable depending on the control group chosen.

As before, we perform several heterogeneity tests to understand the characteristics of the SSB products as well as the types of consumers that are more affected by the introduction of the SSB tax.

Table 8 reports the results of the same model but for a sample of establishments located in high income regions in Catalonia whereas Table 9 reports the same results for establishments in low income regions (see the data section above and Table 3 for more detail on this categorization). We can see that the estimates are similar across income groups although the effects are slightly stronger for high income regions (an estimated reduction of 17.7% in low income regions versus a reduction of 27.5% in high income regions when the comparison group is zero/light beverages). The results become significant for low income regions also when the control group is water products and, as before, the size of the coefficient is higher when the control group is water (-4.8 liters per week, establishment and product versus -23.2 liters). For the high income regions the comparison with water products results in a non-significant coefficient.

Tables 10 and 11 show the results by type of container. We can clearly see that the main effects come from changes in the consumption of SSB's in big recipients. This is an important finding as it implies that those individuals that consume more SSB's (as they buy it in large recipients) are also the ones that are strongly reducing their consumption of SSB's in response to the introduction of the tax. This is also consistent with the findings in the previous section for prices, which showed that SSB's in big recipients

were subject to larger increases in its prices as a result of the tax. In Table 10 we can see that, for big recipients, SSB consumption is reduced by 26% compared to zero/light beverages while consumption in small recipients is reduced by 16% (Table 11).

The triple difference models compare the consumption of SSB with either zero/light products or with water products before and after the introduction of the tax and with respect to the same behaviour one year before the tax (in 2016). However, the coefficient of the triple interaction term represents the total effect of the policy, which can affect both the consumption of SSB's as well as the consumption of the control products: the consumption of light/zero and water products can increase as a result of the tax on SSB's. Therefore, in order to understand what part of the estimated effect in the triple difference model is strictly due to reductions in SSB's and what part is due to increases in the consumption of zero/light or water products, we estimate a separate model for each of the three types of products (SSB's, zero/lights, and water) comparing the consumption behaviour in the weeks after the introduction of the tax in 2017 with respect to the consumption in the weeks before the introduction as well as with respect to the same consumption pattern in 2016, which allows us to also control for any seasonality trends affecting only SSB's, zero/light products or water.

Thus, the model that we estimate is the following:

$$P_{its} = \alpha + \beta_1 Post + \beta_2 2017 + \beta_3 Post * 2017 + \delta_t + \gamma_r$$

As before P are the purchases of product "i" in week-year "t" and store "s". Post is a dummy variable that takes the value 1 for weeks starting on the 1st May and 2017 is another dummy variable taking the value of 1 for year 2017. We control for fixed effects of week-year and for fixed effects of income region. We estimate this model separately for SSB's, for zero/lights and for water drinks. Therefore, the interaction between "Post" and "2017" will capture any changes in the purchases of SSB's (or zero/lights or water products) in the weeks after the introduction of the tax with respect to the weeks before the tax and in comparison with the same difference in 2016.

In Table 12 we can see that the purchases of SSB's are reduced by 4.7 liters per product, establishment and week, which implies a reduction by 15.42% with respect to the mean of SSB purchases before the reform. At the same time, in the second column of Table 12 we observe that the purchases of zero/light products increase in 3.5 liters per product, establishment and week. Thus, almost 75% of the decrease in SSB consumption is

substituted by consumption of zero and light drinks. In the third column of Table 12 we can see that the impact of the tax does not significantly affect the consumption of water products. Comparing Tables 13 and 14 we can see changes in the consumption of the three types of products in high versus low income regions. As before, the effects are very similar in high and low income regions although slightly bigger for high income regions. In Table 13 we estimate that the consumption of SSB's was reduced by 4.8 liters per product, establishment and week in high income regions (an impact of 14% with respect to the mean) while the consumption of zero/light products increased by 8 liters. On the other hand, in Table 14 we can see that, in low income regions, the reduction in SSB's consumption was of 3.8 liters (an impact of 13%) and the increase in zero/light products amounted to 1.6 liters. In the two regions the impact of the SSB tax on water consumption is not significant.

Table 15 shows the results for big recipients while Table 16 shows the results for small recipients. We can see in Table 15 that consumption of SSB products in big recipients is reduced in 13.6 liters per product, establishment and week which implied a drop by 39% with respect to the mean. For big recipients we do not find a substitution to zero/light products but to water products, with an increase in its consumption by 67 liters. For small recipients (Table 16) there is no significant reduction in SSB products.

4.3. Robustness checks

We next present a series of robustness checks to assess the validity of the assumptions underlying the analysis as well as the strength of our results. As it can be seen in figures 6, 7 and 8, which plot the evolution of SSB's consumption against zero/lights products, there is a remarkable spike in week 16, two weeks before the introduction of the tax as well as a strong drop in week 17, one week before the tax comes into effect. If we analyse the same behaviour in the previous year, 2016, we can see in Figure 16 that there is no such spike in week 16 in the year before the introduction of the tax. The increase in consumption is, thus, most likely due to the imminent introduction of the tax. This hypothesis is reinforced when we look at Figure 24 which plots google trend searches for the word "sugar tax" in both Catalan and Spanish language. We can see a strong increase in those searches for weeks 17 and 18 of 2017. Therefore, our first robustness check is to assess the validity of our results when we drop from the sample week 17 as well as weeks 16 and 17 in order to avoid capturing any of these temporary

increases and decreases of the consumption of SSB. In Table 17 we can see that when we drop week 17 from the analysis the results are almost identical to the baseline results of the triple difference model reported in Table 7. We estimate a drop in SSB consumption of 6 liters per product, establishment and week when the comparison group are zero/light drinks and a drop of 14 liters per product, establishment and week when compared to water products. In our baseline regressions (showed in Table 7) the corresponding coefficients were 6 liters and 16.5 liters, which are almost the same.

In Table 18 we additionally drop week 16 from the analysis and we perform the regressions excluding both week 16 and week 17. We can see that, even without these two weeks, the results (a drop in 5.6 liters vis-à-vis zero/lights and a drop in 10 liters vis-à-vis water products) are almost exactly the same than our baseline results in Table 7.

Therefore, we conclude that our results are not dependent on potential anticipation effects of consumers, which seem to increase their purchases of SSB products around two weeks before the tax is implemented. Even when we do not take into account these anticipation effects, our estimates are almost identical in size and significance levels than our baseline results with the entire sample.

We have seen in the previous section that we do not find important differences in consumer's responses for high and low income regions. The policy is efficient in reducing the consumption of SSB across the Catalan territory in a very similar way with respect to income differences across regional units. In order to further explore the potential existence of different responses in the territory, we perform the estimation dividing the sample along several alternative dimensions. For example, in Table 19 we focus only on the city of Barcelona and we divide the neighbourhoods into those with a higher/lower household income, according to information provided by the Barcelona City Hall (see Table 22 for a detailed description of this categorization). As before, we do not find any important differences in the estimates for high and low income neighbourhoods in Barcelona and the tax has a strong and significant effect in all types of neighbourhoods. In Table 19 we can see that, when compared to zero and lights, we estimate a reduction in the consumption of SSB's of 2.2 liters per week, establishment and product in high income neighbourhoods while the effect is of 2.6 liters in the low income neighbourhoods. The second regional division that we implement is for touristic and non-touristic regions in Catalonia. As explained above, it could be the case that touristic areas do not respond so strongly to the SSB tax as there may be more people

unaware of the tax while, at the same time, tourists may be less responsive to increases in prices. In Table 23 we can see the division in touristic and non-touristic areas that we do as well as the percentage of the yearly tourists that each of the areas receives. For example, the three areas that we classify as non-touristic receive only 1.3%, 1.4% and 1.5% of all the tourists that visited Catalonia in 2017. On the other hand, the areas that we classify as touristic receive 40.8%, 17.2% and 14% of the tourists that visited Catalonia in 2017. Table 20 shows that the impact of the tax is, indeed, stronger in non-touristic areas with a drop in SSB consumption (compared to zero/light products) of 8 liters as compared to the drop of 6 liters experienced in touristic areas. When we use water products as the comparison group, the effect is again stronger in non-touristic areas.

Another regional dimension that is interesting to explore is differences in obesity rates. As the target of the tax is the reduction in the consumption of SSB due to the negative health impacts of excessive sugar consumption, in Table 21 we present the results for regions with a higher/lower obesity rate. We can see that regions with a higher obesity rate respond strongly to the reduction in SSB as a result of the introduction of the tax. In particular, SSB consumption is reduced by 9 liters in regions with a higher incidence of obesity while it is reduced by 5 liters in regions with a lower incidence of obesity. Thus, even if we do not have data on health outcomes, the result of a stronger drop in SSB consumption in areas with a higher incidence of obesity points towards potential long-term positive effects on health outcomes of the introduction of the tax.

Therefore, although the impact of the tax is significant in all the Catalan territory, we do report stronger effects in non-touristic regions as well as in regions with a stronger incidence of obesity.

Finally, we test the assumption of the existence of parallel trends in the weeks prior to the introduction of the SSB tax by estimating an event study model in which we interact the SSB identifier with a dummy for each of the weeks before and after the introduction of the tax. In these regressions we also include fixed effects for income regions and time (week) as well as an SSB identifier (to capture any permanent differences in the consumption of the different types of products). Therefore, the interaction term can be interpreted as the differential evolution in the consumption of SSB's before and after the introduction of the tax (vis-à-vis either zero/light products or water products). We define week 0 as week 17 which corresponds to the last week before the policy is introduced. Then, week 1 is the first week in which the policy is in place (week 18 from

30 April to 6 May). Figure 19, which plots the interaction coefficients of SSB consumption with respect to the consumption of zero/light products and the 95% confidence intervals, shows that in the six periods before the implementation of the tax, the evolution of both types of products is pretty similar up until week -1, when we see a strong and significant differential increase in the consumption of SSB's. This is consistent with the anticipation effect mentioned above that we already observed in the descriptive graphs (Figures 6 to 10). From week 0 onwards there is a substantial and significant drop in the consumption of SSB's which reinforces the estimated coefficients of our models. This drop is relatively permanent in the first 4-5 weeks of the tax. When we generate the same graph separately for high and low income regions, we can see (Figures 20 and 21) that the evolution is similar to the one described for the general case. However, the anticipation effect in week -1 is larger in high income regions, probably because they are better informed about the upcoming tax, and the subsequent drop in consumption seems to be more permanent in low income regions. Finally, Figures 22 and 23 show the same models but comparing the evolution of SSB consumption with the evolution of the consumption of water for high (Figure 22) and low (Figure 23) income regions. We can see that in both figures the consumption of SSB becomes significantly lower than the consumption of water from the second and third week. This is consistent with figures 12 and 13 showing descriptive evidence of the evolution of SSB and water products and showing a separation of the two consumption paths from the second week after the tax is implemented.

Overall, the results of the event study models reinforce the conclusions of our main findings of strong decreases in SSB consumption as a result of the introduction of the tax. They also confirm the existence of an anticipation effect around two weeks before the tax is introduced in which sales of SSB products increase substantially. In any case, as shown above, our results are consistent to the exclusion of these prior weeks in which the anticipation effect takes place.

5. Conclusions

In 2016 the WHO issued a report that called for the introduction of taxes on sugar-sweetened beverages in developed countries and, in particular, the WHO recommended that the tax should result in an increase in retail prices by 20% or more in order to be effective in reducing consumption. In this paper we analyze the impact of an SSB tax

introduced in Catalonia on May 2017 that required, by law, a 100% pass through of the tax to the final consumer. Therefore, final prices were effectively increased by more than 20% for SSB's in big recipients (2 liters) and by around 5-10% for small recipients (cans). Although SSB taxes have been recently introduced in other developed countries such as Mexico (2014), France (2012) and some cities in the USA (2015 in Berkeley and later on in Seattle, Philadelphia, Boulder or Oakland), none of these previous taxes included the requirement of a 100% pass through to the final consumer. Therefore, and as suggested by the WHO, we find evidence that when retail prices experience large increases due to the tax, consumption responses are also large. Our results show that consumption of SSB's decreased by 22% vis-à-vis zero/lights but the reduction was much more pronounced for big recipients (-26%) than for small recipients (-16%), following the differences reported in price increases. This effect is partly due to the reduction in SSB consumption and partly due to increases in zero/light drinks (substitution effect) whose prices remained stable. At the same time, our results show that the impact is stronger in non-touristic regions as well as in areas with a higher incidence of obesity rates. Therefore, there is scope for considering that the tax may lead to improvements in health outcomes in the middle/long term.

It is important to note that our data comes from a supermarket chain that covers the entire territory but represents 10% of the total Catalan market. However, if we assume that the consumption behavior would be similar for consumers in other supermarkets, we can use our estimates to develop a back-of-the-envelope calculation of the amount of grams of sugar and the corresponding calories that are saved as a result of the tax. Our baseline models show a reduction in SSB consumption of 403.200 liters per week (see the results section above). We know that each gram of sugar contains 4 calories and we can assume that SSB's have an average of 8 grams of sugar per 100ml. Thus, the reduction in SSB consumption saves 32.256.000 grams of sugar per week. From the Catalan Health Survey (2016 wave) we know that 22% of the population in Catalonia drinks SSB's on a daily basis (5.462.000 inhabitants aged 20-80 in Catalonia in 2016) which entails a reduction in 107 calories on average per person per week.

We believe that our results are informative for policy-makers that plan to introduce similar taxes in other countries, like the UK, Ireland or South Africa which are set to implement an SSB tax in 2018.

REFERENCES

Berardi, N., Sevestre, P., Tepaut, M. and Vigneron, A. (2012), *The impact of a 'soda tax' on prices.Evidence from French micro data.* Banque de France, Document de Travail Nº 415.

Bergman, U.M, Hansen, N.L. (2016), *Are Excise Taxes on Beverages Fully Passed Through to Prices? The Danish Evidence.* Danmarks Nationalbank Working Paper

Block G. (2004), *Foods contributing to energy intake in the US: data from NHANES III and NHANES 1999---2000*. J Food Compos Anal. 2004;14(3---4):439---447

Cawley, J., Frisvold, D.E., (2017), *The Pass-Through of Taxes on Sugar-Sweetened Beverages to Retail Prices: The Case of Berkeley, California.* Journal of Policy Analysis and Management, Vol. 36, No. 2, 303–326

Colantuoni, F., Rojas, C., (2015), *The Impact Of Soda Sales Taxes On Consumption: Evidence From Scanner Data*, Contemporary Economic Policy (ISSN 1465-7287) Vol. 33, No. 4, October 2015, 714–734, doi:10.1111/coep.12101

Colchero MA, Salgado JC, Unar-Munguía M, Molina M, Ng S, Rivera-Dommarco JA (2015), *Changes in Prices After an Excise Tax to Sweetened Sugar Beverages Was Implemented in Mexico: Evidence from Urban Areas*. PLoS ONE 10(12): e0144408. doi:10.1371/journal.pone.0144408

Etilé, F., Lecocq, S., Boizot-Szantaï, C., (2017) *The Incidence of Soft Drink Taxes on Consumer Prices and Welfare: Evidence from the French \Soda Tax"*. Working Paper.

Falbe, J., Rojas, N., Grummon, A.H., and Madsen, K.A., (2015). *Higher Retail Prices of Sugar-Sweetened Beverages 3 Months After Implementation of an Excise Tax in Berkeley, California.* American Journal of Public Health;105:2194–2201. doi:10.2105/AJPH.2015.302881

Fletcher, J., Frisvold, D.E., Tefft, N. (2010a) *Can Soft Drink Taxes Reduce Population Weight?*. Contemporary Economic Policy (ISSN 1465-7287) Vol. 28, No. 1, January, 2010, 23–35, doi:10.1111/j.1465-7287.2009.00182.x

Fletcher, J., Frisvold, D.E., Tefft, N. (2010b), *The effects of soft drink taxes on child and adolescent consumption and weight outcomes.* Journal of Public Economics 94, 967–974, doi:10.1016/j.jpubeco.2010.09.005

Gil J, G López Casasnovas and T Mora, 2013. Taxation of unhealthy consumption of food and drinks: An updated literature review, Hacienda Pública Española, IEF, vol. 207(4)

Harding, M., Lovenheim, M. (2017), *The effect of prices on nutrition: Comparing the impact of product-and nutrient-specific taxes.* Journal of Health Economics, http://dx.doi.org/10.1016/j.jhealeco.2017.02.003

López Casasnovas G (2013) ¿Cambia la fiscalidad y los estilos de vid? Impuestos para luchar contra la obesidad Rev Esp Salud Pública 2013; 87:541-548. Nº 6 Noviembre-Diciembre

OECD (2014), *Obesity and the economics of prevention: Fit not Fat, Key facts-Spain, Update 2014*. Link: https://www.oecd.org/spain/Obesity-Update-2014-SPAIN.pdf

OECD (2017), *Obesity Update 2017*. Link: http://www.oecd.org/health/obesity-update.htm

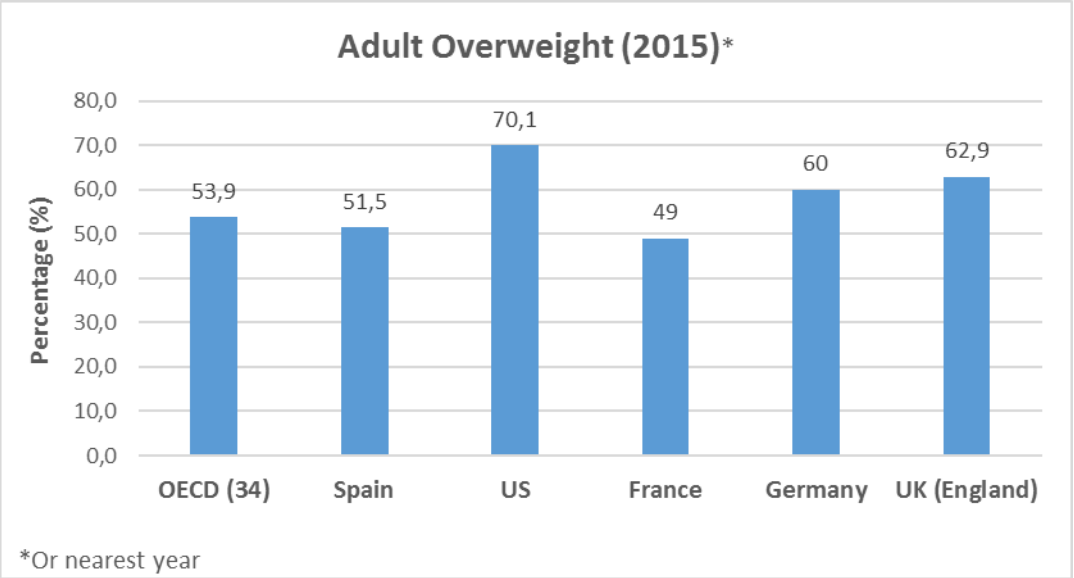
Ortún V, G López-Valcárcel B, Pinilla J. El impuesto sobre bebidas azucaradas en España Rev Esp Salud Pública. 2016;Vol. 90: 13 de octubre 9-140, December

Reedy J, Krebs-Smith SM. (2010), *Dietary sources of energy, solid fats, and added sugars among children and adolescents in the United States*. J Am Diet Assoc. 2010;110(10): 1477---1484

WHO (2016), *Fiscal Policies for Diet and Prevention of Noncommunicable Diseases: technical meeting report, 5-6 May 2015, Geneva, Switzerland.*

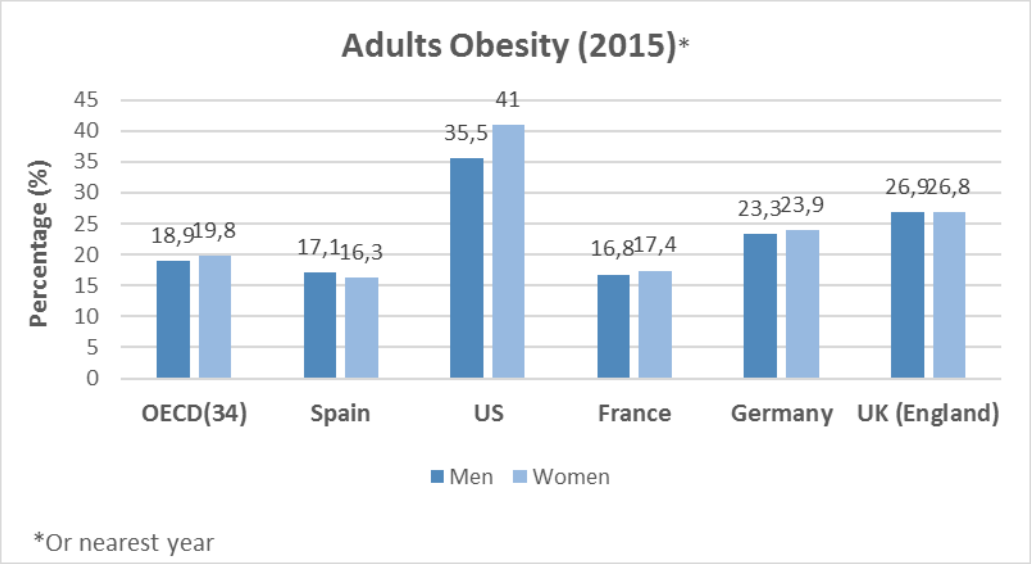
FIGURES AND TABLES

Figure 1. Adult overweight rates in selected countries.



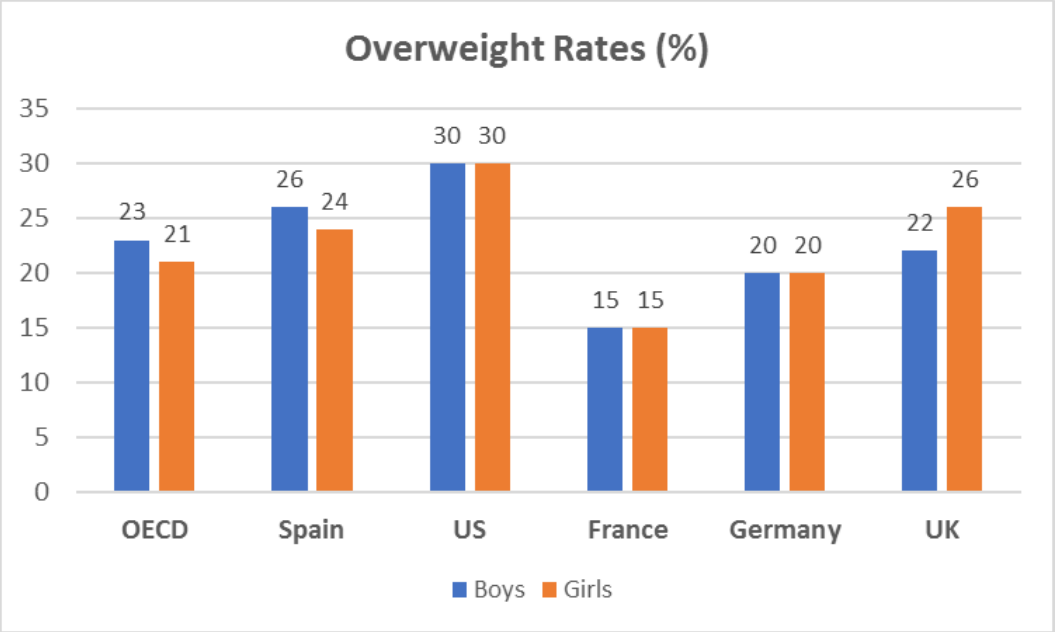
Source: OECD Health Statistics 2017.

Figure 2. Adult obesity rates in selected countries.



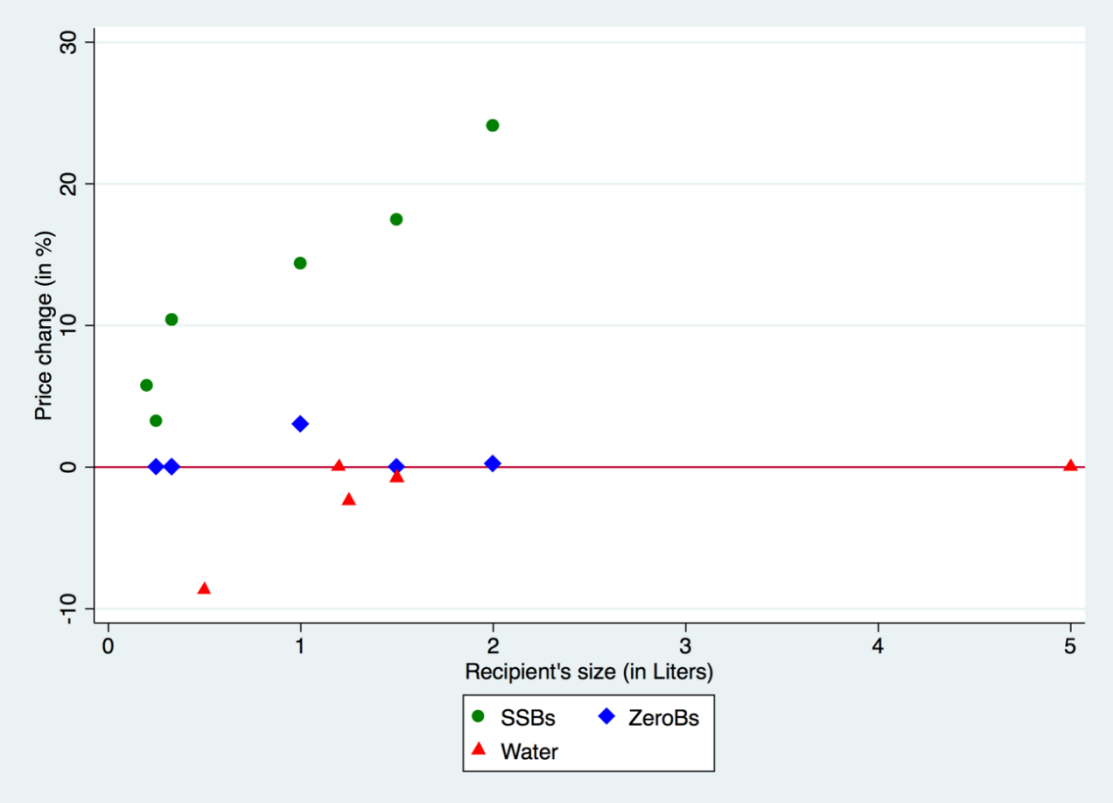
Source: OECD Health Statistics 2017.

Figure 3. Children's overweight rates in selected countries.



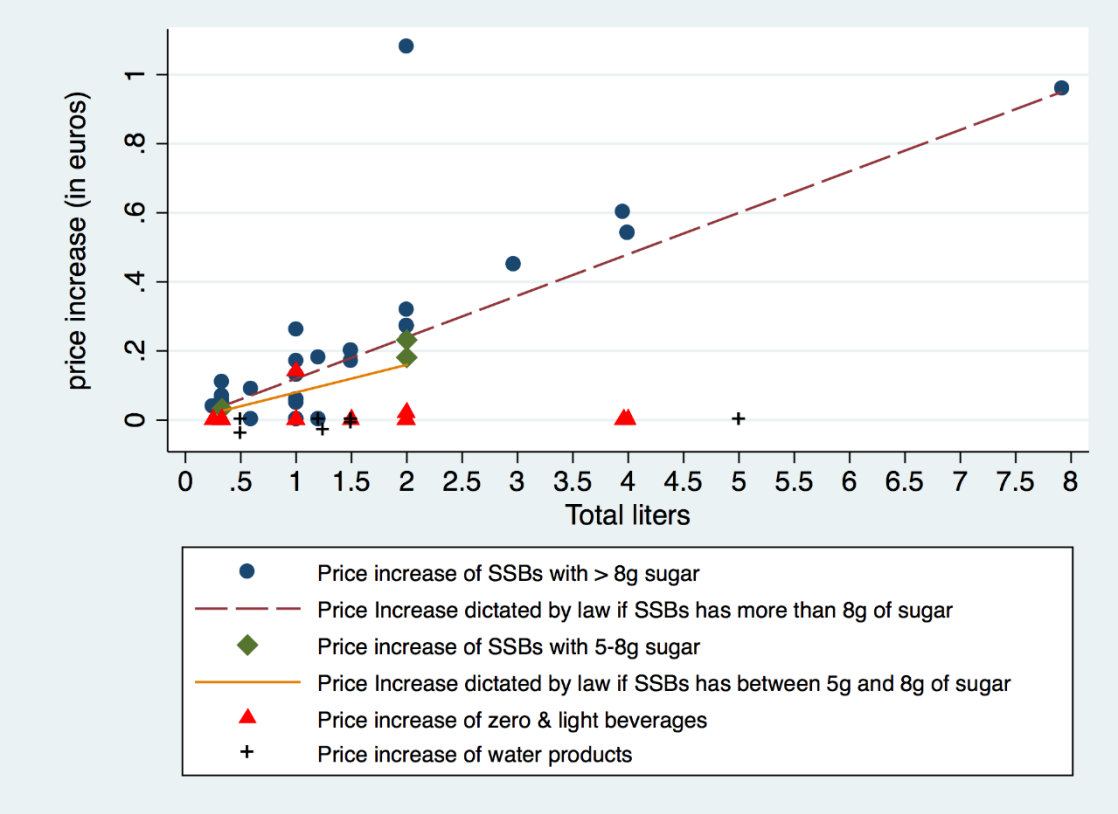
Source: OECD Report (2014).

Figure 4. Price change in percentage by recipient size.



Source: Author's own calculation using data on prices for 105 selected products one month before the introduction of the SSB tax and one month after the introduction of the tax. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 5. Price change in euros by total liters.



Note: The solid and dashed lines represent the average price increase dictated by the law depending on the content of sugar and the size of the recipient of each product. The other elements represent the real average increase in prices observed in our data for each product.
Source: Author's own calculation using data on prices for 105 selected products one month before the introduction of the SSB tax and one month after the introduction of the tax. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Table 3. SSBs against zero/lights and water, only 2017.

	SSBs vs Zero	SSBs vs Water
Post	18.30***	89.39***
	(5.694)	(22.45)
SSB	7.592***	-232.6***
	(1.446)	(18.21)
Post*SSB	-1.379***	-57.98***
	(0.464)	(9.887)
Constant	15.94***	256.6***
	(1.647)	(11.56)
Mean Dependent Variable	28.21	28.21
Observations	261,519	164,564
R-squared	0.036	0.194
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week and establishment and (2) SSB's and water products per week and establishment. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18, which corresponds to the week of 30 April-6 May in 2017, and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax. Standard errors are clustered at the income region level.

Table 4. Mean, maximum and minimum family available gross income by high/low income regions.

Income Region	**Family Income (In thousand €)**	**Max**	**Min**
Low	13.46	14.51	10.12
High	16.81	33.60	14.60

Source: Idescat (Catalan Statistical Institute).

Table 5. SSBs against zero/light and water – High/Low Income Region, only 2017.

	SSBs vs Zero High Income	SSBs vs Water High Income	SSBs vs Zero Low Income	SSBs vs Water Low Income
Post	33.52**	145.8***	10.60**	60.79***
	(9.945)	(38.08)	(3.544)	(17.33)
SSB	8.821***	-238.1***	6.953**	-229.6***
	(1.044)	(28.25)	(2.097)	(24.32)
Post*SSB	-0.350	-79.45***	-1.917***	-46.86***
	(0.943)	(16.89)	(0.305)	(9.095)
Constant	13.00***	253.9***	11.30***	225.5***
	(1.819)	(16.31)	(1.974)	(15.84)
Mean Dependent Variable	28.08	28.08	27.85	27.85
Observations	90,748	56,933	170,771	107,631
R-squared	0.053	0.193	0.027	0.196
Income Region FE	YES	YES	YES	YES
YearWeek FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) and (3) SSB's and zero/light products per week and establishment and (2) and (4) SSB's and water products per week and establishment. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18, which corresponds to the week of 30 April-6 May in 2017, and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax. Standard errors are clustered at the income region level.

Table 6. SSBs against zero/light and water – Big/Small Recipient, only 2017.

	SSBs vs Zero Big Recipient	SSBs vs Zero Small Recipient	SSBs vs Water Big Recipient	SSBs vs Water Small Recipient
Post	8.770**	27.38***	80.72***	93.00***
	(3.514)	(7.976)	(18.23)	(25.03)
SSB	10.77***	3.367**	-256.3***	-220.4***
	(1.417)	(1.545)	(19.80)	(18.23)
Post*SSB	-1.360*	-0.640*	-46.55***	-62.57***
	(0.685)	(0.354)	(7.920)	(11.01)
Constant	15.78***	16.62***	279.9***	243.2***
	(1.273)	(2.155)	(14.83)	(9.775)
Mean Dependent Variable	30.31	25.46	30.31	25.46
Observations	142,480	119,039	81,211	83,353
R-squared	0.052	0.042	0.255	0.163
Income Region FE	YES	YES	YES	YES
YearWeek FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) and (2) SSB's and zero/light products per week and establishment and (3) and (4) SSB's and water products per week and establishment. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18, which corresponds to the week of 30 April-6 May in 2017, and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax. Standard errors are clustered at the income region level.

Table 7. Triple Diff in Diff: SSBs against zero/lights and water.

	SSBs vs Zero	SSBs vs Water
Post	1.716**	30.22***
	(0.703)	(10.26)
SSB	8.813***	-262.7***
	(1.378)	(22.44)
2017	2.439***	-32.03***
	(0.548)	(6.852)
Post*SSB	4.537***	-41.43***
	(1.017)	(13.52)
Post*2017	16.60**	59.17***
	(6.324)	(13.87)
SSB*2017	-1.235***	30.10***
	(0.314)	(6.573)
Post*SSB*2017	-5.911***	-16.55**
	(0.646)	(6.273)
Constant	12.00***	281.2***
	(2.022)	(16.42)
Mean Dependent Variable	26.95	26.95
Observations	606,763	392,798
R-squared	0.050	0.211
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment and (2) SSB's and water products per week, year and establishment. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 8. Triple Diff in Diff: SSBs against zero/lights and water – High Income Region.

	SSBs vs Zero	SSBs vs Water
Post	-0.438	56.27**
	(0.831)	(18.53)
SSB	9.973***	-254.1***
	(1.009)	(29.94)
2017	2.958**	-15.95**
	(1.068)	(4.979)
Post*SSB	7.283***	-73.74**
	(1.473)	(25.24)
Post*2017	33.95**	89.48***
	(10.56)	(20.36)
SSB*2017	-1.174**	15.97***
	(0.420)	(4.261)
Post*SSB*2017	-7.627***	-5.704
	(0.763)	(10.11)
Constant	8.282**	262.5***
	(2.752)	(16.57)
Mean Dependent Variable	27.66	27.66
Observations	214,045	138,850
R-squared	0.073	0.203
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment and (2) SSB's and water products per week, year and establishment in high income regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 9. Triple Diff in Diff: SSBs against zero/light and water – Low Income Region.

	SSBs vs Zero	SSBs vs Water
Post	2.970***	15.97**
	(0.486)	(5.148)
SSB	8.265***	-267.3***
	(2.008)	(31.79)
2017	2.219***	-40.78***
	(0.621)	(8.510)
Post*SSB	2.910***	-23.65**
	(0.731)	(7.259)
Post*2017	7.632*	44.82**
	(3.885)	(14.95)
SSB*2017	-1.323**	37.75***
	(0.426)	(8.616)
Post*SSB*2017	-4.824***	-23.20***
	(0.560)	(5.272)
Constant	8.717***	267.1***
	(2.267)	(23.30)
Mean Dependent Variable	27.00	27.00
Observations	392,718	253,948
R-squared	0.037	0.218
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment and (2) SSB's and water products per week, year and establishment in low income regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 10. Triple Diff in Diff: SSBs against zero/light and water – Big Recipient.

	SSBs vs Zero	SSBs vs Water
Post	5.505***	51.94***
	(0.822)	(8.885)
SSB	13.42***	-251.1***
	(1.542)	(22.54)
2017	1.017	-2.899
	(0.703)	(7.057)
Post*SSB	6.656***	-37.75***
	(1.243)	(11.24)
Post*2017	3.278	28.81**
	(4.159)	(11.07)
SSB*2017	-2.673***	-5.257
	(0.320)	(7.059)
Post*SSB*2017	-8.006***	-8.801
	(0.803)	(5.925)
Constant	13.17***	275.3***
	(1.994)	(17.90)
Mean Dependent Variable	30.86	30.86
Observations	339,798	194,266
R-squared	0.079	0.274
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment and (2) SSB's and water products per week, year and establishment for products in big recipients. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 11. Triple Diff in Diff: SSBs against zero/light and water – Small Recipient.

	SSBs vs Zero	SSBs vs Water
Post	-1.441*	11.04
	(0.774)	(10.88)
SSB	3.613***	-274.3***
	(1.220)	(22.99)
2017	5.664***	-49.04***
	(0.735)	(7.856)
Post*SSB	2.967***	-43.15**
	(0.783)	(14.82)
Post*2017	28.85***	81.93***
	(8.672)	(16.56)
SSB*2017	-0.225	53.94***
	(0.584)	(7.312)
Post*SSB*2017	-3.603***	-19.42**
	(0.584)	(6.723)
Constant	9.289***	284.5***
	(2.115)	(15.55)
Mean Dependent Variable	22.01	22.01
Observations	266,965	198,532
R-squared	0.054	0.186
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment and (2) SSB's and water products per week, year and establishment for products in small recipients. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 12. Total Purchased Litters. 2016 vs 2017.

	SSBs	Zero and Light Beverages	Water
Post	23.93***	11.88**	144.0**
	(7.050)	(4.168)	(53.95)
2017	1.048**	2.587***	-40.73***
	(0.460)	(0.479)	(8.277)
Post*2017	-4.707***	3.540***	-19.37
	(1.111)	(1.105)	(16.51)
Constant	20.00***	14.04***	282.4***
	(1.481)	(0.958)	(12.31)
Mean Dependent Variable	30.48	20.55	302.76
Observations	284,464	216,267	72,152
R-squared	0.043	0.034	0.039
Income Region FE	YES	YES	YES
YearWeek FE	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's, (2) zero/light products and (3) water products per week, year and establishment. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards) and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 13. Total Purchased Litters – High Income Regions Only. 2016 vs 2017.

	SSBs	Zero and Light Beverages	Water
Post	41.60**	20.93**	267.7**
	(12.40)	(7.896)	(102.6)
2017	1.860*	2.773**	-21.01**
	(0.919)	(1.046)	(7.243)
Post*2017	-4.875**	8.065***	-35.47
	(1.936)	(1.327)	(38.84)
Constant	16.82***	12.11***	246.3***
	(2.353)	(1.837)	(16.88)
Mean Dependent Variable	32.86	20.9	316.77
Observations	99,977	75,562	25,088
R-squared	0.060	0.055	0.049
Income Region FE	YES	YES	YES
YearWeek FE	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's, (2) zero/light products and (3) water products per week, year and establishment in high income regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards) and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 14. Total Purchased Litters – Low Income Regions Only. 2016 vs. 2017.

	SSBs	Zero and Light Beverages	Water
Post	14.22**	6.874**	77.02**
	(4.430)	(2.706)	(32.49)
2017	0.592	2.529***	-51.83***
	(0.455)	(0.512)	(9.410)
Post*2017	-3.806***	1.615**	-5.729
	(1.006)	(0.553)	(7.691)
Constant	12.56***	14.72***	229.1***
	(1.449)	(0.743)	(7.142)
Mean Dependent Variable	29.17	20.36	295.19
Observations	184,487	140,705	47,064
R-squared	0.035	0.023	0.034
Income Region FE	YES	YES	YES
YearWeek FE	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's, (2) zero/light products and (3) water products per week, year and establishment in low income regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards) and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 15. Total Purchased Litters – Big Recipients Only. 2016 vs 2017.

	SSBs	Zero and Light Beverages	Water
Post	22.20***	7.897**	116.0**
	(6.430)	(3.134)	(46.10)
2017	-0.436	-0.306	-31.03***
	(0.714)	(0.590)	(6.800)
Post*2017	-13.64***	-0.455	67.59***
	(2.341)	(0.948)	(13.71)
Constant	24.50***	16.72***	286.3***
	(1.409)	(0.665)	(10.60)
Mean Dependent Variable	34.89	20.69	302.25
Observations	154,508	125,492	25,226
R-squared	0.051	0.036	0.050
Income Region FE	YES	YES	YES
YearWeek FE	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's, (2) zero/light products and (3) water products per week, year and establishment for products in big recipients. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards) and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 16. Total Purchased Litters – Small Recipients Only. 2016 vs 2017.

	SSBs	Zero and Light Beverages	Water
Post	27.51***	17.58***	152.5**
	(7.688)	(5.436)	(56.64)
2017	4.296***	7.054***	-44.38***
	(0.486)	(0.719)	(10.00)
Post*2017	1.488	6.761**	-58.17**
	(1.436)	(2.364)	(20.74)
Constant	13.40***	9.639***	278.8***
	(1.625)	(1.472)	(13.65)
Mean Dependent Variable	25.11	20.35	303.02
Observations	129,956	90,775	46,926
R-squared	0.053	0.056	0.041
Income Region FE	YES	YES	YES
YearWeek FE	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Note: The dependent variables are the purchases of (1) SSB's, (2) zero/light products and (3) water products per week, year and establishment for products in small recipients. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards) and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 17. Robustness check: Triple Diff in Diff: SSBs against zero/light and water - Week 17 drooped.

	SSBs vs Zero	SSBs vs Water
Post	-1.827**	18.31*
	(0.854)	(10.15)
SSB	9.087***	-261.8***
	(1.407)	(22.26)
2017	7.962***	-25.32**
	(2.250)	(9.679)
Post*SSB	4.259***	-42.32***
	(1.007)	(13.36)
Post*2017	11.08**	52.49***
	(4.519)	(9.588)
SSB*2017	-1.218***	27.98***
	(0.328)	(6.356)
Post*SSB*2017	-5.927***	-14.42**
	(0.643)	(6.112)
Constant	15.51***	293.0***
	(1.773)	(16.70)
Mean Dependent Variable	27.58	27.58
Observations	587,885	379,004
R-squared	0.050	0.210
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment and (2) SSB's and water products per week, year and establishment. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 18. Robustness check: Triple Diff in Diff: SSBs against zero/light and water - Week 16 and 17 drooped.

	SSBs vs Zero	SSBs vs Water
Post	0.483	32.63***
	(0.768)	(9.991)
SSB	8.946***	-254.5***
	(1.367)	(21.94)
2017	2.609***	-25.20***
	(0.561)	(6.508)
Post*SSB	4.400***	-49.64***
	(1.022)	(13.17)
Post*2017	16.43**	52.37***
	(6.069)	(15.41)
SSB*2017	-1.500***	23.80***
	(0.335)	(5.805)
Post*SSB*2017	-5.644***	-10.24*
	(0.581)	(4.992)
Constant	13.13***	278.5***
	(1.853)	(16.35)
Mean Dependent Variable	26.95	26.95
Observations	568,265	364,874
R-squared	0.051	0.210
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment and (2) SSB's and water products per week, year and establishment in low income regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 19. Robustness checks: Triple Diff in Diff: SSBs against zero/light and water – High and Low-Income Neighborhoods in Barcelona.

	SSBs vs Zero - High Income	SSBs vs Zero - Low Income	SSBs vs Water - High Income	SSBs vs Water - Low Income
Post	4.400***	2.311**	8.849	6.460
	(0.665)	(0.778)	(4.669)	(6.687)
SSB	1.396**	2.400***	-238.4***	-192.0***
	(0.540)	(0.360)	(23.33)	(14.23)
2017	2.446**	0.00482	-46.35***	-41.55***
	(0.852)	(0.663)	(8.785)	(5.414)
Post*SSB	-0.104	0.606**	-6.333	-7.766
	(0.386)	(0.248)	(5.335)	(6.290)
Post*2017	-4.836**	-1.823**	6.907	6.980
	(1.595)	(0.584)	(7.393)	(8.611)
SSB*2017	-1.785**	-1.040**	46.08***	36.45***
	(0.705)	(0.342)	(8.761)	(5.423)
Post*SSB*2017	-2.243***	-2.611***	-19.96**	-12.38
	(0.464)	(0.344)	(7.677)	(7.952)
Constant	12.57***	18.03***	241.4***	198.4***
	(0.794)	(0.609)	(18.65)	(10.99)
Mean Dependent Variable	18.41	17.34	17.49	16.75
Observations	81,360	100,318	28,265	35,239
R-squared	0.044	0.052	0.325	0.276
Income Region FE	YES	YES	YES	YES
YearWeek FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) and (2) SSB's and zero/light products per week, year and establishment and (3) and (4) SSB's and water products per week, year and establishment in low income regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 20. Robustness checks: Triple Diff in Diff: SSBs against zero/light and water – More touristic and less touristic regions.

	SSBs vs Zero Tourist	SSBs vs Zero Non-Tourist	SSBs vs Water Tourist	SSBs vs Water Non-Tourist
Post	0.690	1.249	39.77**	37.55**
	(0.945)	(1.413)	(14.88)	(8.298)
SSB	7.186***	12.93***	-257.8***	-205.6***
	(1.861)	(0.432)	(19.72)	(3.572)
2017	2.097***	1.092**	-33.76***	1.145
	(0.480)	(0.260)	(5.085)	(15.53)
Post*SSB	5.357***	5.185***	-53.88**	-38.36***
	(1.549)	(0.740)	(20.11)	(6.165)
Post*2017	23.34**	19.17**	71.35***	58.29***
	(9.511)	(4.447)	(22.55)	(8.039)
SSB*2017	-1.300***	-1.900	31.91***	1.161
	(0.363)	(0.885)	(4.929)	(12.90)
Post*SSB*2017	-6.153***	-8.097***	-11.66	-19.86*
	(1.046)	(0.815)	(7.051)	(6.621)
Constant	15.25***	12.99***	279.6***	226.3***
	(0.887)	(0.926)	(20.57)	(5.141)
Mean Dependent Variable	24.53	25.23	29.15	30.25
Observations	326,825	42,039	209,453	27,052
R-squared	0.039	0.047	0.202	0.232
Income Region FE	YES	YES	YES	YES
YearWeek FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) and (2) SSB's and zero/light products per week, year and establishment and (3) and (4) SSB's and water products per week, year and establishment in low income regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 21. Robustness checks: Triple Diff in Diff: SSBs against zero/light – Regions with higher/lower obesity rates.

	SSBs vs Zero *Lower Obesity*	SSBs vs Zero *Higher Obesity*
Post	1.931**	0.269
	(0.697)	(0.987)
SSB	8.734***	10.32***
	(1.442)	(1.678)
2017	2.541***	2.579***
	(0.630)	(0.527)
Post*SSB	4.000***	7.445***
	(0.891)	(1.696)
Post*2017	13.23**	35.98***
	(5.636)	(6.137)
SSB*2017	-1.304***	-1.602
	(0.410)	(0.876)
Post*SSB*2017	-5.322***	-9.191***
	(0.614)	(1.204)
Constant	15.71***	13.42***
	(0.853)	(0.843)
Mean Dependent Variable	27.05	27.91
Observations	513,248	91,003
R-squared	0.028	0.063
Income Region FE	YES	YES
YearWeek FE	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variables are the purchases of (1) SSB's and zero/light products per week, year and establishment in low obesity regions and (2) SSB's and zero/light products per week, year and establishment in high obesity regions. Regressions include income region and year-week fixed effects. Post is a dummy variable equal to one for the weeks after the tax is introduced (week 18 and onwards). SSB is a dummy variable equal to one for SSB's, which are the products that are subject to the tax and 2017 is a dummy equal to one for the observations of year 2017 and zero for the ones in 2016. Standard errors are clustered at the income region level.

Table 22. Mean family available gross income by high/low Barcelona Neighborhoods.

Type Neighborhood	Family Income Mean	Neighborhood	Family Income (Index)	Family Income (€)
1	25,284	Sarrià	186.6	36,573
		La Dreta de l'Eixample	170	33,320
		Les Corts	119.9	23,500
		Vallcarca i els Petinents	112.9	22,128
		El Camp d'en Grassot i Gràcia Nova	108.1	21,187
		Sant Antoni	104	20,384
		La Vila de Gràcia	101.5	19,894
0	15,637	Sant Pere, Santa Caterina i la Ribera	97.8	19,168
		La Sagrada Familia	95.9	18,796
		Sants	92.3	18,090
		La Font de la Guatlla	84.9	16,640
		Horta	80.6	15,797
		La Sagrera	77.9	15,268
		Sant Andreu	77	15,092
		El Congrés i els Indians	71.7	14,053
		Sant Martí de Provençals	68.7	13,465
		La Marina de Port	68.3	13,386
		Porta	62.5	12,250

Source: Catalan Statistical Office (Idescat).

Table 23. Mean, maximum and minimum family available gross income by touristic and non-touristic regions.

Tourist Region	Family Income	Max Family Income	Min Family Income	Regions	% of Tourists Received (2017)
No	13.55	14.8	11.2	*Paisatges de Barcelona,*	1.3%
				Terres de Lleida	1.4%
				and *Terres de l'Ebre*	1.5%
Yes	15.86	33.6	10.1	Barcelona,	40.8%
				Costa Brava	17.2%
				and *Costa Daurada*	14%

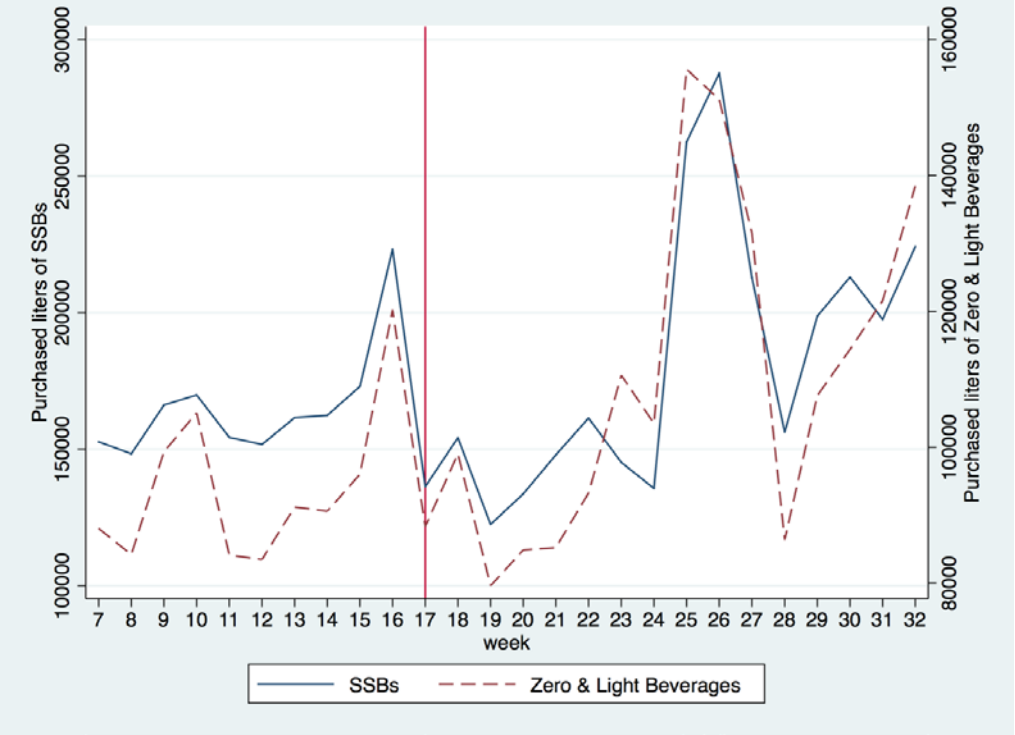
Source: Catalan Statistical Office (Idescat).

Table 24. Obesity rates and population size in sanitary regions in Catalonia.

Obesity	Population	% of Population with Overweight	Sanitary Regions
0	3,566,952	14 %	*Barcelona*
	359,215	15 %	*Catalunya Central*
	258,448	15 %	*Lleida*
	607,166	15%	*Girona*
1	52,419	16%	*Alt Pirineu i Aran*
	428,161	17%	*Camp de Tarragona*
	128,936	19%	*Terres de l'Ebre*

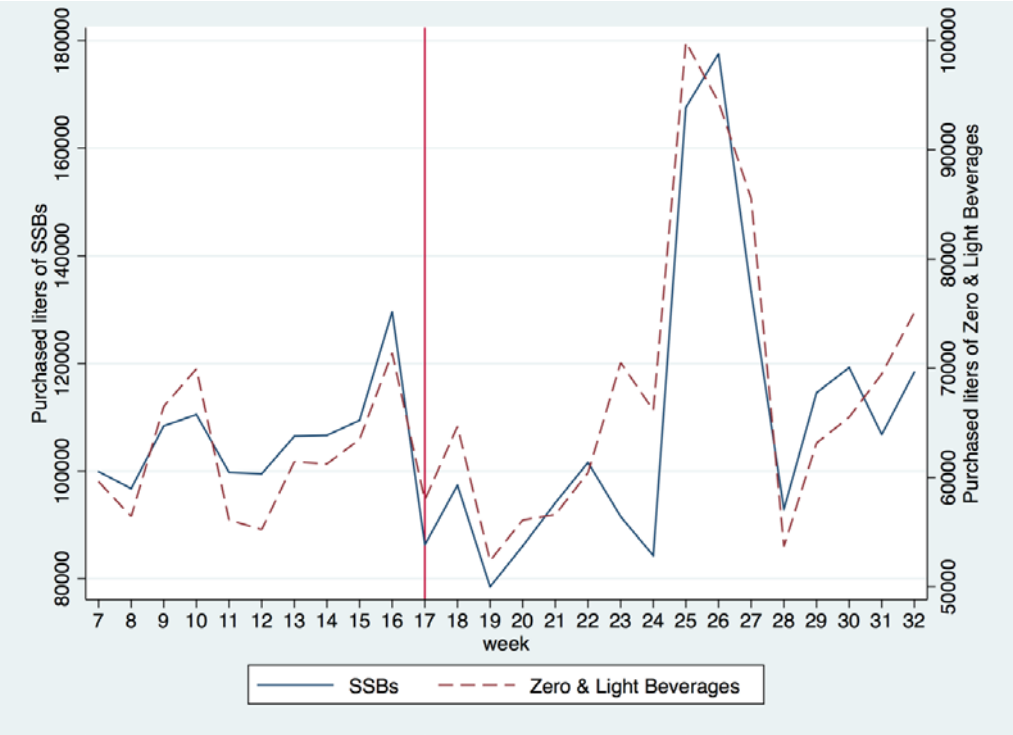
Source: Catalan Health Survey (ESCA).

Figure 6. SSBs against Zero/Light Beverages, Only 2017.



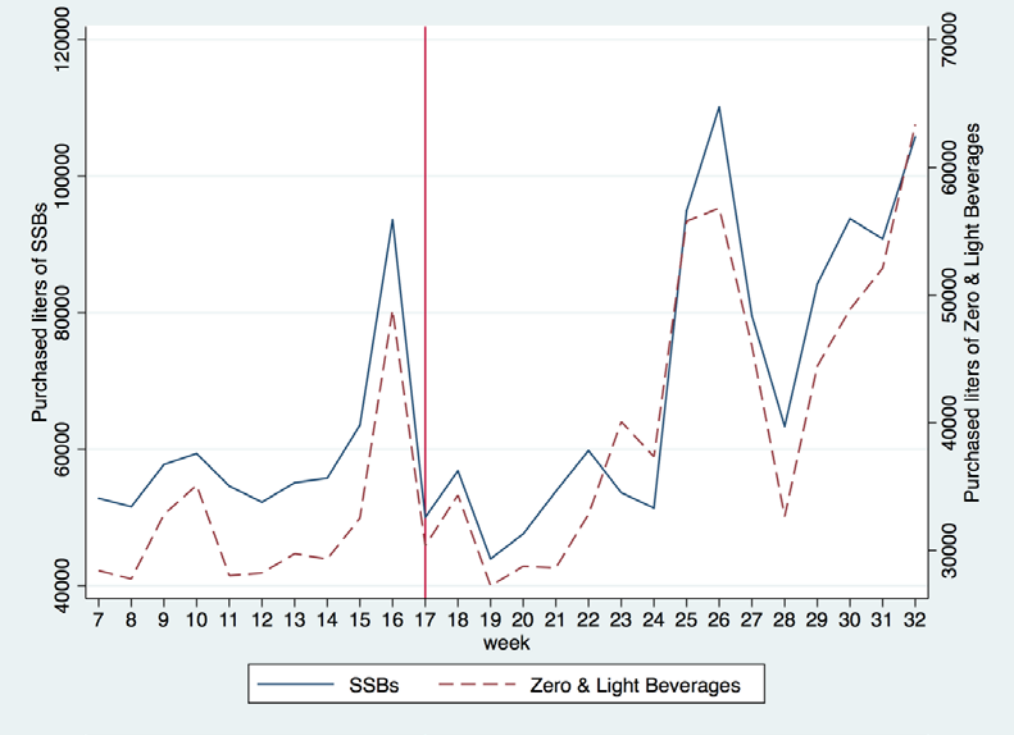
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and zero/light products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 7. SSBs against Zero/Light Beverages – High Income Regions, Only 2017.



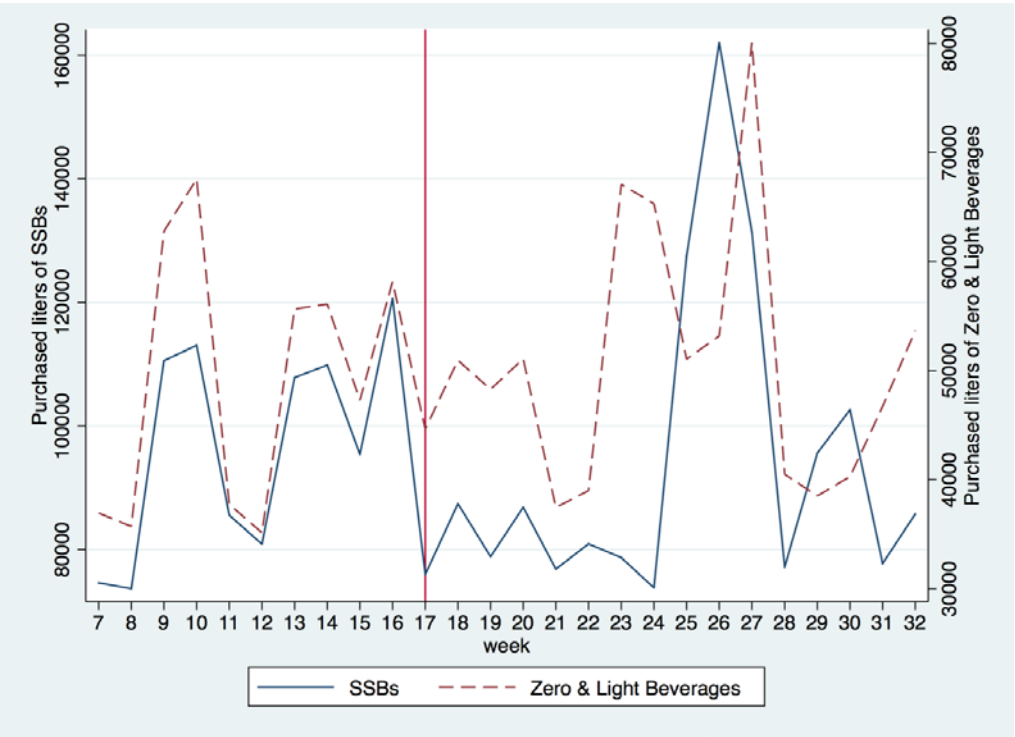
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and zero/light products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 8. SSBs against Zero/Light Beverages – Low Income Regions, Only 2017.



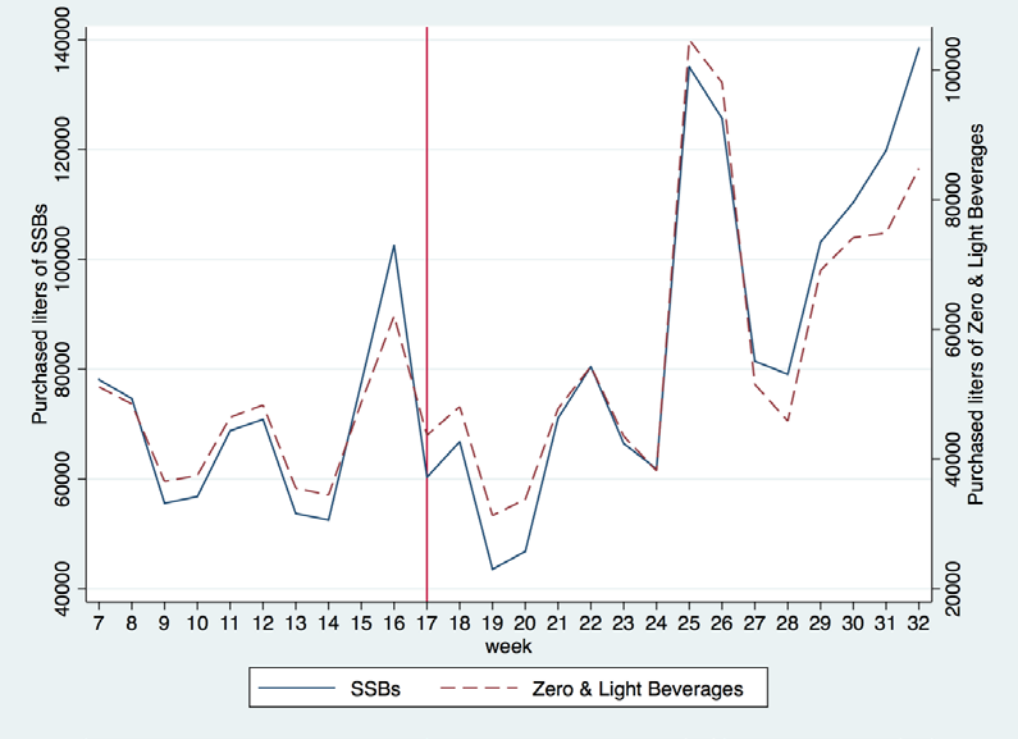
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and zero/light products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 9. SSBs against Zero/Light Beverages – Big Recipient, Only 2017.



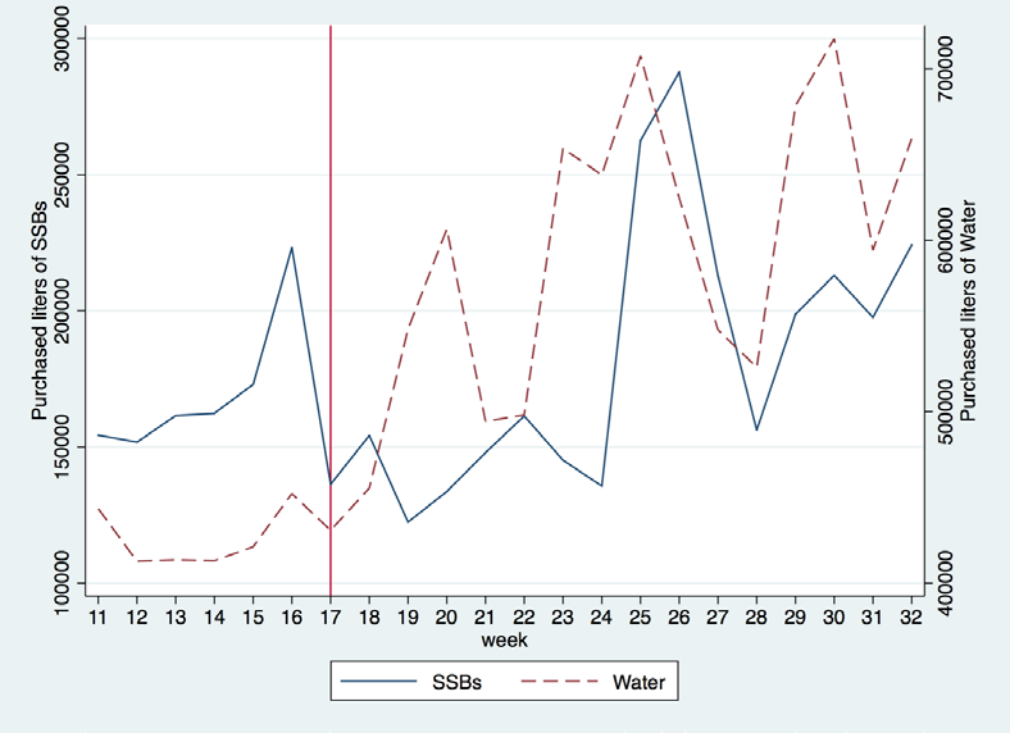
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and zero/light products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 10. SSBs against Zero/Light Beverages – Small Recipient, Only 2017.



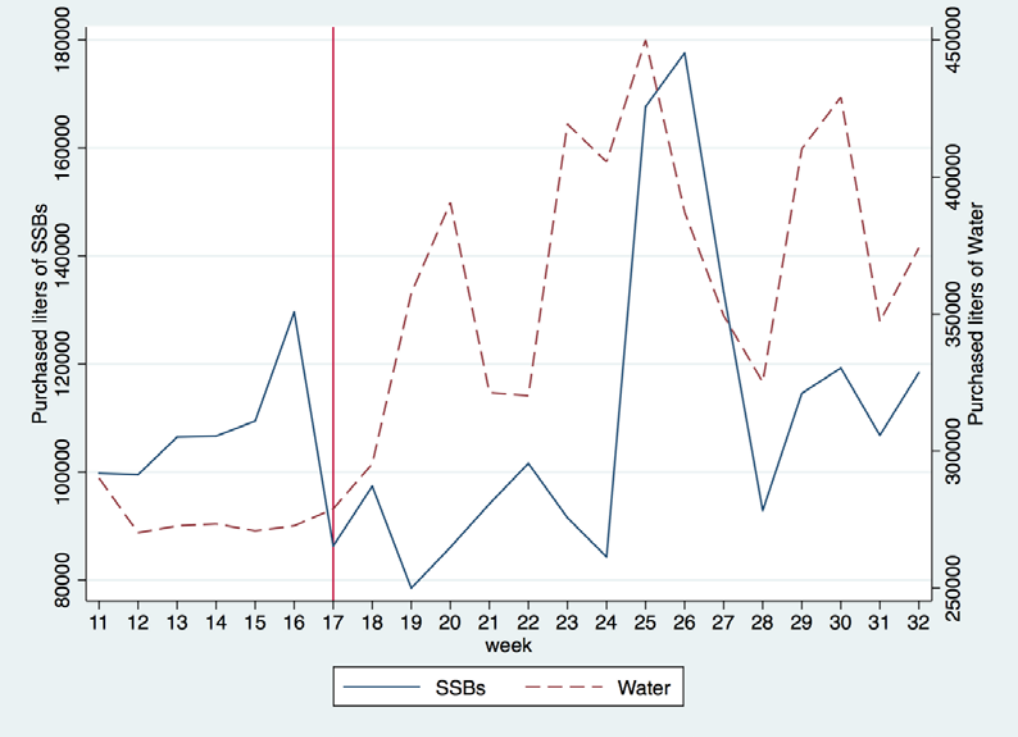
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and zero/light products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 11. SSBs against Water, Only 2017.



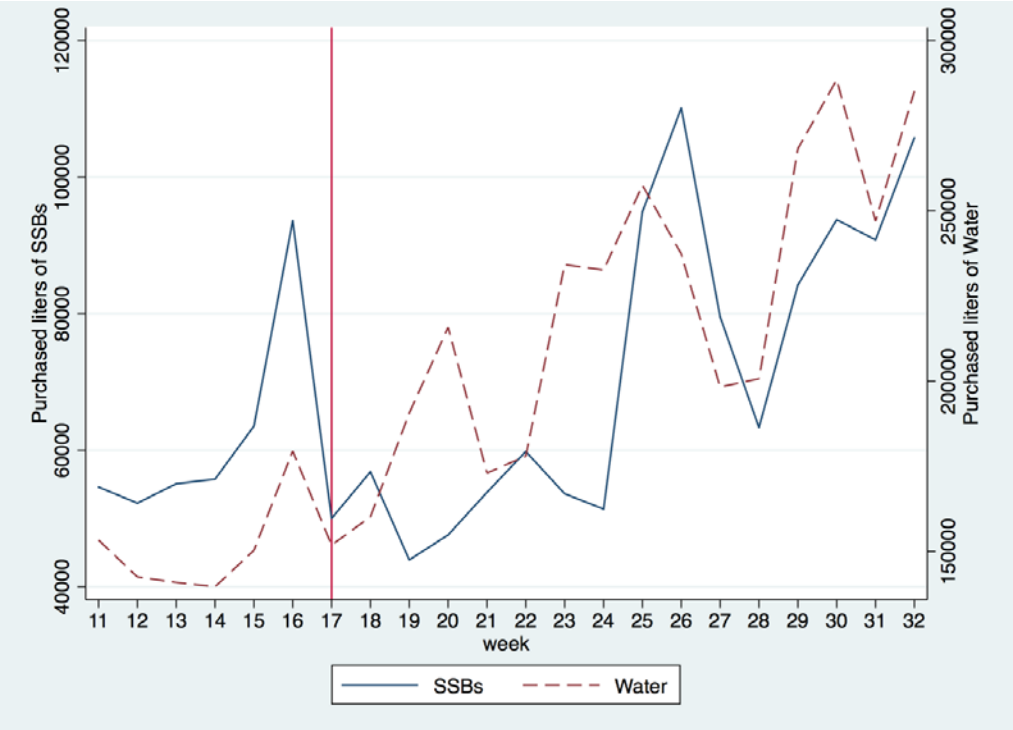
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and water products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 12. SSBs against Water – High Income Regions, Only 2017.



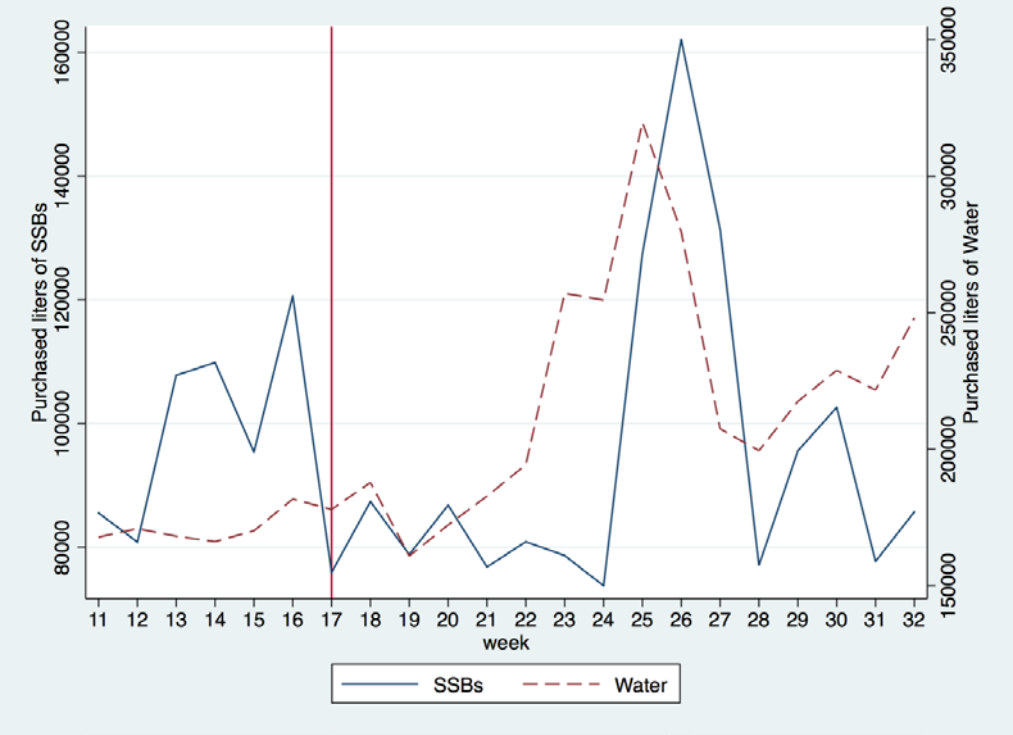
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and water products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 13. SSBs against Water – Low Income Regions, Only 2017.



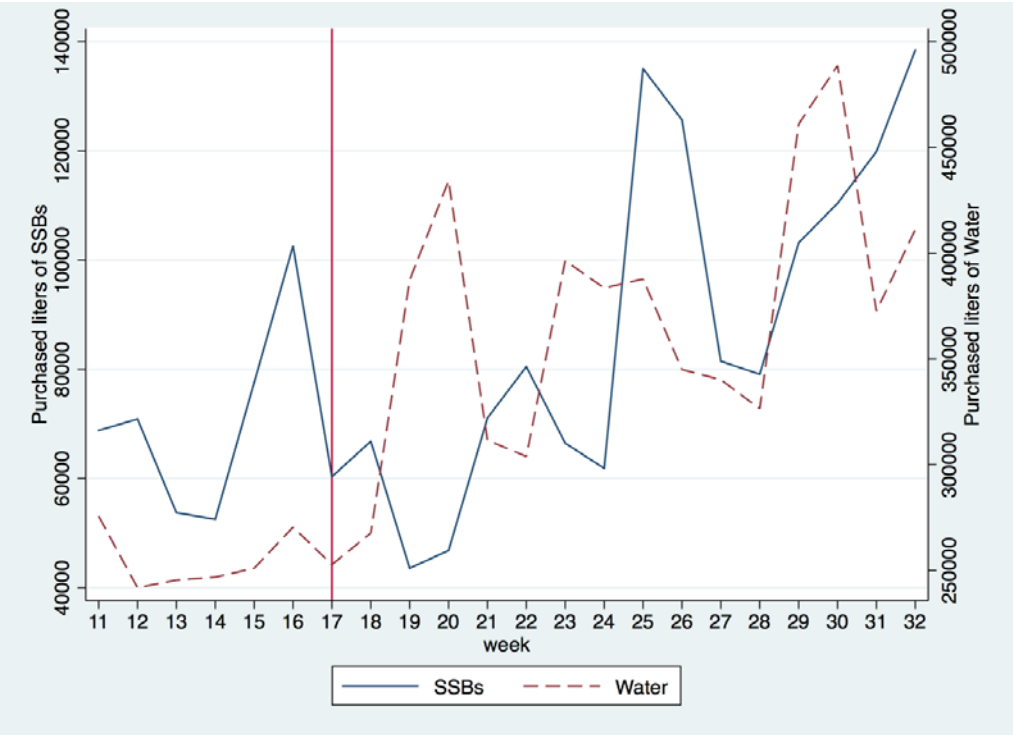
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and water products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 14. SSBs against Water – Big Recipient, Only 2017.



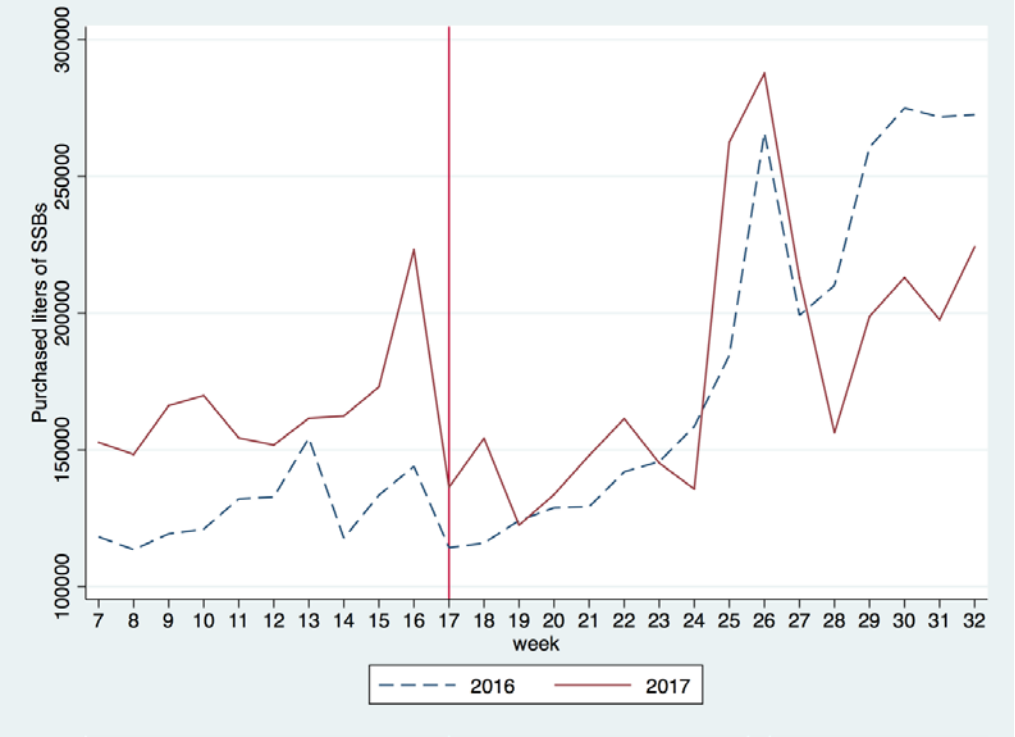
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and water products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 15. SSBs against Water – Small Recipient, Only 2017.



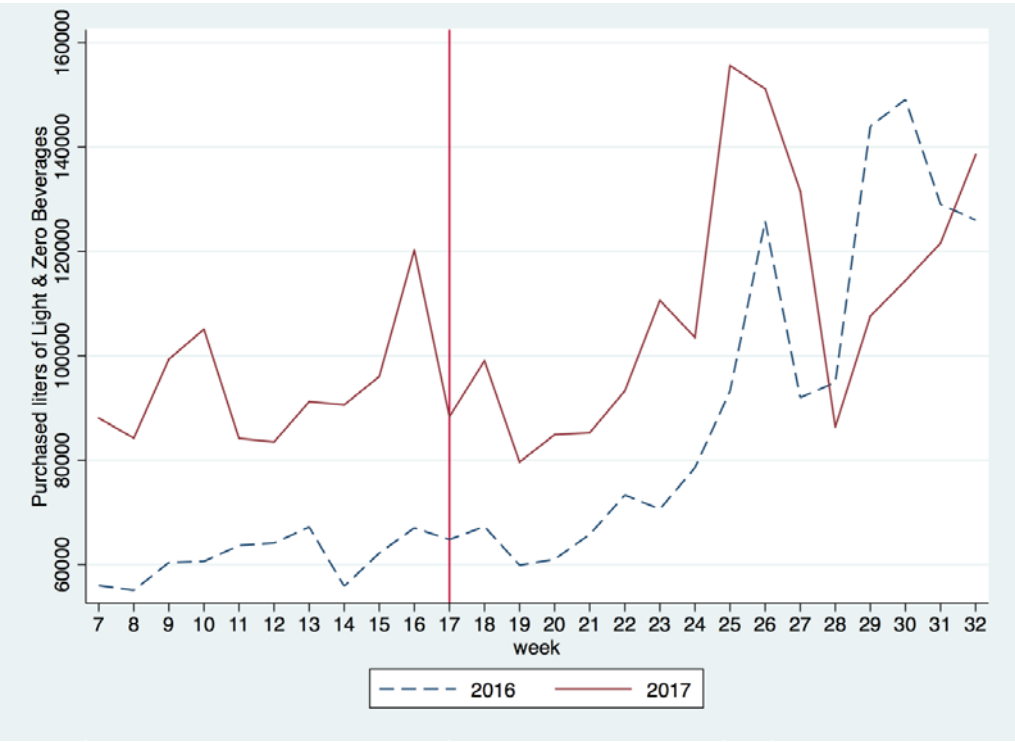
Source: Author's own calculation using data on total liters purchased of SSB products (solid line, left-hand side axis) and water products (dashed line, right-hand side axis) for weeks 7 to 32 in 2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 16. SSBs, 2016-17.



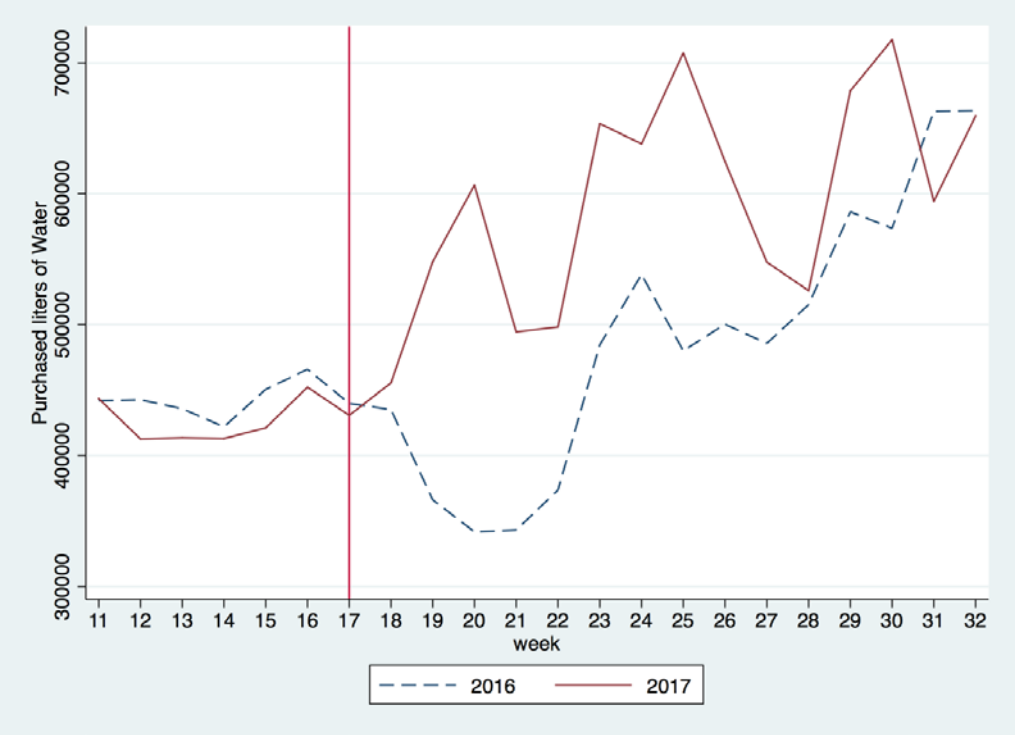
Source: Author's own calculation using data on total liters purchased of SSB products in 2016 (dashed line) and 2017 (solid line) for weeks 7 to 32 in 2016-2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 17. Zero and Light Beverages, 2016-17.



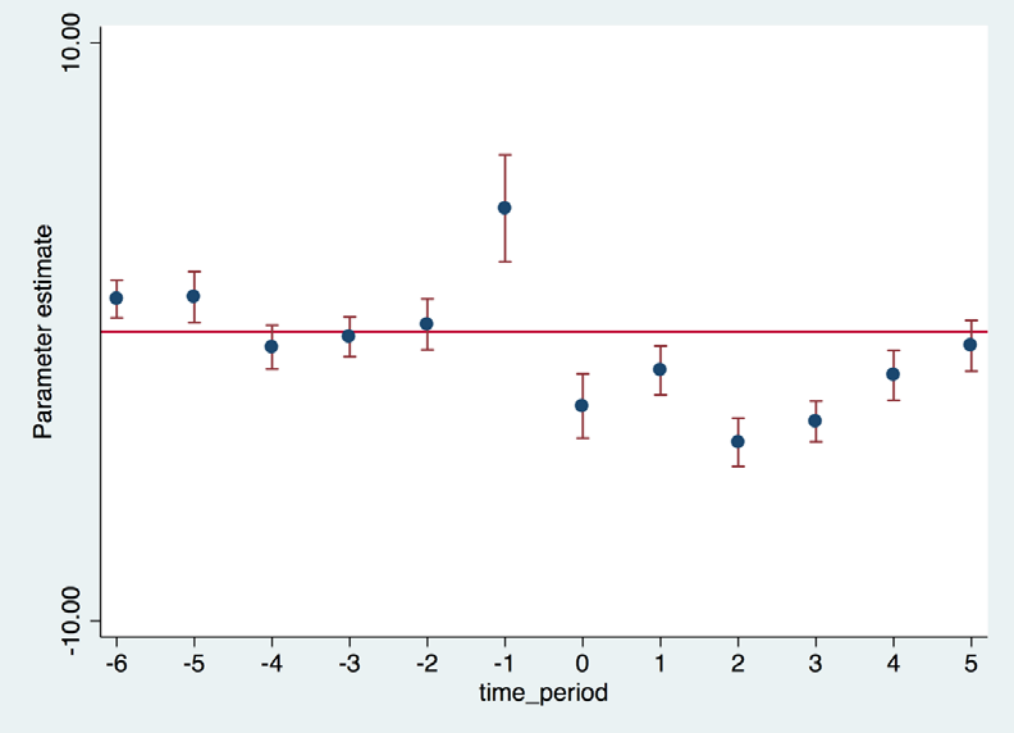
Source: Author's own calculation using data on total liters purchased of zero/light products in 2016 (dashed line) and 2017 (solid line) for weeks 7 to 32 in 2016-2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 18. Water, 2016-17.



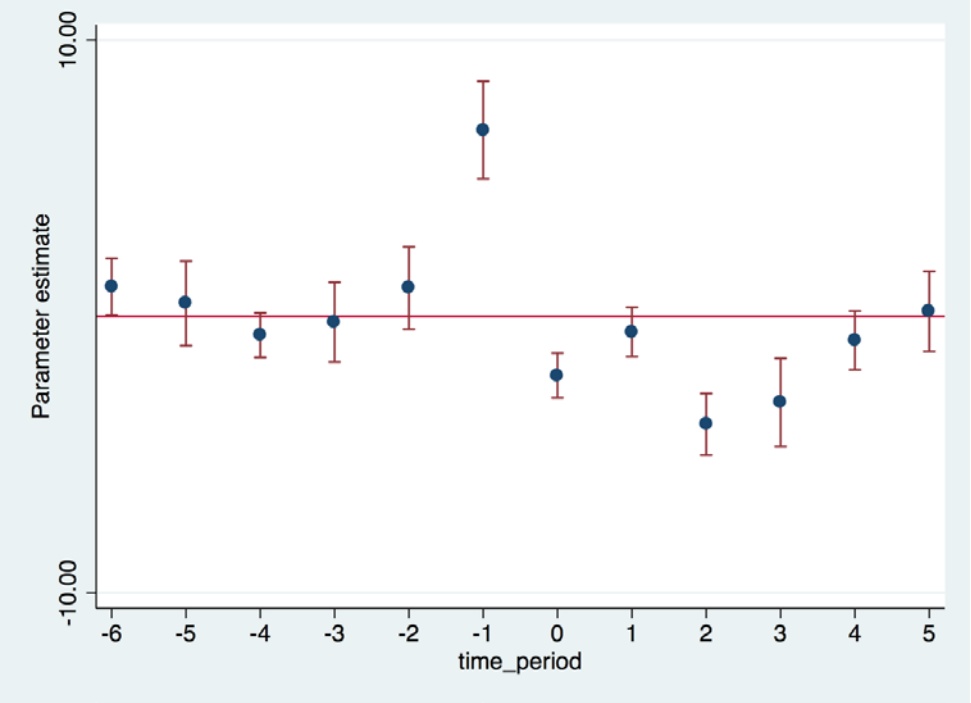
Source: Author's own calculation using data on total liters purchased of water products in 2016 (dashed line) and 2017 (solid line) for weeks 7 to 32 in 2016-2017. Data comes from a supermarket chain that has a 10% market share of the Catalan market.

Figure 19. Event study: SSBs against Zero and Light Beverages, Only 2017.



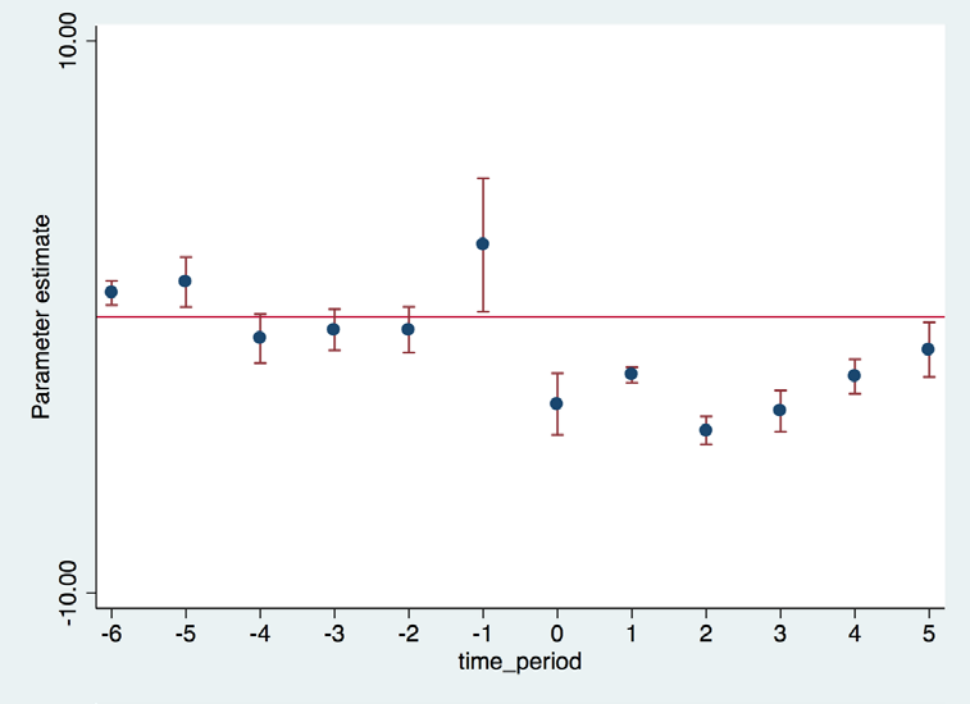
Note: The figure plots the coefficients of the interaction terms between week dummies and an SSB dummy in an event study model. Period 1 corresponds to the first week in which the tax is in place (week 18). Source: Data from a supermarket chain that has a 10% market share of the Catalan market.

Figure 20. Event study: SSBs against Zero and Light Beverages – High Income Regions, Only 2017.



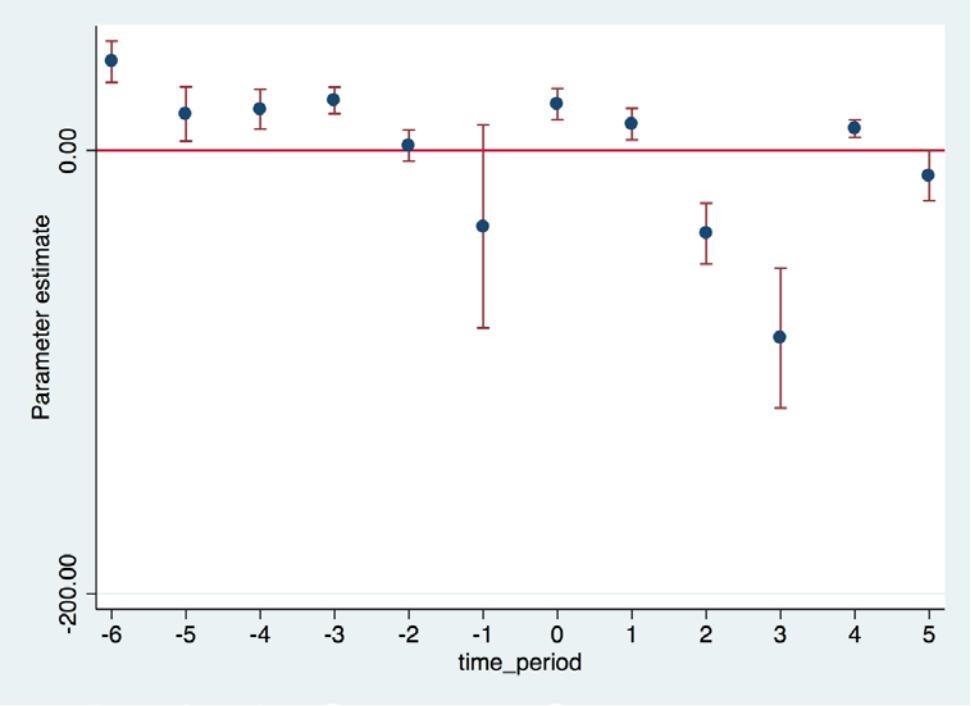
Note: The figure plots the coefficients of the interaction terms between week dummies and an SSB dummy in an event study model. Period 1 corresponds to the first week in which the tax is in place (week 18). Source: Data from a supermarket chain that has a 10% market share of the Catalan market.

Figure 21. Event study: SSBs against Zero and Light Beverages – Low Income Regions, Only 2017.



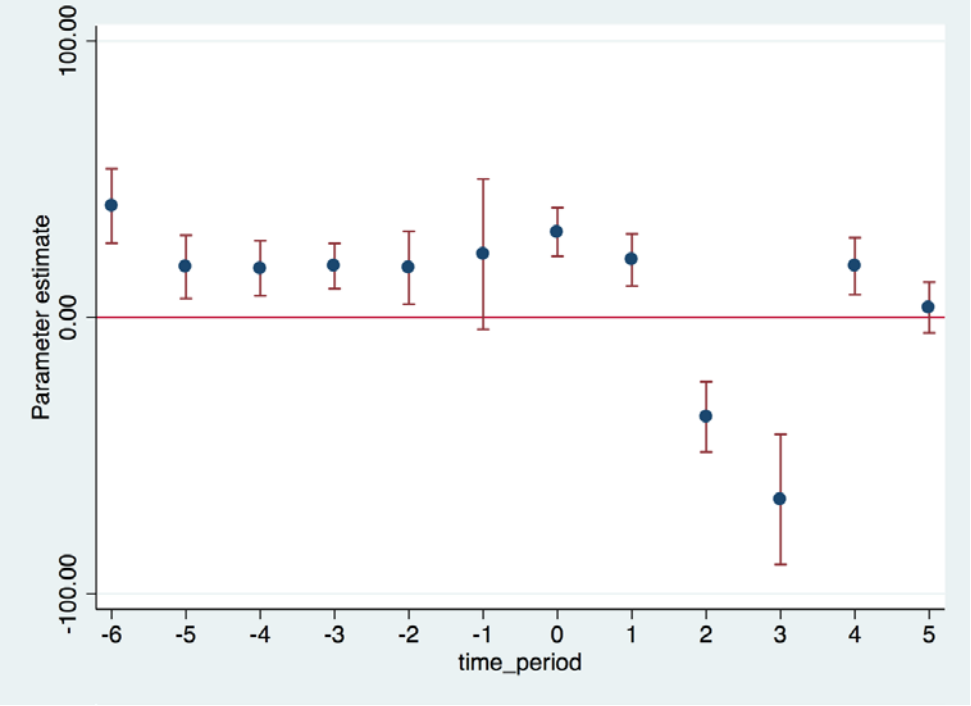
Note: The figure plots the coefficients of the interaction terms between week dummies and an SSB dummy in an event study model. Period 1 corresponds to the first week in which the tax is in place (week 18). Source: Data from a supermarket chain that has a 10% market share of the Catalan market.

Figure 22. Event study: SSBs against Water – High Income Regions, Only 2017.



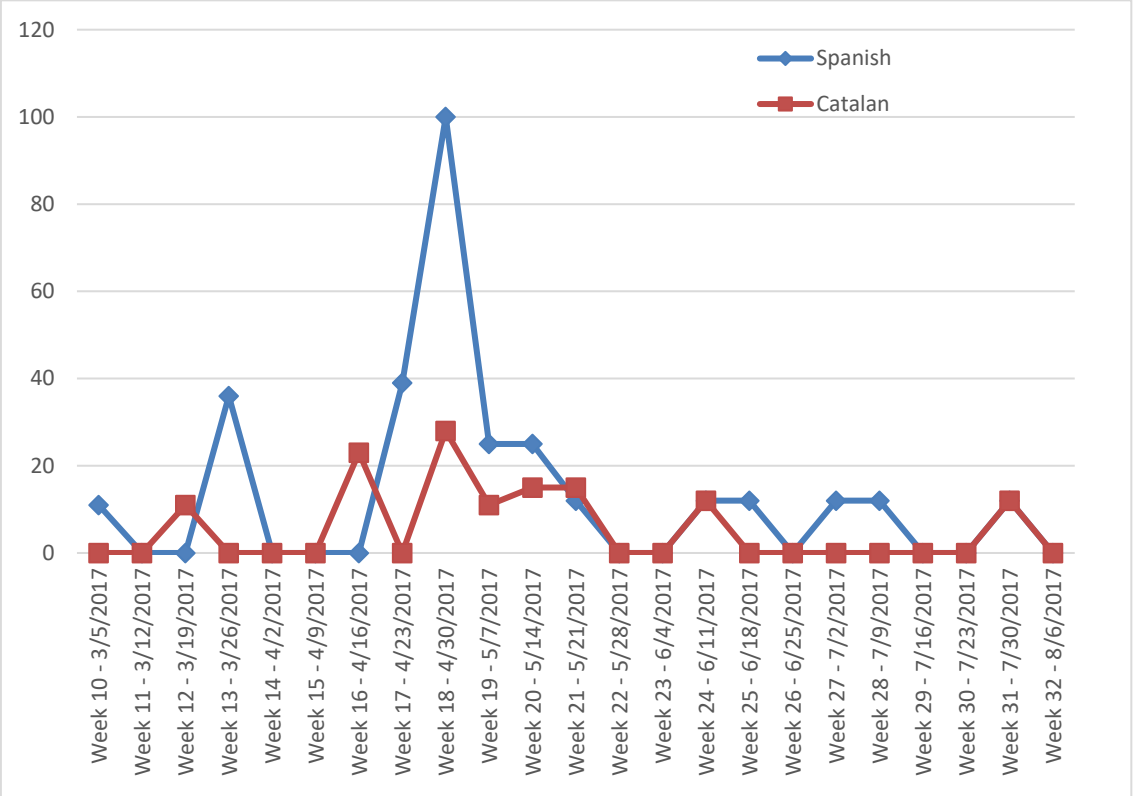
Note: The figure plots the coefficients of the interaction terms between week dummies and an SSB dummy in an event study model. Period 1 corresponds to the first week in which the tax is in place (week 18). Source: Data from a supermarket chain that has a 10% market share of the Catalan market.

Figure 23. SSBs against Water – Low Income Regions, Only 2017.



Note: The figure plots the coefficients of the interaction terms between week dummies and an SSB dummy in an event study model. Period 1 corresponds to the first week in which the tax is in place (week 18). Source: Data from a supermarket chain that has a 10% market share of the Catalan market.

Figure 24. Google trend searches for sugar tax in the two official languages: Spanish and Catalan.



Source: Google trends.

APPENDIX

Table 1A. Family Income Groups

Income Group	Comarques/ Municipalities/ Districts	Family Income (in thousands €)	Family Income Max	Family Income Min
1	Nou Barris Montsià Baix Ebre	11.14	12.10	10.12
2	Alt Empordà Alt Urgell Baix Empordà	12.87	13.20	12.70
3	Selva Terra Alta Urgell	13.33	13.40	13.20
4	Sant Andreu (BCN) Baix Penedès Noguera	13.47	13.50	13.40
5	Sants-Montjuic (BCN) Solsonès Pla d'Urgell	13.62	13.70	13.55
6	Ciutat Vella (BCN) Garrigues Priorat	13.97	14.00	13.90
7	Segarra Horta-Guinardó (BCN) Aràn	14.04	14.10	14.00
8	Baix Camp Cerdanya Anoia	14.27	14.40	14.10
9	Ribera d'Ebre Segrià Sant Martí (BCN)	14.44	14.51	14.40
10	Conca de Barberà Alt Camp Pallars Jussà	14.70	14.80	14.60
11	Berguedà Moianès Pallars Sobirà	14.90	14.90	14.90
12	Pla de l'Estany Osona Tarragonès	15.07	15.10	15.00
13	Alta Ribagorça Bages Garrotxa	15.27	15.40	15.20
14	Garraf Gironès Sant Adrià del Besos	15.60	15.60	15.60
15	Maresme Alt Penedès Vallès Oriental	15.83	15.90	15.70
16	Badalona L'Hospitalet de Llobregat Ripollès	16.23	16.50	15.90
17	Vallès Occidental Baix Llobregat Vila de Gràcia (BCN)	17.43	18.90	16.50
18	Eixample (BCN) Les Corts (BCN) Sarrià-Sant Gervasi (BCN)	26.25	33.60	19.91

Universitat
Pompeu Fabra
Barcelona