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Brown Sugar, how come you taste so good? The impact of a soda tax on prices and consumption

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Abstract:

Increasing obesity-related problems and rising healthcare expenditures have led governments in developed countries to consider the introduction of soda taxes. We study a recent such tax, implemented in Portugal, using extremely detailed panel data from one of the two largest retailers in the country, covering the period between February 2015 and January 2018. We take advantage of the tax breakdown by sugar levels to examine how soda prices and quantities purchased reacted. For identification, we rely on difference-in-differences models with various vectors of fixed effects, comparing each group of products to water.

For drinks with more than 80 grams of sugar per liter, results indicate almost full price pass-through to the consumer. For drinks with less than 80 grams of sugar per liter, price pass-through surpassed 100%. Regarding consumption, our findings suggest stockpiling behavior in the quarter when the tax was approved and before it was actually implemented. In the implementation period, there are no significant changes in quantities purchased for most beverages *vis-à-vis* water, with the exception of soda drinks with comparatively low levels of sugar. This suggests that benefits of the soda tax in terms of reducing sugar intake are mainly due to reformulation, as producers reduced the sugar content of some drinks to fall below the 80 grams per liter threshold.

JEL Classification Codes: C23, D12, H20, I18, Q18

Keywords: soda tax, sugar-sweetened beverages tax, pass-through, policy evaluation, Portugal

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1. Introduction

A growing number of governments around the world are introducing sugar-sweetened beverage taxes (SSB or soda taxes for short) to change consumer behavior, generate revenue, and incentivize manufacturers to reformulate products. In fact, the World Health Organization's Global Action Plan for the Prevention and Control of Non-Communicable Diseases 2013-2020 added soda taxes to their list of recommended policies, as there is overwhelming evidence linking SSB consumption to diseases such as obesity and diabetes (see e.g. Malik et al., 2010 and Malik et al., 2010 for a review of the evidence).[3] As of July 2019, more than 40 countries have implemented or are on the verge of implementing SSB taxes, including for example Mexico, France, the UK, Portugal, South Africa, as well as Catalonia in Spain and several cities in the US (e.g. Berkeley, California, Boulder, Colorado, and Philadelphia, Pennsylvania; see Global Food Research Program UNC, 2019).

This study assesses the impacts of the Portuguese soda tax, implemented in February 2017, on soda prices and consumption. We use extremely rich product-store-month-level sales data from a large retailer with 400+ stores. To estimate the causal impacts of the tax, we adopt difference-in-differences and event study designs, using bottled water as the comparison group and controlling for several vectors of high-dimensional fixed effects. We explore the impacts of the soda tax on four distinct groups of soda products. This distinction takes into account the structure of the Portuguese soda tax, which taxes more heavily drinks with higher sugar content and has led manufacturers to alter several drinks' recipes. All analyses are performed on both the unbalanced and balanced panels; the latter including only the most popular drinks. Lastly, we study responses to the tax in different periods: when it was only being discussed in the media, when it was formally considered and debated in the parliament, and finally when it was enacted.

The economic reasoning underlying SSB taxes is that of making consumers internalize the costs they impose on themselves (internalities) and on others (externalities) from consuming too much SSBs. Internalities have to do with individuals ignoring the effects of consuming SSBs on their health, because they are misinformed or because they fail to consider health problems that tend to appear

[3]Macro-level results of a recent study suggest that for each additional teaspoon of added sugar per person, spending on diabetes per capita rises by as much as 26.8% and the growth rate of total health care expenditure per capita increases by 1.8 percentage points in the long run (Castro, 2017).

far in the future.[4] Externalities, in this case, are mainly healthcare costs of treating conditions related with SSB consumption, that are shared by everyone through public or private insurance.

SSB taxes have different welfare effects if we focus on internalities or externalities. If poorer individuals tend to consume more SSBs than richer ones, then the internality benefits of the tax are likely to be progressive, while the externality benefits will be regressive. In the end, the total regressivity of a SSB tax will also depend on the allocation of the tax revenues (see e.g. Allcott et al., 2019b for a detailed exposition of this issue). SSB taxes opponents' main argument is precisely regressivity; however, when internality benefits and tax revenue allocation are taken into account, the evidence suggests that the benefits of SSB taxes are likely to be flat across the income distribution, or possibly the highest for the lowest-income consumers, at least in the US (Allcott et al., 2019a; see also Dubois et al., 2018, Etilé and Sharma, 2015, and Etilé et al., 2018).

Soda taxes can decrease the intake of sugar from SSBs, and consequently lead to improvements in population health, through three channels. The first channel is by increasing prices. In principle, consumers respond negatively to higher soda prices. However, whether soda prices increase or not depends, first, on whether manufacturers and retailers pass on the tax to the consumer, or alternatively (partly) absorb it. This in turn depends on manufacturers' and retailers' market power as well as the price elasticity of demand for SSBs. Manufacturers may also reformulate recipes in order to avoid (higher) taxes. Thus, the first question to be addressed concerns the impact of soda taxes on consumer prices (i.e. price pass-through). Available evidence on enacted soda taxes shows significant heterogeneity in price pass-through across countries and specific drink groups, ranging from less than 40% to more than 100% (Aguilar et al., 2018; Arteaga et al., 2017; Berardi et al., 2016; Bollinger and Sexton, 2018; Capacci et al., 2019; Cawley and Frisvold, 2017; Cawley et al., 2018; Cawley et al., 2018; Etilé et al., 2018; Falbe et al., 2015; Grogger, 2017; Rojas and Wang, 2017; Seiler et al., 2019).

The second channel is precisely the incentive for manufacturers to reformulate recipes towards formulas with less added sugar. If SSBs contain less sugar, then sugar intake will be lower, by construction. Nevertheless, if consumers dislike the

[4]Pigouvian taxation of internalities has also been advocated in the context of unhealthy foods (O'Donoghue and Rabin, 2006; Haavio and Kotakorpi, 2011; Cremer et al., 2016), cigarette consumption (Gruber and Kőszegi, 2004), and energy markets (Allcott et al., 2014).

new recipes, they may substitute towards comparatively sweeter SSBs or other (unhealthy) products.

The third channel is increased consumer awareness. Regardless of any impact on price, media coverage and public debate around soda taxes may raise consumer awareness towards the detrimental effects of sugar intake and SSB consumption for health, and consequently decrease SSB consumption. Globally, salience is a key component of a soda tax, as there is robust evidence that consumers underreact to taxes that are not salient (Chetty et al., 2009). One paper finds that soda consumption at the University of California campus, in Berkeley, fell immediately after the Berkeley soda tax was passed, two years before prices increased on-campus (Taylor et al., 2019).

Other factors to keep in mind are substitution towards untaxed products that also generate internalities and externalities, e.g. candy or beer, and leakage, namely the possibility to purchase soda outside of the taxed jurisdiction (Allcott et al., 2019b). There is suggestive evidence of substitution towards diet soda in countries where it is untaxed (e.g. Allcott et al., 2019a; Castelló and López-Casasnovas, 2018). For example Finkelstein et al. (2013) don't find evidence of substitution towards sugary foods or pizza. As for leakage, Bergman and Hansen (2017) find that the tax pass-through for beer and soda in Denmark is an increasing function of distance to the German border. Bollinger and Sexton (2018), Cawley and Frisvold (2017), Cawley et al. (2018), and Seiler et al. (2019) also find evidence of cross-border shopping as a response to the soda taxes implemented in Berkeley and Philadelphia.

Most existing studies on consumer responses to soda taxes enacted in Mexico, Chile, Catalonia, Berkeley, and Philadelphia find that consumption of soda decreased, from 6% in Mexico to more than 20% in Berkeley and Philadelphia (Aguilar et al., 2018; Arteaga et al., 2017; Castelló and López-Casasnovas, 2018; Cawley et al., 2018; Falbe et al., 2016; Mora et al., 2018; Nakamura et al., 2018; Seiler et al., 2019; Taylor et al., 2019). Due perhaps to specific data or methodologies, a few studies on the Berkeley soda tax don't find significant impacts on consumption (Bollinger and Sexton, 2018; Rojas and Wang, 2017) and one finds a small positive impact (Debnam, 2017).

The literature so far has mainly relied on survey or home-scan data (e.g. Kantar World Panel) or hand-collected data on a few products or stores, with only a few studies having access to retail data (Berardi et al. (2016); Castelló and López-

Casasnovas (2018); Seiler et al., 2019). To try to estimate causal impacts, the vast majority of studies employ difference-in-differences designs, either comparing taxed products to untaxed ones (e.g. bottled water), or regions where soda is taxed to regions where it is not.

The studies cited above estimate the impacts of enacted soda taxes around the world ex-post. Several other studies provide ex-ante estimates of the impacts of soda taxes, by estimating demand systems for soda and related products and then simulating the impact of the introduction of a soda tax. For example, Finkelstein et al. (2013) and Xiang et al. (2018) estimate that a 20% tax-induced increase in SSB prices would decrease per capita energy purchases by 24-29 kcal/day (see also Andalón and Gibson, 2018; Caro et al., 2018; Dubois et al., 2018; Etilé and Sharma, 2015; Gomo and Birg, 2018; Harding and Lovenheim, 2017).

To summarize, most studies on the ex-post impacts of soda taxes implemented in France, Mexico, Chile, Spain, and the US find increases in SSB prices and drops in SSB consumption. However, the magnitudes of the effects differ substantially across countries and studies, reflecting on the one hand the different tax rates and designs across countries, and on the other the different types of data and methodological approaches employed.

This study adds to the previous literature by assessing for the first time the causal impacts of the Portuguese soda tax. We start by determining the extent of pass-through to consumer prices, and then analyze the impacts of the tax on soda consumption.

We make three main contributions. First, soda taxes that vary according to drinks' sugar content, penalizing more heavily drinks with a lot of sugar, are increasingly popular. In particular, this tax design led manufacturers in Portugal to change recipes in order to pay a lower tax, and we distinguish between the effects of the soda tax on drinks that remained above the threshold and those that saw their sugar content reduced. This is an unexplored issue in previous studies.

Second, we have extremely detailed product-store-month-level data from a large retailer with more than 400 stores distributed across the country and 21% market share. Our data are nationally representative and allow us to estimate the causal impacts of the tax through a difference-in-differences design, using bottled water as the comparison group and controlling for several vectors of high-dimensional

fixed effects. Few previous studies are able to control for potential confounders as rigorously as we are. We also present event study specifications, providing evidence in favor of the parallel-trends assumption.

Third, we study the impacts of the soda tax before it was introduced, when it was only being discussed in the media and debated in the parliament, i.e. before and after prices changed due to the tax. This allows us to (partly) separate-out price effects from the other two channels (product reformulations and increased awareness). This is something that Taylor et al. (2019) also explore, but our data are more detailed and representative.

The remainder of this study is organized as follows: the next section presents the institutional background and sections 3 and 4 present the data and empirical strategy. Next, we present the results and finally, section 6 discusses the main findings and concludes.

2. Institutional Background

The Portuguese soda tax was implemented nationwide in February 2017 and received extensive media coverage. It was first mentioned almost one year earlier, in May 5, 2016.[5] The tax proposal was included in the government budget proposal for 2017, submitted to the parliament for discussion in mid-October 2016. The soda tax was finally approved on December 28, 2016, together with the government budget for 2017 (Decree-law no. 42/2016).

The Portuguese soda tax applies to non-alcoholic drinks with added sugar or sweeteners, including liquid or powder concentrates.[6] Tax-exempt products include (1) milk-, soy-, or rice-based drinks, (2) fruit-, algae-, or veggie-based juice and nectar, as well as cereal- and nut-based drinks, and (3) drinks considered essential for special dietary needs. Table 1 compares the main features of the Portuguese and other soda taxes that have already been studied. Similarly to Catalonia, in Portugal there are different brackets defined based on drinks' sugar content. The amount of the tax is 0.08€ per liter for drinks with less than 80 grams of sugar per liter, and 0.16€ per liter for drinks with 80 grams or more sugar per liter. The usual 23%

[5] "Sumos e refrigerantes vão ter imposto extra", in *Expresso* (https://expresso.pt/sociedade/2016-05-28-Sumos-e-refrigerantes-vao-ter-imposto-extra#gs.ziLEots6)

[6] Examples are Sunquick and Tang. In this case, the tax is calculated based on the sugar content of the final diluted mix.

VAT adds up to the soda tax.[7] So, unlike in Catalonia, neither drinks with relatively little added sugar nor light drinks are exempt, and drinks with a lot of sugar pay a comparatively higher tax.

Table 1. **Soda taxes worldwide**

Country	**Date of implementation**	**Tax rate**	**Includes diet soda?**
Portugal	February 2017	16 euro cents/L for drinks with $>$ 80 g sugar/L, or 8 cents/L for drinks with $<$ 80 g sugar/L	Yes
France	January 2012	7 euro cents/L	Yes
Mexico	January 2014	one peso/L	No
Spain (Catalonia)	May 2017	12 euro cents/L for drinks with $>$ 80 g sugar/L, or 8 cents/L for drinks with $50 - 80$ g sugar/L	No
USA (Berkeley, CA)	March 2015	1 dollar cent/ounce	No
USA (Boulder, CO)	July 2017	2 dollar cents/ounce	Yes
USA (Philadelphia, PA)	January 2017	1.5 dollar cents/ounce	Yes

Notes: Non-exhaustive list. Source: Global Food Research Program UNC (2019).

The tax is levied on producers. The different tax breaks are a way to incentivize producers to reduce drinks' sugar content in order to be subject to a lower tax (Allcott et al., 2019b; Cremer et al., 2019). In fact, several products that used to have more than 80 grams of sugar per liter now have 78-79 grams instead, paying a tax half as large. The UK, which also introduced a graduated soda tax, seems to be experiencing similar effects (Roache and Gostin, 2017). In Portugal, between 2016 and 2017 alone, lemony drinks' and fruit-flavored soda's average sugar content decreased by 32.2% and 17.3% respectively (e.g. 7Up, Fanta; dos Santos, 2018). The drinks that still have more than 80 grams of sugar per liter include cola-flavored and some energy drinks. Overall, the change in the caloric content per 100 mililitres of non-alcoholic beverages was -11% from 2016 to 2017 (-21% from 2013 to 2017; Grupo de Trabalho, 2018). Until December 2017, the share of products with 80 grams of sugar or more per liter decreased from 61% to 37.9% of the sales volume. Aggregate data also indicate a 15% reduction in the total amount of sugar intake in 2017, arising from a transfer of consumption from high-sugar drinks to drinks with less

[7]More precisely, the tax is 8.22 and 16.46 euro cents per liter, plus 23% VAT, which gives 10.11 and 20.25 euro cents per liter.

than 80 grams of sugar per liter (Goiana-da Silva et al., 2018). Of course, this mixes together the effect of recipe reformulations and any potential substitution effects.

One year after the tax was implemented, news reports suggest that consumer prices increased by about 25-30% and sales decreased by about 5%.[8] Besides affecting recipes and prices, the soda tax may have changed consumer perception about soda. An online survey by Nielsen, conducted in the summer of 2017, revealed that 60% of Portuguese consumers pay attention to drinks' sugar content; 50% of respondents also admit that nutritional information may influence their purchasing behavior. In 2017, the Portuguese soda tax generated almost 70 million euros in revenue, 10 million euros less than expected.

3. Data

We use data from one of the two largest retailers in Portugal for the period February 2015-January 2018. This retailer has 21% of the Portuguese market share and more than 400 stores that cover the mainland and Madeira territories comprehensively.[9] This contributes to the national representativeness of our analyses.

The dataset includes monthly information on sales and sales volume at the product and store levels, from which we can compute unit prices. Prices include VAT and other taxes; unlike in the US, in Portugal price tags include any applicable taxes. We can identify products by name/brand, and container size. A product corresponds to a specific bar code, meaning that a 1-liter bottle and a 33-centiliter can of Coca-Cola are two distinct products, for instance.

Geographically, we know only if a store is located in the North, Center, South, or Madeira regions. These regions display both between and within heterogeneity, e.g. they include both rural and urban areas. In addition, we can identify stores located in the two main metropolitan areas (Lisbon and Oporto), and stores located within 30 kilometers from the border with Spain. Unfortunately, we lack more detailed store locations or client information, preventing us from investigating potentially heterogeneous responses by local income level or other characteristics.

[8] "Preços subiram 30% com imposto sobre refrigerantes", in *Diário de Notícias* (https://www.dn.pt/dinheiro/interior/precos-subiram-30-com-imposto-sobre-refrigerantes-9096084.html).

[9] "Quota de mercado da Sonae MC aproxima-se dos 22%", in *Jornal Económico* (https://jornaleconomico.sapo.pt/noticias/quota-de-mercado-da-sonae-mc-aproxima-se-dos-22-350698)

We define four main *treated* product groups, directly affected by the tax, based on the drink's sugar content. Information on each drink's sugar content was gathered from online sources and field visits to the supermarket in mid 2018.[10] The first group includes drinks with more than 80 grams of sugar per liter (*High Sugar, HS*); examples are Coca-Cola and Red Bull. The second group includes drinks with sugar levels just below that threshold (*Medium Sugar, MS*); e.g. Fanta, 7Up. According to the available evidence, these drinks seem to have experienced reductions in their sugar contents; i.e. they contained more than 80 grams of sugar per liter before the tax was implemented (section 2). The third group includes drinks with any sugar level below 70 grams per liter, unlikely to have dropped from more than 80 grams per liter pre-tax (*Low Sugar, LS*), such as most iced tea and flavored water drinks. The fourth group includes zero-added sugar/artificially-sweetened drinks (*Zero Sugar, ZS*); e.g. Coca-Cola Zero, Diet 7up. In sum, *High Sugar* drinks pay the highest tax (0.16€ per liter +VAT), and all other drinks pay the lowest tax (0.08€ per liter +VAT).

Our comparison group is *Water*, for three reasons. First, water is neither taxed nor likely to be indirectly affected by the tax. Cawley et al. (2018) and Seiler et al. (2019) explore the impacts of the Philadelphia soda tax on water consumption and find no evidence of substitution of soda for bottled water. Second, with the exception of sugar, the water-bottling industry uses the same inputs as the soda industry (e.g. machines, electricity, water, plastic/glass). So, water and soda are likely to share similar cost structures in packaging, marketing, and logistics (Etilé et al., 2018). Recent trends against plastic packaging should also affect both soda and bottled water in a similar manner. Finally, soda brands have very low market shares in the bottled water segment, which mitigates any strategic manipulation of prices. The Coca-Cola Company and Sumol-Compal are the main competitors in the Portuguese soda market, while the bottled water market is highly fragmented, with more than 30 brands/firms competing.

We conduct our analyses on the full sample (Unbalanced Panel) that includes all products, sold in any store in any month over the period February 2015-January 2018. For comparison, we also estimate our models on a restricted sample (Balanced Panel) that includes only products available in *all* stores in *every* month over the period February 2015-January 2018. Descriptive statistics for both samples are presented in Table A1 in the Appendix.

[10] A few drinks with unknown sugar content that accounted for very few observations or total sales were excluded. Liquid and powder concentrates were also dropped.

Figures A1 through A4 in the Appendix show the evolution of prices and quantities sold for each treatment group versus water, in the unbalanced panel (Panel A) and the balanced one (Panel B). The graphs display similar patterns for water and each of the treatment groups in the pre-tax period, suggesting that the parallel-trends assumption holds (i.e. that water is a good comparison group). Overall, water shows a very constant trend over the entire period under analysis.

4. Empirical Strategy

4.1. Difference-in-Differences Model

We apply difference-in-differences models to compare each treated product group (PG) to *Water*, the comparison group (section 3). In the following econometric specification, q denotes the quarter (Feb-Apr 2015 through Nov 2017-Jan 2018), i the product (e.g. 33-centiliter can of Pepsi, 1.5-liter bottle of Luso water), s the store (each of 400+ stores), m the month of the year (Jan, Feb, ..., Dec), and r the region (North, Center, South, or Madeira):

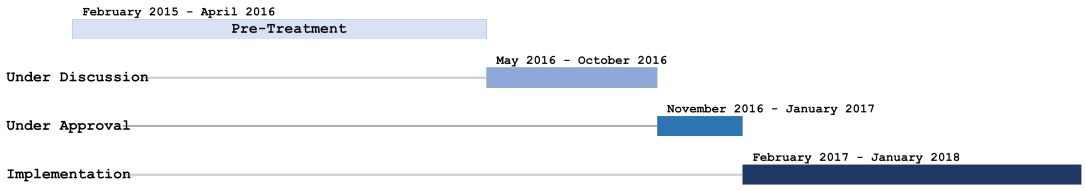
$$\begin{aligned} y_{q,i,s,m,r} = \beta_1 \text{Under Discussion}_q \times \text{PG}_i + \beta_2 \text{Under Approval}_q \times \text{PG}_i \\ + \beta_3 \text{Implementation}_q \times \text{PG}_i + \lambda_q + \alpha_{i,s} + \delta_{m,r} + \varepsilon_{q,i,s,m,r} \end{aligned} \tag{1}$$

The dependent variable, y, is either price (in euros per liter) or the natural logarithm of quantity sold. The natural logarithm accounts for the skewness in the distribution of sales volume and allows us to interpret consumption responses in percentage.

We compare the pre-treatment period (Feb 2015-Apr 2016) with three distinct post-treatment periods: 1) $UnderDiscussion$, the two quarters between May and October 2016, when the tax was only being discussed in the media, 2) $UnderApproval$, the quarter between November 2016 and January 2017, when the tax was formally proposed and debated in the parliament, and 3) $Implementation$, from February 2017 onwards, when the tax was actually in place (Figure 1). The parameters of interest are represented by β_j.

In the previous section, we motivate the use of bottled water as the comparison group. We also test the parallel-trends assumption formally (see next section). In

Figure 1: **Timeline of Events**



addition, the different vectors of fixed effects included in Equation (1) control for potential confounders that may hinder the identification of the causal impact of the soda tax. Quarter fixed effects (λ_q) control for aggregate trends related for example to the business cycle. Product-store fixed effects ($\alpha_{i,s}$) account for unobserved factors that may impact specific products or stores, such as preferences, competition, and other local characteristics. We also include month-region fixed effects ($\delta_{m,r}$) to control for seasonality. In the tables presented in the results section and in the appendix, Equation 1 corresponds to specification (3). Specification (1) controls only for quarter, product, and store fixed effects (not product-store fixed effects), and specification (2) controls only for quarter and product-store fixed effects.

Standard errors are clustered at the brand level to accommodate any serial correlation across different container sizes of the same product, that may for example be substitutes (Bertrand et al., 2004).

4.2. Event Study Design

We complement the previous strategy with event studies. The econometric specification is similar, except that it includes interactions between the treatment group and every quarter:

$$y_{q,i,s,m,r} = \sum(\beta_q Quarter_q \times \text{PG}_i) + \lambda_q + \alpha_{i,s} + \delta_{m,r} + \varepsilon_{q,i,s,m,r} \tag{2}$$

The omitted quarter is Feb-Apr 2016, before the first news piece on the soda tax. Again, the parameters of interest are represented by β_j and standard errors are clustered at the brand level.

The event study design presents two key advantages beyond the difference-in-differences model. First, it is a way of formally testing the parallel-trends assumption. That is, we may test if prices or consumption of soda and water

displayed similar patterns in the pre-tax period. If so, then it is reasonable to believe that prices or consumption patterns of bottled water in the post-tax period represent a good counterfactual for what would be the price or consumption patterns of soda, had there been no tax. Second, with event study specifications we may look at the dynamics in more detail, distinguishing between short- and medium-run responses to the tax.

5. Results

5.1. Difference-in-differences Baseline Results

We present the difference-in-differences results for price (in euros) and ln(quantity of liters sold), based on three alternative specifications.[11] Overall, all specifications give similar results. We focus on the most conservative one, specification (3), which includes quarter, product-store, and month-region fixed effects, as specified in Equation (1). We present results based on the unbalanced panel (Panel A) and the balanced one (Panel B); see section 3.

Starting with *High Sugar* drinks, we find that when the tax was implemented, and compared to one year earlier, before the tax was ever mentioned, prices increased by 16 cents on average, *vis-à-vis* water prices (Panel A of Table 2). The price increase is slightly larger, at 17 cents, when considering only the most popular products (Panel B). This increase is consistent with pass-through to consumer prices below but not too far from 100%.

Regarding sales, the point estimates suggest a 8% drop in the *Under Discussion* period, consistent with an awareness effect, and a 6% drop in the *Implementation* period. However, these effects are imprecisely estimated and not statistically different from zero. In the balanced panel, which includes only the most popular products, we find a statistically significant 19% increase in sales in the *Under Approval* period, right before the tax was implemented. This suggests a stockpiling effect, whereby consumers may have purchased large quantities of these drinks in anticipation of the price increase due to the tax in the following quarter.

Moving on to *Medium Sugar* drinks, which saw their recipes reformulated to fall below the 80 grams of sugar per liter threshold, we see that the average increase in prices is less pronounced than in the case of *High Sugar* drinks, at 15 cents per liter

[11] Results for ln(price) are presented in Table A2 in the Appendix, for comparison.

Table 2. **Difference-in-differences Baseline Results: *High Sugar (HS)***

	Price (in euros)			ln(Quantity of liters sold)		
	(1)	(2)	(3)	(1)	(2)	(3)
			A. Unbalanced Panel			
$UnderDiscussion \times HS$	-0.043**	-0.040**	-0.040**	-0.087	-0.084	-0.084
	(0.018)	(0.015)	(0.015)	(0.051)	(0.053)	(0.051)
$UnderApproval \times HS$	-0.009	-0.015	-0.016	0.019	-0.003	-0.005
	(0.046)	(0.048)	(0.048)	(0.086)	(0.093)	(0.093)
$Implementation \times HS$	0.156***	0.159***	0.160***	-0.071	-0.059	-0.065
	(0.039)	(0.034)	(0.034)	(0.075)	(0.080)	(0.080)
N	647966	647966	647966	647966	647966	647966
adj. R^2	0.974	0.980	0.980	0.846	0.899	0.904
			B. Balanced Panel			
$UnderDiscussion \times HS$	-0.028*	-0.028*	-0.027*	-0.034	-0.033	-0.034
	(0.015)	(0.015)	(0.015)	(0.059)	(0.059)	(0.059)
$UnderApproval \times HS$	-0.029	-0.029	-0.029	0.190***	0.190***	0.189***
	(0.057)	(0.057)	(0.057)	(0.054)	(0.054)	(0.054)
$Implementation \times HS$	0.173***	0.173***	0.173***	-0.056	-0.056	-0.056
	(0.052)	(0.052)	(0.052)	(0.090)	(0.090)	(0.090)
N	301075	301075	301075	301075	301075	301075
adj. R^2	0.983	0.983	0.983	0.890	0.936	0.940
Quarter FE	✓	✓	✓	✓	✓	✓
Product FE	✓			✓		
Store FE	✓			✓		
Product-store FE		✓	✓		✓	✓
Month-region FE			✓			✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018.

(Panel A of Table 3). In this case, the price increase corresponds to pass-through to consumer prices well above 100% (the tax amounts to about 10 cents when including VAT). This may reflect, at least in part, additional costs borne by producers related to product reformulation, repackaging, and brand repositioning. Regarding sales, the only estimate worth notice is a 24% increase in the quarter prior to the tax implementation in the balanced panel (again, a stockpiling effect; Panel B).

Regarding *Low Sugar* drinks, prices increased by 15-16 cents per liter, on average, which again corresponds to more than the amount of the tax (Table 4). In this case, we do find significant drops in consumption in both the *Under Discussion* and *Implementation* periods; as much as a 18% drop in the unbalanced panel. One possible explanation is increased awareness that drinks with added sugar in general are bad for health, whereas Cola-flavored drinks (in the *High Sugar* group) have always been perceived as unhealthy. An alternative explanation is that drinks with

Table 3. **Difference-in-differences Baseline Results: *Medium Sugar (MS)***

	Price (in euros)			ln(Quantity of liters sold)		
	(1)	(2)	(3)	(1)	(2)	(3)
			A. Unbalanced Panel			
$UnderDiscussion \times MS$	-0.033**	-0.032**	-0.031**	-0.009	-0.022	-0.026
	(0.015)	(0.014)	(0.014)	(0.110)	(0.107)	(0.107)
$UnderApproval \times MS$	0.010	0.004	0.003	0.081	0.042	0.041
	(0.027)	(0.025)	(0.025)	(0.179)	(0.184)	(0.184)
$Implementation \times MS$	0.154***	0.152***	0.152***	0.013	0.010	0.003
	(0.023)	(0.021)	(0.021)	(0.104)	(0.112)	(0.113)
N	567786	567786	567786	567786	567786	567786
adj. R^2	0.950	0.963	0.963	0.785	0.849	0.855
			B. Balanced Panel			
$UnderDiscussion \times MS$	-0.050***	-0.050***	-0.050***	0.049	0.049	0.049
	(0.015)	(0.015)	(0.015)	(0.098)	(0.098)	(0.098)
$UnderApproval \times MS$	-0.017	-0.017	-0.017	0.239***	0.239***	0.239***
	(0.017)	(0.017)	(0.017)	(0.078)	(0.078)	(0.079)
$Implementation \times MS$	0.143***	0.143***	0.143***	0.037	0.037	0.038
	(0.018)	(0.018)	(0.018)	(0.086)	(0.086)	(0.086)
N	317611	317611	317611	317611	317611	317611
adj. R^2	0.970	0.971	0.971	0.858	0.908	0.913
Quarter FE	✓	✓	✓	✓	✓	✓
Product FE	✓			✓		
Store FE	✓			✓		
Product-store FE		✓	✓		✓	✓
Month-region FE			✓			✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018.

comparatively less sugar may be less addictive, which may translate into a more elastic demand compared to drinks with more sugar. In the balanced panel, once again we find a surge in sales in the quarter prior to implementation.

Lastly, for *Zero Sugar* drinks, we find about 100% price pass-through (Table 5). Looking at the balanced panel, we find a statistically significant increase in consumption in the *Under Approval* period, in line with our findings for the other drink groups. In addition, the point estimate for the *Implementation* interaction term indicates a 12% increase in sales, suggestive of a substitution effect towards artificially-sweetened beverages, but it is not statistically different from zero due to a large standard error.

Table 4. **Difference-in-differences Baseline Results: *Low Sugar (LS)***

	Price (in euros)			ln(Quantity of liters sold)		
	(1)	(2)	(3)	(1)	(2)	(3)
			A. Unbalanced Panel			
$UnderDiscussion \times LS$	-0.017**	-0.016**	-0.016**	-0.144**	-0.150**	-0.150**
	(0.006)	(0.006)	(0.006)	(0.069)	(0.065)	(0.066)
$UnderApproval \times LS$	-0.009	-0.011	-0.011	0.132	0.088	0.085
	(0.013)	(0.011)	(0.011)	(0.079)	(0.089)	(0.089)
$Implementation \times LS$	0.154***	0.154***	0.154***	-0.183**	-0.184**	-0.185**
	(0.026)	(0.026)	(0.025)	(0.074)	(0.077)	(0.077)
N	1107429	1107429	1107429	1107429	1107429	1107429
adj. R^2	0.943	0.956	0.957	0.813	0.875	0.879
			B. Balanced Panel			
$UnderDiscussion \times LS$	-0.019**	-0.019**	-0.019**	-0.053	-0.053	-0.052
	(0.007)	(0.007)	(0.007)	(0.058)	(0.058)	(0.058)
$UnderApproval \times LS$	-0.011	-0.011	-0.011	0.238*	0.238*	0.237*
	(0.012)	(0.012)	(0.012)	(0.120)	(0.120)	(0.119)
$Implementation \times LS$	0.162***	0.162***	0.162***	-0.135*	-0.134*	-0.134*
	(0.025)	(0.025)	(0.025)	(0.065)	(0.065)	(0.065)
N	510064	510064	510064	510064	510064	510064
adj. R^2	0.930	0.931	0.932	0.844	0.904	0.908
Quarter FE	✓	✓	✓	✓	✓	✓
Product FE	✓			✓		
Store FE	✓			✓		
Product-store FE		✓	✓		✓	✓
Month-region FE			✓			✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018.

Table 5. **Difference-in-differences Baseline Results: *Zero Sugar (ZS)***

	Price (in euros)			ln(Quantity of liters sold)		
	(1)	(2)	(3)	(1)	(2)	(3)
			A. Unbalanced Panel			
$UnderDiscussion \times ZS$	-0.038***	-0.042***	-0.042***	-0.041	-0.044	-0.041
	(0.011)	(0.010)	(0.010)	(0.049)	(0.048)	(0.048)
$UnderApproval \times ZS$	-0.019	-0.021	-0.022	-0.003	-0.041	-0.040
	(0.061)	(0.056)	(0.055)	(0.132)	(0.134)	(0.127)
$Implementation \times ZS$	0.091***	0.093***	0.093***	0.020	0.034	0.027
	(0.022)	(0.020)	(0.020)	(0.086)	(0.090)	(0.091)
N	499099	499099	499099	499099	499099	499099
adj. R^2	0.977	0.984	0.984	0.853	0.902	0.906
			B. Balanced Panel			
$UnderDiscussion \times ZS$	-0.042***	-0.042***	-0.041***	0.010	0.010	0.009
	(0.010)	(0.010)	(0.010)	(0.097)	(0.097)	(0.097)
$UnderApproval \times ZS$	-0.013	-0.013	-0.013	0.172**	0.172**	0.171**
	(0.046)	(0.046)	(0.046)	(0.066)	(0.066)	(0.066)
$Implementation \times ZS$	0.102**	0.102**	0.102**	0.119	0.119	0.119
	(0.043)	(0.042)	(0.042)	(0.156)	(0.155)	(0.155)
N	224960	224960	224960	224960	224960	224960
adj. R^2	0.985	0.985	0.985	0.895	0.935	0.939
Quarter FE	✓	✓	✓	✓	✓	✓
Product FE	✓			✓		
Store FE	✓			✓		
Product-store FE		✓	✓		✓	✓
Month-region FE			✓			✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018.

5.2. Internal Validity: Event Study and Falsification Tests

We test the internal validity of our results by estimating event study specifications, as shown in Equation (2), and by conducting a placebo test.

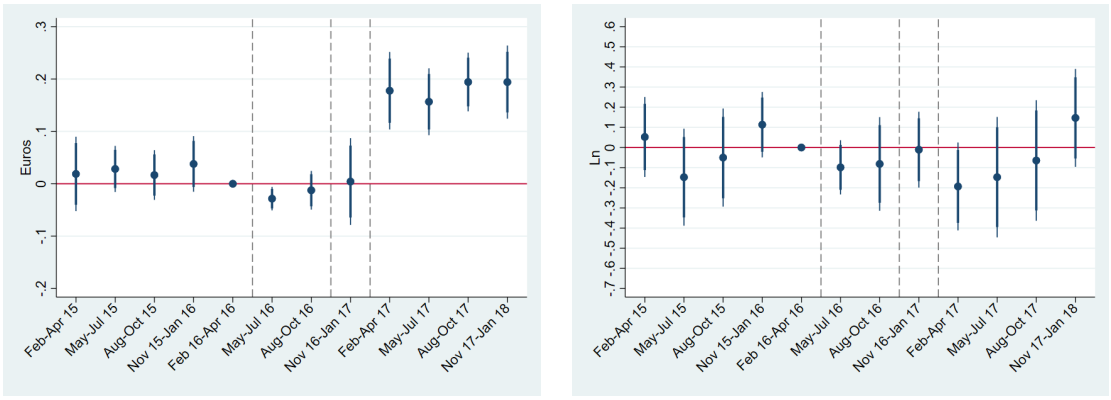
Event study results are shown in Figures 2 through 5, where the top panels display the results for the unbalanced panel and the bottom panels display the results for the balanced panel. We present both 90% and 95% confidence intervals. As a reminder, the omitted quarter is February-April 2016, before the first news piece on the soda tax.

Overall, we find support for the parallel-trends assumption and the validity of our difference-in-differences results, as confidence intervals for pre-treatment period interactions include the value zero. In addition, we highlight two main findings, looking at these plots. First, for any group of drinks, price increases appear mostly

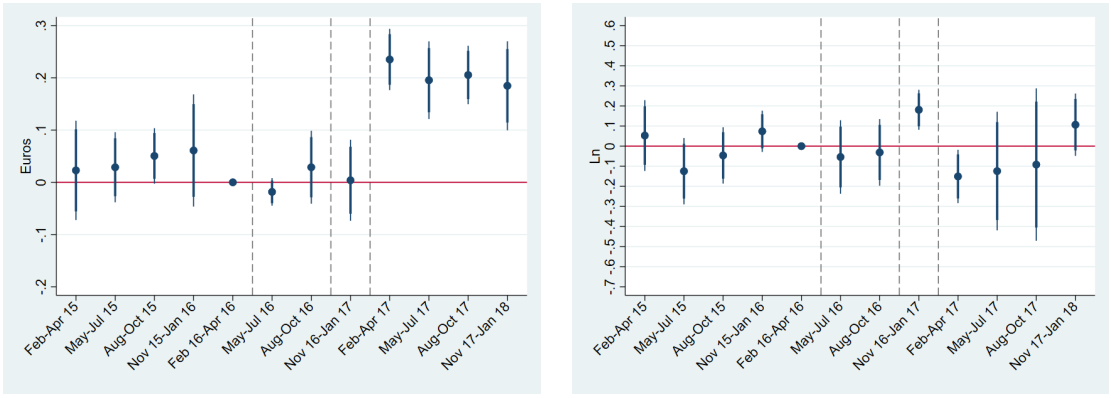
stable along the four quarters of the *Implementation* period. Second, in the *High Sugar* group, we find that consumption did decrease in the first quarter of the *Implementation* period, specially in the balanced panel, where we also find evidence of stockpiling in the pre-implementation quarter. However, consumption quickly returned to previous levels, resulting overall in the non-significant 6% drop that we find in the difference-in-differences results.

Figure 2: **Event Study Results: *High Sugar***

A. Unbalanced Panel



B. Balanced Panel



Notes: 90% and 95% confidence intervals using standard errors clustered by brand.

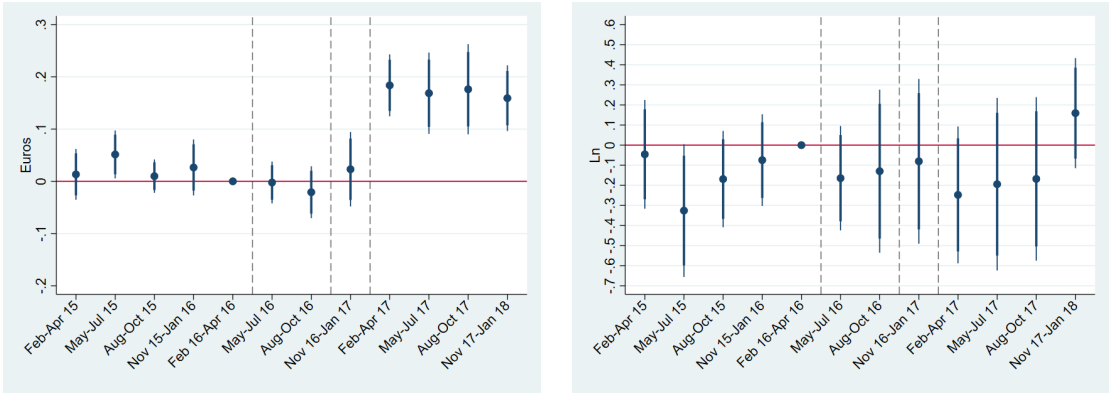
Our placebo test consists in estimating Equation (1) only with data for the pre-treatment period (i.e., February 2015-April 2016). We estimate the difference-in-differences model pretending the tax is implemented in the quarter before the first news piece on the soda tax. As expected, results indicate non-significant impacts of the fake tax introduction (Table A3).

5.3. Robustness Checks

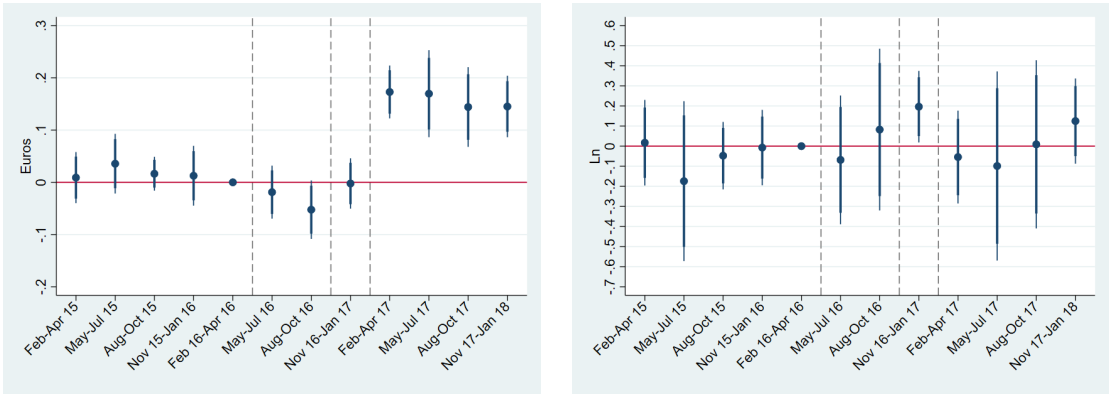
Our first robustness check consists in adding sparkling water to the comparison group, as a means to enlarge sample sizes and eventually obtain more precise

Figure 3: **Event Study Results:** ***Medium Sugar***

A. Unbalanced Panel



B. Balanced Panel



Notes: 90% and 95% confidence intervals using standard errors clustered by brand.

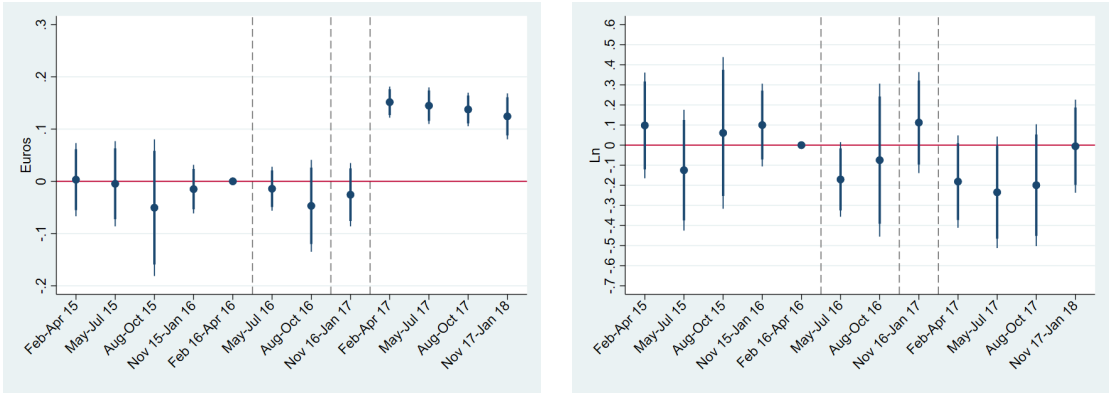
estimates. Our go-to comparison group did not include sparkling water because, contrary to other countries, in Portugal sparkling water has little expression. Results are virtually unchanged by this enlargement of the comparison group (Table A4).

Second, we acknowledge that consumers may have different elasticities regarding popular multinational brands and retailer's own brand products. We test the sensitivity of our findings to the exclusion of the retailer's own brand products. Third, we consider potential cross-border shopping as a means to avoid higher tax-induced prices in Portugal, and exclude from the sample stores close to the border with Spain (within 30km distance). Some studies on soda taxes in the US find evidence of cross-border shopping (see also Beatty et al. (2009) on the impacts of differentials in alcohol and tobacco taxes near an international border). Neither excluding own brand products nor excluding stores close to Spain impacts visibly our main findings (Table A5).

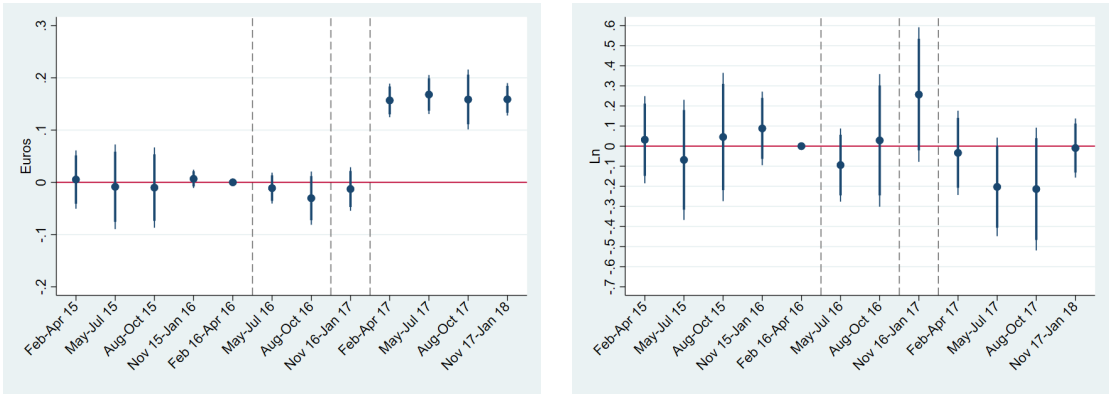
Fourth, we distinguish between the impacts of the soda tax in the Lisbon and

Figure 4: **Event Study Results: *Low Sugar***

A. Unbalanced Panel



B. Balanced Panel



Notes: 90% and 95% confidence intervals using standard errors clustered by brand.

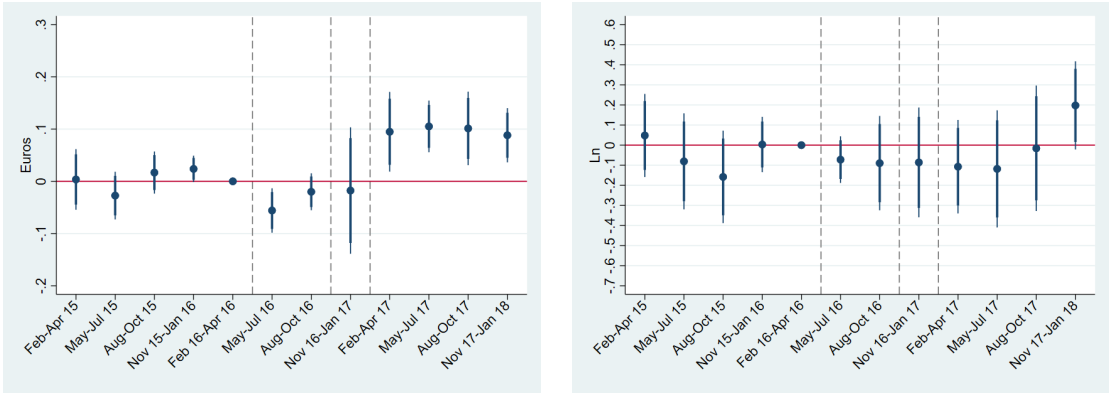
Oporto metropolitan areas versus the rest of the country. Excluding observations from the most urban and densely populated areas in the country also gives very similar results (Table A6).

5.4. Is there substitution from large to small container sizes?

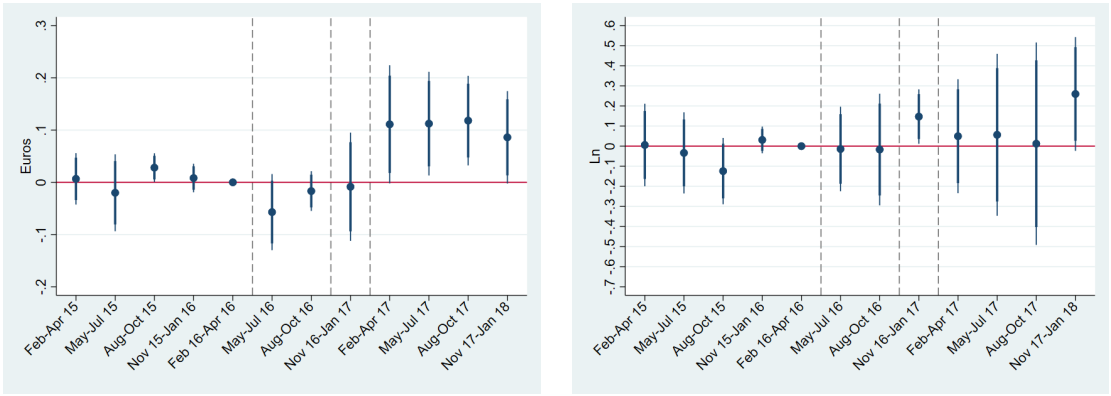
Consumers may react to the introduction of the soda tax by substituting from larger to smaller container sizes, compensating for the increase in price by reducing quantity purchased, in liters. To test this hypothesis, we split the treatment groups into <1 liter and 1+ liters container sizes. The comparison group is unaltered. Results are reported in Table A7. For all product groups, consumption of larger packages is hit in a more severe way; the exception is *Low Sugar* products in the balanced panel, where point estimates are virtually the same. These findings are in line with the findings of Castelló and López-Casasnovas (2018). In some cases, the differential impact of the tax implementation on consumption may partly reflect different price increases in the two groups. Yet, even in the *Under Discussion* period,

Figure 5: **Event Study Results: *Zero Sugar***

A. Unbalanced Panel



B. Balanced Panel



Notes: 90% and 95% confidence intervals using standard errors clustered by brand.

when prices don't change substantially in economic terms, we see larger drops in the consumption of large container sizes. This suggests that heavier soda consumers are the main ones reducing consumption. For more sugary drinks (HS and MS), consumption tends to increase in the *Under Approval* period, especially for larger packages, consistent with the idea of stockpiling.

6. Concluding Remarks

A recent WHO report called for the introduction of taxes on sugar-sweetened beverages in developed countries (WHO, 2017). In particular, WHO recommended that to be effective in reducing consumption, a soda tax should result in at least 20% increase in retail prices. One of the arguments to introduce soda taxes is to improve consumer diets through the reduction of sugar intake from soda. Determining the impact of soda taxes on consumption can only be done empirically, as in theory there are several mechanisms that may entail both positive and negative effects.

Those mechanisms include the elasticity of consumption to soda prices, changes in recipes, and amplified consumer awareness of the detrimental health effects of sugar and soda. Understanding better these mechanisms is also key to inform the design of more efficient public policies (Cawley and Ruhm, 2011; Cornelsen and Smith, 2018).

Portugal introduced a soda tax in February 2017, levied on producers. The amount of the tax is 0.08€ (+VAT) per liter for drinks with less than 80 grams of sugar per liter, and 0.16€ (+VAT) per liter for drinks with more than 80 grams of sugar per liter. We study the impacts of this tax on prices and consumers' purchasing behavior. First, we find substantial pass-through of the tax to consumer prices: almost 100% for drinks with more than 80 grams of sugar per liter, more than 100% for drinks with less sugar, and about 100% for artificially-sweetened beverages (average price increases of about 16%, 19%, and 8% respectively, compared to water). One possible reason underlying price overshooting for drinks with less than 80 grams of sugar per liter is costs associated with product reformulations.

Second, regarding consumption, our results suggest limited impacts of the tax. We do find a significant and substantial drop in consumption of drinks with comparatively lower sugar content (-18%). For drinks with very high sugar content, the point estimate suggests a 6% drop in consumption, but it is not estimated with enough precision to be statistically significant. Moreover, event study results show an immediate drop in consumption that quickly rebounds. This suggests that the main benefits of the soda tax in terms of reducing sugar intake are mainly through product reformulations, as producers reduced the sugar content of several drinks to fall below the 80 grams per liter threshold. In fact, the Portuguese government introduced a new soda tax breakdown in 2019.[12] In short, drinks with relatively less sugar, *light*, and *zero* products, are now subject to a lower tax, whereas drinks with high sugar content pay an aggravated tax. This new design is expected to further promote product reformulations towards lower sugar content. These changes are outside of our period of analysis but are worth studying in future research. Possibly because in Portugal artificially-sweetened beverages are also taxed, we find no significant evidence of substitution towards this type of drinks.

It is worth mentioning that even though it appears that producers are able to

[12]Drinks with less than 25 grams of sugar per liter now pay a tax of 0.01€ per liter, drinks with 25 grams or more and less than 50 grams of sugar per liter pay a tax of 0.06€ per liter, drinks with 50 grams or more and less than 80 grams of sugar per liter pay a tax of 0.08€ per liter, and drinks with 80 grams or more sugar per liter pay a tax of 0.20€ per liter (+VAT).

increase prices without significantly impacting demand (i.e., demand for most soda products appears rather inelastic), they still bother with product reformulations. This may be to accommodate consumers' increasing preferences for healthier options, as well as to come progressively closer to targets negotiated with the government or even in anticipation of the new tax brackets.[13]

As far as awareness is concerned, in most cases we find a slight decrease in consumption when the tax first started to be mentioned in the media, but the estimates are not precisely estimated and are not significantly different from zero.

Lastly, consumers appear to have engaged in stockpiling of the most widely consumed products in the quarter prior to the tax implementation. This is not a surprising finding in the context of Portugal. For example, in 2019 fuel truck drivers have been striking and when a new strike is announced, consumers run to gas stations.[14]

The comparison between previous findings and ours is not straightforward, as we split drinks into different groups. The drop in consumption of low sugar drinks is somewhere in the middle of the range of prior studies' estimates. Overall, it is important to note that although we do not find statistically significant results for most drink groups, our estimates are more conservative than most, as we include in our main specification product-store fixed effects, and our standard errors are clustered at the brand level.

To conclude, the Portuguese soda tax has two main distinctive features: it depends on sugar content, taxing more heavily drinks with a lot of sugar, and artificially-sweetened beverages are also taxed. Due to its structure, the Portuguese soda tax led producers to reformulate many recipes towards lower sugar content. This seems to have been the main channel through which the tax reduced sugar intake from soda. This finding is in line with recent developments in soda taxes worldwide, with not only Portugal but also France introducing more tax brackets in 2019 and 2018 respectively, and for example the UK structuring its 2018 soda tax in a similar manner. We believe that our results are of practical relevance not only for policymakers planning to implement similar taxes in other countries but also for

[13] In May 2019, the government and several industry representatives signed a compromise to cut sugar, salt, and fat content in thousands of products until 2022 (https://expresso.pt/revista-de-imprensa/2019-05-02-Acordo-da-Saude-com-a-industria-alimentar-sal-e-acucar-vao-ser-reduzidos-em-2000-produtos).

[14] https://sicnoticias.pt/economia/2019-04-16-Corrida-as-bombas-de-gasolina

countries or regions that have very recently introduced bracketed soda taxes.

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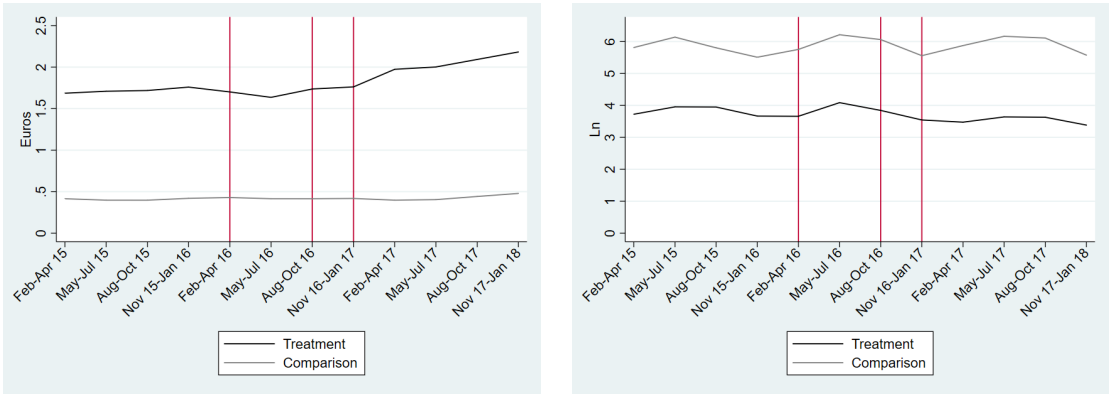
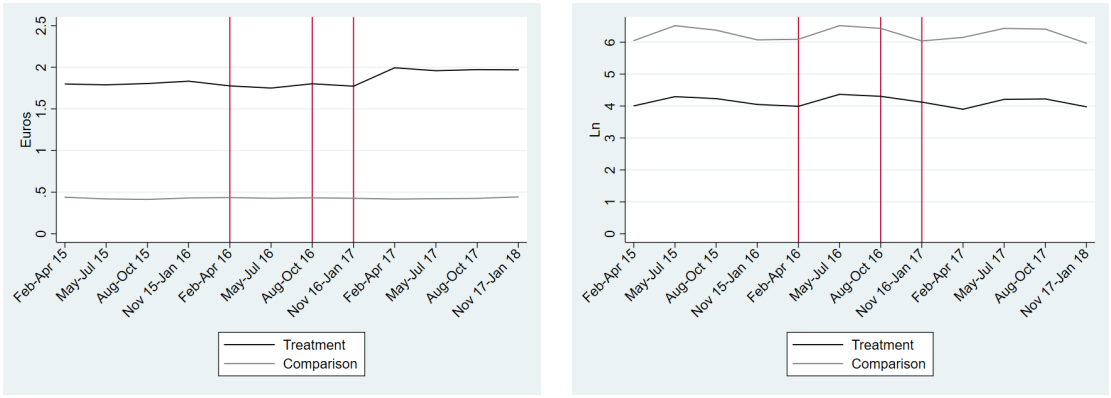
Appendix

Figure A1: **Trends in Prices and Quantities: *High Sugar***

A. Unbalanced Panel



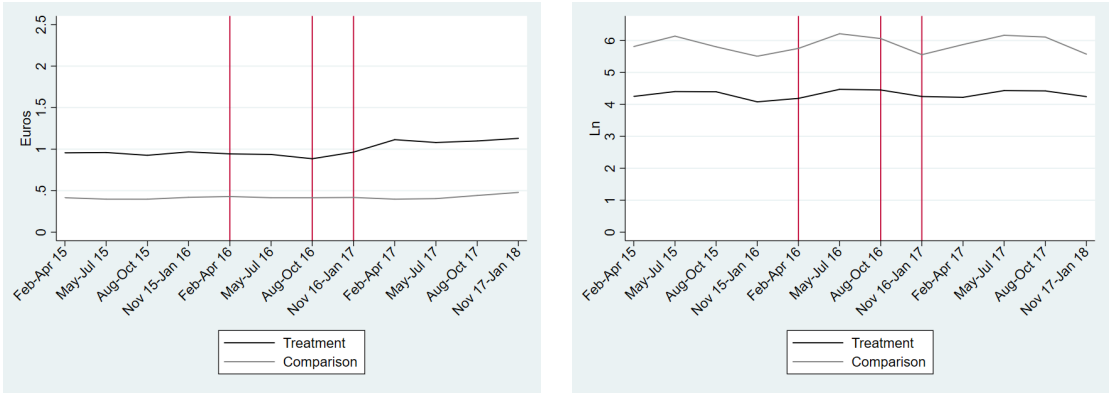
B. Balanced Panel



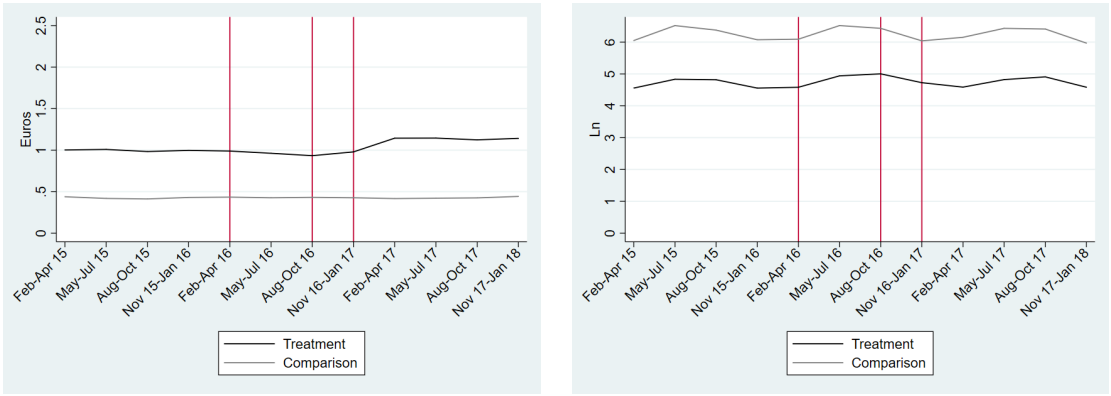
Notes: Average price (in euros) and ln(quantity of liters sold).

Figure A2: **Trends in Prices and Quantities: *Medium Sugar***

A. Unbalanced Panel



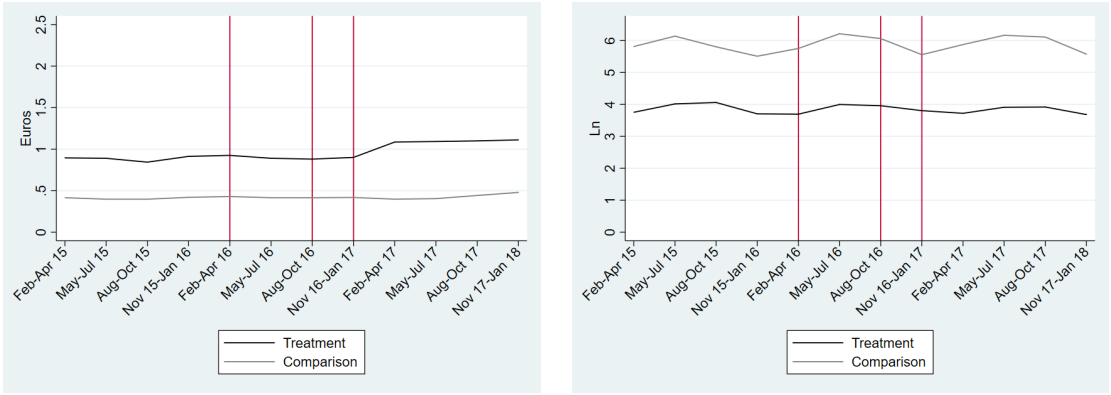
B. Balanced Panel



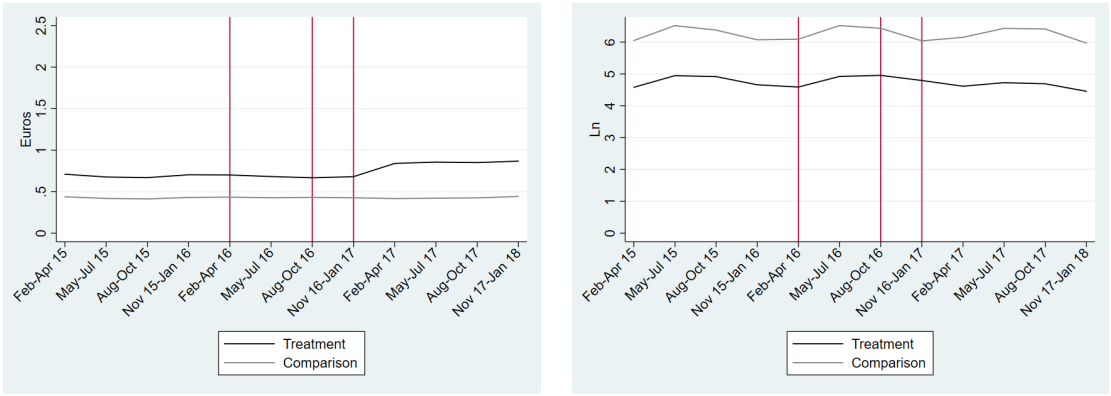
Notes: Average price (in euros) and ln(quantity of liters sold).

Figure A3: **Trends in Prices and Quantities: *Low Sugar***

A. Unbalanced Panel



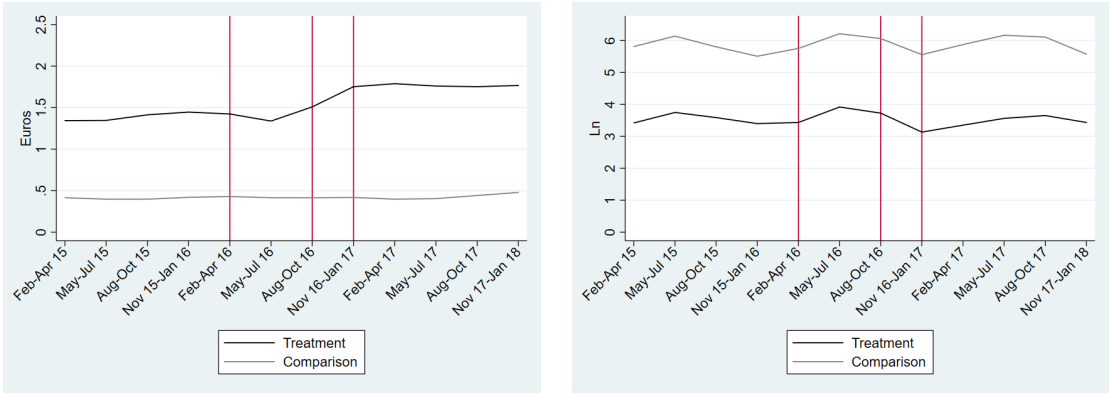
B. Balanced Panel



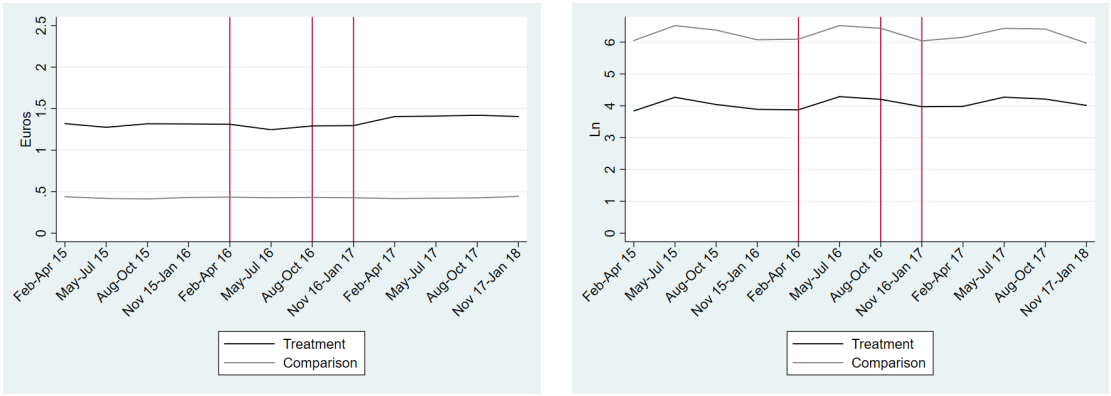
Notes: Average price (in euros) and ln(quantity of liters sold).

Figure A4: **Trends in Prices and Quantities: *Zero Sugar***

A. Unbalanced Panel



B. Balanced Panel



Notes: Average price (in euros) and ln(quantity of liters sold).

Table A1. **Descriptive statistics**

	Full	Before	Discuss	Approval	Implement	Full	Before	Discuss	Approval	Implement
	Price in euros					Quantity sold (liters)				
					A. Unbalanced Panel					
					Comparison group: *Water*					
Avg	0.42	0.41	0.42	0.42	0.43	1899.53	1863.68	2273.06	1479.55	1872.23
SD	0.30	0.27	0.28	0.28	0.33	5344.12	5354.86	6127.92	4232.96	5184.60
Obs	295359	114319	48036	26012	106992	295359	114319	48036	26012	106992
					High Sugar (HS)					
Avg	1.84	1.72	1.69	1.76	2.06	216.73	237.15	276.45	207.09	170.00
SD	1.61	1.60	1.62	1.56	1.61	1257.36	977.60	1980.30	1471.38	1045.77
Obs	352607	139868	57137	27071	128531	352607	139868	57137	27071	128531
					Medium Sugar (MS)					
Avg	1.00	0.95	0.91	0.96	1.10	228.25	221.28	251.94	227.33	224.03
SD	0.50	0.47	0.46	0.48	0.53	503.33	494.38	522.35	539.00	495.14
Obs	272427	109342	49568	19928	93589	272427	109342	49568	19928	93589
					Low Sugar (LS)					
Avg	0.96	0.89	0.89	0.90	1.10	188.24	195.77	200.54	177.60	174.31
SD	0.62	0.59	0.58	0.59	0.65	420.58	445.79	446.95	374.06	380.54
Obs	812070	339566	145032	66716	260756	812070	339566	145032	66716	260756
					Zero Sugar (ZS)					
Avg	1.56	1.39	1.43	1.75	1.77	114.88	104.48	138.38	97.52	119.78
SD	1.10	0.98	1.10	1.17	1.18	308.02	248.93	381.67	258.54	339.73
Obs	203740	84955	32262	13436	73087	203740	84955	32262	13436	73087
					B. Balanced Panel					
					Comparison group: *Water*					
Avg	0.43	0.43	0.43	0.43	0.43	2653.14	2622.62	3095.95	2217.50	2578.79
SD	0.27	0.27	0.27	0.27	0.27	6385.42	6411.21	7182.98	5383.30	6144.02
Obs	163881	68268	27318	13659	54636	163881	68268	27318	13659	54636
					High Sugar (HS)					
Avg	1.85	1.80	1.78	1.77	1.97	179.34	189.78	218.41	181.66	146.17
SD	1.77	1.82	1.81	1.69	1.70	363.29	395.26	485.00	334.04	230.60
Obs	137194	57142	22872	11436	45744	137194	57142	22872	11436	45744
					Medium Sugar (MS)					
Avg	1.03	1.00	0.95	0.98	1.14	304.21	287.46	354.79	294.26	302.32
SD	0.50	0.49	0.48	0.47	0.52	582.63	574.87	609.33	585.92	576.33
Obs	153730	64039	25626	12813	51252	153730	64039	25626	12813	51252
					Low Sugar (LS)					
Avg	0.74	0.69	0.67	0.68	0.85	334.52	356.07	376.74	313.00	291.88
SD	0.31	0.30	0.28	0.29	0.30	574.21	613.89	627.50	503.57	504.43
Obs	346183	144184	57714	28857	115428	346183	144184	57714	28857	115428
					Zero Sugar (ZS)					
Avg	1.33	1.31	1.27	1.30	1.41	115.43	115.96	134.28	100.74	109.01
SD	1.08	1.11	1.09	0.96	1.05	187.40	209.89	191.91	138.82	163.70
Obs	61079	25442	10182	5091	20364	61079	25442	10182	5091	20364

Notes: *Full*: February 2015-January 2018; *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018.

Table A2. **Difference-in-differences Results: Prices in ln**

	ln(Price)			
	HS	*MS*	*LS*	*ZS*
		A. Unbalanced Panel		
UnderDiscussion × *PG*	-0.034***	-0.035*	-0.019	-0.052***
	(0.011)	(0.017)	(0.012)	(0.011)
UnderApproval × *PG*	0.008	0.009	-0.018	0.014
	(0.019)	(0.032)	(0.014)	(0.015)
Implementation × *PG*	0.161***	0.162***	0.190***	0.082*
	(0.053)	(0.032)	(0.024)	(0.044)
N	647966	567784	1107415	499099
adj. R^2	0.985	0.973	0.966	0.987
		B. Balanced Panel		
UnderDiscussion × *PG*	-0.032**	-0.062***	-0.033*	-0.050***
	(0.012)	(0.015)	(0.017)	(0.007)
UnderApproval × *PG*	0.015	-0.015	-0.021	0.017
	(0.021)	(0.023)	(0.017)	(0.018)
Implementation × *PG*	0.213***	0.149***	0.226***	0.133*
	(0.072)	(0.033)	(0.025)	(0.073)
N	301075	317611	510061	224960
adj. R^2	0.988	0.981	0.965	0.986
Quarter FE	✓	✓	✓	✓
Product-store FE	✓	✓	✓	✓
Month-region FE	✓	✓	✓	✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018. *PG* stands for the following product groups: *HS*(*HighSugar*), *MS*(*MediumSugar*), *LS*(*LowSugar*), and *ZS*(*ZeroSugar*).

Table A3. **Difference-in-differences Placebo Results**

	Price (in euros)				ln(Quantity of liters sold)			
	HS	MS	LS	ZS	HS	MS	LS	ZS
				A. Unbalanced Panel				
$Fev - Apr2016 \times PG$	-0.026	-0.026	0.025	-0.005	-0.004	0.135	-0.067	0.044
	(0.023)	(0.018)	(0.041)	(0.014)	(0.071)	(0.088)	(0.111)	(0.065)
N	253013	222241	452699	198364	253013	222241	452699	198364
adj. R^2	0.982	0.958	0.956	0.986	0.907	0.861	0.878	0.913
				B. Balanced Panel				
$Fev - Apr2016 \times PG$	-0.030	-0.019	-0.004	-0.006	0.019	0.065	-0.020	0.007
	(0.027)	(0.018)	(0.021)	(0.014)	(0.053)	(0.080)	(0.080)	(0.047)
N	177911	160980	282091	137346	177911	160980	282091	137346
adj. R^2	0.984	0.962	0.946	0.987	0.942	0.913	0.908	0.952
Quarter FE	✓	✓	✓	✓	✓	✓	✓	✓
Product-store FE	✓	✓	✓	✓	✓	✓	✓	✓
Month-region FE	✓	✓	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). $UnderDiscussion$: May-October 2016; $UnderApproval$: November 2016-January 2017; $Implementation$: February 2017-January 2018. PG stands for the following product groups: $HS(HighSugar)$, $MS(MediumSugar)$, $LS(LowSugar)$, and $ZS(ZeroSugar)$.

Table A4. **Difference-in-differences Different Comparison Group**

	Price (in euros)		ln(Quantity of liters sold)	
	Baseline	With Sparkling Water	Baseline	With Sparkling Water
		A. Unbalanced Panel		
$UnderDiscussion \times HS$	-0.040**	-0.027	-0.084	-0.094*
	(0.015)	(0.016)	(0.051)	(0.051)
$UnderApproval \times HS$	-0.016	-0.019	-0.005	-0.036
	(0.048)	(0.048)	(0.093)	(0.084)
$Implementation \times HS$	0.160***	0.148***	-0.065	-0.060
	(0.034)	(0.035)	(0.080)	(0.068)
N	647966	770332	647966	770332
adj. R^2	0.980	0.977	0.904	0.898
$UnderDiscussion \times MS$	-0.031**	-0.019	-0.026	-0.035
	(0.014)	(0.016)	(0.107)	(0.106)
$UnderApproval \times MS$	0.003	0.000	0.041	0.010
	(0.025)	(0.026)	(0.184)	(0.179)
$Implementation \times MS$	0.152***	0.141***	0.003	0.008
	(0.021)	(0.022)	(0.113)	(0.104)
N	567786	690152	567786	690152
adj. R^2	0.963	0.952	0.855	0.859
$UnderDiscussion \times LS$	-0.016**	-0.004	-0.150**	-0.158**
	(0.006)	(0.010)	(0.066)	(0.066)
$UnderApproval \times LS$	-0.011	-0.015	0.085	0.054
	(0.011)	(0.014)	(0.089)	(0.080)
$Implementation \times LS$	0.154***	0.142***	-0.185**	-0.179***
	(0.025)	(0.026)	(0.077)	(0.066)
N	1107429	1229795	1107429	1229795
adj. R^2	0.957	0.952	0.879	0.876
$UnderDiscussion \times ZS$	-0.042***	-0.029**	-0.041	-0.051
	(0.010)	(0.012)	(0.048)	(0.048)
$UnderApproval \times ZS$	-0.022	-0.025	-0.040	-0.071
	(0.055)	(0.056)	(0.127)	(0.121)
$Implementation \times ZS$	0.093***	0.082***	0.027	0.031
	(0.020)	(0.021)	(0.091)	(0.082)
N	499099	621465	499099	621465
adj. R^2	0.984	0.977	0.906	0.899
		B. Balanced Panel		
$UnderDiscussion \times HS$	-0.027*	-0.018	-0.034	-0.047
	(0.015)	(0.017)	(0.059)	(0.059)
$UnderApproval \times HS$	-0.029	-0.040	0.189***	0.154***
	(0.057)	(0.058)	(0.054)	(0.052)
$Implementation \times HS$	0.173***	0.158***	-0.056	-0.076
	(0.052)	(0.052)	(0.090)	(0.084)
N	301075	376191	301075	376191
adj. R^2	0.983	0.980	0.940	0.931
$UnderDiscussion \times MS$	-0.050***	-0.041**	0.049	0.036
	(0.015)	(0.017)	(0.098)	(0.097)
$UnderApproval \times MS$	-0.017	-0.029	0.239***	0.203**
	(0.017)	(0.019)	(0.079)	(0.077)
$Implementation \times MS$	0.143***	0.129***	0.038	0.017
	(0.018)	(0.019)	(0.086)	(0.079)
N	317611	392727	317611	392727
adj. R^2	0.971	0.959	0.913	0.908
$UnderDiscussion \times LS$	-0.019**	-0.010	-0.052	-0.066
	(0.007)	(0.011)	(0.058)	(0.058)
$UnderApproval \times LS$	-0.011	-0.023	0.237*	0.202*
	(0.012)	(0.015)	(0.119)	(0.118)
$Implementation \times LS$	0.162***	0.147***	-0.134*	-0.155**
	(0.025)	(0.026)	(0.065)	(0.057)
N	510064	585180	510064	585180
adj. R^2	0.932	0.936	0.908	0.904
$UnderDiscussion \times ZS$	-0.041***	-0.032**	0.009	-0.004
	(0.010)	(0.013)	(0.097)	(0.097)
$UnderApproval \times ZS$	-0.013	-0.024	0.171**	0.135**
	(0.046)	(0.047)	(0.066)	(0.064)
$Implementation \times ZS$	0.102**	0.088*	0.119	0.098
	(0.042)	(0.043)	(0.155)	(0.151)
N	224960	300076	224960	300076
adj. R^2	0.985	0.974	0.939	0.930
Quarter FE	✓	✓	✓	✓
Product-store FE	✓	✓	✓	✓
Month-region FE	✓	✓	✓	✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018. *PG* stands for the following product groups: $HS(HighSugar)$, $MS(MediumSugar)$, $LS(LowSugar)$, and $ZS(ZeroSugar)$.

Table A5. **Difference-in-differences Robustness Results**

	Price (in euros)			ln(Quantity of liters sold)		
	Baseline	No Own Brand	No Border	Baseline	No Own Brand	No Border
			A. Unbalanced Panel			
$UnderDiscussion \times HS$	-0.040**	-0.046**	-0.040**	-0.085	-0.080	-0.083
	(0.015)	(0.017)	(0.014)	(0.051)	(0.059)	(0.051)
$UnderApproval \times HS$	-0.016	-0.025	-0.016	-0.005	-0.035	-0.005
	(0.048)	(0.059)	(0.048)	(0.093)	(0.114)	(0.093)
$Implementation \times HS$	0.160***	0.146***	0.160***	-0.065	-0.060	-0.063
	(0.034)	(0.041)	(0.034)	(0.080)	(0.084)	(0.080)
N	647412	532198	633089	647412	532198	633089
adj. R^2	0.980	0.978	0.980	0.904	0.879	0.904
$UnderDiscussion \times MS$	-0.031**	-0.033*	-0.032**	-0.026	-0.051	-0.024
	(0.014)	(0.016)	(0.014)	(0.107)	(0.118)	(0.107)
$UnderApproval \times MS$	0.003	0.000	0.003	0.041	0.034	0.042
	(0.025)	(0.028)	(0.025)	(0.184)	(0.212)	(0.184)
$Implementation \times MS$	0.152***	0.154***	0.152***	0.003	-0.043	0.004
	(0.021)	(0.024)	(0.021)	(0.113)	(0.129)	(0.113)
N	567289	480691	554839	567289	480691	554839
adj. R^2	0.963	0.958	0.963	0.854	0.801	0.855
$UnderDiscussion \times LS$	-0.016**	-0.012	-0.016**	-0.150**	-0.128	-0.149**
	(0.006)	(0.007)	(0.006)	(0.066)	(0.077)	(0.065)
$UnderApproval \times LS$	-0.011	-0.011	-0.011	0.085	0.116	0.084
	(0.011)	(0.015)	(0.011)	(0.089)	(0.108)	(0.089)
$Implementation \times LS$	0.154***	0.162***	0.154***	-0.185**	-0.198**	-0.185**
	(0.025)	(0.031)	(0.025)	(0.078)	(0.097)	(0.077)
N	1106727	838023	1082533	1106727	838023	1082533
adj. R^2	0.957	0.953	0.957	0.879	0.830	0.879
$UnderDiscussion \times ZS$	-0.042***	-0.045***	-0.042***	-0.041	-0.030	-0.040
	(0.010)	(0.010)	(0.010)	(0.048)	(0.052)	(0.048)
$UnderApproval \times ZS$	-0.022	-0.034	-0.022	-0.041	-0.058	-0.039
	(0.055)	(0.071)	(0.056)	(0.127)	(0.158)	(0.127)
$Implementation \times ZS$	0.093***	0.078***	0.093***	0.027	0.029	0.029
	(0.020)	(0.019)	(0.020)	(0.091)	(0.101)	(0.091)
N	498730	412539	487810	498730	412539	487810
adj. R^2	0.984	0.983	0.984	0.906	0.882	0.906
			B. Balanced Panel			
$UnderDiscussion \times HS$	-0.027*	-0.033	-0.027*	-0.033	0.016	-0.032
	(0.015)	(0.023)	(0.015)	(0.059)	(0.060)	(0.059)
$UnderApproval \times HS$	-0.029	-0.054	-0.029	0.190***	0.229***	0.189***
	(0.057)	(0.086)	(0.057)	(0.054)	(0.072)	(0.054)
$Implementation \times HS$	0.173***	0.146*	0.172***	-0.056	0.004	-0.055
	(0.052)	(0.078)	(0.052)	(0.090)	(0.075)	(0.090)
N	300967	210932	294813	300967	210932	294813
adj. R^2	0.983	0.981	0.983	0.940	0.915	0.940
$UnderDiscussion \times MS$	-0.050***	-0.057***	-0.051***	0.049	0.029	0.051
	(0.015)	(0.017)	(0.015)	(0.098)	(0.116)	(0.098)
$UnderApproval \times MS$	-0.017	-0.024	-0.017	0.238***	0.280***	0.239***
	(0.017)	(0.016)	(0.017)	(0.079)	(0.075)	(0.078)
$Implementation \times MS$	0.143***	0.144***	0.143***	0.038	-0.010	0.039
	(0.018)	(0.022)	(0.018)	(0.086)	(0.099)	(0.086)
N	317467	253532	310808	317467	253532	310808
adj. R^2	0.971	0.964	0.971	0.913	0.866	0.914
$UnderDiscussion \times LS$	-0.019**	-0.011	-0.019**	-0.052	-0.011	-0.052
	(0.007)	(0.007)	(0.007)	(0.058)	(0.067)	(0.057)
$UnderApproval \times LS$	-0.011	-0.015	-0.011	0.237*	0.398***	0.235*
	(0.012)	(0.016)	(0.012)	(0.119)	(0.076)	(0.119)
$Implementation \times LS$	0.162***	0.184***	0.162***	-0.134*	-0.157*	-0.135**
	(0.025)	(0.029)	(0.025)	(0.065)	(0.0 85)	(0.065)
N	509992	335847	498978	509992	335847	498978
adj. R^2	0.932	0.902	0.932	0.908	0.851	0.908
$UnderDiscussion \times ZS$	-0.041***	-0.050***	-0.042***	0.009	0.077	0.009
	(0.010)	(0.014)	(0.010)	(0.097)	(0.123)	(0.098)
$UnderApproval \times ZS$	-0.013	-0.035	-0.013	0.171**	0.253***	0.171**
	(0.046)	(0.073)	(0.046)	(0.066)	(0.052)	(0.066)
$Implementation \times ZS$	0.102**	0.064	0.102**	0.119	0.228	0.120
	(0.042)	(0.053)	(0.042)	(0.155)	(0.150)	(0.155)
N	224888	164518	220281	224888	164518	220281
adj. R^2	0.985	0.984	0.985	0.939	0.915	0.940
Quarter FE	✓	✓	✓	✓	✓	✓
Product-store FE	✓	✓	✓	✓	✓	✓
Month-region FE	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018. *PG* stands for the following product groups: $HS(HighSugar)$, $MS(MediumSugar)$, $LS(LowSugar)$, and $ZS(ZeroSugar)$.

Table A6. **Difference-in-differences Location Results**

	Price (in euros)			ln(Quantity of liters sold)		
	Baseline	Lis/ Op	No Lis/ Op	Baseline	Lis/ Op	No Lis/ Op
			A. Unbalanced Panel			
$UnderDiscussion \times HS$	-0.040**	-0.038***	-0.042**	-0.085	-0.076	-0.091
	(0.015)	(0.013)	(0.016)	(0.051)	(0.048)	(0.055)
$UnderApproval \times HS$	-0.016	-0.018	-0.015	-0.005	0.004	-0.011
	(0.048)	(0.051)	(0.046)	(0.093)	(0.094)	(0.093)
$Implementation \times HS$	0.160***	0.158***	0.161***	-0.065	-0.057	-0.071
	(0.034)	(0.033)	(0.035)	(0.080)	(0.083)	(0.079)
N	647412	268608	378804	647412	268608	378804
adj. R^2	0.980	0.980	0.980	0.904	0.900	0.906
$UnderDiscussion \times MS$	-0.031**	-0.030**	-0.032**	-0.026	-0.040	-0.016
	(0.014)	(0.014)	(0.015)	(0.107)	(0.106)	(0.108)
$UnderAprroval \times HS$	0.003	0.001	0.005	0.041	0.056	0.030
	(0.025)	(0.025)	(0.025)	(0.184)	(0.173)	(0.192)
$Implementation \times MS$	0.152***	0.151***	0.154***	0.003	0.008	-0.001
	(0.021)	(0.020)	(0.022)	(0.113)	(0.106)	(0.119)
N	567289	236691	330598	567289	236691	330598
adj. R^2	0.963	0.965	0.962	0.854	0.852	0.856
$UnderDiscussion \times LS$	-0.016**	-0.017**	-0.016**	-0.150**	-0.139**	-0.157**
	(0.006)	(0.007)	(0.006)	(0.066)	(0.062)	(0.069)
$UnderApproval \times LS$	-0.011	-0.012	-0.010	0.085	0.083	0.086
	(0.011)	(0.010)	(0.012)	(0.089)	(0.087)	(0.092)
$Implementation \times LS$	0.154***	0.154***	0.155***	-0.185**	-0.179**	-0.189**
	(0.025)	(0.026)	(0.025)	(0.078)	(0.076)	(0.079)
N	1106727	458807	647920	1106727	458807	647920
adj. R^2	0.957	0.955	0.958	0.879	0.878	0.880
$UnderDiscussion \times ZS$	-0.042***	-0.042***	-0.041***	-0.041	-0.065	-0.024
	(0.010)	(0.010)	(0.010)	(0.048)	(0.045)	(0.050)
$UnderApproval \times ZS$	-0.022	-0.024	-0.021	-0.041	-0.027	-0.049
	(0.055)	(0.056)	(0.055)	(0.127)	(0.139)	(0.119)
$Implementation \times ZS$	0.093***	0.096***	0.091***	0.027	0.007	0.042
	(0.020)	(0.020)	(0.021)	(0.091)	(0.093)	(0.091)
N	498730	205082	293648	498730	205082	293648
adj. R^2	0.984	0.985	0.984	0.906	0.903	0.908
			B. Balanced Panel			
$UnderDiscussion \times HS$	-0.027*	-0.027	-0.028*	-0.033	-0.019	-0.043
	(0.015)	(0.016)	(0.014)	(0.059)	(0.054)	(0.066)
$UnderApproval \times HS$	-0.029	-0.039	-0.021	0.190***	0.231***	0.158***
	(0.057)	(0.065)	(0.052)	(0.054)	(0.063)	(0.053)
$Implementation \times HS$	0.173***	0.169***	0.175***	-0.056	-0.032	-0.074
	(0.052)	(0.053)	(0.051)	(0.090)	(0.096)	(0.087)
N	300967	128501	172466	300967	128501	172466
adj. R^2	0.983	0.984	0.983	0.940	0.943	0.938
$UnderDiscussion \times MS$	-0.050***	-0.046***	-0.053***	0.049	0.023	0.069
	(0.015)	(0.015)	(0.015)	(0.098)	(0.094)	(0.102)
$UnderApproval \times MS$	-0.017	-0.016	-0.018	0.238***	0.244***	0.234**
	(0.017)	(0.016)	(0.018)	(0.079)	(0.072)	(0.085)
$Implementation \times MS$	0.143***	0.141***	0.145***	0.038	0.054	0.025
	(0.018)	(0.018)	(0.019)	(0.086)	(0.077)	(0.093)
N	317467	135373	182094	317467	135373	182094
adj. R^2	0.971	0.974	0.969	0.913	0.918	0.911
$UnderDiscussion \times LS$	-0.019**	-0.017**	-0.021***	-0.052	-0.042	-0.060
	(0.007)	(0.008)	(0.007)	(0.058)	(0.057)	(0.058)
$UnderApproval \times LS$	-0.011	-0.009	-0.013	0.237*	0.235*	0.239*
	(0.012)	(0.011)	(0.012)	(0.119)	(0.116)	(0.122)
$Implementation \times LS$	0.162***	0.165***	0.160***	-0.134*	-0.118*	-0.147**
	(0.025)	(0.026)	(0.024)	(0.065)	(0.060)	(0.070)
N	509992	215434	294558	509992	215434	294558
adj. R^2	0.932	0.926	0.935	0.908	0.911	0.907
$UnderDiscussion \times ZS$	-0.041***	-0.038***	-0.044***	0.009	-0.003	0.018
	(0.010)	(0.009)	(0.011)	(0.097)	(0.099)	(0.097)
$UnderApproval \times ZS$	-0.013	-0.015	-0.012	0.171**	0. 214**	0.139**
	(0.046)	(0.051)	(0.043)	(0.066)	(0.081)	(0.060)
$Implementation \times ZS$	0.102**	0.104**	0.101**	0.119	0.118	0.119
	(0.042)	(0.045)	(0.041)	(0.155)	(0.165)	(0.150)
N	224888	95061	129827	224888	95061	129827
adj. R^2	0.985	0.986	0.984	0.939	0.942	0.938
Quarter FE	✓	✓	✓	✓	✓	✓
Product-store FE	✓	✓	✓	✓	✓	✓
Month-region FE	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018. *PG* stands for the following product groups: $HS(HighSugar)$, $MS(MediumSugar)$, $LS(LowSugar)$, and $ZS(ZeroSugar)$.

Table A7. **Difference-in-differences Different Sizes**

	Price (in euros)			ln(Quantity of liters sold)		
	Baseline	Less 1L	1L or More	Baseline	Less 1L	1L or More
			A. Unbalanced Panel			
$UnderDiscussion \times HS$	-0.040**	-0.048**	-0.034**	-0.084	-0.012	-0.136**
	(0.015)	(0.021)	(0.013)	(0.051)	(0.055)	(0.051)
$UnderApproval \times HS$	-0.016	-0.039	0.003	-0.005	0.030	-0.040
	(0.048)	(0.085)	(0.016)	(0.093)	(0.107)	(0.117)
$Implementation \times HS$	0.160***	0.153**	0.167***	-0.065	0.003	-0.130
	(0.034)	(0.059)	(0.021)	(0.080)	(0.073)	(0.102)
N	647966	455341	487984	647966	455341	487984
adj. R^2	0.980	0.981	0.965	0.904	0.919	0.878
$UnderDiscussion \times MS$	-0.031**	-0.048***	-0.025	-0.026	0.072	-0.071
	(0.014)	(0.014)	(0.015)	(0.107)	(0.052)	(0.136)
$UnderApproval \times MS$	0.003	-0.021	0.015	0.041	0.093	0.015
	(0.025)	(0.018)	(0.030)	(0.184)	(0.113)	(0.222)
$Implementation \times MS$	0.152***	0.179***	0.140***	0.003	0.084	-0.035
	(0.021)	(0.023)	(0.029)	(0.113)	(0.072)	(0.145)
N	567786	381824	481321	567786	381824	481321
adj. R^2	0.963	0.983	0.921	0.855	0.898	0.838
$UnderDiscussion \times LS$	-0.016**	-0.049***	-0.005	-0.150**	-0.079	-0.174**
	(0.006)	(0.008)	(0.005)	(0.066)	(0.052)	(0.084)
$UnderApproval \times LS$	-0.011	-0.014	-0.010	0.085	-0.138**	0.167
	(0.011)	(0.015)	(0.012)	(0.089)	(0.066)	(0.102)
$Implementation \times LS$	0.154***	0.145***	0.158***	-0.185**	-0.122	-0.211**
	(0.025)	(0.038)	(0.021)	(0.077)	(0.087)	(0.083)
N	1107429	516459	886329	1107429	516459	886329
adj. R^2	0.957	0.972	0.893	0.879	0.920	0.864
$UnderDiscussion \times ZS$	-0.042***	-0.028**	-0.056***	-0.041	-0.030	-0.051
	(0.010)	(0.012)	(0.013)	(0.048)	(0.036)	(0.076)
$UnderApproval \times ZS$	-0.022	-0.053	0.036***	-0.040	0.086	-0.236
	(0.055)	(0.086)	(0.012)	(0.127)	(0.104)	(0.190)
$Implementation \times ZS$	0.093***	0.106***	0.076**	0.027	0.079	-0.039
	(0.020)	(0.022)	(0.031)	(0.091)	(0.076)	(0.170)
N	499099	406759	387699	499099	406759	387699
adj. R^2	0.984	0.986	0.959	0.906	0.918	0.871
			B. Balanced Panel			
$UnderDiscussion \times HS$	-0.027*	-0.039*	-0.015	-0.034	0.028	-0.098*
	(0.015)	(0.019)	(0.010)	(0.059)	(0.056)	(0.048)
$UnderApproval \times HS$	-0.029	-0.078	0.023	0.189***	0.158*	0.221***
	(0.057)	(0.095)	(0.015)	(0.054)	(0.082)	(0.067)
$Implementation \times HS$	0.173***	0.154	0.192***	-0.056	-0.005	-0.110
	(0.052)	(0.092)	(0.009)	(0.090)	(0.072)	(0.105)
N	301075	234273	230683	301075	234273	230683
adj. R^2	0.983	0.983	0.960	0.940	0.945	0.934
$UnderDiscussion \times MS$	-0.050***	-0.055***	-0.048**	0.049	0.134**	-0.001
	(0.015)	(0.014)	(0.017)	(0.098)	(0.051)	(0.125)
$UnderApproval \times MS$	-0.017	-0.020	-0.015	0.239***	0.190***	0.268**
	(0.017)	(0.018)	(0.020)	(0.079)	(0.037)	(0.110)
$Implementation \times MS$	0.143***	0.186***	0.118***	0.038	0.122	-0.013
	(0.018)	(0.028)	(0.022)	(0.086)	(0.072)	(0.108)
N	317611	221261	260231	317611	221261	260231
adj. R^2	0.971	0.984	0.934	0.913	0.944	0.899
$UnderDiscussion \times LS$	-0.019**	-0.045***	-0.013*	-0.052	-0.078**	-0.045
	(0.007)	(0.003)	(0.006)	(0.058)	(0.027)	(0.066)
$UnderApproval \times LS$	-0.011	0.009	-0.017	0.237*	-0.069**	0.319***
	(0.012)	(0.008)	(0.012)	(0.119)	(0.029)	(0.099)
$Implementation \times LS$	0.162***	0.128***	0.171***	-0.134*	-0.138**	-0.133*
	(0.025)	(0.008)	(0.027)	(0.065)	(0.054)	(0.072)
N	510064	237063	436882	510064	237063	436882
adj. R^2	0.932	0.984	0.904	0.908	0.946	0.904
$UnderDiscussion \times ZS$	-0.041***	-0.044**	-0.038***	0.009	0.02	0.018
	(0.010)	(0.016)	(0.007)	(0.097)	(0.067)	(0.177)
$UnderApproval \times ZS$	-0.013	-0.042	0.023**	0.171**	0.296***	0.017
	(0.046)	(0.084)	(0.010)	(0.066)	(0.076)	(0.170)
$Implementation \times ZS$	0.102**	0.111**	0.092	0.119	0.158*	0.070
	(0.042)	(0.043)	(0.058)	(0.155)	(0.074)	(0.346)
N	224960	197567	191274	224960	197567	191274
adj. R^2	0.985	0.986	0.965	0.939	0.945	0.932
Quarter FE	✓	✓	✓	✓	✓	✓
Product-store FE	✓	✓	✓	✓	✓	✓
Month-region FE	✓	✓	✓	✓	✓	✓

Notes: Standard errors in parentheses are clustered by brand. Stars indicate significance levels of 10% (*), 5% (**), and 1%(***). *UnderDiscussion*: May-October 2016; *UnderApproval*: November 2016-January 2017; *Implementation*: February 2017-January 2018. *PG* stands for the following product groups: $HS(HighSugar)$, $MS(MediumSugar)$, $LS(LowSugar)$, and $ZS(ZeroSugar)$.

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