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ORIGINAL PAPER

The causal impact of sugar taxes on soft drink sales: evidence from France and Hungary

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Abstract
Sugar-sweetened beverages (SSBs) are associated with increased body weight and obesity, which induce a wide array of health impairments such as diabetes or cardiovascular disorders. Excise taxes have been introduced to counteract SSB consumption. We investigated the effect of sugar taxes on SSB sales in Hungary and France using a synthetic control approach. For France, we found a slight decrease in SSB sales after tax implementation while overall soft drink sales increased. For Hungary, there was only a short-term decrease in SSB sales which disappeared after 2 years, leading to an overall increase in SSB sales. However, both effects are characterized by great uncertainty.

Keywords Sugar-sweetened beverages · Synthetic control · Sales · Sugar tax · Soft drinks

Introduction

Consumption of sugar-sweetened beverages (SSBs) promotes weight gain and obesity [29], which are both significant risk factors for type 2 diabetes, cardiovascular disorders, metabolic syndrome and cancer [3, 14, 24, 30, 41]. In addition, SSBs have unfavourable consequences on dental health [31, 38]. As a result, health care costs increase, incurring negative consumption externalities for society [2].

To reduce the negative effects of SSB consumption, excise taxes (i.e. taxes charging a fixed amount per unit of volume, e.g. €1 per litre) have been suggested as an effective policy tool [40]. According to economic theory, an increase in price predicts lower consumption. As there exist (imperfect) substitutes for SSBs, SSB demand is assumed to be at least imperfectly elastic [11].

With regard to smoking, raising the price of cigarettes is considered to be one of the most effective interventions to prevent and reduce cigarette use [13, 19, 32]. However, in contrast to smoking, the market for foods and beverages is much more flexible and offers more choices. People allocate their budget among many different beverages based on their prices and preferences, and many inter-relationships exist between different drink categories and excise tax. For example, Quirmbach et al. [33] found that increasing the price of soft drinks may change purchase patterns for alcohol. This phenomenon reflects cross-price elasticities of demand, as the soft drink tax not only affects the demand for soft drinks but the demand for alcoholic beverages as well [11].

Although most previous studies found a reduction in SSB sales caused by excise tax, these studies faced strong limitations regarding data validity and control groups and did not estimate long-term effects [11]. Therefore, evidence for the success of an excise tax on SSB sales is less clear [12]. For simplicity, we refer to this excise tax on SSBs or soft drinks as the colloquial 'sugar tax' in what follows.

For France, previous research by Capacci et al. [10] used household-level scanner data to carry out a difference-in-differences analysis using two alternative control groups: (1) two nearby regions in Italy; (2) water. They find that this led to a modest reduction in purchases of soft drink (around 2%). They also find evidence of a small increase in purchases of fruit juice. Regarding the pass-through of the tax in France, Etilé et al. [16] identified a pass-through of 39% and thus no over-shifting of the tax to SSB prices. Berardi et al. [4] found under-shifting for both flavored water and fruit-flavored beverages. However, they showed a full pass-through for soda and suggested a full shifting to prices.

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For Hungary, a study by the European Commission [15] found a reduction in demand of up to 10% for cola product. Hungary was already experiencing declining demand pretax, although the decline appeared to be accelerated by the tax [39]. Apart from this study, the tax impact in Hungary was only assessed for food consumption. Bíró [6] identified a small reduction in the consumption of processed foods.

Research question

In this study, we investigate how a sugar tax influences sales in three different drink categories: SSBs, juice, and bottled water. We also look at total soft drink sales after implementation of such a tax. Among the countries that have recently enacted taxes on SSBs, we chose France and Hungary for our analysis. Both countries introduced a sugar tax around 2012, allowing a stable post-intervention period of several years. We adopt a population-level perspective in evaluating the effect of a sugar tax on soft drink sales using commercial data. Specifically, we implement a synthetic control study to assess whether the introduction of sugar taxes in France and Hungary leads to reduced soft drink sales in the mentioned categories relative to other European countries. This approach allows us to estimate the net effect of the tax in these countries, while accounting for potential spill-over effects and avoiding selection bias.

Materials and methods

Policy background

In France, the tax on sweetened soft drinks was incorporated in January 2012 and applies to all non-alcoholic beverages containing added sugar or sweeteners. It amounts to 7.55 eurocents per litre at the retail level (VAT included) and is paid by manufacturers and processors in France and by French importers. In July 2018, the French government introduced a banded tax (with products containing more than 11g of sugar being taxed at 20 cents per litre and the tax rate increasing progressively up to this maximum tax) [23].

Hungary's public health tax came into effect in September 2011, and is a tax on foods and drinks that contain large quantities of sugar (over 8 g sugar per 100 ml). The tax is 200 Forint (≈ €0.61 as of June 2020) per litre for syrups, 250 Forint per litre for energy drinks containing methyl xanthine and taurine, 40 Forint per litre for energy drinks with methyl xanthine only, and 7 Forint per litre for other soft drinks. It also applies to the salt and caffeine content of pre-packaged foods and snacks and is paid by the producer.

Data

Our analysis is based on data from Euromonitor International for the years 2004-2018. Euromonitor provides yearly market reports for food and beverage sales in many European countries using data obtained from various industry sources, such as surveys across the supply chain, store checks, and company analyses [17]. These sources are proprietary and cannot be independently validated. Soft drink sales are measured by 'off-trade volume' (in litres), where beverages are sold for subsequent consumption away from the place of purchase. This includes grocery stores, supermarkets, and other retailers (including internet retailing), but also bars, restaurants, and cafes. We examined four categories of beverages: *sugar-sweetened beverages (SSBs)*, *juice*, *bottled water*, and *all soft drinks*. Only SSBs were subject to taxation. The category *SSBs* contains sweetened, non-alcoholic drinks containing carbonates (e.g. cola, lemonade, orange carbonates), but also (carbonated or non-carbonated) sports and energy drinks. The *juice* sector is the aggregation of 100% juice, nectars (25–99% juice content), juice drinks (up to 24% juice content), and coconut and other plant waters. *Bottled water* includes both still and carbonated (spring, mineral, and purified), flavoured and unflavoured, bottled water. *All soft drinks* is the aggregation of the previous categories plus all remaining beverages not found there, e.g. ready-to-drink teas and coffees, milk drinks and drinking yoghurts. Protein drinks and meal replacement beverages are always omitted. See Appendix Table 4 for more details on these categories.

Intervention analysis

To estimate the causal impact that sugar or soft drink taxation has on soft drink sales, we use a *synthetic control* approach [1]. This method has been shown to be useful for the analysis of intervention effects through time-series data at the population-level [8]. It requires finding matching control markets for the test market where the intervention took place using time series based on historical data prior to the intervention. The synthetic control approach assumes that the outcome time series can be explained in terms of a set of control time series that were themselves not affected by the intervention. Furthermore, the relation between treated series and control series is assumed to be stable during the post-intervention period. The causal impact of the intervention is then analysed by comparing the observed data for test and control markets following the intervention, while factoring in differences between the markets prior to the event.

In our analysis, we use *dynamic time warping* (DTW) [35] to do the time-series matching, followed by a *Bayesian structural time series* (BSTS) model that forecasts the counterfactual or potential outcome that would be realized if the test market had not received the intervention. The DTW technique finds the best alignment between two time series within some user-defined constraints. For this, it uses the warping curve instead of the Euclidean distance, because the Euclidean distance often over-penalizes instances where relationships between markets are temporarily shifted. Specifically, assume two time series of length T denoted by $X = (x_1, ..., x_T)$ and $Y = (y_1, ..., y_T)$, where X is the test market (here, France or Hungary) and Y is a control market. The goal of the DTW approach is to find a warping curve $\phi(t) = (\phi_x(t), \phi_z(t))$ that minimizes the distance between the time series. The warping curve remaps the indexes of the original time series-through the warping functions $\phi_x(t)$ and $\phi_y(t)$ such that the remapped series are as similar as possible. Similarity is defined by the distortion between X and Y,

$$D(X, Y) = \sum_{i=1}^{T} d(\phi_x(t), \phi_y(t)) m_\phi(t),$$

where $m_\phi(t)$ is a per-step weighting coefficient at index t, and d is a local non-negative dissimilarity function between any pair of the remapped data points. Finding the warping curve ϕ that minimizes $D(X, Y)$ is a an optimization problems with constraints to preserve the ordering of the indexes $\phi_x(t+1) > \phi_x(t)$ and limiting the length of the permissible steps. See Giorgino et al. [22] for more details. The DTW matching is an important step to find the best matching control markets for the two test markets which are then used in the BSTS model.

The BSTS model constructs a synthetic baseline for the post-intervention period that incorporated the ten best matched control markets as predictors, as well as other features of the time series. The following structural time series model, also called state space model, is created for the pre-intervention period:

$$\begin{aligned} Y_t &= \mu_t + x_t\beta + \varepsilon_t, \quad \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \\ \mu_{t+1} &= \mu_t + v_t, \quad v_t \sim N(0, \sigma_v^2). \end{aligned}$$

The first equation is often called the *observation equation* that relates the observed data Y_t to a local level term μ_t and a linear regression term $x_t\beta$. The second equation is called the transition equation because it defines how the latent states evolve over time and is often referred to as the unobserved trend. The linear regression term, $x_t\beta$, "averages" over the selected control markets. Parameters in the model are estimated by Markov chain Monte Carlo through a Gibbs sampler. The advantage of this Bayesian approach is that the samples from the posterior distribution can be used to report statistics such as the average absolute and relative effect caused by the intervention, including their credible intervals (CIs). See Scott and Varian [36], Brodersen et al. [9] and Kurz et al. [27] for more details.

Here, the years 2004–2011 mark the pre-intervention period, the post-intervention period spans from 2012–2018. We implement DTW and BSTS in the `R` [34] programming language with the `MarketMatching` package [25]. Code is available online [26].

We report the treatment effect of interest, defined as the difference between the observed series, i.e. the post-intervention outcome trend observed in France or Hungary, and the synthetic control time series, i.e. the post-intervention counterfactual series, alongside the 95% Bayesian CIs. Note that the treatment effect is the average treatment effect on the treated (ATT).

We chose France and Hungary as the test markets where the intervention, i.e. implementation of a sugar tax, was enforced. For control markets, we initially considered all other EU-28 countries [18] plus Switzerland. These countries share many externalities and are under the regulations of the EU sugar quota system. Because it is important that the control markets are unaffected by the intervention, we had to exclude a range of countries. The following countries were removed because they implemented their own sugar tax: Finland (reintroduced sugar tax in 2011 and increased the tax rate in subsequent years), United Kingdom, Ireland, Estonia (all introduced sugar tax in 2018), Latvia (sugar tax in 2004), Belgium (sugar tax in 2016), Spain (sugar tax introduced 2017 in one of its regions, Catalonia), and Portugal (sugar tax in 2017). In addition, we removed Denmark because it repealed the previously existing tax on soft drinks in 2014. See Cawley et al. [11], Allcott et al. [2], Wright et al. [40], and Lloyd-Williams et al. [28] for an overview of sugar taxation policies in European countries and globally. Euromonitor data were not available for all remaining countries so we could only include the following EU-28 control markets: Austria, Bulgaria[1], Croatia[2], Czech Republic, Germany, Greece, Italy, Lithuania, Netherlands, Poland, Romania, Slovakia, Slovenia, Sweden, and Switzerland.

Results

France

Table 1 shows the results of the BSTS analysis for France, and Fig. 1 visualizes the observed and predicted sales data over time. Appendix Table 3 contains the selected control markets and their BSTS model estimates. For SSBs, we find a yearly average value of 2124 million litres during the post-intervention period. In contrast, in the absence of sugar taxation, we would have expected average sales of 2237 million litres. The 95% CI of this counterfactual prediction is [1639; 2697]. Subtracting this prediction from the observed cost yields an estimate of the causal effect that the intervention

[1] Bulgaria joined the EU during the observation period, in 2007, but we include the whole period.

[2] Croatia joined the EU during the observation period, in 2013, but we include the whole period.

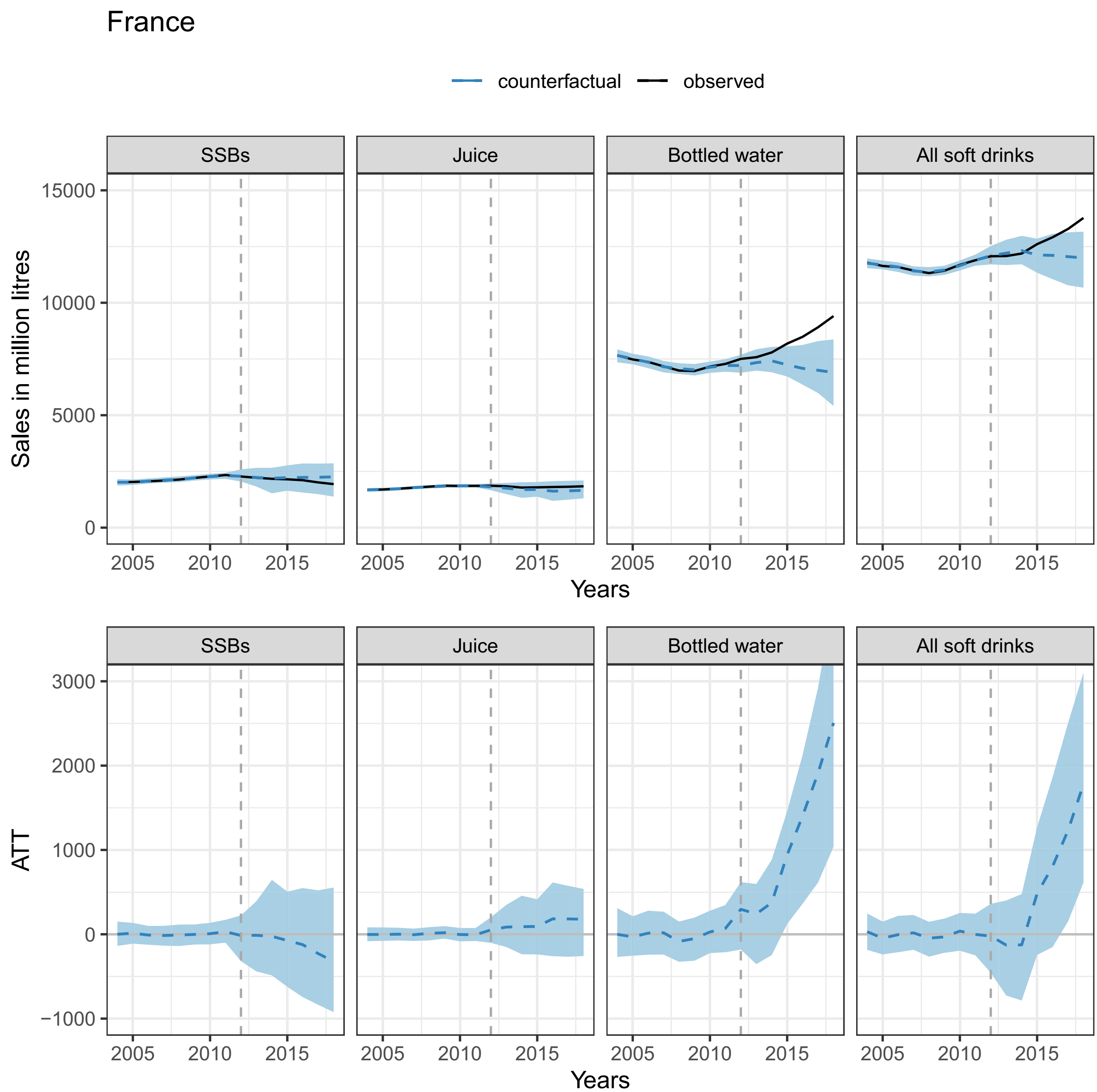

Fig. 1 Average soft drink sales (in million litres) in different categories per year in France. The upper plots show the observed expenditures (solid black line) and the counterfactual synthetic controls (dashed blue line) including the 95% credible interval according to the Bayesian structural time series model. The lower plots show the average treatment effect on the treated (ATT), i.e. the difference between the observed and estimated sales

had on the cost variable. This effect is −113 million litres with a 95% CI of [−572;485]. In relative terms, SSB sales showed a decrease of 5%. However, when considering the intervention period as a whole, the posterior probability of a causal effect is only 79%. This means the effect is not statistically significant and may be spurious. While SSB sales decreased, juice and bottled water sales increased by 7.2% and 15% in the post-intervention period, respectively. Total soft drink sales also increased by 5.2%, on average, after introduction of the sugar tax, compared with what would be expected without a sugar tax.

Hungary

Results for Hungary are available in Table 1 and Fig. 2. Appendix Table 3 contains the selected control markets

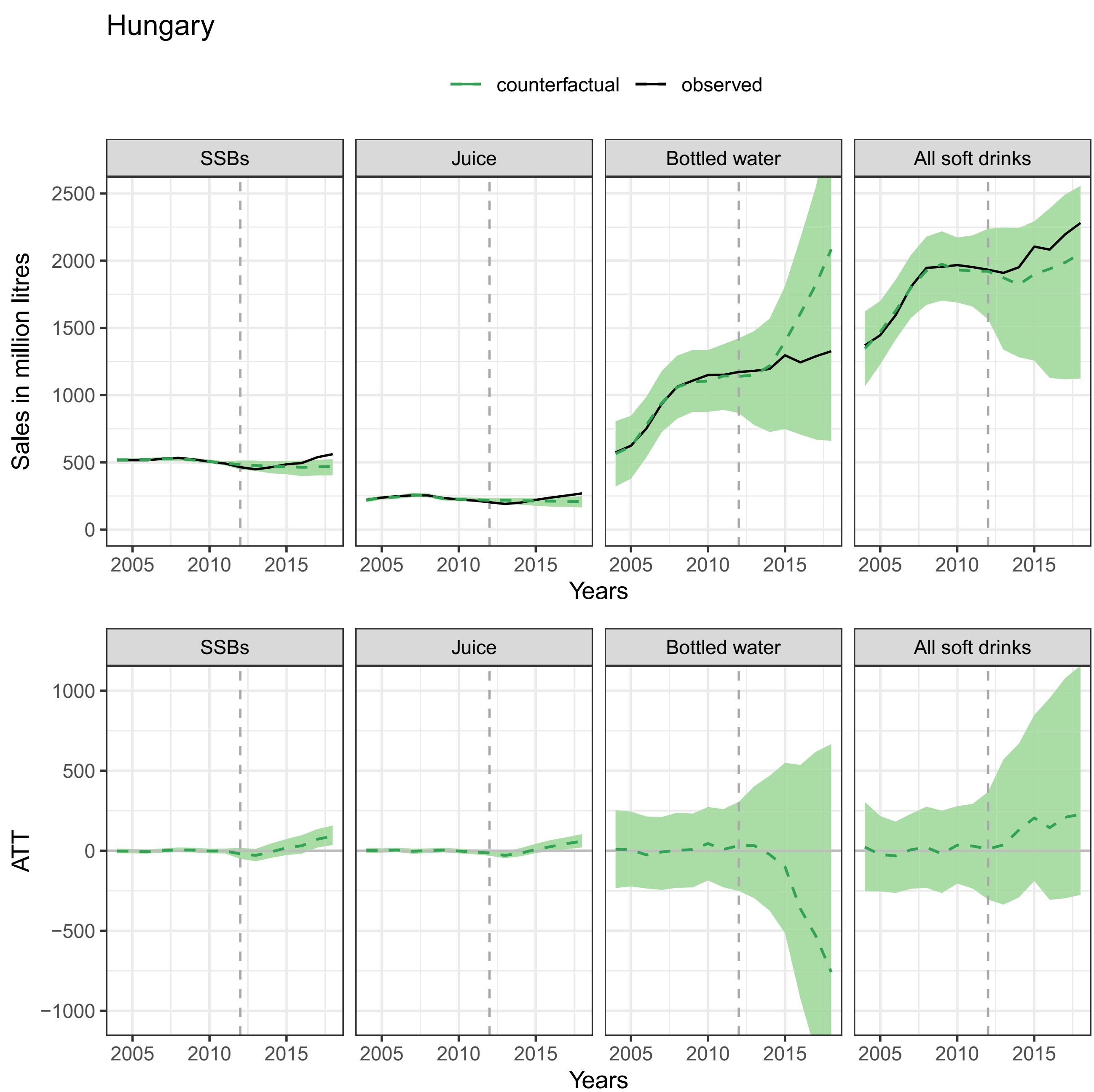

Fig. 2 Average soft drink sales (in million litres) in different categories per year in Hungary. The upper plots show the observed expenditures (solid black line) and the counterfactual synthetic controls (dashed green line) including the 95% credible interval according to the Bayesian structural time series model. The lower plots show the average treatment effect on the treated (ATT), i.e. the difference between the observed and estimated sales

and their BSTS model estimates. For SSBs, we see a slight slump in sales figures in the 2 years following the introduction of the tax, but from 2014 the trend reverses. This leads to a yearly average increase of 55 million litres (CI [23; 83]) or 12% (CI [5.2%; 19%]) in sales for the whole post-intervention period. The posterior probability of this effect is 99% so it includes only a slight amount of uncertainty. For juice, sales increased by 11%, on average, compared with what would be expected without the tax; bottled water sales decreased by 21% on average. As for France, we find higher total soft drink sales in the post-intervention period than what would be expected if the intervention had not taken place.

Table 1 The causal effect of sugar taxation on soft drink consumption in France and Hungary based on the Bayesian structural time series model. All values are sales in million litres

	France			
	SSBs	Juice	Bottled water	All soft drinks
Actual	2124	1820	8266	12,701
Predicted	2237	1698	7196	12,076
95% CI	[1639; 2697]	[1403; 2000]	[6652; 7996]	[11,313; 12,855]
Absolute effect	−113	122	1071	625
95% CI	[−572;485]	[−180;417]	[270; 1615]	[−154;1388]
Relative effect	−5%	7.2%	15%	5.2%
95% CI	[− 26%; 22%]	[− 11%; 25%]	[3.8%; 22%]	[− 1.3%; 11%]
Posterior prob. of causal effect	79%	67%	99%	94%
	Hungary			
	SSBs	Juice	Bottled water	All soft drinks
Actual	499	229	1,255	2,087
Predicted	444	207	1588	1980
95% CI	[420; 509]	[177; 229]	[916; 2033]	[1661; 2200]
Absolute effect	55	22	−332	108
95% CI	[23; 83]	[−0.3; 52]	[−778; 339]	[−113; 427]
Relative effect	12%	11%	−21%	5.4%
95% CI	[5.2%; 19%]	[−0.1%; 25%]	[−49%; 21%]	[−5.7%; 22%]
Posterior prob. of causal effect	99%	97%	90%	85%

Sensitivity analysis

To validate the BSTS approach, we examined how well the outcome data can be predicted before the beginning of the intervention. For this, we set the intervention date two years earlier than when it actually happened. This means a hypothetical introduction of the sugar tax in the year 2010 for France and 2009 for Hungary, respectively. We would expect not to find a significant effect for these hypothetical intervention years, i.e. counterfactual estimates and actual data should agree reasonably closely. Table 2 shows the results of the sensitivity analysis. For France, effect sizes and probabilities for a causal effect are all lower for SSBs and juice, as expected. The sensitivity analysis shows a slightly larger effect for bottled water and all soft drinks, where bottled water makes the largest contribution. However, in both cases the confidence bands are larger and include more uncertainty than the main analysis. For Hungary, all absolute effects are lower in the sensitivity analyses compared with the main analysis. Generally, this confirms that the BSTS model predicts the data reasonably well and produces valid inferences.

Discussion

Our study findings indicate a small decrease in SSB sales in France after implementation of the sugar tax compared with what would have been expected without the tax. In contrast, we saw higher sales for juices and especially bottled water, resulting in a considerable increase in total soft drink sales. This result suggests that consumers changed their demand patterns as a result of the sugar tax. As another drink category is affected by price changes for SSBs, product substitution seems to be relevant in consumer decision-making. For Hungary, sales of SSBs dipped in the years immediately after the sugar tax came into effect, but caught up after that, totalling more sales than would have been expected without taxation. Again, considering all soft drink categories, we found an increase in sales relative to other European countries that did not implement a sugar tax. All our estimates include a great amount of uncertainty; due to the small number of data points in the analysis confidence intervals are generally large. Euromonitor data are only available annually, so it is not possible to use more granular data. In consequence, we cannot conclude that changes in sales after the sugar tax intervention were definitely a result of the levy.

To our knowledge, the current study is among the first to estimate soft drink sales in different categories from France and Hungary at the population level. For France, only one

Table 2 Results of the sensitivity analysis with a hypothetical intervention year 2 years prior to the actual implementation of the sugar tax in France and Hungary based on the Bayesian structural time series model. All values are sales in million litres.

	France			
	SSBs	Juice	Bottled water	All soft drinks
Actual	2151	1825	8143	12,600
Predicted	2204	1727	6935	12,198
95% CI	[1713; 2904]	[1395; 2068]	[6109; 7989]	[11,286; 13,553]
Absolute effect	−53	98	1208	402
95% CI	[−608;466]	[−243;430]	[154; 2034]	[−953;1, 314]
Relative effect	−2.4%	5.7%	17%	3.3%
95% CI	[−34%; 20%]	[−14%; 25%]	[2.2%; 29%]	[−7.8%; 11%]
Posterior prob. of causal effect	64%	69%	97%	91%
	Hungary			
	SSBs	Juice	Bottled water	All soft drinks
Actual	495	224	1223	2042
Predicted	515	225	1345	1894
95% CI	[455; 570]	[156;307]	[503; 2289]	[1077; 2686]
Absolute effect	−20	−0.3	−123	148
95% CI	[−75;40]	[−83;68]	[−1067;720]	[−222;779]
Relative effect	−3.9%	−0.15%	−9.1%	7.8%
95% CI	[−15%; 7.7%]	[−37%; 30%]	[−79%; 54%]	[−43%; 51%]
Posterior prob. of causal effect	82%	57%	63%	74%

study seems to have measured the effect of the sugar tax on SSB sales. As mentioned previously, Capacci et al. [10] detected a small reduction of sales which was, however, subject to some uncertainty. This shows parallels to our study. Compared to the meta-analysis of 17 studies by Teng et al. [39], our results for France are slightly lower. This meta-analysis associated a 10% sugar tax with an average decline in taxed beverage purchases of 10.0%. The same study estimated a 1.9% increase in total untaxed beverage consumption resulting from a 10% SSB tax, a little less than what we found for both France and Hungary.

For Hungary, previous literature has only evaluated the tax impact on the consumption of processed food. Bíró [6] found a slight decrease of 3.4% in the 16 months following the introduction of the tax. This suggests comparable effects on processed food as on SSB sales. However, this study did not consider a longer time period which prevents a comparison to our long-term findings of an effect reversal.

This study is not without limitations. Most importantly, soft drink categories, as defined by Euromonitor, may have failed to capture some beverages with added sugar. For example, (non-pure) juice drinks and nectars with added sugar are included in the *juice* category but face taxation under the French and Hungarian legislation. In addition, especially for Hungary with its sugar threshold value for taxation, the SSB category in our analysis probably contains beverages that are not subject to tax. However, according to Hungarian retailer websites (TESCO, COOP, and SPAR), prices for Coke Zero (not subject to tax) and regular Coke (subject to tax) are the same. This suggests that retailers increased prices for both tax and non-tax products in the same category. Novel categories of sugary drinks such as ready-to-drink coffees and teas, flavoured milk, drinking yoghurts, and soy milk alternatives are also not captured in our SSB category despite being tax-relevant. Still, because these are niche products and SSBs are dominated by colas and lemonades with high sugar content, we believe our analysis reflects the actual impact of the sugar tax.

Cross-border shopping might be a limitation. For example, Bergman and Hansen [5] found a small but non-significant effect that the pass-through of the Danish tax on soda and alcohol was higher the further the retailer was from Denmark's border with Germany. This might be explained by the general much higher excise taxes in Denmark than in Germany. It could therefore also be that French and Hungarian citizen buy their soft drinks at neighbouring countries to avoid the tax, but we consider this a minor issue because the excise taxes in France's and Hungary's neighbouring countries are comparable.

The proprietary nature of the Euromonitor data precludes additional in-depth analyses for the drink categories, but also for different socio-economic subgroups. Sales data at the population level cannot account for differences in individuals. For example, previous research found that the effect of a sugar tax varies across income groups [37].

Fletcher et al. [20] found that a sugar tax can have a slight effect on reducing population weight. However, for France, the reduction in SSB sales is made up for by the increase in juice sales. Pure fruit juice has a similar energy density and sugar content to SSBs and might not be substantially different from consumption of SSBs with regard to health consequences [21]. In conclusion, our results make it difficult to determine whether a sugar tax really has an effect on health.

Complementing interventions apart from sugar taxes might increase the effects on SSB sales and thus population health. For example, experimental evidence suggests that plain packaging and warning labels can reduce preferences for SSBs and purchasing probabilities [7]. Including these features in tax policy interventions could significantly reduce SSB sales.

Appendix

BSTS model parameters and selected control markets

See Table 3.

Table 3 Ten best matched control countries for France and Hungary from the DTW procedure and their β estimates from the linear regression component in the BSTS analysis

	France			
	SSBs	Juice	Bottled water	All soft drinks
β_1	[Austria]: 0.0734	[Austria]: 0.071	[Austria]: 0.3809	[Austria]: 0.6215
β_2	[Bulgaria]: −0.33	[Czech Republic]: −0.6039	[Czech Republic]: −0.4154	[Czech Republic]: −1.05
β_3	[Czech Republic]: −0.1872	[Germany]: −0.908	[Germany]: 0.2006	[Germany]: 0.7003
β_4	[Greece]: −0.4073	[Greece]: 0.0924	[Greece]: −0.9582	[Greece]: −0.784
β_5	[Italy]: 0.5376	[Italy]: 0.9001	[Italy]: 0.2374	[Italy]: 0.1027
β_6	[Netherlands]: 0.7586	[Netherlands]: 0.7807	[Netherlands]: −0.6389	[Netherlands]: 0.7415
β_7	[Poland]: 0.6091	[Poland]: −0.0466	[Poland]: 0.5974	[Poland]: 0.2469
β_8	[Romania]:−0.244	[Romania]: 0.6477	[Romania]: −0.0904	[Romania]: −1.654
β_9	[Sweden]: 0.8738	[Sweden]: −0.0642	[Slovakia]: −1.1031	[Sweden]: 0.2157
β_{10}	[Switzerland]: 0.8366	[Switzerland]: 0.6805	[Switzerland]: −0.1451	[Switzerland]: −0.1325
	Hungary			
	SSBs	Juice	Bottled water	All soft drinks
β_1	[Austria]: 0.3725	[Austria]: 0.087	[Austria]: 0.1206	[Austria]: 0.1189
β_2	[Bulgaria]: 0.9197	[Bulgaria]: 0.5105	[Bulgaria]: 0.8348	[Bulgaria]: 0.861
β_3	[Croatia]: 1.0028	[Croatia]: 0.2044	[Croatia]: 0.0881	[Croatia]: 0.0212
β_4	[Czech Republic]: 0.294	[Czech Republic]: 0.4834	[Czech Republic]: −0.038	[Czech Republic]: 0.0016
β_5	[Greece]: 0.8412	[Greece]: 0.2067	[Greece]: 0.7037	[Greece]: 0.6039
β_6	[Lithuania]: 0.2264	[Lithuania]: 0.9375	[Netherlands]: 0.935	[Netherlands]: 0.8445
β_7	[Slovakia]: 0.9293	[Romania]: −0.1273	[Romania]: 0.6552	[Romania]: 0.8169
β_8	[Slovenia]: 1.1271	[Slovakia]: −0.3556	[Slovakia]: 0.3575	[Slovakia]: 0.8679
β_9	[Sweden]: 0.2904	[Sweden]: −0.1276	[Sweden]: -0.0088	[Sweden]: 0.098
β_{10}	[Switzerland]: 0.2043	[Switzerland]: −0.084	[Switzerland]: 0.0265	[Switzerland]: 0.0538

Definition of data

See Table 4.

Table 4 Data description in more detail. Symbols "+" and "−" indicate if the subcategory was included in the analysis for the country

Category	Subcategory	Definition	France	Hungary
SSBs	Standard regular cola	Includes all regular colas, which are not flavoured, decaffeinated, functional or in any other way altered. It does not include low-calorie cola carbonates. Leading brands in off-trade volume include Coca-Cola, Pepsi and Big Cola.	+	+
SSBs	Specialty regular cola	Includes all regular colas, which are flavoured, not decaffeinated, functional or in any other way altered. It does not include low-calorie cola carbonates. Leading brands in off-trade volume include Pepsi Twist, Cherry Coke and Pepsi Wild Cherry	+	+
SSBs	Low calorie cola carbonates	All products that have, and which are marketed on the basis of having, lower calorie content than regular cola carbonates are included here. This is regardless of whether they contain artificial sweeteners, sugar, both or alternatively neither. This is the aggregation of standard low calorie cola carbonates and speciality low calorie cola carbonates	+	−
SSBs	Juice-based lemonade/lime	Lemonade and/or lime-based carbonated drinks, which contain lemon or lime juice, fruit and/or pulp. Leading brands in off-trade volume include 7-Up, Sprite and Fanta Lemon	+	+
SSBs	Ginger ale	Carbonated beverage made with ginger. This does not include Ginger Beer (in Other Non-Cola Carbonates) which is similar to ginger ale but has a stronger ginger flavour. Common varieties are Canada Dry, Scweppes and Seagram's	+	+
SSBs	Seltzer	Seltzer (also commonly referred to as soda water or club soda), is water which is carbonated and thus made effervescent by the addition of carbon dioxide gas under pressure. There are no additives or flavourings. Examples of soda water brands are Canada Dry, Schweppe's and Seagram's	+	+
SSBs	Tonic water	Tonic water is a carbonated beverage that derives its somewhat bitter taste from the addition of quinine. This also includes tonic waters that are lightly flavoured (for example tonic water with lemon). However, this does not include tonics that are bitter (that are included in Other Mixers). Common varieties are Canada Dry, Schweppe's and Seagram's	+	+
SSBs	Other mixers	Tonic water with lemon or lime or orange flavour added is known as bitter lemon or bitter lime or bitter orange, respectively. This sub-category also includes non-alcoholic carbonated bitter appertifs such as Crodino or Sanbitter. Such soft drinks are more popular in Europe than in the United States. Common brands are Canada Dry and Schweppe's	+	+
SSBs	Other non-Cola carbonates	All carbonated soft drinks that are not included in regular cola carbonates, low-calorie cola carbonates, lemonade-lime, orange or mixers. However, carbonated flavoured bottled waters are excluded from this subsector. Products with flavours spanning a combination of sectors, for example orange, pineapple and lemon are included here. Leading brands in off-trade volume include Mountain Dew, Dr Pepper and Shasta	+	+
SSBs	Energy drinks	These are drinks that are designed to boost energy levels. They usually contain high levels of caffeine and the amino acid taurine. Other ingredients associated with stimulating properties, such as guarana and ginseng, are also commonly used. Leading brands in off-trade volume include Red Bull, Monster and RockStar	+	+

Table 4 (continued)

Category	Subcategory	Definition	France	Hungary
SSBs	Sports drinks	The choice of sports drink usually depends on the provision of fluids, carbohydrates or both. Included into this subsector are isotonic, hypotonic and hypertonic sports drinks. Isotonic are products that replace lost body fluids, electrolytes (sodium, potassium and chlorides) and glucose in similar concentrations to existing body fluid without causing either swelling or shrinkage of cells. These products usually contain about 5-8% carbohydrate and are intended to be consumed during exercise and/or heat exposure. Hypotonic this product is a weaker solution than your body fluid. These drinks contain less carbohydrate and therefore have lower osmolality (fewer dissolved particles than blood). These drinks help the body to speed up water absorption and are best used when you need urgent fluid replacement, as in after exercise. These drinks are not the best for energy replacement. Hypertonic—this drink is a stronger solution than your body fluid. These drinks are designed to replace and maintain energy levels during exercise of at least 1 h. They are absorbed slowly and therefore are not appropriate for fluid replacement. Leading brands in off-trade volume include Gatorade, Powerade and Aquarius	+	+
Juice	100% juice	All frozen and unfrozen 100% pure fruit or vegetable juice (still). Note this subsector is measured as an RTD volume rather than frozen weight/volume. Leading brands in off-trade volume include Minute Maid Premium, Old South and Welch's 100% Juice White Grape Peach	+	+
Juice	Nectars (25–99% juice)	This is the aggregation of unfrozen nectars and frozen nectars	+	+
Bottled water	Carbonated bottled water	Includes all carbonated bottled water, excluding flavoured and/or functional carbonated water. Leading brands in off-trade volume include Aqua Minerale, Ferrarelle and IVESS	+	+
Bottled water	Flavored bottled water	Includes all flavoured bottled water, both carbonates and still. Commonly fruit juice or essence has a content of 1 mg/l. In addition, flavoured bottled water does not normally contain colourings. The product can be either sugarised or sugar-free. Leading brands in off-trade volume include Levité, H2OH! and Be-Light	+	+
Bottled water	Functional bottled water	This subsector utilises production techniques further than water purification processes. Functional bottled water is therefore novel as the product is altered and/or has been structurally changed to include vitamins, minerals, fruits or herbs	+	+
Bottled water	Still bottled water	Includes all bottled water that is not carbonated, flavoured and/or functional. Leading brands in off-trade volume include Aqua, Wahaha and Bonafont	+	+

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Declarations

Conflict of interest The authors declare no competing interests.

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