The impact of a ‘soda tax’ on prices: evidence from French micro data

Nicoletta Berardi\textsuperscript{a}, Patrick Sevestre\textsuperscript{b}, Marine Tépaut\textsuperscript{c} and Alexandre Vigneron\textsuperscript{d}

\textsuperscript{a}Banque de France Microeconomic and Structural Analysis Directorate, Paris, France; \textsuperscript{b}AMSE-GREQAM, Aix-Marseille Université, Marseille, France; \textsuperscript{c}Université de Paris I - Panthéon Sorbonne, Paris, France; \textsuperscript{d}Université Paris-Est Créteil, Créteil Cedex, France

ABSTRACT

Based on an original data set of more than 500,000 non-alcoholic beverage price records, we evaluate the impact on consumer prices of the ‘soda tax’, an excise on drinks with added sugar or sweetener, introduced in France in January 2012. We adopt a difference in differences approach and find that the tax was gradually passed through to the prices of the taxed beverages. After 6 months of its introduction, it was fully shifted to soda prices and almost fully shifted to the prices of fruit drinks, while the pass-through for flavoured waters was incomplete. We also find that the pass-through was heterogeneous across brands and retail groups.

KEYWORDS

Soda tax; pass-through; tax incidence; excise tax

JEL CLASSIFICATION

E31; D40

I. Introduction

In January 2012 a ‘soda tax’ was introduced in France, based on the claim that drinks containing added sugar or sweetener are unhealthy and that their consumption should be discouraged. A similar tax already existed in some countries, such as Denmark, Finland and Hungary and in many US states (OECD 2012; Bridging the Gap Program 2011). The excise concerns all non-alcoholic beverages with added sugar or sweetener, such as soda, but also flavoured water and fruit-flavoured drink. It amounted to 7.16 cents per litre in January 2010.\textsuperscript{1} A full pass-through of the soda tax would amount to a price increase of 7.55 cents per litre, given that value-added tax (VAT) also applies to the excise.

The aim of this article is to evaluate the impact of the French soda tax on the price of the three categories\textsuperscript{2} of drinks concerned: (i) flavoured water; (ii) fruit-flavoured drink and ready-to-drink tea; and (iii) soda (including cola, tonic water, energy drinks and other soft drinks). Because the tax was not necessarily immediately and fully shifted to prices, our analysis allows for gradual price reactions over time. We also consider the possibility of heterogeneity in the tax pass-through across retail groups and beverage brands.

This article contributes to the still sparse literature on the impact of sugar-sweetened beverage (SSB) taxes on prices. Despite the increasing interest in the impact of SSB taxes on soft drinks consumption and, consequently, on health or obesity (e.g. Brownell et al. 2009; Dharmasena and Capps 2012; Finkelstein et al. 2013; Jacobson and Brownell 2000; Lin, Smith, and Lee 2010; Smith, Lin, and Lee 2010; Fletcher, Frisvold, and Tefft 2010), there is still little evidence regarding the impact of an SSB tax on soda prices. In fact, most studies into the impact of a soda tax on obesity and health simply assume that the tax is fully passed through to prices.\textsuperscript{3}

The theoretical literature regarding the impact of excise taxes on prices in markets with perfect competition is unambiguous: assuming the standard upward sloping supply curve and downward sloping demand, the tax is under-shifted to prices. In particular, the lower the elasticity of demand and the higher the elasticity of supply, the larger the pass-through of the tax to prices. The tax is fully passed-through to prices only if demand is totally inelastic or if the supply curve is infinitely elastic (Fullerton and Metcalf 2002). However, when goods are sold on markets characterized by imperfect competition, excise taxes may be either

\textsuperscript{1}Law No. 2011-1977, passed on 28 December 2011 (the government initially planned to set the tax at 3.58 cents per litre and to only apply it to beverages with added sugar).

\textsuperscript{2}We distinguish these three categories following the standard definition of segments in the beverage market (see for instance http://www.rayon-boissons.com/Chiffres-du-marche/Ventes-annuelles-de-boissons-sans-alcool-en-GMS-16474).

\textsuperscript{3}One notable exception is Wang (2015), who considers different possible levels of the pass-through, ranging from 25% to 100%.
under-shifted, fully shifted or even over-shifted to prices depending on the characteristics of demand and of production costs.

Empirical studies regarding the impact of tax changes on prices reach very heterogeneous conclusions as well. For instance, studying the impact of excise taxes on the prices of alcoholic beverages or cigarettes, Kenkel (2005) and Young and Bielińska-Kwapisz (2002) conclude that taxes are over-shifted to alcoholic beverage prices, while Hanson and Sullivan (2009) come to a similar conclusion regarding cigarette prices. In contrast, Chou and Muehlegger (2010) and Harding, Leibtag, and Lovenheim (2012) find that taxes are under-shifted, while De Cicca, Kenkel, and Liu (2013) find a full shifting to prices. Conclusions on the impact of changes in gasoline sales tax also vary: Doyle and Samphantharak (2008) find an under-shifting of changes in gasoline sales tax in Illinois and Indiana, while Marion and Muehlegger (2011) find a full pass-through across the US as a whole. Among the few empirical assessments conducted up till now on the pass-through of tax changes to soda prices, Besley and Rosen (1999) find an over-shifting of sales taxes to soda prices in the US. Based on the analysis of micro price data used to compute the Danish Consumer Price Index, Bergman and Hansen (2013) evaluate the impact of the increases in soft drink taxes in 1998 and 2001 and conclude that they were strongly over-shifted to consumer prices. Using a very different approach, Bonnet and Réquillart (2013) come to the same conclusion for France. They specify a structural model where competition is horizontal (among producers on the one hand and among retailers on the other hand), as well as vertical (between producers and retailers), and use simulations to show that an SSB tax is likely to be over-shifted to prices.

In order to evaluate the extent of the pass-through of the French soda tax to prices, we apply a difference in differences approach to an original data set made up of more than 500,000 price records. Each observation at a given date refers to a non-alcoholic beverage (defined by its brand, quantity, packaging, etc. and individually identified by its barcode) sold in a specific shop (defined by its name, retail group and address). Overall, the prices of 845 different beverage products sold in one or more of the 760 supermarkets present in the data set are followed from August 2011 to June 2012.4

We find that, after 6 months, the tax was fully shifted to soda prices, while there was a significant under-shifting of the tax to the prices of flavoured water and a slight under-shifting to the prices of fruit-flavoured drink. Note that the preponderance of soda sales among the non-alcoholic beverages liable to the tax suggests a quasi-full shifting of the excise to beverage prices at the macroeconomic level, supporting the full shifting assumption often made in studies about the impact of SSB taxes on soft drink consumption. Moreover, our results point to a significant heterogeneity of the soda tax pass-through not only across product categories, but also across retail groups, as well as across beverage brands. In particular, the average quasi-full shifting of the tax results from the combination of an under-shifting of the tax for large producers’ brands and an over-shifting in the case of private labels. At the same time, we find that the two main retail groups in France often passed through the soda tax less than other retailers. These results are shown to be consistent with a simple producer–retailer bargaining framework.

The remainder of the article is structured as follows. Detailed presentations of the data and empirical strategy are provided in Sections II and III, respectively. Section IV presents the results regarding the average magnitude and timing of the pass-through, while Section V looks at the heterogeneity of the pass-through across brands and retailers. Section VI concludes.

II. Data

Our analyses of the impact of the soda tax are based on data collected by Prixing, a start-up that offers a mobile price comparison app and website. Prixing has developed automatic procedures enabling it to collect price lists from drive-throughs, known as ‘drives’ or ‘click-and-collect’ in France. This retail channel is a relatively recent service developed by French supermarkets5 over the past 10 years. It has

---

4The data were collected and made available to us by Prixing, a start-up company which offers consumers a free price comparison app for mobile devices (see http://www.prixing.fr).

5Note that in France medium and large supermarkets account for more than 70% of grocery sales (Anderton et al. 2011).
two distinctive features: customers go to a drive-through to collect goods previously ordered on the supermarket’s website; and, more importantly for our analysis, prices are exactly the same as those in the physical store associated with the drive-through.6

Because our focus in this article is on the soda tax, we have restricted the sample to non-alcoholic beverages and, more specifically, to three categories of products: (i) bottled water (both unflavoured and flavoured), (ii) fruit drink and ready-to-drink tea and (iii) soda (including cola, tonic water, energy drinks and other soft drinks). A ‘product’ is a specific beverage defined by its brand, its physical characteristics (nature and volume of the contents, presence of added sugar or sweetener, etc.) and its packaging (e.g. 1 litre of pure apple juice, in a glass bottle, produced by Pampryl). It is uniquely identified by its EAN barcode.7

The data have been trimmed to exclude observations where information was missing and outliers. Specifically, for all products within classes defined by product category × brand × month × soda tax liability, we computed the distributions of prices per litre and discarded observations below the 1st and above the 99th percentiles. From the original price records (usually collected on a daily basis) for each specific product sold in a specific shop, we kept one price observation per month, chosen as the most frequently observed price over that month.8 We then excluded prices associated with monthly increases or decreases exceeding ±30% in log-differences.9 Finally, to avoid composition effects and allow for a proper difference in differences analysis, we only kept the combinations of products and shops for which prices were available every month over the period August 2011 to June 2012.

Despite this data trimming, our sample compares favourably – in terms of both the number of observations and the product and shop coverage – with most of those used in the literature for assessing the impact of taxes on prices. Indeed, our econometric sample contains 567,842 observations consisting of 51,622 price trajectories for 845 products sold in at least one of the 760 drive-throughs from which prices were collected.10 Lastly, we weighted the data to ensure that the weighted sample was representative of both the retail groups’ and brands’ respective national market shares.11

Table 1 provides some descriptive statistics for our final sample, broken down into: bottled water products with added sugar/sweetener (typically flavoured water), and those without; fruit drink products with added sugar/sweetener and pure fruit juices (without added sugar/sweetener); and soda products, which all contain either added sugar or sweetener. Note that, unsurprisingly, average prices differ markedly across products depending on their composition.

Table 1. Descriptive statistics (August 2011–June 2012 sample).

<table>
<thead>
<tr>
<th>Product category</th>
<th>Added sugar/ sweetener</th>
<th>No. of obs. per month</th>
<th>No. of products</th>
<th>No. of shops</th>
<th>Mean price (euro/litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Flavoured</td>
<td>Yes</td>
<td>1292</td>
<td>25</td>
<td>504</td>
<td>0.78 0.78 0.83</td>
</tr>
<tr>
<td>- Unflavoured</td>
<td>No</td>
<td>9806</td>
<td>166</td>
<td>747</td>
<td>0.55 0.55 0.54</td>
</tr>
<tr>
<td>Fruit drink:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Fruit-flavoured</td>
<td>Yes</td>
<td>9515</td>
<td>157</td>
<td>635</td>
<td>1.19 1.19 1.25</td>
</tr>
<tr>
<td>- Pure juice</td>
<td>No</td>
<td>13,705</td>
<td>271</td>
<td>722</td>
<td>1.70 1.72 1.74</td>
</tr>
<tr>
<td>Soda</td>
<td>Yes</td>
<td>17,304</td>
<td>226</td>
<td>716</td>
<td>1.23 1.23 1.30</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>51,622</td>
<td>845</td>
<td>760</td>
<td>– – –</td>
</tr>
</tbody>
</table>

6Most drive-throughs are associated with a supermarket, but there are also a few ‘stand-alone’ drive-throughs (known as ‘drives-entrepôt’ in French).
7The EAN barcodes (originally European Article Number, now renamed International Article Number even though the abbreviation EAN has been retained) are international product identification numbers.
8This monthly modal price is similar in spirit to the reference price as defined in Eichenbaum, Jaimovich, and Rebelo (2011), that is a ‘normal’ price around which there may be temporary fluctuations (e.g. due to temporary promotions). Since we are not interested in the day-to-day impact of the tax on prices, ignoring temporary price discounts should not be an issue. Temporary discounts are not very frequent in our sample or in the French retail sector in general, and are not seasonal (see Baudry et al. 2007; and Berardi, Gautier, and Le Bihan 2013), so their impact, if any, should be negligible. Moreover, for these temporary sales to have a significant impact on the pass-through estimates, there would need to be a strong and permanent change in their frequency and magnitude, specifically for taxed products after the implementation of the tax, a phenomenon for which we have no indication.
9Using a higher threshold (±30%) does not cause any significant change in the estimation results (available upon request).
10In order to check the robustness of our results to the sample composition, we built a second econometric sample covering the period November 2011 to June 2012 (see section ‘Further robustness checks’). This restricted period enables us to significantly increase the number of products for which we could continuously track prices (see Appendix B).
11See Appendix A for more details. The results obtained using the unweighted data (available upon request) were not qualitatively different from those presented below.
specific characteristics. For instance, pure fruit juices are more expensive than fruit-flavoured beverages (because the former are higher quality products).

III. Empirical strategy for the assessment of the tax pass-through

Definition of control groups

The pass-through of the soda tax to prices could be evaluated in different ways. One way would be to estimate a ‘standard’ econometric model including a dummy for the excise implementation, as well as a number of controls for product, shop and time period characteristics. However, the exogeneity of the soda tax implementation and its magnitude, as well as the existence of untaxed beverages likely to constitute satisfactory control groups, lead us to use a difference in differences approach. In this context, the empirical strategy used to identify the pass-through of the soda tax relies on the comparison of the treated individuals with those of a control group, which is assumed to reflect the behaviour of the treated group if the treatment had been absent. Therefore, one of the prerequisites for a satisfactory control group is that it exhibit a price evolution that is as similar as possible to that of the treated group before the treatment, i.e. before the introduction of the excise in January 2012.

Figures 1–3 show (respectively for flavoured water, fruit-flavoured drink and tea, and soda) the evolution of the average prices of the products that became liable to the tax in January 2012 (the left-hand panel in each figure), together with the evolution of prices for alternative control groups (the other panels), month by month from August 2011 to June 2012. The average monthly price is normalized to the average price in December 2011 (the month before the introduction of the excise) for taxed and untaxed beverages within each product category, so that each bar represents the difference between the average price in a given month and the average prices prevailing in December 2011. The observed price changes are shown as percentages of the expected price change (including VAT) in the event of a full pass-through.

Figure 1. Evolution of average prices of taxed flavoured water and of corresponding control groups, normalized to prices in December 2011 and expressed as a percentage of full pass-through.

Note: The left-hand panel shows the difference between the average monthly price of the taxed product category and its price in December 2011, expressed as a percentage of full pass-through (7.55 cents, inclusive of VAT). The second panel shows the evolution of prices for the preferred control group. The last panels show the evolution of prices for alternative control groups.
pass-through of the excise. For instance, 80% of full-pass-through corresponds to a nominal price increase of 6 cents.

The left panels in Figures 2 and 3 show that, both in the case of fruit-flavoured drink and tea and in the case of soda, the average price trajectory of the products liable to the tax was remarkably flat before the introduction of the tax. Flavoured water (Figure 1) does not exhibit the same pattern: the average price increased at a steady (yet quantitatively limited) pace during the pre-tax period. These graphs also show that the prices of the taxed beverages increased sharply from January 2012 onwards, suggesting that the tax had a fairly significant and immediate impact.

In each figure, the evolution of the average price of products constituting our preferred control group is shown in the second panel (i.e. to the immediate right of the treated group panel). The benchmark control group for flavoured water is the whole set of beverages not affected by the excise, that is unflavoured bottled water and pure fruit juice. As can be seen, the overall evolution of the prices of these untaxed beverages before the introduction of the tax was quite similar to that of the taxed flavoured water (Figure 1). For taxed fruit-flavoured drink and soda, the evolution of prices before the introduction of the tax was fairly flat, similarly to the contemporaneous evolution of prices of unflavoured bottled water, which therefore constitute their benchmark control group (Figure 2 and 3).

Finally, the right-hand panels of each figure show alternative control groups, which we used to check the robustness of our conclusions. The first set of alternative control groups was obtained using a matching procedure: each taxed beverage sold in a given shop was matched with all the untaxed beverages sold in the same shop, with weights proportional to the closeness of their pre-tax price evolution (see the section ‘Econometric estimation of the pass-through’ for a more detailed presentation of this matching procedure). The last panels of Figures 1 and 2 show the price evolution for the last alternative control groups we considered. These correspond to untaxed products of the same category (that is unflavoured bottled water for the bottled water category in Figure 1 and pure fruit

\[12\text{80\% of the excise tax including VAT (7.16 cents plus 5.5\% VAT), that is 80\% of 7.55 cents.}\]
juice for the fruit drink and tea category featured in Figure 2). There is no equivalent control group for soda, as there is no such thing as a soda without added sugar or sweetener. This definition of the control groups relies on the supposed similarities between the taxed and the untaxed beverages within each category. However, these control groups do not strictly comply with the common trend assumption.

Before moving on to describe the econometric models and estimated results, note that Figures 1–3 clearly show at a descriptive level that all the alternative control groups lead to the same qualitative conclusion: the tax was under-shifted to the prices of flavoured water and fruit-flavoured drink and fully shifted to soda prices.

**Econometric estimation of the pass-through**

Figures 1–3 suggest that the implementation of the soda tax led to a significant increase in the prices of the beverages concerned. However, a proper quantitative assessment of the impact of the tax on prices calls for the use of treatment analysis tools. Our preferred estimates of the pass-through for (taxed) flavoured water, fruit-flavoured drink and soda are obtained using a standard difference in differences approach, in which the control groups are chosen such that they share similar pre-tax average evolutions of prices to those of treated products. We separately estimate three econometric models, which can be written compactly as:

$$ P_{i(c)jt} = \sum r \beta^c r D_{i(c)jt} + \lambda^c t + \alpha^{c} j + \delta^c i + \epsilon_{i(c)jt}, $$

where $w, f, s$ stand for the three product categories: bottled water, fruit drink and soda. $P_{i(c)jt}$ is the monthly modal price per litre (in euro cents), as defined in Section II, of product $i$ within category $c$ sold in shop $j$ at time $t$; the dummy variable $D_{i(c)jt}$

---

13 We assume here that the evolution of prices within each product category does not depend on those of the other categories, consistently with the fact that pre-tax trends do not seem to exhibit any strong correlation (see Figures 1–3). Moreover, the cross-price elasticities estimated for France by Bonnet and Réquillart (2013) for cola, iced tea and fruit drinks are quite small.
equals 1 when a product is liable to the tax (i.e. it contains added sugar/sweetener and from January 2012 onwards, that is for periods $\tau \in \{\text{Jan., Feb., Mar., Apr., May, Jun.}\}$), while it equals 0 otherwise (i.e. until December 2011 for taxed products and in all periods for untaxed products). The parameters of interest are $\beta^c_\tau$ for $c = w, f, s$ (bottled water, fruits drink and soda, respectively), which measure the price increase (in euro cents per litre) induced by the tax. These have to be compared to 7.55 cents, which is the price increase that would be associated with a full pass-through of the tax. The parameters $\lambda^c_\tau$, $\alpha^i(c)$ and $\delta^c_\tau$ are fixed effects controlling respectively for the aggregate time effects, for product time-invariant characteristics (including whether or not they contain added sugar/sweetener, whether the brand is a private label or a national brand, etc.) and for time-invariant shop characteristics (retail group, location, local competition, etc.).

In order to test the robustness of the results, three additional sets of pass-through estimates are obtained, using respectively: (1) a matching procedure; (2) the same difference in differences approach as above, but with different control groups; and (3) a simple difference approach.

The matching procedure is designed to achieve maximal similarity between the evolution of prices of treated and untreated observations before January 2012. The procedure we use is inspired by the synthetic control approach proposed by Abadie, Diamond, and Hainmueller (2010). However, given the large number of potential controls, their optimizing procedure is not feasible in our case. We thus adapt their approach and adopt a matching procedure in two steps: first, we consider as ‘neighbours’ of a taxed beverage $i$ within category $c$ sold in a shop $j$ all the untaxed beverages sold in that same shop; second, these untaxed beverages are given weights which are inversely proportional to the distance between their pre-tax price variations and those of the taxed beverage. More precisely, the distance is defined as

$$
\sum_{\text{Sep.} = \text{Dec.}} \left( p^{\text{taxed}}_{i(c)j}\tau - p^{\text{taxed}}_{i(c)j}\tau - 1 \right) - \left( p^{\text{untaxed}}_{i(c)j}\tau - p^{\text{untaxed}}_{i(c)j}\tau - 1 \right),
$$

that is the sum over the period from September to December of the absolute values of the difference between the pre-tax monthly price variations $\left( p^{\text{taxed}}_{i(c)j}\tau - p^{\text{taxed}}_{i(c)j}\tau - 1 \right)$ of the taxed beverage and those of an untaxed beverage sold in the same shop $\left( p^{\text{untaxed}}_{i(c)j}\tau - p^{\text{untaxed}}_{i(c)j}\tau - 1 \right)$. If the price of the taxed product remained unchanged over the whole pre-tax period, only untaxed products with unchanged prices over the same period are considered as possible neighbours, and all matching observations are then given the same weights. Finally, the synthetic control associated with a taxed product is computed as the weighted average of its neighbours. This procedure thus amounts to building synthetic controls that are close to the treated unit, since the products used as controls share similar pre-tax price trends and are sold in the same shop.

The second set of alternative pass-through estimates is complementary, in that it corresponds to simple and intuitive control groups, though not necessarily ones that are statistically optimal. Indeed, for each category (bottled water, fruits drink and tea), we simply take all the untaxed products in the same category as the control group for taxed products (i.e. untaxed bottled water for taxed fruit-flavoured water and untaxed pure fruit juice for taxed fruit-flavoured drink). In this case, the control groups are essentially defined on the basis of similarity with the taxed products. However, the assumption of pre-tax parallel trends is not necessarily met.

The third set of alternative trends is not necessarily met. The second set of alternative pass-through estimates is based on a simple difference analysis. Figures 2 and 3 show that, at least on average, the prices of both taxed fruit-flavoured drink and soda remained fairly stable between August and December 2011. Therefore, it does not seem unreasonable, at least for these two product categories, to assume that simply comparing their prices before and after the tax (i.e. before and after January 2012) may provide a relatively satisfactory estimate of the pass-through.

### IV. Average magnitude and timing of the pass-through of the soda tax to prices

Have producers and retailers passed the soda tax through to consumer prices? When and to what

Note that using this procedure we were unable to find a match for a few of the taxed products sold in a given shop. We thus discarded these observations from our estimation sample for all the analyses. A comparison with the estimates obtained with our initial sample (see Berardi et al. 2012) shows that this did not have any significant implications for our pass-through estimates.
extent? We first present the difference in differences estimated pass-through over time resulting from our preferred control groups (section ‘Benchmark results’). We then check the robustness of the benchmark result to alternative control groups (section ‘Alternative control groups and simple differences’), to anticipation behaviour and to an alternative sample (Section ‘Further robustness checks’).

**Benchmark results**

The left-hand panel in Table 2 shows the estimated average impact of the tax on the prices of products liable to the tax in each of the three product categories under consideration (flavoured water, fruit-flavoured drink and tea, and soda). Since there may be lags in the transmission of the tax to prices, we report the estimated pass-through month by month over the first semester of 2012. The right-hand panel shows the results of testing the extent of the pass-through as of June 2012.

In contrast with the results available in the literature on the impact of SSB taxes on prices, we find no indication, on average, of a significant over-shifting of the tax. Indeed, we only find a full pass-through of the tax in the case of soda, and an almost full pass-through for fruit-flavoured drink. More specifically, the average increase in soda prices reached the expected 7.55 euro cents in April 2012 and, even though soda prices still increased by a small amount after April 2012, in June 2012 the test cannot reject the assumption that there was a full shifting (while that of a significant over-shifting can be rejected at the usual 5% level). Regarding fruit-flavoured drink, the estimated pass-through (7.1 cents) was below the threshold for full pass-through, thus indicating a slight under-shifting of the tax (with a pass-through coefficient of 94%). However, neither the assumption of full shifting nor that of under-shifting can be rejected (the p-value obtained when testing full shifting is larger than that obtained when testing for under-shifting). Finally, the pass-through for flavoured water was clearly incomplete. In June 2012 it amounted to only about 4.7 cents (62% of the full pass-through).

Our estimates are significantly lower than those obtained by Bergman and Hansen (2013) who, in the case of Denmark, always get an estimated impact above 200% for excise tax changes. The magnitude of our pass-through estimates is also lower than those recently obtained in the case of France by Bonnet and Réquillart (2013) using a more structural approach. According to their results, an excise tax on soda would be over-shifted to prices, with pass-through coefficients ranging from 107% to 140%, depending on the brand. One explanation of the discrepancy between our results and theirs is that they rely on a model which assumes that producers have more power than retailers when negotiating producer/wholesale prices and are able to use resale price maintenance. Section V illustrates a simple model allowing for the opposite scenario (i.e. that retailers can be more powerful than producers) and leads to predictions that are consistent with our estimates. This may be more appropriate in France as, first, the official definition of ‘unfair terms’ (‘déséquilibre significatif’ in French) regarding the regulation of negotiations between producers and

<table>
<thead>
<tr>
<th>Pass-through estimates</th>
<th>Pass-through degree tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product category:</strong></td>
<td><strong>Jan.</strong></td>
</tr>
<tr>
<td>Bottled water</td>
<td>3.8</td>
</tr>
<tr>
<td>(0.2)</td>
<td>(0.3)</td>
</tr>
<tr>
<td>Fruit drink</td>
<td>3.3</td>
</tr>
<tr>
<td>(0.6)</td>
<td>(0.6)</td>
</tr>
<tr>
<td>Soda</td>
<td>3.5</td>
</tr>
<tr>
<td>(0.5)</td>
<td>(0.6)</td>
</tr>
</tbody>
</table>

All regressions include month, shop and product fixed effects.

Left-hand panel: Standard errors, clustered by shop, are given in parentheses. Right-hand panel: T-stat with p-value in parentheses, where: under-shifting corresponds to $H_0: \text{pass-through} \leq 0.9 \times 7.55 \text{ cents per litre}$; full shifting corresponds to $H_0: \text{pass-through} = 7.55 \text{ cents per litre}$; over-shifting corresponds to $H_0: \text{pass-through} \geq 1.1 \times 7.55 \text{ cents per litre}$.

---

15 As the main focus of interest for this article is the coefficients $\beta_c$, which estimate the price effect of the tax, the tables do not show estimates for the other parameters. The full estimation results are available on request.
retailers mainly lists examples of abuses by large retailers (such as excessive penalties imposed by retailers on producers, excessive terms regarding price renegotiation for the benefit of the retailer, etc.). Second, if implemented as assumed by Bonnet and Réquillart (2013), retail price maintenance should limit the differences in prices for the products concerned, at least in stores belonging to the same retail group. However, empirical evidence suggests the opposite, even for large, well-known and dominant producers (Dauvers 2014). Our data also show price differences often exceeding 30% for the same product across drive-throughs belonging to the same retail group.

The absence of over-shifting in our results is not surprising, given that the elasticity of demand for non-alcoholic beverages with respect to prices has been estimated to be significantly larger than 1, in absolute value (e.g. Bonnet and Réquillart 2013; Bonnet and Dubois 2010; on French data, as well as Pofahl, Capps, and Clauson 2005; or Alviola, Capps, and Wu 2010; on US data). Moreover, these studies also show that the price elasticity of demand is higher for bottled water (in absolute value) than for the two other groups of products (which have similar price elasticities). Indeed, Bonnet and Réquillart (2013) estimate that demand elasticities for soda and fruit drink range from −2.13 to −3.95 (depending on the brand), while Bonnet and Dubois (2010), using similar data (the TNS/Kantar Worldpanels for 2005 and 2006 in France) and a similar approach (a random coefficients logit model), estimate that the elasticity of bottled water demand is −5.8. This provides an explanation for the differences between our estimated pass-throughs for bottled water, on the one hand, and for fruit drink and soda on the other hand. Moreover, the lower pass-through obtained for bottled water may also stem from the fact that flavoured water is more easily substituted by other products than are fruit-flavoured drink and soda. Indeed, unflavoured bottled water is similar to and cheaper than (taxed) flavoured water. This contrasts with fruit drink: pure fruit juice is significantly more expensive than fruit-flavoured drink, thus making substitution more unlikely. In the case of soda, finding a close (and untaxed) substitute is even more difficult, as all sodas are liable to the tax and the degree of product differentiation is quite high across sodas.

Aside from the magnitude of the pass-through, it is also interesting to note that the pass-through of the tax to beverage prices was spread over several months. Despite the fact that a significant number of retailers left their prices unchanged in January 2012, i.e. even after the tax became effective (see Berardi et al. 2012), between one half (for fruit-flavoured drink) and two-thirds (for soda) of the tax was, on average, already passed-through to the prices in that same month. This cannot be attributed to a simple January seasonal effect, since the official price indices for bottled water on the one hand, and fruit drink and soda on the other hand, do not exhibit seasonal patterns (see Figure C1 in Appendix C). Finally, the stabilization of the pass-through estimates for flavoured water and soda (and to a lower extent for fruit-flavoured drink) from May 2012 onwards can be considered an indication that all the desired price adjustments associated with the SSB tax had been completed by the end of the first half of 2012.

**Alternative control groups and simple differences**

In order to assess the robustness of the estimates provided in the previous section, we estimate the tax pass-through using the alternative control groups described in Section III. The estimated average pass-through coefficients (as of June 2012) resulting from these alternative control groups are shown in Table 3.

First, in the case of the synthetic control groups obtained using our matching procedure, a comparison between the second and the third columns of Table 3 indicates that the pass-through estimated by this computationally very intensive procedure are extremely similar to our benchmark.

The fourth column of Table 3 shows the estimated pass-through for the second set of alternative control groups, i.e. unflavoured bottled water and pure fruit juice as alternative control groups for (taxed) flavoured water and fruit-flavoured drink, respectively. Although these results still point to an under-shifting of the tax

---


17 This phenomenon is also emphasized by Bergman and Hansen (2013) regarding the impact of the Danish SSB taxes.
Table 3. Average pass-through (in cents per litre) in June 2012 for alternative control groups and first difference (August 2011–June 2012 sample).

<table>
<thead>
<tr>
<th>Product category</th>
<th>Preferred control gr.</th>
<th>Alternative (matching)</th>
<th>Alternative (untaxed prod. of same prod. categ.)</th>
<th>First diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottled water</td>
<td>4.7 (0.3)</td>
<td>4.7 (0.3)</td>
<td>5.9 (0.5)</td>
<td>4.9 (0.2)</td>
</tr>
<tr>
<td>Fruit drink</td>
<td>7.1 (0.7)</td>
<td>6.8 (0.4)</td>
<td>3.9 (0.3)</td>
<td>6.3 (0.3)</td>
</tr>
<tr>
<td>Soda</td>
<td>7.7 (0.3)</td>
<td>7.5 (0.4)</td>
<td>– (0.2)</td>
<td>7.0 (0.2)</td>
</tr>
</tbody>
</table>

All regressions include month, shop and product fixed effects. Standard errors, clustered by shop, are given in parentheses.

Table 4. Average pass-through (in cents per litre) by month, allowing for anticipated price increases (August 2011–June 2012 sample).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottled water</td>
<td>0.1</td>
<td>0.0</td>
<td>0.1</td>
<td>3.9</td>
<td>4.4</td>
<td>4.9</td>
<td>5.0</td>
<td>5.1</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>(0.1)</td>
<td>(0.1)</td>
<td>(0.2)</td>
<td>(0.2)</td>
<td>(0.3)</td>
<td>(0.3)</td>
<td>(0.3)</td>
<td>(0.3)</td>
<td>(0.3)</td>
</tr>
<tr>
<td>Fruit drink</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
<td>3.4</td>
<td>4.5</td>
<td>6.5</td>
<td>6.8</td>
<td>6.8</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>(0.2)</td>
<td>(0.2)</td>
<td>(0.2)</td>
<td>(0.5)</td>
<td>(0.6)</td>
<td>(0.5)</td>
<td>(0.8)</td>
<td>(0.8)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>Soda</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>3.6</td>
<td>5.5</td>
<td>7.2</td>
<td>7.6</td>
<td>7.9</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>(0.1)</td>
<td>(0.1)</td>
<td>(0.1)</td>
<td>(0.5)</td>
<td>(0.6)</td>
<td>(0.4)</td>
<td>(0.5)</td>
<td>(0.5)</td>
<td>(0.4)</td>
</tr>
</tbody>
</table>

All regressions include month, shop and product fixed effects. Standard errors, clustered by shop, are given in parentheses.

For flavored water and fruit-flavored drink, from a quantitative point of view the pass-through appears to be larger than our benchmark for flavored water and smaller for fruit-flavored drink. This is due to the fact that, although the treated and control groups are similar in nature, the latter do not comply with the common trend assumption. On the one hand, the larger pass-through for flavored water stems from the stability of unflavored bottled water prices before January 2012, which does not perfectly match the slightly increasing prices of the former. On the other hand, the lower pass-through for fruit-flavored drink stems from the fact that the average price of pure fruit juice trended upwards prior to the tax.\(^{18}\)

The last column of Table 3 shows the estimated pass-through coefficients relying on simple differences, i.e. the impact of the pass-through is estimated based only on the difference between the price of products liable to the tax before and after the tax was implemented. The results again point to an under-shifting of the tax and to the same ranking of the pass-through across product categories as in our benchmark results: the pass-through was larger for soda than for fruit-flavored drink, while fruit-flavored drink in turn exhibited a larger pass-through than flavored water.

**Further robustness checks**

Beyond considering alternative control groups, we also test for the reliability of our benchmark estimates running two other types of robustness checks. First, we estimate an alternative model allowing for a rise in the price of products liable to the tax from October 2011, i.e. when the excise was discussed in the Parliament.\(^{19}\) Indeed, it is possible that producers and/or retailers may have started raising their prices before January 2012 in anticipation of the excise. To check whether this was the case, we estimate a model allowing retailers to increase the prices of products containing sugar or a sweetener starting from October 2011 (i.e. before these products were actually taxed). The results are shown in Table 4 and point to an absence of anticipation behaviour.

Second, we also check the robustness of our results by estimating our benchmark model on a different sample, starting in November 2011 rather than in August 2011. The rationale for this choice is that prices remained rather flat between August and December 2011. Therefore, using pre-tax prices from a couple of months before the implementation of the tax (November and December 2011) should not make a big difference with respect to using pre-tax prices from August to December 2011. However, the main advantage of starting our sample in November 2011 is the huge increase in the number of products covered. Indeed, the number of products that can be observed continuously between November 2011 and June 2012 is much larger than between August 2011 and June 2012. This alternative ‘November to June’ sample contains the prices of 1,019 products sold in 958 shops, amounting to a total of 1,056,416 observations (versus 845 products sold in 760 shops, amounting to 567,842 observations in our ‘August to June’ sample). As the estimates in Table 5 show, the pass-through coefficients obtained for this larger sample are qualitatively similar to those obtained for the sample covering the longer period. The main

\(^{18}\)Moreover, although pure fruit juice at first appears to be an intuitive control group for fruit-flavoured drink in terms of the product nature, its composition (100% fruit juice) differs markedly from that of fruit-flavoured drink and ready-to-drink tea (where the main ingredient is water).

\(^{19}\)It was finally voted into law in December 2011, just a few days before being implemented.
Table 5. Average pass-through (in cents per litre) by month, based on a larger sample covering a shorter period (November 2011–June 2012 sample).

<table>
<thead>
<tr>
<th>Product category</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottled water</td>
<td>3.0</td>
<td>4.4</td>
<td>4.8</td>
<td>5.3</td>
<td>5.2</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>(0.2)</td>
<td>(0.2)</td>
<td>(0.2)</td>
<td>(0.1)</td>
<td>(0.1)</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Fruit drink</td>
<td>3.2</td>
<td>4.9</td>
<td>5.9</td>
<td>6.4</td>
<td>6.6</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>(0.2)</td>
<td>(0.2)</td>
<td>(0.2)</td>
<td>(0.1)</td>
<td>(0.1)</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Soda</td>
<td>2.9</td>
<td>4.9</td>
<td>6.2</td>
<td>6.7</td>
<td>7.0</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>(0.2)</td>
<td>(0.3)</td>
<td>(0.2)</td>
<td>(0.1)</td>
<td>(0.1)</td>
<td>(0.1)</td>
</tr>
</tbody>
</table>

All regressions include month, shop and product fixed effects. Standard errors, clustered by shop, are given in parentheses.

The difference is that the conclusion that the French soda tax was not fully passed through to prices extends here to soda.

V. Heterogeneity in the pass-through of the soda tax to prices

The tax pass-through is affected by the competitive relationships between producers on the one hand, between retailers on the other hand, as well as between producers and retailers in the non-alcoholic beverage markets (Bonnet and Réquillart 2011, 2013). To assess the heterogeneity in the way retailers and producers of beverages shifted the SSB tax to their prices, we estimate a model where the pass-through is allowed to vary simultaneously across brands and retail groups:

\[
P_{(i)cjt} = \sum_{r,b \times g} \beta^c_{r,b \times g} \times D^b_{(i)cjtr} \times D^g_{(i)cjtr} \times D^c_{jtr} + \lambda^c_t + \alpha^c_{(i)cj} + \delta^c_j + \epsilon_{(i)cjt}, \quad c = w, f, s
\]

where \(w, f, s\) stand for the three product categories (bottled water, fruit drink and soda). \(D^b_{(i)cjtr}\), \(\lambda^c_t\), \(\alpha^c_{(i)cj}\) and \(\delta^c_j\) are defined as in section ‘Econometric estimation of the pass-through’; \(D^b_{(i)cjtr} = 1\) if product \(i\) within category \(c\) is branded \(b\), otherwise \(D^b_{(i)cjtr} = 0\); \(D^g_{jtr} = 1\) if shop \(j\) belongs to retail group \(g\), otherwise \(D^g_{jtr} = 0\). The pass-through parameters \(\beta^c_{r,b \times g}\) are then specific to each combination of brand and retail group.

We consider the six retail groups present in our data set (see Table A1 in Appendix A) and all product brands for which we knew the market share (see Tables A2–A4 in the Appendix A).

Figure 4 shows the distribution of all the available estimates of the coefficient \(\hat{\beta}^c_{r,b \times g, t}\) (16 for flavoured water, 32 for fruit-flavoured drink and 63 for soda) and points to a fairly strong heterogeneity in the estimated pass-through coefficients. Both low pass-through (i.e. below 0.7) and high pass-through (i.e. above 1.3) are very common and these differences are statistically significant. The assumption of a common pass-through either across brands or across retail groups is strongly rejected by a formal \(F\)-test. We also test for significant under-shifting and over-shifting of the tax for each of the 111 combinations of product brands and retail groups. In 43 cases (out of 111), the assumption of under-shifting (i.e. a pass-through below 0.9) is accepted, while the alternative assumptions of full shifting (i.e. pass-through = 1) and over-shifting (i.e. pass-through above 1.1) are both rejected. In a few limited cases, we can accept the assumption of full shifting alone. In the remaining cases, however, at least two of the assumptions cannot be rejected.

We also estimate a somewhat simpler model where we consider three kinds of brands/producers (‘Private labels’, ‘Large producer brands’ and ‘Small producer brands’) and two types of retailers (‘Leading retailers’ and ‘Other retailers’). The horizontal and vertical relations between producers and retailers depend on their relative size and on the retailers’ bargaining power when negotiating with producers through their buying groups (Bonnet and Réquillart 2011, 2013; Bonnet and Dubois 2010). Regarding brands, ‘Large producer brands’ correspond to all brands produced by the manufacturer(s) of the two brands with the largest market

\[^{20}\]These markets are clearly not perfectly competitive and provide goods that are more or less strongly differentiated (Gasmi, Laffont, and Vuong 1992; Cotterill, Franklin, and Ma 1996; Dube 2005).

\[^{21}\]While information on the market shares of the main French retail groups is publicly available, for reasons of confidentiality we are unable to provide econometric results allowing the identification of these on groups.

\[^{22}\]The products corresponding to the remaining brands were grouped together in an ‘Others’ brand/category sharing all the same pass-through.
shares in a product category (bottled water, fruit drink, soda)\(^{23}\); all remaining brands, other than 'Private labels', are classified as 'Small producer brands'. Concerning retailers, the two retail groups with the largest market share in France (Carrefour and Leclerc) are defined as 'Leading retailers', while the other groups are classified as 'Other retailers'. The estimation results are provided in Table 6 and confirm that the pass-through was heterogeneous across beverage brands and retail groups. First, the average quasi-full shifting of the tax results from a combination of an under-shifting for large producers’ brands and an over-shifting for private labels. Second, the two main retail groups in France often passed through the soda tax to a lesser extent than other retailers.

In order to rationalize these results, we sketch a simple producer–retailer bargaining framework which takes into account the fact that retailers in France compete strongly on prices, and that, by law, processed food producers and retailers must negotiate on sales terms once a year.\(^{24}\) This kind of negotiation basically sets a price list for different quantities sold by the producer to the retailer, as well as possible rebates and discounts. Let us then assume that the bargaining between producers and retailers can be modelled as a Nash-bargaining game:

\[
\max_{P_p} \left[ (P_p - C_{m_p}) \varphi(X) - \pi_p^0 \right]^{\theta} \\
\left[ (E(P_c) - P_p) \varphi(X) - \pi_c^0 \right]^{1-\theta}
\]

where:

\(\pi_p^0\)

and

\(\pi_c^0\)

are the producers' and retailers' minimum utilities, respectively, \(X\) is the bundle of quantities sold, \(E(P_c)\) is the expected price of the competitors, \(\varphi(X)\) is a utility function, and \(\theta\) is a parameter of elasticity of substitution between producers and retailers. The bargaining problem above can be solved by finding the Nash equilibrium of the game.

\(\textbf{Table 6.}\) Average pass-through in cents per litre in June 2012 by brand type and retailer size (August 2011–June 2012 sample).

<table>
<thead>
<tr>
<th>Product category:</th>
<th>Retailers:</th>
<th>Brands:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Private label brands</td>
<td>Large producer brands</td>
</tr>
<tr>
<td>Bottled water</td>
<td>Leading retailers</td>
<td>8.4 (1.7)</td>
</tr>
<tr>
<td></td>
<td>Other retailers</td>
<td>5.9 (0.3)</td>
</tr>
<tr>
<td>Fruit drink</td>
<td>Leading retailers</td>
<td>10.1 (0.7)</td>
</tr>
<tr>
<td></td>
<td>Other retailers</td>
<td>9.1 (0.5)</td>
</tr>
<tr>
<td>Soda</td>
<td>Leading retailers</td>
<td>7.1 (0.8)</td>
</tr>
<tr>
<td></td>
<td>Other retailers</td>
<td>10.3 (0.5)</td>
</tr>
</tbody>
</table>

All regressions include month, shop and product fixed effects. Standard errors, clustered by shop, are given in parentheses.

\(^{23}\)Grouping together brands produced by the same manufacturer reflects the fact that their prices may not be independent. In our data, the ‘Large producer brands’ are brands belonging to Danone and Nestlé Waters for bottled water, to Pepsico-Unilever and Orangina-Schweppes for fruit drink and to Coca-Cola and Orangina-Schweppes for soda.

\(^{24}\)Negotiation over sales terms in year \(t\) usually start at the end of year \(t - 1\), but have to be completed by the beginning of March of year \(t\). New conditions cannot apply retrospectively to the period before the agreement was reached. However, the price agreement can be renegotiated if a major and unforeseen event affects producer’s production costs (including changes in taxes, such as a SSB tax).
- \( P_p \) is the vector of the producer price list, i.e. the list of prices associated with the different possible quantities purchased by the retailer\(^{25}\);
- \( Cm_p \) is the vector of the producer’s marginal cost, which may vary depending on the quantity purchased by the retailer, \( X \), which in turn determines the production level;
- \( \varphi(X) \) is the vector of the different quantities that may be purchased by the retailer, \( X \), weighted by their probability of realization, which is assumed to be common knowledge for both the producer and the retailer. When the negotiation takes place, these quantities are just hypothetical purchase quantities. Indeed, the result of the negotiation is only an agreement about a price list. Retailers have no obligation regarding the volume they buy from the producer and can decide to stop selling a product whenever they wish\(^{26}\);
- \( \pi^0_p \) is the producer’s profit when there is no agreement (we shall assume that in this case the product is not sold by the retailer, so that \( \pi^0_p = 0 \));
- \( E(P_c) \) is the expected retail price, anticipated by the retailer based on its knowledge of consumers’ demand characteristics and competition\(^{27}\);
- \( \pi^0_r \) is the retailer’s profit when there is no agreement (we shall assume that in this case the product is not sold, so that \( \pi^0_r = 0 \));
- \( \theta \) is the bargaining power of the producer and \( (1 – \theta) \) that of the retailer. The bargaining power depends on the relative weight of the producer and the retailer in the market, as well as on the elasticity of substitution between the product under negotiation and its substitutes (if any).

Participation constraints are written simply as \( P_p > Cm_p \) for the producer and \( P_p \leq P_r \) for the retailer. It is easy to show that, given these two participation constraints, the solution of this simple bargaining game is \( P_p = E(P_c)^\theta \times Cm_p^{(1-\theta)} \) or in logarithms:

\[
\ln(P_p) = \theta \ln(E(P_c)) + (1 - \theta) \ln(Cm_p).
\]

If \( \theta = 1 \), the producer has all the bargaining power and \( P_p = P_c \). In other words, the margin goes entirely to the producer, while the retailer’s margin is zero. If on the contrary \( \theta = 0 \), then \( P_p = Cm_p \), so that the producer makes no margin.

In a second step, the retailer sets the consumer price of the product by (possibly) adding a margin to the producer’s price:

\[
\ln(P_r) = \ln(P_p) + (1 - \theta) \ln(M).
\]

This model then simply states that the total margin \( M \) is shared between producers and retailers according to their bargaining power. The total margin depends on the characteristics of demand (elasticity) and on those of the market (competition). In particular, the greater the elasticity of demand and the stronger the degree of competition, the lower the margin. In this framework, assuming a constant marginal cost of production, the French excise tax corresponds to a 7.55 euro cents increase in the producers marginal cost. Producers with no bargaining power (\( \theta = 0 \)) have a zero margin. Their participation constraint thus implies that they must fully shift the tax to the production price. Then, depending on market conditions at the retail level, retailers may either fully shift the tax or absorb part of it in their margin. Depending on market conditions, the tax may thus be over-shifted (low elasticity of demand, low competition), or under-shifted (high elasticity of demand, strong competition). When producers have strong bargaining power (\( \theta = 1 \)), the extent to which they can pass the tax through to prices indirectly depends on the market conditions for their product at the retail level. The tougher the competition, the lower the margin and, consequently, the lower the pass-through of the tax to prices.

\(^{25}\)For the sake of simplicity, we assume that the producer’s price makes the most of the retailer’s marginal cost. Including another component in the retailer’s marginal cost would not change the main messages of the model, nor the interpretation of our results.


\(^{27}\)When bargaining with producers, retailers seem likely to have fairly precise expectations, \( E(P_c) \), about the price at which they will sell the product, given what they know about their competitors’ prices and about the elasticity of consumer demand. In the case of a product for which there is no direct competition stricto sensu with other retailers (e.g. for private label products), the expected price can be considered to be essentially determined by what retailers know about the elasticity of demand.
Are the predictions drawn from this simple model consistent with our empirical findings? With regards to the heterogeneity of the pass-through across brands, we find that, regardless of the product category (bottled water, fruit drink, soda) and of the size of the retail group, the tax pass-through was higher for private labels than for other brand products. This finding is consistent with our theoretical framework, since private labels are characterized by weaker producer bargaining power and lower demand elasticity than other products. Contrary to private labels, the pass-through coefficients estimated for ‘Large producer brands’ reveal an under-shifting of the tax to prices in almost all cases. This is consistent with the theoretical predictions of our model where large producers have some bargaining power in negotiations with retailers. Indeed, if producers’ price-cost margins are large, they have the option of not fully shifting the tax to their prices. Moreover, if retailers compete strongly over price, and demand is rather elastic to price, then the tax will also be under-shifted to consumer prices. Regarding ‘Small producer brands’, we find that the estimated pass-through coefficients are larger than those of ‘Large producer brands’ in the case of fruit drink. This is consistent with our simple bargaining framework, since it seems reasonable that the former should have lower margins and thus find it hard not to shift the tax to their price. In the case of soda, the pass-through is not greater for smaller producers than it is for larger producers, probably due to the specific characteristics of energy drinks.

Concerning the heterogeneity of pass-through across retail groups, in most cases the tax pass-through is lower for the two largest retail groups than it is for the others. This is probably due to the fierce price competition between these two large retail groups, each of which regularly claims to be the cheapest. Another complementary explanation, consistent with our model, is that the largest retailers were able to oblige producers to under-shift the tax, while smaller retailers were in a weaker bargaining position.

Overall, our estimation results are consistent with the prediction of a fairly simple model in which the consumer price depends on production costs as well as on the characteristics of demand (elasticity) and of the market (competition). The margin, defined as the difference between the retail price and the cost of production, is shared between producers and retailers on the basis of their respective bargaining power.

VI. Conclusion

Our results show a significant under-shifting of the tax to the prices of flavoured water, as well as a slight under-shifting to the prices of fruit-flavoured drink. However, the full pass-through obtained for soda, together with the large share of these products (75%) in total supermarket sales of non-alcoholic beverages liable to the tax (about 2.5 billion euro in 2011), suggests a quasi-full shifting of the excise to beverage prices at the macroeconomic level. Our findings contrast with the limited results available on the effect of SSB taxes on prices (Bonnet and Réquillart 2013; Bergman and Hansen 2013) and support the assumption of full shifting often made in studies into the impact of SSB taxes on soft drinks consumption, either explicitly (see Dharmasena and Capps 2012; Brownell et al. 2009) or more or less implicitly (see Smith, Lin, and Lee 2010; Finkelstein et al. 2013; Block et al. 2010; Lin, Smith, and Lee 2010).

Another important finding is the pervasive heterogeneity of the pass-through, not only across

---

28Indeed, Bonnet and Réquillart (2011) and Bonnet and Dubois (2010) have shown that, for soft drinks and waters in France, the price-cost margin is lower for private labels than for other brands, which suggests low bargaining power for producers of private label products. Bonnet and Réquillart (2013) and Bergès-Sennou, Bontems, and Réquillart (2004) argue that the producers of private label products sell at production marginal cost.

29Bonnet and Réquillart (2013) show that the demand elasticity for private label beverages, while significant, is smaller than for other brands (between −2.13 and −3.65 for private labels, compared to −3.25 to −3.95 for other brands). The lower elasticity of demand for private label products may also explain why we find that retailers over-shifted the tax to the prices of these products in most cases.

30Mark-ups in the French beverage sector are large relative to the food industry (see https://www.banque-france.fr/economie-et-statistiques/entreprises/structure-et-performances-des-entreprises/fascicules-dindicateurs-sectoriels.html).

31As far as small producers of soda are concerned, the estimates are strongly affected by a well-known brand of energy drinks, which saw large price decreases in 2012. When this particular brand is excluded from the sample, the ‘Small producer brands’ pass-through rises from −1.9 for ‘Leading retailers’ and 6.1 for ‘Other retailers’ to 5.0 and 6.8, respectively (results available on request). Moreover, the average price of ‘Small producer brand’ sodas is significantly higher than that of private labels and other brands. In particular, these products include most of the energy drinks in our sample, which seem to have high price-cost margins. This is likely to be due to strong product differentiation in this segment of the beverage market. Indeed, these particular soft drinks have a much higher average price and a much higher standard deviation than other beverages, suggesting the existence of a number of small monopolies. These factors may have enabled producers of energy drinks to under-shift the tax to prices.

product categories, but also across beverage brands and retailers. The average full shifting of the tax stems from a combination of an under-shifting of the tax for large producers’ brands and an over-shifting for private labels. Since private label products are characterized by both lower average prices and higher pass-through than other brands, it seems likely that the soda tax will have a larger impact on low income households. At the same time, we find that two large French retail groups frequently passed through the soda tax less than the others. These results are shown to be consistent with a simple producer–retailer bargaining framework.

Overall, the absence of an over-shifting of the excise, together with the limited magnitude of the tax (7.55 euro cents, corresponding to a price increase of 7% on average), allow us to agree with Boizot-Szantai and Etilé (2011) and Bonnet and Réquillart (2013) regarding the low expected impact of the soda tax in terms of sugar consumption and health.

Acknowledgements

We thank the editor and the two anonymous referees for many insightful and useful suggestions. We wish to say a special thank you to Prixing, the start-up that provided the data used in this article, and in particular to Eric Larchevêque, the owner and CEO of the company at the time. Thanks also to Christine Boizot-Szantai, Céline Bonnet, Clément Carbonnier, Claire Chambolle, Pauline Givord, Stéphane Gregoir, Vincent Réquillart and Julio Rotemberg, as well as to the participants at seminars at the Banque de France, GREMAQ-Toulouse School of Economics and INRA-ALISS, and at conferences (2012 JMA, AFSE, LAGV and 18th International Conference on Panel Data). Errors and shortcomings are our own. The views expressed in this article are those of the authors and do not necessarily represent those of their institutions.

Disclosure statement

No potential conflict of interest was reported by the authors.

References


Appendix A: More about the data base

We weighted the data so that it was representative of the national market shares of both retail groups and brands. Not all retail groups have developed drive-throughs at the same pace. In particular, one of the major retail groups in France has lagged behind its competitors, while one of the smaller players offered this option at most of its supermarkets. Therefore, our sample of drive-throughs (although almost exhaustive) did not necessarily provide a representative picture of supermarket sales at the aggregate level. The weight given to each observation in our sample was defined in two steps. First, the weight \( \omega_{bg} \) of brand \( b \) sold in retail group \( g \) was computed as the product of brand market share \( MB_b \) (see Tables A2–A4) and retail group market share \( MG_g \) (see Table A1):

\[
\omega_{bg} = MB_b \times MG_g.
\]

The same rule was used to calculate the market share of each retail group’s private label: the total market share of private labels was split across retail groups, assuming that their respective market share was the same as that of the retail group itself (as the available information did not allow a less restrictive assumption).

Second, the weight \( \omega_{bg} \) was divided by the number of observations available for brand \( b \) in retail group \( g \), assuming that brand market shares are broadly similar across shops of the same retail group:

\[
\omega_{bg}^* = \frac{\omega_{bg}}{N_{bg}}.
\]

Market share figures provided in the table combine market shares provided by Rayon-boissons.com for bottled plain, sparkling, and flavoured water separately.

Private labels include: Auchan, carrefour, casino, leclerc, intermarche and produit u.

Other brands include: Abatilles, aix les bains, arvens, carola, lisbeth, mont dore, mont rouscou, mont d’arée,

### Table A1. Composition of the sample by retail chain and group.

<table>
<thead>
<tr>
<th>Retail chain</th>
<th>No. of shops</th>
<th>Retail group</th>
<th>Group market share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auchan</td>
<td>41</td>
<td>Auchan</td>
<td>10.9%</td>
</tr>
<tr>
<td>Simply Market</td>
<td>38</td>
<td>Auchan</td>
<td>10.9%</td>
</tr>
<tr>
<td>Carrefour</td>
<td>2</td>
<td>Carrefour</td>
<td>18.7%</td>
</tr>
<tr>
<td>Carrefour</td>
<td>1</td>
<td>Carrefour</td>
<td>18.7%</td>
</tr>
<tr>
<td>Casino</td>
<td>20</td>
<td>Casino</td>
<td>5.0%</td>
</tr>
<tr>
<td>Geant Casino</td>
<td>57</td>
<td>Casino</td>
<td>5.0%</td>
</tr>
<tr>
<td>Leclerc</td>
<td>107</td>
<td>Leclerc</td>
<td>18.6%</td>
</tr>
<tr>
<td>Intermarche</td>
<td>179</td>
<td>Les</td>
<td>12.6%</td>
</tr>
<tr>
<td>Ecomarche</td>
<td>3</td>
<td>Mousquetaires</td>
<td>12.6%</td>
</tr>
<tr>
<td>Hyper u</td>
<td>40</td>
<td>Systeme u</td>
<td>9.2%</td>
</tr>
<tr>
<td>Marche u</td>
<td>4</td>
<td>Systeme u</td>
<td>9.2%</td>
</tr>
<tr>
<td>Super u</td>
<td>263</td>
<td>Systeme u</td>
<td>9.2%</td>
</tr>
<tr>
<td>U Express</td>
<td>5</td>
<td>Systeme u</td>
<td>9.2%</td>
</tr>
<tr>
<td>Total</td>
<td>760</td>
<td></td>
<td>75.0%</td>
</tr>
</tbody>
</table>

Sources: Prixing and, for retail groups market shares, Kantar Worldpanel cited by Agro-Media (2012).

### Table A2. Composition of the sample by brand for bottled water.

<table>
<thead>
<tr>
<th>Brand</th>
<th>Market share in 2011</th>
<th>No. of shops</th>
<th>Products With/Without Added sugar/sweetener</th>
</tr>
</thead>
<tbody>
<tr>
<td>All private labels</td>
<td>20.1%</td>
<td>508</td>
<td>x  x</td>
</tr>
<tr>
<td>Cristaline</td>
<td>17.3%</td>
<td>72</td>
<td>0  x</td>
</tr>
<tr>
<td>Evian</td>
<td>6.3%</td>
<td>581</td>
<td>0  x</td>
</tr>
<tr>
<td>Volvic</td>
<td>5.9%</td>
<td>583</td>
<td>x  x</td>
</tr>
<tr>
<td>Contrex</td>
<td>5.0%</td>
<td>485</td>
<td>x  x</td>
</tr>
<tr>
<td>Salvetat</td>
<td>5.0%</td>
<td>447</td>
<td>0  x</td>
</tr>
<tr>
<td>Vittel</td>
<td>4.1%</td>
<td>382</td>
<td>0  x</td>
</tr>
<tr>
<td>Badoit</td>
<td>3.9%</td>
<td>399</td>
<td>0  x</td>
</tr>
<tr>
<td>Hepar</td>
<td>2.7%</td>
<td>122</td>
<td>0  x</td>
</tr>
<tr>
<td>San Pellegrino</td>
<td>2.5%</td>
<td>264</td>
<td>x  x</td>
</tr>
<tr>
<td>Quezac</td>
<td>2.1%</td>
<td>207</td>
<td>0  x</td>
</tr>
<tr>
<td>St-Yorre</td>
<td>1.9%</td>
<td>181</td>
<td>0  x</td>
</tr>
<tr>
<td>St Amand</td>
<td>1.8%</td>
<td>94</td>
<td>0  x</td>
</tr>
<tr>
<td>Courmayeur</td>
<td>1.2%</td>
<td>152</td>
<td>0  x</td>
</tr>
<tr>
<td>Vichy Celestins</td>
<td>1.0%</td>
<td>100</td>
<td>0  x</td>
</tr>
<tr>
<td>Rozana</td>
<td>0.8%</td>
<td>128</td>
<td>0  x</td>
</tr>
<tr>
<td>Taillefine</td>
<td>0.4%</td>
<td>61</td>
<td>x  0</td>
</tr>
<tr>
<td>Perrier</td>
<td>0.1%</td>
<td>364</td>
<td>0  x</td>
</tr>
<tr>
<td>Other brands</td>
<td>17.9%</td>
<td>417</td>
<td>0  x</td>
</tr>
</tbody>
</table>

Sources: Prixing and, for brand market shares, Rayon-boissons.com (http://www.rayon-boissons.com/), a professional website focusing on beverages.

### Table A3. Composition of the sample by brand for fruit drink.

<table>
<thead>
<tr>
<th>Brand</th>
<th>Market share in 2011</th>
<th>Market share used in the analysis</th>
<th>No. of shops</th>
<th>Products with/without added sugar/sweetener</th>
</tr>
</thead>
<tbody>
<tr>
<td>All private labels</td>
<td>56.5%</td>
<td>48.0%</td>
<td>562</td>
<td>x  x</td>
</tr>
<tr>
<td>Oasis</td>
<td>–</td>
<td>11.0%</td>
<td>565</td>
<td>0  x</td>
</tr>
<tr>
<td>Tropicana</td>
<td>11.5%</td>
<td>9.8%</td>
<td>644</td>
<td>0  x</td>
</tr>
<tr>
<td>Joker</td>
<td>11.2%</td>
<td>9.5%</td>
<td>408</td>
<td>x  x</td>
</tr>
<tr>
<td>Lipton</td>
<td>–</td>
<td>4.0%</td>
<td>365</td>
<td>x  0</td>
</tr>
<tr>
<td>Pampyril</td>
<td>3.4%</td>
<td>2.9%</td>
<td>100</td>
<td>0  x</td>
</tr>
<tr>
<td>Fruitre</td>
<td>2.3%</td>
<td>2.0%</td>
<td>76</td>
<td>0  x</td>
</tr>
<tr>
<td>Ocean</td>
<td>2.3%</td>
<td>2.0%</td>
<td>358</td>
<td>0  x</td>
</tr>
<tr>
<td>Spray</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressade</td>
<td>2.3%</td>
<td>2.0%</td>
<td>112</td>
<td>0  x</td>
</tr>
<tr>
<td>Pago</td>
<td>1.1%</td>
<td>1.0%</td>
<td>89</td>
<td>x  x</td>
</tr>
<tr>
<td>Rea</td>
<td>0.9%</td>
<td>0.8%</td>
<td>92</td>
<td>0  x</td>
</tr>
<tr>
<td>Granini</td>
<td>0.4%</td>
<td>0.3%</td>
<td>38</td>
<td>x  0</td>
</tr>
<tr>
<td>Other</td>
<td>7.3%</td>
<td>6.7%</td>
<td>600</td>
<td>x  x</td>
</tr>
<tr>
<td>brands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Prixing and, for brand market shares, Rayon-boissons.com.

Other brands: nestle, ogeu, pierval, plancoet, st antonin, spa, st alban, telle quelle, thonon, vals, vernière and wattwiller.

Market share figures published by Rayon-boissons.com differ slightly from those used in our analysis because, given their characteristics, two brands (Oasis and Lipton) were moved from the ‘soda’ category to the ‘fruit drink and ready to drink tea’ category.

Private labels include: Auchan, carrefour, casino, leclerc, intermarche and produit u.

Other brands include: Alter éco, andros, bjorg, brut de pomme, éthiquable, fanta, gayelord hauser, innocent, la ferme fruitière, minute maid, nestea, pulco, sunny delight, teisseire, tropico.

Market share figures published by Rayon-boissons.com differ slightly from those used in our analysis because,
given their characteristics, two brands (Oasis and Lipton) were moved from the 'soda' category to the 'fruit drink and ready to drink tea' category.

Private labels include: Auchan, carrefour, casino, leclerc, intermarche and produit u.

Other brands include: breizh cola, burn, canada dry, dark dog, dr pepper, elsass cola, gini, kas, lorina, mirinda, monster, powerade, ricqlès, rivella, selecto, sumol, sun.

For the econometric analysis, Lipton was introduced into the category 'fruit drink and ready-to-drink tea'.

Web addresses of the sources:

(1) Total sales by product category:

(2) Market shares by product category:
http://www.rayon-boissons.com/Chiffres-du-marche/Parts-de-marche-annuelles-des-marques-de-jus-de-fruits-en-GMS-20023
http://www.rayon-boissons.com/Chiffres-du-marche/Parts-de-marche-des-principales-marques-de-sodas-20162
Appendix C: Seasonality

Figure C1. Monthly change in the French National Statistical Office’s series for bottled water (first panel) and for soda, fruit drink and concentrated fruit syrups (second panel).