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The impact of a ‘soda tax’ on prices. Evidence from French micro data

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Résumé : A partir d'une base de données constituée de centaines de milliers d'observations sur le prix de boissons non alcoolisées vendues dans plus de 800 supermarchés en France, nous évaluons l'impact de la 'taxe soda', instituée depuis le 1er Janvier 2012, sur le prix des boissons concernées, à savoir les boissons contenant du sucre ajouté ou des édulcorants . L'approche retenue, en "différence de différences", nous permet de montrer que la taxe a progressivement été repercutée dans le prix de ces boissons au cours des cinq premiers mois de l'année 2012. Toutefois, alors qu'en Juin 2012, la taxe était totalement repercutée dans le prix des sodas, la taxe n'a été repercutée qu'à environ 85% pour les boissons aux fruits et les eaux aromatisées. Nous montrons également que l'impact de la taxe sur les prix a été différent selon les groupes de distribution et selon les marques de boissons.

Mots-clés: Taxe d'accise, boisson, sucre ajouté, incidence, ajustement de prix.

Codes JEL : C31, D22, H22, L81

Abstract : Based on a unique database consisting of hundreds of thousands of non-alcoholic beverage price records collected in about 800 supermarkets in France, we evaluate the impact on prices of the soda tax, an excise on drinks with added sugar or sweetener, introduced in January 2012 in France. We adopt a difference in differences approach and find that the tax was passed-through to consumer prices gradually over the first semester of 2012. After 6 months, the tax was fully shifted to soda prices while the pass-through to prices of fruit drinks and flavored waters was not complete. We also find that the impact of this tax was different across retailing groups and beverage brands.

Keywords: Excise tax, beverage, added sugar, tax incidence, price adjustment.

JEL codes : C31, D22, H22, L81

1 Introduction

In August 2011, the French government decided to set a new tax on sodas, based on the claim that drinks containing added sugar are unhealthy and that their consumption should be discouraged. A similar tax already existed in some countries, like Denmark, Finland and Hungary and in many US states (OECD, 2012; Bridging the Gap Program, 2011). The French Parliament decided to extend this tax to "light" soft drinks containing sweeteners. Thus, the tax concerns all non-alcoholic beverages with added sugar or sweetener, and notably sodas, fruit drinks and flavoured waters. Moreover, while the government initial project was to set the tax at 3.58 euros per hectoliter, the Parliament decided to double this tax, which was eventually voted to be 7.16 euros per hectoliter.¹ This corresponds to about 11 euro cents for a 1.5 liter of soda, i.e. about 6% of the average price of sodas. This tax was effective from January 1st, 2012.

The aim of this paper is to evaluate the impact of this tax on the price of the three main categories of concerned drinks: (*i*) sodas (including cola, energy, tonic and other soft drinks), (*ii*) flavoured waters, and (*iii*) fruit drinks and ready-to-drink teas. Our analysis allows the tax effect to be heterogeneous, not only across different product categories, but also across retailing groups and beverage brands. Moreover, because different retailing groups may have had different price adjustment strategies and/or timing, each dimension of potential heterogeneity is interacted with time dummies to allow for different price reactions over time.

This paper adds to the still sparse literature on the impact of sugar sweetened beverage (SSB) excise taxes on prices. Indeed, quite surprisingly, the increased interest in the expected impact of SSB taxes on soft-drinks consumption and, consequently, on health or obesity (e.g. see Brownell et al. 2009; Dharmasena and Capps, 2010; Finkelstein et al., 2012; Jacobson and Brownell, 2000; Lin et al., 2010; Smith et al., 2010) did not induce a corresponding flow of research regarding the impact of an SSB tax on soda prices. The impact of a 'soda tax' on obesity and health has been most often estimated under the assumption of a full pass-through of the tax to prices. If we except the paper by Besley and Rosen (1999) who considered the impact of sales taxes on the prices of a large number of products in US states, it is only very recently that Bergman and Hansen (2012) and Bonnet and Requillart (2012) provided an empirical assessment of the pass-through of a 'soda tax' to prices. However, beyond these two studies, a few other empirical papers consider the impact of specific excise taxes on prices either for alcoholic beverages (Kenkel, 2005; Young and Bieliska-Kwapisz, 2001) or cigarettes (Hanson and Sullivan, 2009; De Cicca, Kenkel and Liu, 2010; Chiuo and Muehlegger, 2012; Harding, Leibtag and Lovenheim, 2012).

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 a unique data set made of about 52,000 price trajectories, referring to very specific non-alcoholic beverages (defined by their brand, quantity, packaging, etc. and individually identified by their bar code) sold in specific outlets (defined by their name -i.e., distribution chain-, their retailing group and their

¹Law number 2011-1977, passed on December 28th, 2011.

address). Overall, the prices of 850 different beverage products sold in one or more of the 800 supermarkets present in the dataset are followed from August 2011 to June 2012. These data were collected and made available to us by Prixing, a start-up company providing consumers with a free mobile price comparator.² We find that, after 6 months, the tax was fully shifted to soda prices while the pass-through to prices of fruit drinks and flavoured waters was not complete. Moreover, our results point to some significant differences in the pass-through across retailing groups as well as across beverage brands.

The remaining of the paper is structured as follows: Section 2 provides a brief literature review about the pass-through of excise taxes to prices. A detailed presentation of our data and of the difference in differences approach we use is provided in Section 3. Our main results are presented and discussed in Section 4 while Section 5 contains a number of robustness checks. Section 6 concludes.

2 Soft-drinks excise taxes and prices. A brief literature review

The theoretical literature regarding the impact of excise taxes on prices in markets with perfect competition is unambiguous: in most cases, i.e., with a standard upward sloping supply curve and a downward sloping demand, there is undershifting of the tax to prices, i.e. prices increase by less than the tax. In this context, the smaller the elasticity of demand, the larger the pass-through of the tax to prices. Only if demand is totally inelastic or if the supply curve is infinitely elastic (i.e., marginal costs are constant), the tax will be fully passed-through to prices (e.g. see Fullerton and Metcalf, 2002). Things are less obvious when goods are sold on markets where imperfect competition prevails. Depending on the nature of competition, on the characteristics of demand and on those of production costs, excise taxes may be either undershifted, fully shifted or even overshifted to prices. It is also important to distinguish between short-run and long-run effects as, in the long run, firms entries and exits have an influence on the way the tax impacts prices (e.g., see Stern, 1987; Delipalla and Keen, 1992; Anderson et al., 2001). Since non-alcoholic beverages can be considered to be highly differentiated products which notably differ from each other in terms of taste and quality, and because our interest is in the impact of the ‘soda tax’ on prices over the months just following its introduction, we may here restrict our attention to results regarding the short-run impact of excise taxes on prices on markets with differentiated products. Anderson et al. (2001) have shown that in such markets, if firms compete in prices and if the elasticity of demand is constant, an excise tax is overshifted into prices (see also Fullerton and Metcalf, 2002). Fullerton and Metcalf (2002) also consider the case of differentiated products but in a context of spatial competition: firms are not all symmetric competitors: the intensity of competition is stronger with firms selling "close" products than with those selling "far distant" products. They show that, in that case, an excise tax is fully passed-through to producer prices (and over-shifted to consumer prices as long as an ad valorem tax also applies).

²See <http://www.prixing.fr/>

The theoretical literature thus emphasizes the possibility of over-shifting excise taxes to prices on market with differentiated products. Is this prediction corroborated by existing empirical studies regarding the impact of sugar-sweetened beverage (SSB) taxes on prices? There are unfortunately very few papers considering explicitly this issue, at least regarding a SSB tax. Indeed, as previously mentioned, the growing empirical literature about the expected impact of SSB taxes on soft-drinks consumption and health or obesity (e.g. see Brownell et al. 2009; Dharmasena and Capps, 2011; Finkelstein et al., 2012; Jacobson and Brownell, 2000; Lin et al., 2011; Smith et al., 2010) has not been accompanied by a corresponding increase in research regarding the impact of SSB taxes on prices. Two recent papers by Bergman and Hansen (2012) and Bonnet and Requillart (2012) are, however, explicitly devoted to this question. Bergman and Hansen (2012) evaluate the impact of various excise tax variations on alcoholic and non-alcoholic beverage prices in Denmark. Based on the analysis of micro price data used by Statistics Denmark to compute the Danish Consumer Price Index, they come to the conclusion that the two increases in the soft drink tax that occurred in 1998 and 2001 were over-shifted to consumer prices. Using a quite different approach, Bonnet and Requillart (2012) come to the same conclusion. They specify a structural model where competition is horizontal (between producers on the one hand, and between retailers on the other hand), as well as vertical (between producers and retailers) and show, using simulations, that an excise SSB tax is likely to be over-shifted to prices. Beyond these two studies, a few empirical studies consider the more general question of the impact of specific consumption taxes on prices. Besley and Rosen (1999) have considered the impact of sales taxes on a large number of products in US States. They also outline an over-shifting of these taxes to soda prices. The conclusions that can be drawn from other studies devoted to the impact of excise taxes on prices are more diverse. Although Kenkel (2005) and Young and Bieliska-Kwapisz (2001) also conclude to over-shifting of taxes to alcoholic beverage prices, as do Hanson and Sullivan (2009) regarding cigarette prices, De Cicca, Kenkel and Liu (2010) find full shifting while Chiou and Muehlegger (2010) and Harding et al. (2012) find under-shifting.

3 The data and the model

The data we use for assessing the impact of the ‘soda tax’ implemented in France since January 1st, 2012, have been collected by Prixing, a price comparator available on mobiles and on the internet. These data mainly cover grocery products sold in "drives", a type of retailing outlet that recently developed in France. A "drive" is a place where you collect the goods you have previously ordered on the internet. However, this retailing channel differs from the "usual" internet retailers in that prices are exactly those you would pay if you went shopping in the physical store (most "drives" are associated with a supermarket). The main difference is that the range of products available in "drives" can be smaller than that available in the supermarket itself. This form of retailing has increased quite significantly over the last two years in France. While there were around 500 drives in France at the end of 2010, their number doubled at the end of 2011 and about tripled by the end of the first semester of 2012 to reach about 1500 outlets (RayonBoissons, 2012; Caussil, 2012).

In order to "feed" its price comparator, Prixing has elaborated automatic procedures allowing to collect price lists from these drives for a large array of products. Indeed, the initial databases we have been given access to contains prices of more than 100,000 products sold in "drive" outlets, representing altogether almost 80 millions price spells covering the period March 2010 to September 2012.³ The range of products for which prices are collected is broadly that available in supermarkets, i.e. with a strong predominance of food products (almost two thirds of collected prices), non-durable household goods such as washing-up liquid or dishwasher detergent (around 12%) and personal care products (around 10%). Prices of clothes and household appliances are also recorded though for a much more limited number of items. As of June 2012, these prices were collected in about 1500 drives located in France, most often on a daily basis. However, when the price collection process started, in March 2010, the number of drives was smaller and the price collection not necessarily made on a daily basis. Moreover, not all retailing groups developed this form of retail distribution at the same pace. Indeed, one of the major retailing distribution groups in France lagged behind regarding the opening of this type of outlet while a smaller player offered this option in most of its supermarkets, even in small ones. Our sample of drives (although almost exhaustive) thus did not necessarily provide a representative picture of sales at the aggregate level, especially in the beginning of the period. Then, in order to ensure the representativity of our results, we re-weighted observations according to the market shares of product brands and of retailing groups at the national level (see Appendix A for details). Once this is done, we may reasonably expect our results to be representative since, as documented in Anderton *et al.* (2011), France is one of the European countries where retail distribution is highly concentrated in supermarkets, especially regarding grocery products.⁴ Indeed, hypermarkets and supermarkets represent about 75% of the French grocery market (respectively over 40% for hypermarkets and slightly less than 35% for supermarkets).

Due to technical problems, the first waves of collected price spells were often subject to measurement errors regarding the beginning and end dates of the spells and/or regarding the classification of products. We then decided to limit our analysis to price data available from August 2011 until the end of June 2012. This left us with about 52 millions spells starting in August 2011 or later. Because our focus in this paper is on the 'soda tax', we restricted the sample to non-alcoholic beverages, and more specifically to three categories of products: (*i*) sodas (including cola, energy, tonic and other soft drinks), (*ii*) waters, (*iii*) fruit drinks and ready-to-drink teas. The resulting "beverage sample" contains more than 2 millions price spells associated with about 1700 beverages. This sample still contained spells with inconsistent start and end dates (i.e. a start date posterior to the end date) which we discarded. Moreover, due to the presence of some missing information and outliers regarding in particular prices or the quantity content of the product, some more trimming had to be done. We considered the empirical distributions

³By the end of April 2012, we were provided with a first database covering the period March 2010 to mid-April 2012. We then obtained, in October 2012, a second database that covers the period April to September 2012. The availability of exact identifiers of both products and "drive" outlets allowed us to merge these two datasets.

⁴In Italy and Spain grocery shops are on average characterized by one third of French surface and real sales per store. In Germany surfaces are larger, but real sales per store and square meter anyway lower.

of the price per centiliter, separately for each group of products (water, fruit drink and soda) and by brand \times month \times tax status and we discarded the observations below the first and above the 99th percentiles of each of these distributions. Moreover, prices associated with increases or decreases from one month to the next exceeding $\pm 30\%$, in log-differences, were also excluded. Since the total number of observations was still considerable (more than 15 millions price records), we decided to keep only one price observation per month, chosen as the most frequently observed price over a month for each specific product sold in a specific shop. This choice of the "monthly modal price" is similar in spirit to the reference price as defined in Eichenbaum et al. (2011).⁵ Finally, to avoid average price changes associated with composition effects, we kept in the sample only the individual products for which the price was recorded every month over the period August 2011 to June 2012. This period was chosen as to allow checking for the possibility that some retailers/producers might have anticipated the tax when it was discussed by the Parliament though not yet voted. Table 1 below reports some descriptive statistics of this sample, decomposed into waters that contain added sugar/sweetener (typically flavoured waters), and those that don't, fruit drinks that contain added sugar/sweetener and fruit juices that don't, and sodas, which all contain either added sugar or sweetener.

Table 1: Descriptive statistics - Sample period: August 2011 to June 2012

Product category	Tax	N. obs. per month	N. of products	N. of shops	Mean price (euro per liter)		
					Aug. 2011	Dec.2011	June 2012
Water	No	9806	166	747	0.53	0.53	0.52
	Yes	1294	25	505	0.77	0.78	0.82
Fruit drink	No	13787	271	753	1.69	1.71	1.73
	Yes	9563	157	655	1.18	1.18	1.25
Soda	Yes	17405	226	756	1.25	1.25	1.32
Total		51855	845	804	-	-	-

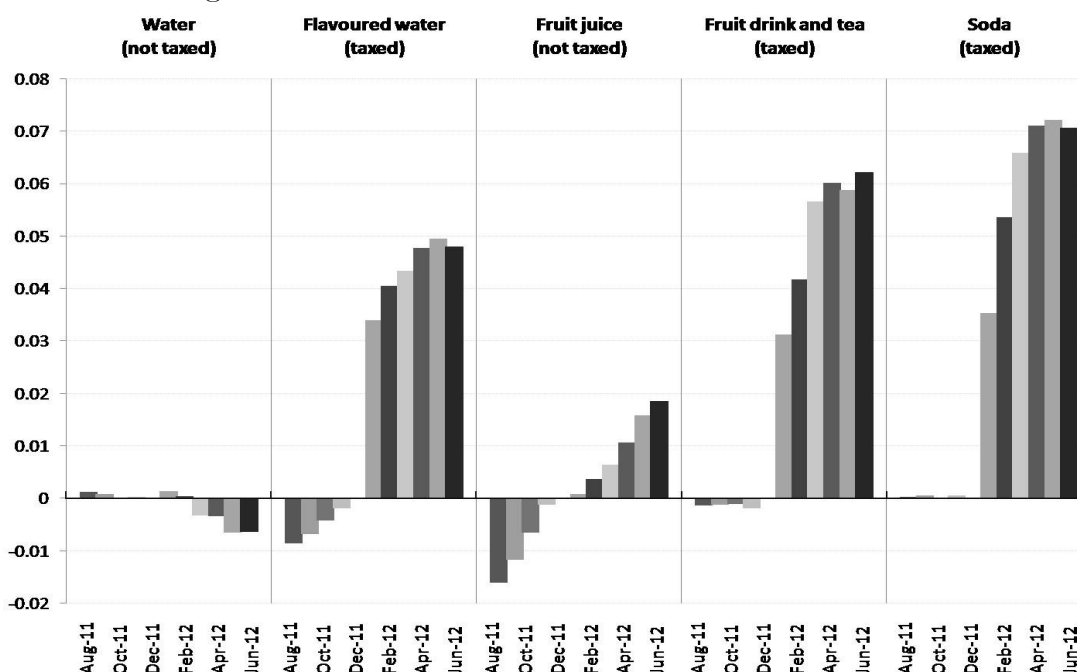
Table 1 shows that despite the trimming that had to be done, our sample compares favourably to most of those used in the literature for assessing the impact of taxes on prices both in terms of number of observations, product coverage and shop coverage. Indeed, our econometric sample contains 570,405 observations made of 51,855 price trajectories regarding the prices of 845 products sold in at least one among the 804 drive outlets in which prices have been collected.⁶ Table 1 also shows that average prices are, not surprisingly, different across product categories. This is a direct consequence of their

⁵In Eichenbaum et al. (2011), reference prices are defined as the modal price over a quarter, while we use monthly reference prices here.

⁶Moreover, in 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. This restricted period allows to significantly increase the number of products for which we are able to track the price (see Appendix B for details).

specific characteristics: pure fruit juices are higher quality products than "ordinary" beverages with a fruit flavour. Similarly, aromatized/flavoured waters are more sophisticated products than "simple" waters. Figure 1 below shows the monthly evolution, between August 2011 and June 2012, of the average normalized price per centiliter for each group of products (waters, fruit drinks and sodas), split between those that contain added sugar/sweetener and are thus liable to the tax, and those that don't. For each product category, prices on this graph are expressed in differences from the average price of the category as of December 2011. In the absence of any other factor that might induce price change, a full pass-through of the tax would then correspond to a price increase of 0,0716 euros per liter. This graph then clearly shows that, except for pure fruit juices and, to a lower extent, for flavoured waters, the average price trajectory was remarkably flat before the introduction of the tax while it started to strongly increase from January onward for those products which are liable to the tax.

Figure 1: Evolution of the average prices of non-alcoholic drinks between August 2011 and June 2012



These elements call for the use of the difference in differences approach, which accounts for such differences as well as for those associated with the brand and other specific characteristics of the products and shops (marketing policy, local competition, etc.). Indeed, the difference-in-differences approach relies on the possibility to compare, before and after the introduction of the tax, the price of products that had ex ante similar dynamics, some of which are liable for the 'soda tax' after January 2012 (the 'treated' group) and others are not (the 'control' group). The implementation of the difference in differences approach relies on the estimation of the following econometric model:

$$P_{ijt} = \sum_{\tau=jan,feb,mar,apr,may,jun}^3 \beta_{\tau} D_{it\tau} + \lambda_t + \alpha_i + \delta_j + \varepsilon_{ijt}$$

where P_{ijt} is the monthly modal price per centiliter of product i sold in shop j at time t ; the dummy variable $D_{it\tau}$ equals 1 when product i is liable to the tax, i.e. it contains added sugar or sweetener and the period is between *January* and *June* 2012, while it equals 0 otherwise. λ_t , α_i and δ_j are fixed effects corresponding respectively to the months under review (August 2011 to June 2012), to product characteristics (including whether they include added sugar or sweetener or not) and to shop characteristics (retailing group, location, local competition, etc.). In this approach, the identification of the tax effect relies on the hypothesis that the tax had not been introduced, the price of the two groups of products would have evolved in a similar way. Note however that, since sodas are all liable to the tax, the control group for this category of products consists of the prices of the same products before January 2012. Given the very flat profile of soda prices before January 2012 (see the graph above), this is a quite reasonable assumption.

4 The impact of the ‘soda tax’ on prices

Have producers and retailers passed the ‘soda tax’ through to consumer prices and to which extent? This section aims at providing an answer to this question, both on average but also by considering the possibility of differences across retailing groups and/or beverage brands.

4.1 The average pass-through: magnitude and timing

Table 2 below reports, for the three categories of products we consider, the average impact of the tax on prices of products that are liable to the tax.⁷ To allow for lags in the reaction of producers/retailers in the transmission of the tax to prices, we have allowed this effect to be gradual over the first semester of 2012.

Table 2 : Average pass-through in cents per liter
(August 2011 - June 2012 sample)

Product	January	February	March	April	May	June
Water	3.7 (0.2)	4.5 (0.3)	5.1 (0.4)	5.6 (0.4)	6.1 (0.5)	5.9 (0.4)
Fruit drink	2.4 (0.6)	3.2 (0.6)	4.4 (0.2)	4.4 (0.3)	3.7 (0.3)	3.8 (0.3)
Soda	3.5 (0.5)	5.4 (0.7)	6.6 (0.4)	7.1 (0.2)	7.2 (0.2)	7.0 (0.2)

Note: all regressions contain month, shop and product fixed effects. Standard errors, clustered by shop, are given in parentheses.

The first point to notice is that, in contrast with the few results available in the literature about the impact of SSB taxes on prices, we do not get any indication of a

⁷Because the main objects of interest of this paper are the coefficient β_τ , which estimate the price effect of the tax, the tables below do not report other parameter estimates. The full estimation results are available on request.

significant over-shifting of the tax, at least on average. Indeed, these results only point to a full pass-through of the tax to soda prices (the average increase in prices for this group of products reached the expected euro cents 7.16 cents in May 2012). Regarding flavoured waters and fruit drinks, the pass-through is only about 85% (6.1 cents) for the former group of products and about 60% (4.4 cents) for the latter group. This is less than the simulation results of Bonnet and Requillart (2012) who predict the impact of the French SSB tax to be an increase in prices by about 11% when all sweetened beverages (i.e. those with added sugar as well as diet ones, with a sweetener) are taxed. Given the average price in their sample, this corresponds to an average increase of around 9 cents per liter. Though we do not know the precision of their estimate, it does not seem too heroic to reject the assumption of equality between our estimates and theirs. Our estimates are also significantly lower than those obtained by Bergman and Hansen (2010) who get estimates of the pass-through of an increase in the tax on sodas which are always greater than 2.

Possible explanations of these discrepancies are diverse. First, one cannot rule out that our estimates understate the true pass-through. In the case of fruit drinks in particular, pure fruit juices which are not liable to the tax have seen their prices increasing regularly over the period August 2011 to June 2012, which was not the case for fruit drinks and ready-to-drink teas, for which prices remained rather stable in 2011. Then, it might be that using pure fruit juices as a control group for the evaluation of the impact of the SSB tax on prices of fruit drinks and ready-to-drink teas leads to an under-estimation of the pass-through. We shall come back to this issue in Section 4 below. On the other hand, the estimated impact of the French SSB tax obtained by Bonnet and Requillart (2012) relies on a model where it is assumed in particular that producers impose their prices to retailers, an assumption which does not seem to be consistent with the estimates we get when we allow the estimated pass-through to differ across retailing groups and beverage brands (see below).

Beyond the issue of the magnitude of the pass-through, it is also interesting to notice that the pass-through of the tax to beverage prices was spread over several months. While already in January, the tax pass-through was, for all product categories, half of its long run value, this long-run value was reached only in April or May 2012, i.e. 4 or 5 months after the tax became effective. The stability of the estimates of the pass-through after May 2012 can be considered as an indication that all the desired price adjustments associated with the SSB tax were completed by the end of the first semester. More surprisingly, a significant number of retailers left their prices unchanged even after the tax became effective. This phenomenon was also emphasized by Bergman and Hansen (2010) regarding the impact of the Danish SSB taxes. A more detailed presentation of this phenomenon is provided in the next section, together with a decomposition of the average pass-through in terms of the frequency and magnitude of price changes.

4.2 Assessing the intensive and extensive margins of the pass-through

The results presented above show that, on average, retailers did not fully shift the tax to prices. However, this can correspond to a large variety of reactions from the retailers. At one extreme, it might be that all retailers adjusted their prices as a response to the tax but did it only partially, e.g. because of a "generalized" fear of consumers' reactions (e.g. see Rotemberg, 2011). Or, at the other extreme, it might be that some retailers more than fully transmitted the tax to prices while others did not change their prices or, even decided to lower them. The analysis of price changes that followed the implementation of the tax shows that, as usual, the truth is a mix of these two options. Some retailers decided to keep their prices unchanged, others decided to increase their prices but by less than the tax while another fraction used the opportunity given by the tax implementation to increase their prices by more than the tax amount.

Indeed, as Table 3 below shows, a significant fraction of prices (between 14% and 17%) of the products which were liable to the tax remained unchanged or even decreased after January 2012 to reach a level that, in June 2012, was below their level in December 2011, i.e. before the tax became effective. This phenomenon is even more striking when considering the evolution of prices over the first quarter of 2012 only: between 12% and 15% of prices did not change during these three months immediately following the implementation of the tax and 7% to 8% even decreased during that period.⁸ It remains, however, that the tax induced a significant drop in the fraction of prices remaining unchanged and, correspondingly, a rise in the proportion of price increases. But it is only for sodas that we also observe a significant drop in the frequency of price decreases.

Table 3 : Frequency of price changes before and after the tax implementation (August 2011 to June 2012)

Product	Tax	August to December			December to March			December to June		
		↘	→	↗	↘	→	↗	↘	→	↗
Water	No	28.4	48.6	23.0	20.2	57.9	21.9	40.8	30.2	29.0
	Yes	8.2	54.9	36.9	8.9	14.9	76.1	12.1	4.5	83.4
Fruit drink	No	18.6	43.9	37.5	17.8	45.7	36.5	24.4	19.8	55.8
	Yes	18.6	47.2	34.2	8.0	14.0	78.0	15.0	2.6	82.4
Soda	Yes	26.6	43.5	29.9	6.7	12.6	80.7	10.1	3.7	86.2

Beyond the differences in changes regarding the likelihood and direction of price changes between products being liable to the tax and other products that are not, there are also differences in the magnitude of these price changes.

⁸In contrast with a common view, consumer price decreases are not that uncommon (e.g. see Baudry et al., 2007 and Berardi et al., 2012 about the dynamics of consumer prices in France).

Table 4 : Average magnitude of price changes
(between August 2011 and June 2012)

Product	Tax	August to December		December to March		December to June	
		↘	↗	↘	↗	↘	↗
Water	No	-1.8	1.8	-3.6	1.8	-3.2	2.4
	Yes	-2.1	2.8	-1.5	5.9	-2.9	6.2
Fruit drink	No	-6.3	7.5	-6.7	5.1	-8.4	7.0
	Yes	-5.3	3.3	-5.1	7.8	-5.4	8.5
Soda	Yes	-3.5	3.1	-4.9	8.6	-6.4	8.9

Not surprisingly, products that are liable to the tax exhibit larger price increases after January than they did before. They also exhibit stronger increases and smaller decreases than products which are not subject to the tax. A summary of these alterations of the characteristics of prices changes associated with the implementation of the tax can be obtained applying a difference in differences approach to these frequency and magnitude of price changes.

Table 5 : Tax-induced changes in the frequency and magnitude of price changes
(January-June 2012 compared to August-December 2011)

Product	Frequency of			Magnitude of	
	↘	→	↗	↘	↗
Water	-8,5	-32.0	40.5	0.6	2.8
Fruit drink	-9,4	-20.5	29.9	2.0	5.7
Soda	-16,5	-39.8	56.3	-2.9	5.8

As expected, the tax induced a drop in the proportion of prices remaining stable or decreasing, corresponding to a significant rise in the proportion of price increases. Moreover, these changes were reinforced by a reduction of the size of price decreases (except for sodas) and by a larger magnitude of price increases. However, these changes underlying the average pass-through of the tax to prices hide some significant differences, both across retailing groups and across beverage brands.

4.3 Heterogeneity of the pass-through across retailing groups and beverage brands

As emphasized in Section 2, the expected impact of an excise tax on prices strongly depends on the nature of competition that prevails on the market. Two features of the retail trade sector and of the beverage production sector seem to benefit from a large consensus. First, these markets are not perfectly competitive. Second, they provide more or less strongly differentiated goods (e.g. see, among many others, Gasmi et al., 1992; Cotterill et al., 1996; Dube, 2005). Unfortunately, characterizing more precisely the nature of competition that prevails on these two markets is less obvious. Competition between retailers has several dimensions: a local one associated with the competition which prevails between outlets and their local competitors; but also a global one, stemming from

the overall size of their group and their capacity to negotiate with producers through their buying groups (e.g. see Bonnet and Requillart, 2011, Bonnet and Dubois, 2010, etc.). The nature of these vertical relationships also clearly depends on the relative size of the retailer and producer and are indirectly affected by the retailer position on its own distribution market. The diversity of competitive situations is then likely to induce the same diversity regarding the way retailers (and producers) of beverages have shifted the SSB tax to their prices. This is indeed what we observe when allowing the pass-through of the tax to differ across retailing groups and beverage brands, as shown in the tables below.

These tables provide estimates of the pass-through for the private label products of each retailing group, the pass-through for the three main national brands of each category of products (i.e. the three main national brands of flavoured waters; the three main brands of fruit drinks and ready-to-drink teas and the three main brands of sodas) as well as the pass-through of other brands, taken as a whole. These estimates are obtained for each retailing group separately. For the sake of readability of the tables, only the coefficients measuring the pass-through, as of March 2012 and as of June 2012, are reported.

Table 6 : Pass-through by retailing group and beverage brand, flavoured waters (as of March 2012 and June 2012)

	March 2012						June 2012					
	Retailing group						Retailing group					
Brand	A	B	C	D	E	F	A	B	C	D	E	F
Private label	7.6	-	3.1	5.1	2.5	7.8	6.9	-	4.4	6.7	4.0	5.7
B1				1.0	2.1	1.1				-0.2	1.5	5.3
B2				0.7	2.6	8.1				0.9	1.7	2.5
B3	3.1		5.0	-0.3	2.5	7.4	2.8		4.0	-1.3	0.9	7.5

Note: all regressions contain month, shop and product fixed effects.

Table 7 : Pass-through by retailing group and beverage brand, fruit drinks and ready-to-drink teas (as of March 2012 and June 2012)

	March 2012						June 2012					
	Retailing group						Retailing group					
Brand	A	B	C	D	E	F	A	B	C	D	E	F
Private label	8.7	3.3	8.5	8.2	1.9	8.2	8.3	8.7	8.5	9.7	6.7	9.2
B4	7.7	4.8	7.5	3.2	4.5	3.2	7.3	2.8	8.4	-1.0	2.0	5.9
B5	6.9	0.6	-	3.1	5.3	7.7	6.5	3.8	-	3.8	4.3	7.8
B6	5.5	10.9	15.4	0.0	7.8	21.2	-6.5	8.9	20.8	-8.6	4.3	12.5
Others	9.6		15.0	5.0	0.2	1.7	3.6		15.0	5.5	-0.8	6.4

Note: all regressions contain month, shop and product fixed effects.

Table 8 : Pass-through by retailing group and beverage brand, sodas
(as of March 2012 and June 2012)

	March 2012						June 2012					
	Retailing group						Retailing group					
Brand	A	B	C	D	E	F	A	B	C	D	E	F
Private label	8.5	0.0	5.7	4.8	8.2	10.0	8.3	7.9	6.4	5.0	10.7	11.2
B7	6.2	7.0	9.3	3.5	5.8	16.6	7.2	7.1	5.9	4.6	6.7	14.3
B8	7.5	3.3	12.0	2.8	4.8	7.0	4.9	3.1	15.3	1.9	3.9	7.9
B9	6.9	3.8	10.8	4.5	5.5	7.8	7.1	6.2	10.1	5.0	5.4	8.2
Others	6.4	11.1	10.2	3.0	5.8	12.5	5.7	7.0	8.3	1.7	4.6	11.2

Note: all regressions contain month, shop and product fixed effects.

Several observations can be drawn from this set of results. First, whatever the group of products we consider, the ranking of retailing groups based on their pass-through is quite similar across beverage brands. In particular, two retailing groups (C and F) are characterized by quite high pass-through coefficients, indicating a propensity to overshift the tax to prices, sometimes quite strongly, for almost all products. On the other hand, two retailing groups (B and D) exhibit lower average pass-throughs together with some more heterogeneity across groups of products. One of these two latter groups had actually marketed on the media its low pass-through of the ‘soda tax’ as a deliberate strategic choice of reducing its margin to shelter its consumers. It is also worth noticing that these two retailing groups with the lowest average pass-through are the two biggest players in the retailing trade market. Therefore, it is also possible that they were able to obtain more favourable conditions when bargaining with their suppliers (e.g., large stocks bought before the tax implementation or postponed price increases).

Another striking regularity that emerges from these results is that the pass-through was significantly higher for private labels than it was for other brands. In a very large majority in cases, retailing groups increased more the price of their own brands than what they did for other brands. One possible explanation is that, given the lower prices and, possibly, margins of these products, retailers have less flexibility to absorb the excise tax and shelter their customers from this tax. This result is consistent with that obtained by Bonnet and Requillart (2012) who also come to the conclusion that the French SSB tax was expected to have a stronger impact on private labels products than on national brands. Allowing, for simplicity, the pass-through coefficient to vary only across the three categories of brands (private label, leading national brand, other brands) confirms this result and also tends to show that the "size" of the market share of a brand may have played a role in the bargaining between producers and retailers. For the three groups of products we consider, "Other (small) brands" are the one with the lowest pass-through:

Table 9 : Pass-through by type of brand
(August 2011 - June 2012 sample;)

Product	Private label	Market leader	Other brands
Water	4.5 (1.4)	2.0 (1.4)	-
Fruit drink	8.8 (0.2)	4.2 (0.4)	4.0 (1.5)
Soda	8.0 (0.2)	7.0 (0.2)	5.4 (0.6)

Note: all regressions contain month, shop and product fixed effects. Standard errors, clustered by shop, are given in parentheses.

5 Robustness checks

In order to assess the reliability of the estimates provided in the previous sections, three types of robustness checks have been implemented. First, we have estimated our models using a different definition of the "control groups". Indeed, as discussed above, in the case of fruit drinks in particular, the evolution of prices between August and December 2011 was different in the "treatment group" (fruit drinks and ready-to-drink teas) than what they were in the "control group" (fruit juices): prices of products from the former group were almost stable while those of the latter group increased regularly during that period and kept doing so from January to June 2012. One may then wonder whether the low degree of pass-through estimated for this group of product might be the result of these diverging trends in prices. The estimates provided in Table 10 below then rely on "simple differences", i.e. the impact of the pass-through is estimated only from differences in the prices of the products that are liable to the tax before and after the tax was implemented. Not surprisingly, the estimated pass-through increases significantly for fruit drinks with respect to its previous estimate. Ignoring the increasing trend of pure fruit juices' prices induced an under-estimation of this pass-through. Indeed, it is not sure that pure fruit juices are the best control group in that the composition of these products (100% fruit juice) clearly strongly differs from that of fruit drinks and ready-to-drink teas for which the main ingredient is water. This is why our preferred estimate of the pass-through for fruit drinks is this second estimate, based on a simple difference.

The opposite phenomenon occurs regarding flavoured waters. Indeed, the price of "standard" waters decreased during the second quarter of 2012 and this participated in the estimation of the pass-through for flavoured waters. Considering that the main input of flavoured waters remains the water itself, one should then consider that our first estimate of the pass-through is more reliable as it takes into account the corresponding decrease in the cost of a major input. Finally, since sodas have no untaxed equivalent, it is not surprising to get here the same estimate of the pass-through as before.

Table 10 : Simple difference average pass-through in cents per liter
(August 2011 - June 2012 sample)

Product	January	February	March	April	May	June
Water	3.4 (2.3)	4.1 (2.5)	4.3 (2.1)	4.8 (2.2)	5.0 (2.1)	4.8 (2.0)
Fruit drink	3.1 (0.5)	4.2 (0.6)	5.7 (0.2)	6.0 (0.2)	5.9 (0.3)	6.2 (0.3)
Soda	3.5 (0.5)	5.4 (0.7)	6.6 (0.4)	7.1 (0.2)	7.2 (0.2)	7.0 (0.2)

Note: all regressions contain month, shop and product fixed effects.
Standard errors, clustered by shop, are given in parentheses.

Another feature of beverage prices that might have an influence on our assessment of the pass-through is the possibility that producers or retailers might have anticipated the date of effectiveness of the tax and started raising their prices before January 2012. In order to check whether this might have been the case, we have estimated an alternative model allowing the price of products liable to the tax to increase from October 2011, i.e. when the Parliament started to discuss about this tax.

Table 11 : Average pass-through in cents per liter;
model with anticipated price increases
(August 2011 - June 2012 sample)

Product	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Water	0.4 (0.1)	0.6 (0.2)	0.9 (0.2)	4.1 (0.2)	4.9 (0.3)	5.5 (0.4)	6.0 (0.5)	6.5 (0.5)	6.3 (0.4)
Fruit drink	-0.7 (0.2)	-1.3 (0.2)	-1.2 (0.3)	1.8 (0.5)	2.5 (0.6)	3.8 (0.2)	3.7 (0.4)	3.0 (0.4)	3.1 (0.4)
Soda	-0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	3.5 (0.5)	5.3 (0.6)	6.5 (0.3)	7.0 (0.2)	7.2 (0.2)	7.0 (0.2)

Note: all regressions contain month, shop and product fixed effects.
Standard errors, clustered by shop, are given in parentheses.

The results we obtain are provided in Table 11 below. They show that this phenomenon marginally affected the price of flavoured waters only. For this group of products, we indeed observe a small increase in prices starting in October. However, the average magnitude of this increase is less than one euro cent per liter and has only a minor influence on the assessment of the impact of the tax at the end of the first semester of 2012. On the contrary, allowing for this anticipation of the tax significantly lowers the estimate of the pass-through we get for fruit drinks. The reason clearly appears: those products have seen their price increasing much less than those of the control group (pure fruit juices) which, mechanically, induces a lower pass-through at the end of the period. This result is a further argument to consider that the best estimate of the pass-through for

this category of products is the one given in Table 10 above, i.e. the one obtained from simple differences. Last but not least, the price of sodas, the products for which the tax was clearly designed, remained remarkably stable before the tax became effective.

At this point, our preferred estimates of the pass-through are as follows: 6.5 for flavoured waters because it seems that prices of this group of products partly anticipated the implementation of the tax; 6.2 for fruit drinks and ready-to-drink teas since, given the evolution of prices of pure fruit juices, the best control group for these products seems to be their own prices before the tax was implemented. Finally, the pass-through for sodas is estimated at 7.2, corresponding to a full shifting of the tax to prices. Should this absence of over-shifting come as a surprise? One possible explanation lies in the elasticity of demand for these products. Many studies have estimated the elasticity of non-alcoholic beverages consumption to prices to be significantly larger than 1, in absolute value (e.g. Bonnet and Requillart, 2011 and Bonnet and Dubois, 2010, on French data as well as Pofahl, Capps and Clauson, 2005 or Alviloa, Capps and Wu, 2010 on US data). These studies also show that the price elasticity of demand for water is larger, in absolute value than those for the two other groups of products which appear to have rather close price elasticities. This provides a rationale to the differences in the estimated pass-through between water, on the one hand, and fruit drinks and sodas on the other hand. Moreover, the lower pass-through obtained for water may also stem from the fact that flavoured waters are more easily substituted by other products than fruit drinks and sodas. Indeed, "plain" waters exist and are cheaper than (taxed) flavoured waters. This contrasts with the case of fruit drinks: "pure" fruit juices that exist as a substitute for fruit drinks are significantly more expensive, thus making the substitution more unlikely. In the case of sodas, the difficulty to find a close (and untaxed) substitute is even stronger as all sodas are liable to the tax and as the degree of product differentiation is quite high across sodas.

Finally, we implemented a last robustness check by estimating our models on a different sample, starting in November 2011 rather than in August 2011. The rationale for this choice is as follows: in most cases, the evolution of prices between August and December 2011 was not that important so that taking instead as a reference the prices observed between November and December 2011 should not make a too big difference. However, the great advantage of taking such a shorter period is that this allows a huge increase in the product coverage. Indeed, the number of products continuously observed between November 2011 and June 2012 is much larger than that of products observed between August 2011 and June 2012. This "November to June" sample contains prices of 1019 products sold in 958 shops, amounting in total to 1,056,416 observations, against 845 products sold in 804 shops, amounting to 570,405 observations in our "August to June" sample. As the estimation results in Table 12 below show, the results we obtain with this larger sample are qualitatively similar to those obtained with the sample covering the longer period. The highest pass-through is obtained for sodas while flavoured waters come second and fruit drinks third in terms of the magnitude of the pass-through.

Table 12 : Average pass-through in cents per liter
(November 2011 - June 2012 sample)

Product	January	February	March	April	May	June
Water	2.7 (1.4)	4.2 (1.6)	4.7 (1.6)	5.4 (1.3)	5.6 (1.2)	5.6 (1.3)
Fruit drink	3.0 (0.2)	4.5 (0.3)	5.1 (0.2)	5.4 (0.2)	4.8 (1.0)	5.0 (1.0)
Soda	3.0 (0.2)	4.9 (0.3)	6.2 (0.2)	6.7 (0.1)	6.8 (0.1)	6.7 (0.1)

Note: all regressions contain month, shop and product fixed effects. Standard errors, clustered by shop, are given in parentheses.

Estimating the other models considered above also leads to similar estimates. Indeed, our preferred estimates of the pass-through obtained with this new sample amount to 5.7 for flavoured waters with a model allowing for an anticipated impact of the tax (against 6.5 with our August to June sample)⁹ Using our preferred simple difference estimate for fruit drinks leads to an estimate of 6.4 (against 6.2 with the previous sample). Our preferred estimate for sodas being the one in Table 12, i.e. 6.8 (against 7.2 with our previous sample). Overall, these results confirm our main result: on average, the French ‘soda tax’ was not fully passed-through to prices. However, as before, this conclusion must be slightly qualified: some differences are worth being noticed across the different groups of products: pass-through was higher for sodas than for flavoured waters and fruit drinks. Moreover, in most cases, retailing groups have overshifted the tax to the price of their private label products.

6 Conclusion

Following the implementation of a ‘soda tax’ in France on the 1st January, 2012, prices of the beverages liable to the tax increased significantly. Using a difference in differences approach, we show that, on average, the tax has been fully shifted to prices of sodas, a category of products for which no close untaxed substitute product exists. Regarding the two other groups of products liable to the tax, (flavoured waters and fruit drinks), our results show a slight under-shifting of the tax to prices: their prices increased by slightly more than 6 cents per liter, on average, to be compared with a tax set at 7.16 euro cents per liter. The existence of untaxed substitutes may be an explanation of this under-shifting. Our results also point to a strong heterogeneity of the pass-through across retailing groups and brands. Some retailing groups have over-shifted the tax while others had the opposite policy. However, a quite common feature of the pricing policy of the French retailing groups has been to over-shift the tax into the prices of their private label products.

⁹since the sample starts in November, prices are assumed here to have started increasing from December 2011.

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8 Appendix A: More about the database

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

Retail chain	N. of shops "soda sample"	Retail group	Group market share
auchan	41	AUCHAN	10.9 %
simply market	38	AUCHAN	10.9 %
carrefour	2	CARREFOUR	18.7 %
carrefour market	1	CARREFOUR	18.7 %
casino	22	CASINO	5.0 %
geant casino	62	CASINO	5.0 %
leclerc	107	LECLERC	18.6 %
intermarche	181	LES MOUSQUETAIRES	12.6 %
ecomarche	3	LES MOUSQUETAIRES	12.6 %
hyper u	43	SYSTEME U	9.2 %
marche u	4	SYSTEME U	9.2 %
super u	295	SYSTEME U	9.2 %
u express	5	SYSTEME U	9.2 %
Total	804		75.0%

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

Table A2 : Composition of the sample by brand for waters

Brand	Market share	N. of shops	Products with added sugar or sweetener	Products with no added sugar nor sweetener
all private labels	20.1 %	509	x	x
cristaline	17.3 %	72	0	x
evian	6.3 %	581	0	x
volvic	5.9 %	583	x	x
contrex	5.0 %	485	x	x
salvetat	5.0 %	447	0	x
vittel	4.1 %	382	0	x
badoit	3.9 %	399	0	x
hepar	2.7 %	122	0	x
san pellegrino	2.5 %	264	x	x
quezac	2.1 %	207	0	x
st-yorre	1.9 %	181	0	x
st amand	1.8 %	94	0	x
courmayeur	1.2 %	152	0	x
vichy celestins	1.0 %	100	0	x
rozana	0.8 %	128	0	x
taillefine	0.4 %	61	x	0
perrier	0.1 %	364	0	x
other brands	17.9 %	477	0	x

Sources: Pricing and, for brand market shares, RayonBoissons (2012). The figures provided in the table combine market shares provided by RayonBoissons (2012) for plain waters, sparkling waters and flavoured waters separately.

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

Other brands include : abatilles, aix les bains, arcens, carola, lisbeth, mont dore, mont roucou, mont d'arrée, nestle, ogeu, pierval, plancoet, st antonin, spa, st alban, telle quelle, thonon, vals, vernière and wattwiller.

Table A3 : Composition of the sample by brand for fruit drinks

Brand	Market share in 2011	N. of shops	Products with added sugar or sweetener	Products with no added sugar nor sweetener
all private labels	56.5 %	578	x	x
tropicana	11.5 %	663	0	x
joker	11.2 %	420	x	x
pampryl	3.4 %	101	x	x
fruite	2.3 %	80	0	x
ocean spray	2.3 %	361	x	0
pressade	2.3 %	112	x	x
pago	1.1 %	89	x	x
rea	0.9 %	92	x	0
granini	0.4 %	38	x	0
other brands	7.3 %	491	x	x

Sources: Prixing and, for brand market shares, RayonBoissons (2012)

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, lipton, minute maid, nestea, oasis, pulco, sunny delight, teisseire, tropico.

Table A4 : Composition of the sample by brand for sodas

Brand	Market share in 2011	N. of shops	Products with added sugar or sweetener	Products with no added sugar nor sweetener
all private labels	18.7 %	458	x	0
coca-cola	49.4 %	678	x	0
schweppes	4.4 %	607	x	0
orangina	4.0 %	533	x	0
lipton	2.8 %	374	x	0
fanta	2.7 %	447	x	0
pepsi	1.3 %	219	x	0
taillefine	1.0 %	249	x	0
seven up	0.9 %	190	x	0
sprite	0.9 %	321	x	0
red bull	0.6 %	300	x	0
other brands	6.1 %	497	x	0

Sources: Prixing and, for brand market shares, RayonBoissons (2012)

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 drinks and ready-to-drink teas".

As mentioned in the text, there are discrepancies between the number of observations available for the various retail groups and for the product brands and their respective market shares. In order to come to more representative results, we have re-weighted the sample observations. These weights have been defined as follows:

First, the weight ω_{ij} of a brand i in a retail chain j has been defined as the product of the brand market share MB_i as given in Tables A2 to A4 by that of the retail chain MC_j . In particular, the total market share of private labels has been split across retail chains by assuming that their respective market share is that of the retail chain itself:

$$\omega_{ij} = MB_i \times MC_j.$$

Second, this weight ω_{ij} has been divided by the number of observations available for this particular brand in this particular retail chain :

$$\omega_{ij}^* = \omega_{ij} / N_{ij}$$

so that the weighted sample should be representative, at the national level, of both the retail chains relative importance and that of brands.

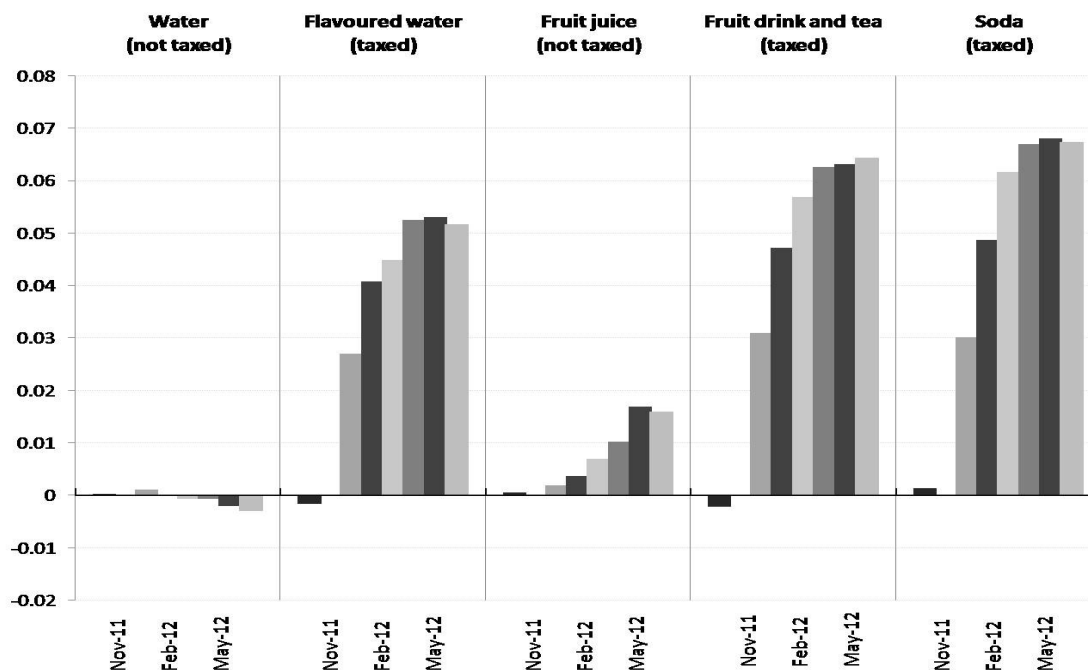
Finally, to check whether starting our analysis in November 2011 rather than in September did not give a biased view regarding the (absence of) average price variations before January 2012, we have built the figure below which provides the average prices by product category split between products which are liable to the tax and those which are not, from September 2011 to March 2012. It shows that the price stability observed in our econometric sample from November to December 2011 is a feature that was already observed before November. As stated in the text, we decided to restrict our period of analysis to November 2011-March 2012 in order to maximize the number of products and shops present in the sample (starting in September significantly reduces this number as this imposes two more months of "continuous" presence).

9 Appendix B: Main characteristics of the alternative econometric sample

Table 1: Descriptive statistics. Sample November 2011 to June 2012

Product	Tax	N. obs. per month	N. of products	N. of shops	Mean price (euro per liter)		
					Nov. 2011	Dec. 2011	Jun. 2012
Water	No	26244	195	955	0.49	0.49	0.49
	Yes	4152	32	865	0.80	0.81	0.86
Fruit drink	No	34680	330	953	1.74	1.74	1.76
	Yes	23226	198	948	1.20	1.21	1.27
Soda	Yes	43750	264	951	1.16	1.16	1.23

Figure A1: Evolution of the average prices of non-alcoholic drinks between November 2011 and June 2012



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