Consumer, Manufacturer and Retailer Responses to Health Price Policies: the example of EU Sugar Price Reform on the Soft Drink Market.

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Abstract

Healthier food diet is likely to prevent numerous non communicable diseases. Then there is a growing interest in evaluating the impact of food price taxation on food consumption. However, strategic reactions of both manufacturers and retailers are missing in empirical analyses. Rather, passive pricing is assumed. Ignoring strategic pricing might lead to under-estimate or over-estimate the impact of food taxation. Based on the example of the soft drink industry, we analyse the bias which is introduced when assuming passive pricing. Using structural econometric model, we first estimate models of vertical relationships between the beverage industry and the retail industry. After selecting the 'best' model of vertical relationships, we then simulate different scenrios of input cost changes or final products taxation. Our results indicate that assuming passive pricing by firms leads to under-estimate the impact on food consumption. In our example, the under-estimation amounts to 15% for regular products and 50% for diet ones when contracts between manufacturers and retailers are not taken into account. We thus conclude that for empirical analysis of food price policies for better health, considering strategic pricing is a key issue.

JEL codes:

Key words: vertical contracts, two part tariffs, competition, manufacturers, private labels, retailers, differentiated products, soft drinks, non nested tests,sugar CMO, passthrough.

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1 Introduction

According to the world health organization, non communicable diseases, cause about 35 million deaths each year representing about 60% of all deaths globally.[1] Moreover up to 80% of heart disease, stroke, and type 2 diabetes and over a third of cancers could be prevented by eliminating shared risk factors, mainly tobacco use, unhealthy diet, physical inactivity and the harmful use of alcohol. A related consequence of unhealthy diet and physical inactivity is the rise in obesity prevalence. To tackle this public health problem, governments have tried to use public information campaigns in the aim to get people to change their food habits. These information campaigns may have positive impacts (Weiss and Tschirhart, 1994; Snyder, 2007) or no impact (**?**) on food consumption. However, they seem to have not been sufficiently effective at changing behavior (Cutler et al., 2003), and have failed to reverse the rising trend in obesity, diabetes and so on. In other areas legislation and taxation have proved more effective as it is the case for cigarettes (Adda and Cornaglia, 2006). These policy tools have been shown to be effective, and are now being considered as tools to influence consumer behavior to improve diets and therefore public health.

As the link between food intake and health is more and more recognised, there is a growing interest in the ex ante analysis of the health impacts of alternative food price policies. The general methodology used is a two-stage procedure which combines a demand model and a health model. The demand model is used to assess the impact on food or nutrient consumption of alternative policies. Then, the health model assesses the impact of food consumption changes on health. For example, Cash et al. (2005), **?**, Purshouse et al. (2010), Dallongeville et al. (2010) use epidemiological models to assess the impact on death, Chouinard et al. (2007), Bonnet and Requillart (2011), Griffith et al. (2010), Smed et al. (2007) look at the effect on some health related indicators such as diet quality or nutrient content. Whatever the way the second stage is developped, a key issue is the demand analysis.

A common limit of almost all these analysis is the assumption of passive pricing that is producers and retailers are supposed not to adjust product prices in response to the tax (subsidy) policy. The only example of integrating strategic pricing is Griffith et al. (2010) who account for a strategic behavior at the manufacturer level. However they ignore manufacturer and retailers relationships. Both the food and the retail food industries are characterised by large firms with market power, and therefore taxes are unlikely to be perfectly passed through. Economic studies on retail pass-through of upstream cost changes conclude to imperfect pass-through (Goldberg and Verboven, 2001; Hellerstein and Villas-Boas, 2008; Goldberg and Hellerstein, 2008; Bonnet et al., 2009; Nakamura and Zerom, 2010). A major explanation is the markup adjustment of manufacturers and retailers due to consumer substitution patterns, market structure, and market power in industries. Overall this literature suggest that final food prices are likely to be adjusted in response to a tax (subsidy) policy.

It is frequently argued that assuming passive pricing provides an upper bound of the impact of the policy (e.g. Allais et al., 2010, p.238). This statement is true only if producers do not fully transmit the impact of the tax (subsidy). However, in some cases, particularly in the monopoly case, the retail price transmission could be larger than 1. In this case, passive pricing assumption leads to under-estimating the impact of a tax.

In this paper, using the example of the sugar sweetened beverages (SSBs) industry, we show that ignoring firms strategic pricing when evaluating the impact of food tax/subsidy policies might lead to under-estimating the impact of such policies. We choose this industry for many reasons. First, there is strong evidence that consumption of SSBs is a contributor to the 'epidemic' of obesity (Harnack et al., 1999; Malik et al., 2006). Second, the industry is highly concentrated making the possibility of strategic pricing more likely. Third, an on-going reform of the sugar policy in the EU might significantly affect the price of the main input used for SSBs production.

[1] World Health Organization, 2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Non-communicable Diseases. http://whqlibdoc.who.int/publications/2009/9789241597418_eng.pdf (accessed 2010, December 17)

The originality of our approach is to deal with a vertical chain composed of oligopolies because both the soft drink industry and the retail industry are highly concentrated. This paper uses structural econometric models that accounts for the structure of the industry. From estimates of consumers' demand on the French soft drink market, we recover price cost margins from several supply models as in Berto Villas-Boas (2007) and Bonnet and Dubois (2010). We then select the model fitting best the data. Using this selected model, we quantify the impact on prices, markets shares of the different SSBs and on household consumption of a decrease in the sugar price. We find that the industry over-transmits a change in input cost. According to our results ignoring strategic pricing by the industry leads to under-estimate the impact on consumption by 15% for regular products and 50% for diet ones. This strongly militates for integrating strategic pricing in the ex ante analysis of food taxation.

The paper is organized as follows. Section 2 presents the main characteristics of the soft drink industry. Section 3 presents the data and descriptive statistics about soft drink consumption. Section 4 describes the model and methods which are used to analyse the demand and to infer the more likely vertical relationships between manufacturers and retailers. In section 5 we discuss demand and supply results, cost estimates. In section 6 we present results of policy simulations and we finally conclude in section 7.

2 The Soft Drink market

In 2004, the turnover of the French soft drink industry reaches 2.2 billion euros, that is 1.6% of the total turnover of the French food industry. Soft drinks represent about 11% of total beverages consumption in France which includes mineral water, alcohol, coffee, tea, drinking milk as well as fruit juices. On average, soft drink consumption increased by 32% from 1994 to 2004. Nevertheless, per capita consumption in France (42.5 litres per year) remains low as compared to per capita consumption in the EU (71.2 litres in average). The three main categories are colas (54% of all soft drinks), fruit drinks (25%) and iced tea (8%). Soft drinks do not include fruit juices and nectars which represent a significant part of beverage consumption. Those products do not contain a significant proportion of added sugar and they are thus not directly affected by the change in sugar price. In our analysis, they are included in the 'outside' option for consumers as they are substitutes for soft drinks. In general, there are two versions of each soft drink: a regular one which is sweetened using caloric sweeteners, and a diet one.

The industry is highly concentrated with the first two manufacturers (the alliance Coca Cola Enterprises and Cadbury Schweppes, the alliance Unilever and Pepsico) sharing 88.6% of the total production in 2004. Each of the manufacturers owns a brand portfolio even if Coca Cola and Pepsico are mainly involved in colas products and Unilever in iced tea.

3 Data

We use data collected by TNS WordPanel. It is a French representative survey of 19,000 households over a three year period (2003-2005) which provides information on purchases of food products (quantity, price, brand, store) and on characteristics of households. According to our sample, the average consumption of regular soft drinks is 34 litres per person per year while the average consumption of diet products is 8 litres per person per year.

From the panel data, we selected the 11 main national brands (NB) of the soft drink industry and three private labels (PL), one for each of the three categories of products (colas, iced tea, fruit drinks). We select the nine largest retailers in France. Taking into account the set of products carried by each retailer we get 105 (or 104 depending on the period) differentiated products which compete on the market.[2]

Market shares are defined as follows. We consider the total market of SSBs including soft drinks, fruit juice and nectar. This is considered as the relevant market. Market shares of a given brand in a given

[2] From the consumer perspective, a product is the combination of a brand and a retailer.

Table 1: **General Descriptive Statistics for Prices and Market Shares.**

		Prices (in euros per liter) Mean (std)	Market Shares Mean in %
Outside Good			66.2
Soft Drinks		0.82 (0.25)	33.8
	Regular products	0.78 (0.26)	80.8
	Diet products	0.92 (0.16)	19.2
	National brands	0.93 (0.153)	73.1
	Private labels	0.47 (0.13)	26.9

retailer is defined as the ratio of the sum of purchases of the brand in the selected retailer during a period of four weeks and the sum of purchases of all brands in all retailers in the relevant market during the same period. In this setting, the outside option represents 66% of the whole market and is composed of the purchases of fruit juice and nectar (40% of the market) as well as purchases of other soft drinks or purchases of the considered soft drinks in non considered retailers (26% of the market).

As shown on Table 1, the average price over all products and all periods is 0.82 euros per liter. Regular products dominates as they represent about 80% of soft drinks purchases; their prices is 15% lower than prices of diet products. PLs hold about 27% of the market of soft drinks and are sold at about half of the price of NBs.

Average NB prices vary from 0.74 to 1.12 €/l while PL prices range from 0.38 to 0.54 €/l. Market shares of retailers are also heterogenous and vary from 2% to 20%. On average, prices in the different retailers are similar except for two retailers which sell at significant lower prices because a large share of their sales comes from private labels.

4 Models and methods

To analyze strategic pricing in food chain, we follow the general methodology recently developped to analyse vertical relationships between manufacturers and retailers (e.g. Berto Villas-Boas, 2007; Bonnet and Dubois, 2010). We first consider a demand model to get price elasticities of demand for every product. The model needs to be as flexible as possible and we opt for a random coefficients logit model (Berry et al., 1995; McFadden and Train, 2000). As strategic pricing in the channel can be modified by the nature of contracts between firms of the sector we design alternative models of vertical relationships between processors and retailers. From the first order conditions characterizing each model of vertical relationship and estimates of demand, we are able to calculate price cost margins for manufacturers and retailers from which we deduce cost estimates. To choose the model of vertical relationship that best fits the data, we estimate a cost model where calculated cost from each vertical relationship model is the endogenous variable and then use a non nested Rivers and Vuong (2002) test to select the best model. Finally, using the selected model, we simulate the impact on consumers prices and consumption of policies. The reader will find much more explanations in Bonnet and Dubois (2010) about the details of the methods.

4.1 The Demand Model: a random coefficients logit model

We use a random-coefficients logit model to estimate the demand model and elasticities. The indirect utility funtion V_{ijt} for consumer i buying product j in period t is given by

$$V_{ijt} = \beta_j + \gamma_t - \alpha_i p_{jt} + \rho_i l_j + \sum_{k=1}^{2} \tau_{ik} c_{k(j)} + \xi_{jt} + \varepsilon_{ijt}$$

where β_j are product fixed effects which capture the (time invariant) unobserved product characteristics, γ_t are time fixed effects which capture time demand shocks, p_{jt} is the price of product j in period t and α_i the marginal disutility of price for consumer i, l_j is a dummy related to an observed product characteristic (which takes 1 if product j is a diet product and 0 otherwise) and ρ_i captures consumer i's taste for the diet characteristic, $c_{k(j)}$ is a dummy that takes 1 if product j belongs to product category k and τ_{ik} represent the consumer i's taste for category k, ξ_{jt} captures the unobserved variation in the product characteristics and ε_{ijt} is an unobserved individual-specific error term.

We assume that α_i, ρ_i and the τ_{ik} vary across consumers. Indeed, consumers may have a different price disutility or different tastes for the diet characteristic or for categories of products considered. We assume their distributions are independent and parameters have the following specification:

$$\begin{pmatrix} \alpha_i \\ \rho_i \\ \tau_{i1} \\ \tau_{i2} \end{pmatrix} = \begin{pmatrix} \alpha \\ \rho \\ \tau_1 \\ \tau_2 \end{pmatrix} + \Sigma v_i$$

where $v_i = (v_i^{\alpha}, v_i^{\rho}, v_i^{\tau_1}, v_i^{\tau_2})'$ a 4x1 vector which captures the unobserved consumers characteristics. Σ is a 4×4 diagonal matrix of parameters $(\sigma_\alpha, \sigma_\rho, \sigma_{\tau_1}, \sigma_{\tau_2})$ that measure the unobserved heterogeneity of consumers. We suppose that $P_v(.)$ is a parametric distribution of v_i.

We can break down the indirect utility given by $V_{ijt} = \delta_{jt} + \mu_{ijt} + \varepsilon_{ijt}$.into a mean utility δ_{jt} and a deviation from this mean utility μ_{ijt}.

The consumer may decide not to choose one of the products considered. Thus, we introduce an outside option allowing for substitution between the considered products and a substitute. The utility of the outside good is normalized to zero. The indirect utility of choosing the outside good is $V_{i0t} = \varepsilon_{i0t}$.

Assuming that ε_{ijt} is independently and identically distributed like an extreme value type I distribution, we are able to write the market share of product j at period t in the following way (Nevo, 2001) :

$$s_{jt} = \int_{A_{jt}} \left(\frac{\exp(\delta_{jt} + \mu_{ijt})}{1 + \sum_{k=1}^{J_t} \exp(\delta_{kt} + \mu_{ikt})} \right) dP_\nu(\nu) \tag{1}$$

where A_{jt} is the set of consumers who have the highest utility for product j in period t, a consumer is defined by the vector $(\nu_i, \varepsilon_{i0t}, ..., \varepsilon_{iJt})$. We assume that P_ν is independently and normally distributed with mean α, ρ, τ_1, τ_2, and standard deviation σ_α, σ_ρ, σ_{τ_1}, σ_{τ_2} respectively.

4.2 Supply models: vertical relationships between processors and retailers

The economic literature has extensively explored vertical relationships between manufacturers and retailers (e.g. Rey and Vergé, 2004). In food retailing, upstream and downstream industries are highly concentrated and it is well known that with chain of oligopolies linear contracts are not efficient as the profit of the chain is not maximised. Indeed, this provides incentives to agents to design more sophisticated contracts such as non linear contracts. In the empirical literature, it is only recently that two-part tariffs were integrated in the analysis (Berto Villas-Boas, 2007; Bonnet and Dubois, 2010). In this paper, we consider both linear pricing, and a set of two part-tariffs contracts where processors have all bargaining power.[3] The general framework of vertical relationships is described by the following game:

- stage 1: Manufacturers propose simultaneously take-it or leave-it contracts to retailers; depending on the supply model, we define only the wholesale price if we assume linear contract, or both a fixed fee and wholesale price in case of two part tariffs, and finally we specify consumer price in addition to the fixed fee and wholesale price for contracts including resale price maintenance;

[3] This primarily affects how profits are shared (through the fixed fees) rather than the choices of prices which is what is studying here. According to Rey and Vergé (2004), equilibrium prices would be the same if retailers have all bargaining power.

- stage 2: Retailers simultaneously accept or reject the offers which are public information. If a retailer rejects one offer, he gets his outside option which is either a positive fixed value if private labels are not acknowledged or the profit coming from private labels otherwise;

- stage 3: Retailers set consumer prices.

The general methodology is as follows. The profit of retailer r is given by:
$\Pi^r = \sum_{j\in S_r}[M(p_j - w_j - c_j)s_j(p) - F_j]$ where M is the size of the market, S_r the set of products that retailer r sells, w_j and p_j the wholesale and retail prices of product j, $s_j(p)$ the market share of product j and c_j the constant marginal cost to distribute product j. In the specific case of private labels, we assume that they are sold to retailers at marginal cost by the producing firms. Assuming price competition among retailers and assuming the existence of the equilibrium, the first-order conditions are given by:

$$s_j + \sum_{k\in S_r}[(p_k - w_k - c_k)]\frac{\partial s_k}{\partial p_j} = 0 \quad \forall j \in S_r, \qquad \text{for } r = 1, ..., R \tag{2}$$

These are standard conditions defining the Bertrand-Nash equilibrium of the third stage of the game. These conditions are valid whatever manufacturers propose linear prices or two-part tariffs.[4]

In the following we focus on two-part tariffs, as the linear case is now well known (refer to Sudhir, 2001; Berto Villas-Boas, 2007; Bonnet and Dubois, 2010). Let define μ_j the constant marginal cost to produce product j and G_f the set of products sold by manufacturer f. The manufacturer maximizes its profit $\Pi^f = \sum_{j\in G_f}[M(w_j - \mu_j)s_j(p) + F_j]$ subject to the participation constraints of each retailer, i.e. for all $r = 1, .., R$, $\Pi^r \geq \sum_{j\in \widetilde{S}_r} M(\widetilde{p}_j^r - w_j - c_j)s_j(\widetilde{p}^r)$ where $\widetilde{S}_r$ is the set of private labels belonging to retailer r and $\widetilde{p}^r = (\widetilde{p}_1^r, ..., \widetilde{p}_J^r)$ is the vector of prices when retailer r sells only its private labels. By convention, we have $\widetilde{p}_j^r = +\infty$ for all brands sold by retailer r except for private labels. The vector of market shares $s(\widetilde{p}^r)$ thus corresponds to market shares when retailer r sold only his private labels.

Manufacturers can adjust franchise fees such that all constraints are binding. Using the participation constraint of retailer r allows us to re-write the profit of manufacturer f as

$$\Pi^f = \sum_{j\in G_f} M(w_j - \mu_j)s_j(p) + \sum_{j=1}^{J} M(p_j - w_j - c_j)s_j(p) - \sum_{r=1}^{R}\sum_{j\in \widetilde{S}_r} M(\widetilde{p}_j^r - w_j - c_j)s_j(\widetilde{p}^r) - \sum_{j\notin G_f} F_j$$

The profit of a manufacturer is no longer a function of the fixed fees attached to his own products. Rather his profit depends on the fixed fees set by the other manufacturers. Everything happens as if the manufacturer chooses only either wholesale prices (no resale price maintenance) or consumer prices (resale price maintenance).

Here we only present the case where manufacturers can use resale price maintenance in their contracts with retailers. In this case, profit maximisation of the manufacturer's program lead to the following first order conditions

$$\sum_{j\in G_f}(w_j - \mu_j)\frac{\partial s_j(p)}{\partial p_k} + s_k(p) + \sum_{j=1}^{J}(p_j - w_j - c_j)\frac{\partial s_j(p)}{\partial p_k} - \sum_{r=1}^{R}\sum_{j\in \widetilde{S}_r}(\widetilde{p}_j^r - w_j - c_j)\frac{\partial s_j(\widetilde{p}^r)}{\partial p_k} = 0 \quad \forall j \in G_f, \qquad \text{for } f = 1, ..., N_f \tag{3}$$

The above conditions only apply for NBs. For PLs, retailers maximize their profit with respect to the retail prices of PLs: $\max_{\{p_k\}_{k\in \widetilde{S}_r}} \sum_{j\in \widetilde{S}_r}(p_j - \mu_j - c_j)s_j(p) + \sum_{j\in S_r\setminus \widetilde{S}_r}(p_j^* - w_j - c_j)s_j(p^*)$ where p_j^* stands for

[4] With resale price maintenance, it is manufacturers who determine consumer prices of national brands. Retailers have only a strategic role in setting prices of private labels. Then, the FOC defined only apply for the subset of private labels retailer r distributes.

the price of NBs choosen by manufacturers. Thus, for PLs, additional equations are obtained from the first order conditions of the profit maximization of retailers which both produce and retail these products:

$$\sum_{j\in\widetilde{S}_r}(p_j-\mu_j-c_j)\frac{\partial s_j(p)}{\partial p_k}+s_k(p)+\sum_{j\in S_r\setminus\widetilde{S}_r}(p_j^*-w_j-c_j)\frac{\partial s_j(p^*)}{\partial p_k}=0 \quad \forall j\in\widetilde{S}_r, \quad \text{for } r=1,...,R \tag{4}$$

Basically, the system of equations 3 and 4 characterises the equilibrium which depends on the structure of the industry at the manufacturer and retailer levels and the demand shape. It should be noted that, because wholesale and retail margins cannot be identified in this system, it will be needed to have additional assumptions on the margins.

4.3 Cost specification and testing between alternative models

Once the demand model is estimated and for each model of vertical relationship, price-cost margins are estimated. We thus obtain estimated costs $C_{jt}^h = p_{jt} - \Gamma_{jt}^h - \gamma_{jt}^h$ for each product j in period t for any supply model h, where $\Gamma_{jt}^h = w_{jt}^h - \mu_{jt}^h$ is the margin of manufacturer on product j and $\gamma_{jt}^h = p_{jt}^h - w_{jt}^h - c_{jt}^h$ is the margin of retailer on product j. We specify a fixed effects model for estimated marginal costs and assume it takes the following specification:

$$C_{jt}^h = \sum_{k=1}^{K}\lambda_k^h W_{jt}^k + w_j^h + w_{jy(t)}^h + \tau_t^h + \eta_{jt}^h$$

where W_{jt} is a vector of inputs, w_j^h represents product fixed effects for model h, $w_{jy(t)}^h$ allows to differentiate the product fixed effect for product j across years and τ_t^h is a monthly fixed effect for model h. We suppose that $E(\eta_{jt}^h|W_{jt}', w_j^h, w_{jy(t)}^h, \tau_t^h) = 0$ in order to identify and estimate consistently $\lambda_k^h, w_j^h, w_{jy(t)}^h$ and τ_t^h. To be consistent with the economic theory Gasmi et al. (1992), we impose the positivity of parameters λ_k^h and use a non linear least square method to estimate them. We use this cost function specification to test any pair of supply models C_{jt}^h and $C_{jt}^{h'}$ and infer which model is statistically the best using a non nested Rivers and Vuong test.

4.4 Simulations

Using the estimated marginal costs from the preferred model of contracts in the vertical chain as well as the other estimated structural parameters, one can simulate the policy experiments of interest. We denote $C_t = (C_{1t}, .., C_{jt}, .., C_{Jt})$ the vector of marginal costs for all products present in period t, where C_{jt} is given by $C_{jt} = p_{jt} - \Gamma_{jt} - \gamma_{jt}$. To model the impact of a change in sugar price, we have to solve the following program:

$$\min_{\{p_{jt}^*\}_{j=1,..,J}} \left\| p_t^* - \Gamma_t(p_t^*) - \gamma_t(p_t^*) - \widetilde{C}_t \right\|$$

where $\|.\|$ is the euclidean norm in $\mathbb{R}^J$, γ_t and Γ_t correspond respectively to the expression of retail and wholesale margins for the best supply model and $\widetilde{C}_t$ is the vector of marginal cost estimated using the new sugar price.

Table 2: **Results of the random-coefficients logit model.**

Coefficients (Std. error)	Mean	Standard Deviation
Price	-7.04(0.41)	2.35 (0.43)
Diet	0.52 (0.02)	0.26 (0.23)
Soda category	1.90 (0.02)	2.96 (0.45)
Ice tea category	-0.71 (0.02)	2.89 (0.59)
Coefficients δ_j, γ_t not shown		
Overidentifying Restriction Test (df)	19.43 (15)	

5 Results on demand and vertical relationships

5.1 Demand results

We estimated the random coefficients logit model using the well-known GMM method proposed by Berry et al. (1995), Nevo (2000) and Nevo (2001). This method requires the use of a set of instruments to solve an omitted variables problem. Indeed, prices may be correlated with the error term of demand equations as unobserved characteristics included in the error term might be correlated with prices (e.g. advertising, promotions). In order to get unbiased price effects, we choose instruments affecting the marginal cost curve. In practice, we use input price indexes of wages, plastic, aluminium, sugar and gazole as it is unlikely that input prices are correlated with unobserved demand determinants. These variables are interacted with manufacturers dummies because we expect that manufacturers obtain from suppliers different prices for raw materials.

Table 2 shows results of the demand model estimates by GMM. The overidentifying restriction test is not rejected which means that instruments are valid. On average, the price has a significant and negative impact on utility. Given the value of the price standard deviation, only 0.1% of the distribution of the price coefficient is positive. The coefficient of the dummy identifying diet products is positive on average meaning that consumers like this characteristic. Whereas the soda category is prefered to the fruit drink category, consumers prefer fruit drinks to ice teas. However, standard deviations for both categories are large meaning that some consumers prefer them and some others do not prefer.

From the structural demand estimates, we compute own and cross-price elasticities for each differentiated products (Table 3). Own-price elasticities of demand for a brand vary between -1.66 and -5.66 and is -4.13 on average. A key result is that demand for regular products is less elastic than demand for diet products (diet products are brands 2, 4, 6 and 9). Indeed, mean own-price elasticity of demand for regular brands is about -3.93 while it is about -4.65 for diet brands, these means are statistically different. These results are in line with those obtained by other studies of the soft drink market in the US, specially if one takes into account the way brands are defined. Thus, price elasticity of demand for a 'product' does depend on the definition of the product. A priori, the more brands are distinguished in the analysis the higher the elasticity of a single brand. Gasmi et al. (1992) estimate own price elasticities to -2 for Coca-Cola and Pepsi-Cola. Using a higher level of disagregation (about 20 brands) for the US market, Dube (2005) found elasticities ranging from -3 to -6 in the Denver area.

The analysis of cross-price elasticities among products in a given retailer reveals that all products are substitute as all cross-price elasticities are positive. Substitutions are mainly among products in same categories.

Table 3: **Own and Cross Price Elasticities between Brands within the same Retailer**

	Brand1	Brand2	Brand3	Brand4	Brand5	Brand6	Brand7	Brand8	Brand9	Brand10	Brand11	Brand12	Brand13	Brand14
Sugar	R	D	R	D	R	D	R	R	D	R	R	R	R	R
Categ.	1	1	1	1	2	2	3	3	3	3	3	1	2	3
Brand1	-4.4514	0.0141	0.0077	0.0076	0.0012	0.0011	0.0013	0.0013	0.0014	0.0014	0.0014	0.0184	0.0020	0.0024
Brand2	0.0180	-4.4510	0.0140	0.0145	0.0021	0.0021	0.0025	0.0023	0.0027	0.0026	0.0026	0.0229	0.0026	0.0032
Brand3	0.2370	0.2341	-4.6570	0.2287	0.0394	0.0372	0.0479	0.0470	0.0483	0.0488	0.0486	0.2512	0.0388	0.0472
Brand4	0.0991	0.1038	0.0976	-4.8877	0.0165	0.0167	0.0213	0.0210	0.0230	0.0215	0.0215	0.1040	0.0161	0.0203
Brand5	0.0077	0.0073	0.0083	0.0081	-4.8089	0.1392	0.0189	0.0195	0.0190	0.0177	0.0180	0.0055	0.1124	0.0137
Brand6	0.0015	0.0015	0.0016	0.0016	0.0284	-4.9310	0.0039	0.0040	0.0042	0.0036	0.0037	0.0010	0.0229	0.0028
Brand7	0.0070	0.0069	0.0080	0.0084	0.0158	0.0157	-4.3426	0.0316	0.0298	0.0272	0.0279	0.0043	0.0093	0.0192
Brand8	0.0079	0.0078	0.0092	0.0097	0.0189	0.0190	0.0366	-4.4429	0.0361	0.0323	0.0333	0.0045	0.0103	0.0215
Brand9	0.0044	0.0047	0.0051	0.0056	0.0099	0.0109	0.0187	0.0196	-4.3680	0.0172	0.0176	0.0027	0.0059	0.0121
Brand10	0.0064	0.0064	0.0071	0.0074	0.0129	0.0130	0.0239	0.0244	0.0238	-4.0948	0.0230	0.0046	0.0089	0.0177
Brand11	0.0039	0.0039	0.0044	0.0045	0.0080	0.0081	0.0150	0.0155	0.0151	0.0141	-4.1880	0.0026	0.0053	0.0108
Brand12	0.0334	0.0337	0.0134	0.0127	0.0013	0.0013	0.0013	0.0012	0.0013	0.0016	0.0016	-2.7464	0.0038	0.0044
Brand13	0.0033	0.0032	0.0025	0.0024	0.0354	0.0357	0.0035	0.0033	0.0036	0.0038	0.0037	0.0037	-3.3226	0.0058
Brand14	0.0068	0.0068	0.0058	0.0059	0.0085	0.0085	0.0146	0.0141	0.0147	0.0152	0.0151	0.0066	0.0096	-2.9183
R means regular; D means diet														

5.2 Prefered model, price-cost margins and cost estimates

Thanks to demand estimates, we compute price cost margins for each supply model. On the basis of Rivers and Vuong tests (results not shown) the best supply model is the model where manufacturers and retailers use two part tariffs contracts with resale price maintenance[5], and where private labels have no strategic role in the manufacturer-retailer relationships. It is coherent with the idea that in this industry brands are strong thus providing market power to upstream producers. According to these results, price cost margins are 45.3% of consumer price on average. Average price-cost margins for PLs (38.65%) are significantly lower than for NBs (47.4%). Price-cost margins for diet brands (49.5%) are significantly higher than for regular products (43.6%). Price cost margins do not differ across retailers except for retailer 8 and 9 which are 'hard discounters' and sell mostly their own brands. Estimated marginal cost calculated from the best supply model is 0.45€/litre on average. Average marginal cost of PLs (0.30€/litre) is lower than NBs (0.50€/litre).

6 Impact of the sugar policy reform

We simulate the impact of a significant decrease in the EU sugar price. Thus, over the last 20 years, the sugar price in the European Union was well above the world market price. However, in February 2006 a reform of the EU sugar policy was introduced which would lead to a significant decrease in the EU sugar price (Européenne, 2006). The reference price, which roughly acts as a floor price, would be reduced by 36% over a 4-year period starting in 2006.[6]

In line with the anticipated impact of the reform of the EU sugar policy, we simulate a 36 % decrease in the sugar price. Using the estimated marginal cost specification for the best supply model, we find a 2.52

[5] Resale price maintenance (RPM) is prohibited by competition authorities. However, in France, specific laws on the retail industry led to a situation where RPM was in practice possible to implement (?).

[6] The reference price for white sugar was 631.9€/t from 1 July 2006 to 30 September 2008. It was 541.5€/t from 1 October 2008 to 30 September 2009 and 404.4€/t after 1 October 2009. By comparison, in 2007, the average world market price of sugar was about 310€/t. (http://ec.europa.eu/agriculture/minco/manco/cmo/index.htm)

Table 4: **Impact of a decrease in the sugar price**

	Change in cost in % Mean (std)	Change in price in % Mean (std)	Pass-through $\triangle p/\triangle c$ Mean (std)	Change in MS in % Mean (std)
Brand 1	-10.69 (3.21)	-4.45 (0.59)	1.09 (0.02)	11.20 (1.49)
Brand 2	–	0.83 (0.12)	-	-12.06 (0.90)
Brand 3	-7.08 (0.69)	-3.55 (0.19)	1.09 (0.02)	9.15 (1.10)
Brand 4	–	0.74 (0.08)	-	-11.44 (0.81)
Brand 5	-3.34 (0.35)	-2.05 (0.18)	1.07 (0.03)	3.62 (0.83)
Brand 6	–	0.57 (0.10)	-	-8.92 (0.81)
Brand 7	-4.05 (0.51)	-2.78 (0.26)	1.16 (0.03)	7.66 (0.92)
Brand 8	-4.22 (0.34)	-3.12 (0.18)	1.23 (0.04)	9.71 (0.75)
Brand 9	–	0.66 (0.06)	-	-7.47 (0.85)
Brand 10	-5.07 (0.52)	-3.27 (0.24)	1.13 (0.03)	9.18 (0.74)
Brand 11	-5.27 (0.60)	-3.55 (0.27)	1.16 (0.03)	10.80 (0.83)
Brand 12	-14.55 (0.75)	-7.65 (2.31)	1.05 (0.02)	10.62 (3.97)
Brand 13	-6.66 (3.24)	-4.21 (1.07)	1.08 (0.02)	7.64 (0.90)
Brand 14	-8.20 (2.38)	-5.61 (0.95)	1.12 (0.01)	12.70 (1.30)

€ cents (or 7.09%) decrease in the total marginal cost of regular soft drinks. An estimate which is close to what is obtained from accounting calculation (about 2 € cents). The percent decrease varies across brands (Table 4) because both sugar content and marginal cost differ across brands. Thus, marginal cost of PLs is lower than marginal cost of NBs partly explaining the larger percent decrease in marginal cost of PLs.

On average, in response to the price cut, consumer price decreases by 4.15% for regular products. The percent price decrease for PLs is larger as they are cheaper than NBs. For regular products the pass-through, measured by the ratio of the difference in retail prices over the difference in marginal costs, is 1.11 on average. Therefore, if the marginal cost decreases by 1 cent the retail price decreases on average by 1.1 cents. The industry overshifts the cost decrease. This result is consistent with the supply model. Indeed, using two part-tariffs contracts with resale price maintenance allows the industry to behave non competitively. Moreover, **?** show that a monopoly producer facing several retailers can use this type of contract to implement the monopoly situation. The pricing rule of monopoly might lead to a pass-through larger than 1 as in our empirical results. This result is also consistent with the analysis of Campa and Goldberg (2006) who found that pass-through rates in the food industry in France are larger than one (1.41). Besley and Rosen (1999) also found, in the US case, that the soft drink industry overshifts tax changes.

The pass-through varies by brand, meaning that taking into account strategic behavior of differentiated products is important. It should be acknowledged that the model integrates the brand portfolio of the manufacturers. Thus a manufacturer chooses his pricing policy for the whole set of products, internalising substitution among his own set of products. The price of diet products does not change significantly; their price increases by less than 1% that is about 1€ cent. As a result of these strategic reactions, the aggregate market share of regular products increases by 9.3% which comes from substitution with diet products whose market share decreases by 10% as well as with the outside option whose market share decreases by 3.2%.[7]

Most studies on food taxation argue assuming passive pricing rather strategic pricing provide an upper bound of the impact of the simulated tax. For each policy scenario, we estimated the change in

[7] The price of the outside option is assumed to be unchanged as a significant part of the goods in the outside option will not be affected by the decrease in the sugar price.

Table 5: **Changes in SSB consumption (litre per person per year)**

	Passive pricing	Strategic pricing
Regular products	1.36 (0.05)	1.56 (0.06)
Diet products	-0.29 (0.00)	-0.43 (0.00)

consumption under passive and strategic pricing. With strategic pricing the changes in consumption are larger (Table 5). The claim that passive pricing provides an upper bound is thus not verified. That claim is valid only when pass-through is lower than one. However, given the way the industry behaves pass-through is larger than 1. For regular products, ignoring strategic pricing leads to under-estimate the change in consumption by 15%. For diet products, the under-estimate reaches 50%.

7 Conclusion

As links between food intake and health are more and more recognised, there is a growing interest in the ex ante analysis of the health impacts of alternative food price policies. A frequently used methodology consists in a two-stage procedure which combines first a demand model and then a health model, meaning that assessing the impact on food consumption of simulated policies is an essential step in this methodology. Most of demand analyses assume that producers fully transmit to consumers the tax or subsidy, they then make the standard assumption of passive pricing. Some of them argue whether the change is not fully transmitted, the analysis then provides an upper bound of the impact on consumption. The case of over transmission is not taken into account.

This paper provides a general methodology for assessing impacts of price policies on the food consumption taking into account pricing strategies of both manufacturers and retailers in the food chain. As an example, we analyze the impact of a change in sugar price or a change in the level of taxation of those products in the soft drink industry. Using the recent development of empirical industrial organization, we have estimated a very flexible demand model, a random coefficients logit model, and several models of vertical relationships of the industry. We have shown that the most likely supply model is the one where manufacturers and retailers use two-part tariffs contracts with resale price maintenance and where private labels play no role in manufacturer/retailer relationships, meaning that manufacturers have a large market power. Using this model, we have simulated the impact on prices of a decrease in sugar price taking into account the strategic choice of agents. We have shown that the pass-through was larger than 1 in average, the industry would then transmit to consumers more than the change in input cost. In particular, we showed that ignoring strategic pricing would lead to under-estimate the change in consumption by 15% for regular products and by 50% for diet products. We thus conclude that when analysing food price policies, it is needed to take into account strategic pricing.

In a longer run, producers might also adapt the composition of their products to taxations or subsidies put in place. For example, if sweetened products are taxed according to their sugar content, this might provide incentives to producers to lower the sugar content of their product in order to avoid or limit the impact of taxes. Dealing with such an issue requires additional information on the composition of products, as well as integrating a choice of quality by producers. An issue which as far as we know is not integrated in the empirical models of industrial organization and then in analysis of public health policies.

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