Non linear contracting and endogenous buyer power between manufacturers and retailers: empirical evidence on food retailing in France

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Non Linear Contracting and Endogenous Buyer Power between Manufacturers and Retailers : Empirical Evidence on Food Retailing in France

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Résumé

We present the first empirical estimation of a structural model taking into account explicitly the endogenous buyer power of downstream players facing two part tariffs contracts offered by the upstream level. We consider vertical contracts between manufacturers and retailers where resale price maintenance may be used with two part tariffs and allow retailers to have some endogenous buyer power from the horizontal competition of manufacturers. Our contribution allows to recover price-cost margins at the upstream and downstream levels as well as fixed fees of two-part tariffs contracts in these different structural models using the industry structure and estimates of demand parameters. We apply it to the market of bottled water in France, estimating a mixed logit demand model on individual level data. Empirical evidence shows that two part tariffs contracts are used with no resale price maintenance and that the buyer power of supermarket chains is endogenous to the structure of manufacturers competition.

Key words : vertical contracts, two part tariffs, endogenous buyer power, double marginalization, competition, manufacturers, retailers, differentiated products, water, mixed logit, non nested tests.

JEL codes : L13, L81, C12, C33

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1 Introduction

Many industries present horizontal and vertical oligopoly structures where upstream sellers deal with downstream buyers. This is particularly the case on markets where manufacturers sell their products through retailing chains, for example for most processed food items in supermarkets. These vertical relationships matter considerably for the final price setting by retailers, for competition analysis and market power estimation. The nature of contracts and the sharing of bargaining power in the vertical chain are then important determinants of equilibrium outcomes.

This paper proposes a first empirical estimation of a structural model taking into account explicitly the endogenous buyer power of downstream players facing two part tariffs contracts offered by the upstream level. We consider vertical contracts between manufacturers and retailers where resale price maintenance may be used with two part tariffs and we allow retailers to have some endogenous buyer power coming from the horizontal competition of manufacturers. Using industry structure and estimates of demand parameters, our contribution allows to recover price-cost margins at the upstream and downstream levels as well as fixed fees of two part contracts in these different structural models.

Recent works in empirical industrial organization have started taking into account the strategic behavior of retailers in the vertical chain as intermediaries between upstream producers and consumers. As information on wholesale prices, on marginal costs of production or distribution, and on vertical restraints are generally difficult to observe, methods often rely on demand side data and require structural modelling of the supply side. Usual empirical industrial organization methods propose to address the estimation of price-cost margins with the estimation of structural models of competition on differentiated products markets such as cars, computers, breakfast cereals, beer (Berry, 1994, Berry, Levinsohn and Pakes, 1995, Nevo, 1998, 2000, 2001, Pinkse and Slade, 2004, Slade, 2004, Ivaldi and Martimort, 2004, Ivaldi and Verboven, 2005, Dubois and Jodar-Rosell, 2010) and recent research studies identification with relaxed assumption on strategic behavior (Rosen, 2007, Pakes, Porter, Ho and Ishii, 2006). Until recently, most papers in this literature assumed

that retailers act as neutral pass-through intermediaries or charge exogenous constant margins as if manufacturers directly set consumer prices. Chevalier, Kashyap and Rossi (2003) showed the important role of distributors on prices and the strategic role of retailers has been recently emphasized in the economics and marketing empirical literatures. While each paper having its own focus, a stream of research followed with an explicit consideration of the strategic roles of retailer, for example : Goldberg and Verboven (2001), Manuszak (2001), Mortimer (2008), Ho (2006), Ho, Ho and Mortimer (2008), Sudhir (2001), Villas-Boas and Zhao (2004), Asker (2005), Villas-Boas (2007), Hellerstein (2008), Meza and Sudhir (2009), Bonnet and Dubois (2010). In particular, Sudhir (2001) considers the strategic interactions between manufacturers and a single retailer on a local market and focuses on a linear pricing model leading to double marginalization. Meza and Sudhir (2009) study how private labels affect the bargaining power of retailers. Ho (2006) studies the welfare effects of vertical contracting between hospitals and health maintenance organizations in the US. Ho (2009) looks at the role of managed care health insurers on the choice of hospitals using the inequality framework of Pakes, Porter, Ho and Ishii (2006). Asker (2005) considers the role of foreclosure in the strategic choices of vertical contracts on the beer market. Hellerstein (2008) explains imperfect pass-through again in the beer market. Manuszak (2001) studies the impact of upstream mergers on retail gasoline markets using a structural model allowing downstream prices to be related to upstream price mark-ups and wholesale prices chosen by upstream gasoline refineries. Hellerstein and Villas-Boas (2010) study the role of foreign outsourcing on the pass-through rate of upstream part suppliers in the automobile industry. Villas-Boas (2009) studies the effects of a ban on wholesale price discrimination on the German coffee market. Bonnet, Dubois and Villas-Boas (2010) study the effects of vertical restraints, and in particular of non linear contracts with resale price maintenance, on the cost pass through of the world market price of coffee on retail prices in Germany.

These recent developments introducing retailers' strategic behavior consider mostly cases where competition between producers and/or retailers remains under linear pricing (like in Sudhir, 2001,

Brenkers and Verboven, 2006) and vertical contracts are quite simple. Villas-Boas (2007) considers the possibility that vertical contracts between manufacturers and retailers make pricing strategies depart from double marginalization by setting alternatively wholesale margins or retail margins to zero. Bonnet and Dubois (2010) extends the analysis modelling explicitly two-part tariffs contracts with or without resale price maintenance, but assuming that the bargaining power between manufacturers and retailers is exogenously fixed.

However, the consideration of endogenous buyer power within a vertical relationship coming from horizontal competition at the upstream level has never been taken into account. Here, we allow retailers to benefit from some endogenous buyer power when facing manufacturers contracts offers. The endogenous buyer power comes from the available competing offers by other manufacturers that can be used as outside options by retailers in addition to the explicit consideration of profits that retailers can always entail from their private label own brands.

We show how we can identify and estimate price-cost margins at the retailer and manufacturer levels under the different competition scenarios considered without observing marginal costs and wholesale prices. Modelling explicitly optimal two part tariffs contracts (with or without resale price maintenance) allows to recover the pricing strategy of manufacturers and retailers. We do not only recover the total price-cost margins as functions of demand parameters but also the division of these margins between manufacturers and retailers under some additional assumptions on the cost structure allowing to estimate unobserved wholesale prices. Using non nested test procedures as in Bonnet and Dubois (2010), we can test between the different models using restrictions on marginal costs or exogenous variables that shift the marginal costs of production and distribution. Besides that fact that we use more recent data than Bonnet and Dubois (2010), we use more flexible demand model and estimate a model with "endogenous" retailer buyer power which happens to lead to very different outcomes.

We apply our modelling to the bottled water market in France using estimates of a mixed logit demand model on individual level data. Empirical evidence shows that two part tariffs contracts

are used with no resale price maintenance and that the buyer power of supermarket chains is endogenously determined by the offers of the multiple manufacturers. This market presents a high degree of concentration both at the manufacturer and retailer levels. It is to be noted that it is actually even more concentrated at the manufacturer level with only three large manufacturers than at the retailer level where we have in France seven large retailing chains.

In section 2, we first present some stylized facts on the bottled water market in France, an industry where the questions of vertical relationships and competition of manufacturers and retailers seem worth studying. Section 3 describes the main methodological contribution on the supply side. We show how price-cost margins can be recovered with demand parameters, with the industry structure and different assumptions on vertical contracts. Section 4 presents the demand model, its identification and estimation method on individual data as well as the methodology developed to test between the different models. In section 5, we discuss the empirical results and tests. Section 6 concludes and some appendices follow.

2 The Bottled Water Market in France

2.1 Stylized Facts

The bottled water market is an important sector of the French food processing industry : 68.2 billion liters were sold in 2006 (Agreste, 2009). It is also a highly concentrated sector since the three main producers (Nestlé Waters, Danone, and Castel) share 90% of the total production of the sector. Two types of water coexist, namely, natural mineral water and spring water. The denomination of "natural mineral" water is officially recognized by an agreement from the French Ministry of Health and puts forward properties favorable to health. Composition must be guaranteed as well as the consistency of a set of qualitative criteria : mineral content, visual aspects, and taste. The exploitation of a "spring water" source requires a license provided by local authorities and an agreement of the local health committee but the water composition is not required to be constant. The differences between the quality requirements involved in the certification of these two kinds of water may explain part of the large differences that exists between the shelf prices of the mineral

water brands and the spring water brands. Moreover, mineral water brands are usually more national and highly advertised.

In France, households buy bottled water mostly in supermarkets (80% of total sales) and on average, these sales represent 1.7% of the total turnover of supermarkets, the bottled water shelf being one of the most productive. Manufacturers thus deal mainly their brands through retailing chains which are also highly concentrated on food retailing (the market share of the first five being around 80% of total food retailing). Since the late 90s, food retailing chains have developed private labels (also called store brands) and the increase in the number of private labels tends to be accompanied by a reduction of the market shares of the main national brands.

This market is thus very concentrated and competition concerns are usually put forward. Regulation of the food retailing and supermarket industry is quite important in France with strong rules on zoning and entry of supermarket stores (Bertrand and Kramarz, 2002, Jodar-Rosell, 2008) and also detailed rules about vertical contracting between manufacturers and retailers. On this last regulation, it has been shown in Bonnet and Dubois (2010), which studied the same market with aggregate data from 1998-2000, that resale price maintenance (RPM) with non linear vertical contracts seemed to explain the observed pricing. This evidence is consistent with the fact that the Galland act (introduced in 1996) prohibited resale at loss for retailers and defined the threshold level of prices from wholesale list prices not including any backward margins. Implementing RPM implicitly was then feasible with this regulation. Such concern led to the removal of the Galland act by the competition authority with a new law called the "Dutreil II" elaborated in 2005 and effective on January 2006. There is thus a policy interest in studying competition and pricing relationships after 2006 which is done in this paper in addition to estimating the demand on individual data and allowing endogenous buyer power for retailers.

2.2 Data and Variables

Our data were collected by the company TNS World Panel and consists of a survey on households' consumption in France using a home-scan technique. We use a representative sample of

French households for the year 2006 for which we have information on their purchases of all food products. The data provides a description of the main characteristics of the goods whose purchases are recorded over the whole year. We thus have quantity, price, brand, date and store of purchase. We use the information on all bottles of water purchased. For the purpose of estimation of our structural models, we will consider the purchases in the seven most important retailers which represent 70.9% of the total purchases of the sample. We take into account the most important brands, that is : five national brands of mineral water, one national brand of spring water, one retailer private label brand of mineral water and one retailer private label spring water. The purchases of these eight brands represent 69.3% of the purchases of the seven retailers. The national brands are produced by three different manufacturers : *Danone*, *Nestlé* and *Castel*. We consider all other non-alcoholic refreshing drinks as the outside good.

We consider eight brands sold in seven retailer chains, which gives 56 differentiated products. For each of these products, we compute an average price for each month using all observed purchases by households during the month. These prices are in euros per liter. Table 1 presents some first descriptive statistics on some of the main variables used.

Variable	Mean	Median	Std. dev.	Min.	Max
Price in €/liter	0.251	0.213	0.127	0.113	0.929
Price in €/liter : Mineral Water	0.369	0.359	0.034	0.200	0.929
Price in €/liter : Spring Water	0.148	0.134	0.034	0.113	0.313
Mineral water dummy (0/1)	0.66	1	0.47	0	1

Table 1 : Summary Statistics

We also use data from the French National Institute for Statistics and Economic Studies (IN-SEE) allowing to characterize supply side cost shifters in this industry with the plastic price, a wage salary index, and diesel oil prices.

3 Competition and Vertical Relationships Between Manufacturers and Retailers

We now introduce an oligopoly model with vertical relationships. As in Rey and Vergé (2010) and Bonnet and Dubois (2010), we consider linear pricing and two part tariffs contracts but allow

also retailers to benefit from some endogenous buyer power when facing manufacturers' offers.

Let's introduce the model considering R retailers and F multi-brand manufacturers. We denote J the number of differentiated products defined by the couple brand-retailer among which J' are manufacturer branded products and $J - J'$ are store brands (also called private labels). We denote by S_r the set of products sold by retailer r and by G_f the set of products produced by firm f.

3.1 Linear Pricing

As in Rey and Vergé (2010), Villas-Boas (2007), Bonnet and Dubois (2010), among others, we consider the game where manufacturers set wholesale prices first, and retailers follow by setting the retail prices. We obtain the usual double marginalization result. For private labels, prices are chosen by the retailer who bears both retailing and production costs. Using backward induction, we consider the retailer's problem who wants to maximize its profit denoted Π^r for retailer r and equal to

$$\Pi^r = \sum_{j \in S_r} (p_j - w_j - c_j) s_j(p)$$

where p_j is the retail price of product j sold by retailer r, w_j is the wholesale price paid by retailer r for product j, c_j is the retailer's (constant) marginal cost of distribution for product j, $s_j(p)$ is the market share of product j, p is the vector of retail prices of all products.

Remark that we normalized the profit by the population size which amounts to define profits as per household profit. Since we will take into account an outside good option denoted good 0, this normalization is equivalent as if we had used the total demand of each good instead of market shares.

Assuming that a pure-strategy Bertrand-Nash equilibrium in prices exists and that equilibrium prices are strictly positive, the price of any product j sold by retailer r must satisfy the first-order condition

$$s_j + \sum_{s \in S_r} (p_s - w_s - c_s) \frac{\partial s_s}{\partial p_j} = 0, \quad \text{for all } j \in S_r. \tag{1}$$

Now, we define I_r as the ownership matrix (size $(J \times J)$) of the retailer r that is diagonal and whose j^{th} element is equal to 1 if the retailer r sells product j and zero otherwise. Let S_p be the

market shares response matrix to retailer prices, containing the first derivatives of all market shares with respect to all retail prices, i.e.

$$S_p \equiv \begin{pmatrix} \frac{\partial s_1}{\partial p_1} & \cdots & \frac{\partial s_J}{\partial p_1} \\ \vdots & & \vdots \\ \frac{\partial s_1}{\partial p_J} & \cdots & \frac{\partial s_J}{\partial p_J} \end{pmatrix}$$

In vector notation, the first order condition (1) implies that the vector γ of retailer r's margins (rows corresponding to products not sold by r are set to zero), i.e. the retail price p minus the wholesale price w minus the marginal cost of distribution c, is[1]

$$\gamma \equiv p - w - c = -\left(I_r S_p I_r\right)^{-1} I_r s(p) \tag{2}$$

Remark that for private labels, this price-cost margin is in fact the total price-cost margin $p - \mu - c$ which amounts to replace the wholesale price w by the marginal cost of production μ in this formula.

Concerning the manufacturers' behavior, we assume they maximize profit choosing the wholesale prices w_j of their own products and given the retailers' response (1). The profit of manufacturer f is given by

$$\Pi^f = \sum_{j \in G_f} (w_j - \mu_j) s_j(p(w))$$

where μ_j is the manufacturer's (constant) marginal cost of production of product j. Assuming the existence of a pure-strategy Bertrand-Nash equilibrium in wholesale prices between manufacturers, the first order conditions are

$$s_j + \sum_{s \in G_f} \sum_{l=1,..,J} (w_s - \mu_s) \frac{\partial s_s}{\partial p_l} \frac{\partial p_l}{\partial w_j} = 0, \quad \text{for all } j \in G_f. \tag{3}$$

We denote I_f the ownership matrix of manufacturer f that is diagonal and whose j^{th} element is equal to one if j is produced by the manufacturer f and zero otherwise.

We introduce P_w the matrix $(J \times J)$ of retail prices responses to wholesale prices, containing

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[1] Abusing notations, we consider the generalized inverse when noting the inverse of non invertible matrices, which means that for example $\begin{bmatrix} 2 & 0 \\ 0 & 0 \end{bmatrix}^{-1} = \begin{bmatrix} 1/2 & 0 \\ 0 & 0 \end{bmatrix}$.

the first derivatives of the J retail prices with respect to the J' wholesale prices.

$$P_w \equiv \begin{pmatrix} \frac{\partial p_1}{\partial w_1} & .. & \frac{\partial p_J}{\partial w_{J'}} & .. & \frac{\partial p_J}{\partial w_1} \\ \vdots & & \vdots & & \vdots \\ \frac{\partial p_1}{\partial w_{J'}} & .. & \frac{\partial p_{J'}}{\partial w_{J'}} & .. & \frac{\partial p_J}{\partial w_{J'}} \\ .. & .. & .. & .. & .. \\ 0 & .. & 0 & .. & 0 \end{pmatrix}$$

Remark that the last $J - J'$ rows of this matrix are zero because they correspond to private label products for which wholesale prices have no meaning.

Then, we can write the first order conditions (3) in matrix form and the vector of manufacturer's margins is[2]

$$\Gamma \equiv w - \mu = -(I_f P_w S_p I_f)^{-1} I_f s(p) \tag{4}$$

The first derivatives of retail prices with respect to wholesale prices depend on the strategic interactions between manufacturers and retailers.

When we assume that retailers follow manufacturers in setting the retail prices given the wholesale prices, P_w can be deduced from the differentiation of the retailer's first order conditions (1) with respect to wholesale price, i.e. for $j \in S_r$ and $k = 1, .., J'$

$$\sum_{l=1,..,J} \frac{\partial s_j(p)}{\partial p_l} \frac{\partial p_l}{\partial w_k} - 1_{\{k \in S_r\}} \frac{\partial s_k(p)}{\partial p_j} + \sum_{l \in S_r} \frac{\partial s_l(p)}{\partial p_j} \frac{\partial p_l}{\partial w_k} + \sum_{l \in S_r} (p_l - w_l - c_l) \sum_{s=1,..,J} \frac{\partial^2 s_l(p)}{\partial p_j \partial p_s} \frac{\partial p_s}{\partial w_k} = 0 \tag{5}$$

where $1_{\{k \in S_r\}} = 1$ if $k \in S_r$ and 0 otherwise. Defining $S_p^{p_j}$ the matrix of the second derivatives of the market shares with respect to retail prices whose elements are :

$$S_p^{p_j} \equiv \begin{pmatrix} \frac{\partial^2 s_1}{\partial p_1 \partial p_j} & \cdots & \frac{\partial^2 s_J}{\partial p_1 \partial p_j} \\ \vdots & . & \vdots \\ \frac{\partial^2 s_1}{\partial p_J \partial p_j} & \cdots & \frac{\partial^2 s_J}{\partial p_J \partial p_j} \end{pmatrix},$$

we can write equation (5) in matrix form[3] :

$$I_r P_w = (I_r - \widetilde{I_r}) S_p' I_r \left[S_p I_r + I_r S_p' I_r + (S_p^{p_1} I_r \gamma | ... | S_p^{p_J} I_r \gamma) I_r \right]^{-1} \tag{6}$$

where $\gamma = p - w - c$, $\widetilde{I_r}$ is the ownership matrix of private labels of retailer r and $I_r - \widetilde{I_r}$ thus designates the ownership matrix of national brands by retailer r. Equation (4) shows that one can

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[2] Rows of this vector that correspond to private labels are zero.

[3] We use the notation $(a|b)$ for horizontal concatenation of a and b. The full matrix P_w can be obtained by summing over r these expressions.

express the manufacturer's price-cost margins vector $\Gamma = w - \mu$ as depending on the function $s(p)$ by replacing the expression (6) for P_w in (4).

3.2 Two-Part Tariffs and Endogenous Retail Buyer Power

We now consider the case where manufacturers and retailers can sign two-part tariffs contracts. As in Rey and Vergé (2010) and Bonnet and Dubois (2010), we assume that manufacturers make take-it-or-leave-it offers to retailers and characterize symmetric subgame perfect Nash equilibria. Rey and Vergé (2010) have proven the existence of equilibria under some assumptions on this multiple common agency game. These contracts consist in the specification of franchise fees and wholesale prices but also on retail prices in the case where manufacturers can use resale price maintenance. All offers are public[4] and retailers simultaneously accept or reject. Contrary to Bonnet and Dubois (2010), where it is assumed that if one offer is rejected then all contracts are refused and retailers obtain a fixed reservation utility, we allow the possibility that a retailer rejects a contract while accepting others. Once offers have been accepted, the retailers simultaneously set their retail prices, demands and contracts are satisfied.

We consider that two-part tariffs contracts are negotiated at the firm level and not by brand, which implies that manufacturers use bundling offers to retailers. This is likely to increase the market power of multiproduct manufacturers and reduce the buyer power of retailers which depends on the brand ownership structure of multiproduct manufacturers and on the presence of store brands owned by retailers. Retailers can then refuse a manufacturer's offers and accept those of other manufacturers but cannot refuse part of the brands offered by a manufacturer while accepting others owned by this same manufacturer.

The profit function of retailer r now writes :

$$\Pi^r = \sum_{s \in S_r} [(p_s - w_s - c_s)s_s(p) - F_s] \tag{7}$$

where F_s is the franchise fee paid by the retailer r for selling product $s \in S_r$ (negative if backward

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[4] This is a convenient benchmark case that can be justified in France by the nondiscrimination laws of the 1986 edict of free pricing which prevents the offer of different wholesale prices to purchasers who provide comparable services.

margins received by the retailer). The profit function of firm f is equal to

$$\Pi^f = \sum_{s \in G_f} [(w_s - \mu_s)s_s(p) + F_s]. \tag{8}$$

Allowing retailers to enjoy some endogenous buyer power, we consider that retailers may be able to refuse some contracts proposed by manufacturers while accepting other two-part tariffs contracts. Contract offers are simultaneous but the incentive constraints of the retailers are such that contracts offered by a manufacturer to a retailer must provide to the retailer a profit at least as large as the profit that the retailer would obtain when refusing the proposed contract but accepting all other offers. Moreover, it must be also that the retailers profits are at least larger than some fixed reservation utility level denoted $\overline{\Pi}^r$ for retailer r.

Thus, the manufacturers set the two-part tariffs contracts parameters (wholesale prices and fixed fees) in order to maximize profits as in (8) subject to the following retailers' participation constraints

$$\Pi^r \geq \overline{\Pi}^r, \tag{9}$$

and incentive constraints

$$\Pi^r \geq \sum_{s \in S_r \backslash G_{fr}} [(\widetilde{p}_s^{fr} - w_s - c_s)s_s(\widetilde{p}^{fr}) - F_s] \tag{10}$$

for all $r = 1, .., R$, where Π^r is the retailer's profit (7) when accepting all the offers, where $\overline{\Pi}^r$ is the retailer r reservation utility, where G_{fr} is the set of products owned by firm f and distributed by retailer r, and $\widetilde{p}^{fr} = (\widetilde{p}_1^{fr}, .., \widetilde{p}_J^{fr})$ is the vector of retail prices when the products of G_{fr} do not exist (by convention we will have $\widetilde{p}_i^{fr} = +\infty$ if $i \in G_{fr}$).

When the retailer r refuses the offers of the manufacturer f, he can accept all other offers and sell all products not manufactured by f, whose set is denoted $S_r \backslash G_{fr}$. The market share $s_s(\widetilde{p}^{fr})$ of each product of the set $S_r \backslash G_{fr}$ corresponds to the market share of product s when all products in G_{fr} are absent.

Then, following Rey and Vergé (2010) arguments, since the manufacturers can always adjust

the fixed fees such that all the constraints (10) will be binding, we have $\forall r = 1, .., R$

$$\sum_{s \in S_r} [(p_s - w_s - c_s)s_s(p) - F_s] = \sum_{s \in S_r \backslash G_{fr}} [(\widetilde{p}_s^{fr} - w_s - c_s)s_s(\widetilde{p}^{fr}) - F_s]$$

In general, if constraints (10) are satisfied, the constraints (9) will be satisfied. The binding constraints (10) imply that the sum of fixed fees paid for the products of f sold through r is

$$\sum_{s \in G_{fr}} F_s = \sum_{s \in S_r} \left[(p_s - w_s - c_s)s_s(p) - (\widetilde{p}_s^{fr} - w_s - c_s)s_s(\widetilde{p}^{fr}) \right] \tag{11}$$

because $s_s(\widetilde{p}^{fr}) = 0$ when $s \in G_{fr}$.

Using this expression, one can rewrite the profit of the manufacturer f as

$$\begin{aligned}
\Pi^f &= \sum_{s \in G_f} [(w_s - \mu_s)s_s(p) + F_s] = \sum_{s \in G_f} (w_s - \mu_s)s_s(p) + \sum_{r=1}^{R} \sum_{s \in G_{fr}} F_s \\
&= \sum_{s \in G_f} (w_s - \mu_s)s_s(p) + \sum_{r=1}^{R} \sum_{s \in S_r} \left[(p_s - w_s - c_s)s_s(p) - (\widetilde{p}_s^{fr} - w_s - c_s)s_s(\widetilde{p}^{fr}) \right]
\end{aligned}$$

because $\cup_{r=1}^{R} G_{fr} = G_f$ (and $G_{fr} \cap G_{fr'} = \varnothing$). The manufacturer's profit is then

$$\Pi^f = \sum_{s \in G_f} (w_s - \mu_s)s_s(p) + \sum_{s=1}^{J} \left[(p_s - w_s - c_s)s_s(p) - (\widetilde{p}_s^{fr(s)} - w_s - c_s)s_s(\widetilde{p}^{fr(s)}) \right] \tag{12}$$

where $r(s)$ denotes the retailer of product s ($\in \{1, .., J\}$).

We will also consider a simpler case where constraints (10) do not exist because it is assumed that if one offer is rejected then all offers must be rejected as in Bonnet and Dubois (2010). Then, the outside opportunities depend on a fixed exogenous reservation utility and we will say that the buyer power of retailer is exogenous.

3.2.1 With Resale Price Maintenance

Let's consider the case where manufacturers use resale price maintenance (RPM) in their contracts with retailers. Then, manufacturers can choose retail prices while the wholesale prices have no direct effect on profit. In this case, the vectors of prices $\widetilde{p}^{fr}$ are such that $\widetilde{p}_i^{fr} = p_i$ if $i \notin G_{fr}$ and the profit (12) of manufacturer f can then be written as[5]

$$\Pi^f = \sum_{s \in G_f} (w_s - \mu_s)s_s(p) + \sum_{s=1}^{J} (p_s - w_s - c_s) \left[s_s(p) - s_s(\widetilde{p}^{fr(s)}) \right]$$

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[5] Because also $s_s(\widetilde{p}^{fr(s)}) = 0$, $\widetilde{p}_s^{fr} = +\infty$ for $s \in G_{fr}$ and by convention $s_s(\widetilde{p}^{fr(s)})\widetilde{p}_s^{fr} = 0$.

Remark that with RPM, the retail buyer power does not change the retail equilibrium prices (but only the fixed fees in the contracts).

Indeed, with RPM, the previous expression of the manufacturer profit can be written

$$\Pi^f = \sum_{s \in G_f} ((p_s - \mu_s - c_s)s_s(p) + \sum_{s \notin G_f} (p_s - w_s - c_s)s_s(p) - \sum_{s=1}^{J}(p_s - w_s - c_s)s_s(\widetilde{p}^{fr(s)})$$

where the part $\sum_{s \in G_f} (p_s - \mu_s - c_s)s_s(p) + \sum_{s \notin G_f} (p_s - w_s - c_s)s_s(p)$ is the expression of the profit when there is no incentive constraint and thus the buyer power is fixed exogenously and $-\sum_{s=1}^{J}(p_s - w_s - c_s)s_s(\widetilde{p}^{fr(s)}) = -\sum_{s \notin G_f} (p_s - w_s - c_s)s_s(\widetilde{p}^{fr(s)})$ (because $s_s(\widetilde{p}^{fr(s)}) = 0$ if $s \in G_f$) is the part corresponding to the "endogenous" rent that the manufacturer has to leave to the retailer.

It is clear from this expression that the "endogenous rent" that the manufacturer leaves to the retailer is not affected by the retail prices on its own products decided using RPM because the vector $\widetilde{p}^{fr(s)}$ corresponds to the vector of prices when firm f products are not sold by retailer r and thus is not affected by retails prices of firm f products.

Now, we can use the first order conditions of the maximization of profit of f with respect to retail prices $p_j \in G_f$ using the simpler expression of profit with no endogenous buyer power since first order conditions are equivalent (as in Bonnet and Dubois, 2010) :

$$0 = s_j(p) + \sum_{s=1}^{J}\left[(p_s - w_s - c_s)\frac{\partial s_s(p)}{\partial p_j}\right] + \sum_{s \in G_f} (w_s - \mu_s)\frac{\partial s_s(p)}{\partial p_j}$$

As Rey and Vergé (2010) argue, a continuum of equilibria exist in this general case with RPM, with one equilibrium corresponding to each possible value of the vector of wholesale prices w.

As we can re-write the retail margins $(p - w - c)$ as the difference between total margins $(p - \mu - c)$ and wholesale margins $(w - \mu)$, the previous $J - J'$ first order conditions can be written in a matrix form as

$$I_f S_p(\gamma + \Gamma) + I_f s(p) - I_f S_p(I - I_f)\Gamma = 0 \tag{13}$$

where $\Gamma = (w_s - \mu_s)_{s=1,..,J}$ is the full vector of wholesale margins and $\gamma + \Gamma$ the vector of total margins.

The previous equations stand for the pricing of brands owned by manufacturers who retail their products through a downstream intermediary. Private labels (store brands) pricing obviously does not follow the same pricing equilibrium. However the retailers' profits coming from private labels are implicitly taken into account in the incentive and participation constraints of retailers when manufacturers make take-it-or-leave-it offers. Taking into account the possibility of endogenous entry and exit of private label products by retailers is out of the scope of this paper.

Thus, in the case of private label products, retailers (who are also "manufacturers") choose retail prices and bear the marginal cost of production and distribution, solving :

$$\max_{\{p_j\}_{j \in \widetilde{S}_r}} \sum_{s \in \widetilde{S}_r} (p_s - \mu_s - c_s) s_s(p) + \sum_{s \in S_r \setminus \widetilde{S}_r} (p_s - w_s - c_s) s_s(p)$$

where $\widetilde{S}_r$ is the set of private label products of retailer r. Thus, for private label products, additional equations are obtained from the first order conditions of the profit maximization of retailers that both produce and retail these products. The first order conditions give

$$\sum_{s \in \widetilde{S}_r} (p_s - \mu_s - c_s) \frac{\partial s_s(p)}{\partial p_j} + s_j(p) + \sum_{s \in S_r \setminus \widetilde{S}_r} (p_s - w_s - c_s) \frac{\partial s_s(p)}{\partial p_j} = 0 \quad \text{for all } j \in \widetilde{S}_r$$

which can be written

$$\sum_{s \in S_r} (p_s - \mu_s - c_s) \frac{\partial s_s(p)}{\partial p_j} + s_j(p) - \sum_{s \in S_r \setminus \widetilde{S}_r} (w_s - \mu_s) \frac{\partial s_s(p)}{\partial p_j} = 0 \quad \text{for all } j \in \widetilde{S}_r$$

In matrix notation, these first order conditions are : for $r = 1, .., R$

$$(\widetilde{I}_r S_p I_r)(\gamma + \Gamma) + \widetilde{I}_r s(p) - \widetilde{I}_r S_p I_r \Gamma = 0 \tag{14}$$

where $\widetilde{I}_r$ is the ownership matrix of private label products by retailer r.

We thus obtain a system of equations with (13) and (14) where $\gamma + \Gamma$ and Γ are unknown, which is the following :

$$\begin{cases} I_f S_p(\gamma + \Gamma) + I_f s(p) - I_f S_p(I - I_f)\Gamma = 0 \text{ for } f = 1, .., F \\ (\widetilde{I}_r S_p I_r)(\gamma + \Gamma) + \widetilde{I}_r s(p) - \widetilde{I}_r S_p I_r \Gamma = 0 \text{ for } r = 1, .., R \end{cases}$$

After solving the system (see appendix 7.1), we obtain the expression for the total price-cost margin of all products as a function of demand parameters, of the structure of the industry and the vector

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Γ of wholesale prices :

$$\gamma + \Gamma \;=\; -\left(\sum_r I_r S_p' \widetilde{I_r} S_p I_r + \sum_f S_p' I_f S_p\right)^{-1}$$

$$\left(\sum_r I_r S_p' \widetilde{I_r}\left[s(p) - S_p I_r \Gamma\right] + \sum_f S_p' I_f \left[s(p) - S_p(I - I_f)\Gamma\right]\right) \qquad (15)$$

With RPM, there is a continuum of equilibria depending on the vector of wholesale prices w. We will see in section 4.2 that further assumptions or restrictions can help characterize and identify some of these equilibria from observed data.

3.2.2 *Without Resale Price Maintenance*

We now present the case where manufacturers cannot apply RPM. Then, whether retailers have endogenous buyer power or not makes a difference on the equilibrium retail prices.

In absence of RPM, the retailers prices $\widetilde{p}^{fr}(w)$ are out of equilibrium prices different from the retail prices in equilibrium. The first order conditions of the maximization of the profit of f (12) with respect to wholesale prices w_j, $j \in G_f$, are then :

$$0 \;=\; \sum_{i=1}^{J}\sum_{s \in G_f}(w_s - \mu_s)\frac{\partial s_s(p)}{\partial p_i}\frac{\partial p_i}{\partial w_j} + \sum_{s=1}^{J}\left[\frac{\partial p_s}{\partial w_j}s_s(p) - \frac{\partial \widetilde{p}_s^{fr(s)}}{\partial w_j}s_s(\widetilde{p}^{fr(s)})\right]$$

$$+ \sum_{i=1}^{J}\sum_{s=1}^{J}\left[(p_s - w_s - c_s)\frac{\partial s_s(p)}{\partial p_i}\frac{\partial p_i}{\partial w_j} - \left(\widetilde{p}_s^{fr(s)} - w_s - c_s\right)\frac{\partial s_s(\widetilde{p}^{fr(s)})}{\partial p_i}\frac{\partial p_i}{\partial w_j}\right]$$

In matrix notation, the previous first order conditions give

$$0 = I_f P_w S_p I_f \Gamma_f + I_f P_w s(p) - I_f \tilde{P}_w^f s(\widetilde{p}^f) + I_f P_w S_p \gamma - I_f P_w S_{\widetilde{p}}^f \widetilde{\gamma}^f$$

where the matrix $S_{\widetilde{p}}^f$ is

$$S_{\widetilde{p}}^f \equiv \begin{pmatrix} \frac{\partial s_1(\widetilde{p}^{fr(1)})}{\partial p_1} & .. & \frac{\partial s_J(\widetilde{p}^{fr(J)})}{\partial p_1} \\ \vdots & & \vdots \\ \frac{\partial s_1(\widetilde{p}^{fr(1)})}{\partial p_J} & .. & \frac{\partial s_J(\widetilde{p}^{fr(J)})}{\partial p_J} \end{pmatrix}$$

and $\tilde{P}_w^f$ is the matrix of first order derivatives of retail prices $\widetilde{p}_j^{fr(j)}(w)$ (for $j = 1, .., J$) with respect to wholesale prices w.

Thus the wholesale margins of products of manufacturer f are

$$\Gamma_f = -\,[I_f P_w S_p I_f]^{-1}\left(I_f P_w s(p) - I_f \tilde{P}_w^f s(\widetilde{p}^f) + I_f P_w S_p \gamma - I_f P_w S_{\widetilde{p}}^f \widetilde{\gamma}^f\right) \qquad (16)$$

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where γ comes from (2) and $\widetilde{\gamma}^f = (\widetilde{\gamma}_1^f, .., \widetilde{\gamma}_J^f)$ where $\widetilde{\gamma}_s^f$ is the sth element of vector $-(I_{r(s)} S_{\widetilde{p}}^f I_{r(s)})^{-1} I_{r(s)} s(\widetilde{p}^f)$.

Remark that out of equilibrium retail prices can be obtained from observed equilibrium retail prices, retail margins at equilibrium and out of equilibrium retail margins using : $\widetilde{p}_s^{fr(s)} = \widetilde{\gamma}_s^{fr(s)} - (p_s - w_s - c_s) + p_s$ where $\widetilde{\gamma}_s^{fr(s)} = \widetilde{p}_s^{fr(s)} - w_s - c_s$ is the out of equilibrium retail margin. Moreover, $\tilde{P}_w^f$ can be deduced from the differentiation of the retailer's first order conditions with respect to wholesale prices. These first order conditions are, for all $r = 1, .., R$ and $\forall j \in S_r$,

$$ s_j(\widetilde{p}^{fr}) + \sum_{s \in S_r \backslash G_{fr}} (\widetilde{p}_s^{fr} - w_s - c_s) \frac{\partial s_s(\widetilde{p}^{fr})}{\partial \widetilde{p}_j^{fr}} = 0 $$

which gives for $r = 1, .., R$, $j \in S_r$ and $s = 1, .., J'$

$$
\begin{aligned}
0 =\ & \sum_{l \in \{1,...,J\} \backslash G_{fr}} \frac{\partial s_j(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_l^{fr(j)}} \frac{\partial \widetilde{p}_l^{fr(j)}}{\partial w_s} - 1_{\{s \in S_r\}} \frac{\partial s_s(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)}} + \sum_{l \in S_r} \frac{\partial s_l(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)}} \frac{\partial \widetilde{p}_l^{fr(j)}}{\partial w_s} \\
& + \sum_{l \in S_r \backslash G_{fr}} \left[(\widetilde{p}_l^{fr} - w_l - c_l) \sum_{s \in \{1,...,J\} \backslash G_{fr}} \frac{\partial^2 s_l(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)} \partial \widetilde{p}_s^{fr(j)}} \frac{\partial \widetilde{p}_s^{fr(j)}}{\partial w_s} \right]
\end{aligned}
\tag{17}
$$

Defining $S_{\widetilde{p}^f}^{p_j}$ the matrix $(J \times J)$ of the second derivatives of the market shares with respect to retail prices whose element (s, l) is $\frac{\partial^2 s_l(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)} \partial \widetilde{p}_s^{fr(j)}}$, i.e.

$$ S_{\widetilde{p}^f}^{p_j} \equiv \begin{pmatrix} \frac{\partial^2 s_1(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)} \partial \widetilde{p}_1^{fr(j)}} & \cdots & \frac{\partial^2 s_J(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)} \partial \widetilde{p}_1^{fr(j)}} \\ \vdots & \ddots & \vdots \\ \frac{\partial^2 s_1(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)} \partial \widetilde{p}_J^{fr(j)}} & \cdots & \frac{\partial^2 s_J(\widetilde{p}^{fr(j)})}{\partial \widetilde{p}_j^{fr(j)} \partial \widetilde{p}_J^{fr(j)}} \end{pmatrix}, $$

we can write equation (17) in matrix form to obtain

$$ \tilde{P}_w^f \left[S_{\widetilde{p}}^f + I_r S_{\widetilde{p}}^{f\prime} + (S_{\widetilde{p}^f}^{p_1} I_r \widetilde{\gamma}^{fr} | ... | S_{\widetilde{p}^f}^{p_J} I_r \widetilde{\gamma}^{fr}) \right] I_r - I_r S_{\widetilde{p}}^f \left(I_r - \widetilde{I}_r \right) = 0 $$

where $\widetilde{\gamma}^{fr} = \widetilde{p}^{fr} - w - c$.

Denoting M_{fr} the matrix $\left[S_{\widetilde{p}}^f + I_r S_{\widetilde{p}}^{f\prime} + (S_{\widetilde{p}^f}^{p_1} I_r \widetilde{\gamma}^{fr} | ... | S_{\widetilde{p}^f}^{p_J} I_r \widetilde{\gamma}^{fr}) \right]$ we can solve this system of equations and get the following expression for $\tilde{P}_w^f$

$$ \tilde{P}_w^f = - \left(\sum_{r=1}^{R} I_r M_{fr}' I_r S_{\widetilde{p}}^f (I_r - \widetilde{I}_r) \right) \left(\sum_{r=1}^{R} I_r M_{fr}' M_{fr} I_r \right)^{-1} $$

Equation (16) shows that one can express the manufacturer's price-cost margins vector as depending on the demand function and the structure of the industry by replacing the expression for $\tilde{P}_w^f$.

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When retailers have no endogenous buyer power :

If retailers have no endogenous buyer power, we can suppress the constraints (10) and take only into account the constraints (9). Then, as shown in appendix 7.2, the manufacturers profit maximization is equivalent to set wholesale prices in the following program

$$\max_{\{w_s\} \in G_f} \sum_{s \in G_f} (p_s - \mu_s - c_s) s_s(p) + \sum_{s \notin G_f} (p_s - w_s - c_s) s_s(p)$$

The first order conditions are : for all $i \in G_f$,

$$\sum_s \frac{\partial p_s}{\partial w_i} s_s(p) + \sum_{s \in G_f} \left[(p_s - \mu_s - c_s) \sum_j \frac{\partial s_s}{\partial p_j} \frac{\partial p_j}{\partial w_i} \right] + \sum_{s \notin G_f} \left[(p_s - w_s - c_s) \sum_j \frac{\partial s_s}{\partial p_j} \frac{\partial p_j}{\partial w_i} \right] = 0$$

which gives in matrix notation

$$I_f P_w s(p) + I_f P_w S_p I_f (p - \mu - c) + I_f P_w S_p (I - I_f) (p - w - c) = 0$$

This implies that the total price-cost margin is such that for all $f = 1, .., F$,

$$\gamma_f + \Gamma_f = (I_f P_w S_p I_f)^{-1} \left[-I_f P_w s(p) - I_f P_w S_p (I - I_f) (p - w - c) \right]. \tag{18}$$

Using (2) to replace $(p - w - c)$ and (6) for P_w, this allows us to estimate the price-cost margins with demand parameters. Remark again that the formula (2) provides directly the total price-cost margin obtained by each retailer on its private label.

3.2.3 Fixed fees

The previous two sub-sections show how pricing decisions (wholesale and retail) can be characterized by first order conditions of profit maximization where fixed fees of the two part tariffs contracts have been substituted using incentive constraints of the model. However, we can also show in which case and how fixed fees can be identified after identification of margins.

Actually, in the case of two part tariffs contracts with endogenous buyer power, using the binding incentive constraint (11), we have

$$\sum_{s \in G_{fr}} F_s = \sum_{s \in S_r} \left[(p_s - w_s - c_s) s_s(p) - (\widetilde{p}_s^{fr} - w_s - c_s) s_s(\widetilde{p}^{fr}) \right]$$

Without resale price maintenance, first order conditions determine retail margins $(p_s - w_s - c_s)$ at equilibrium, and out of equilibrium retail margins $(\widetilde{p}_s^{fr} - w_s - c_s)$ in case r refuses the offer of f are also known if the demand shape is identified as well as marginal costs. Then, $\sum_{s \in G_{fr}} F_s$ can be identified for all pair (f, r).

With resale price maintenance, we also have

$$
\begin{aligned}
\sum_{s \in G_{fr}} F_s &= \sum_{s \in S_r} (p_s - w_s - c_s) s_s(p) - \sum_{s \in S_r \backslash G_{fr}} (p_s - w_s - c_s) s_s(\widetilde{p}^{fr}) \\
&= \sum_{s \in G_{fr}} (p_s - w_s - c_s) s_s(p) + \sum_{s \in S_r \backslash G_{fr}} (p_s - w_s - c_s) \left[s_s(p) - s_s(\widetilde{p}^{fr}) \right]
\end{aligned}
$$

where the vector $\widetilde{p}^{fr}$ is identical to p except for non existent products in case of refusal by r of f products, and because $s_s(\widetilde{p}^{fr}) = 0$ when $s \in G_{fr}$, and $\widetilde{p}_s^{fr} = p_s$ for $s \in S_r \backslash G_{fr}$ (since RPM is used by all manufacturers which implies that retail prices will not depend on the fact that some retailer has refused some manufacturer offer).

This shows that the sum of all fees paid by a manufacturer to a retailer can be identified for any manufacturer-retailer pair using if the demand shape is know and if equilibrium retail margins $(p_s - w_s - c_s)$ can be identified. We know that this is in general not identified without additional assumptions. However, any additional restriction that brings identification of retail margins will also bring identification of the fixed fees.

In the case of exogenous buyer power, things are extremely different because only participation constraints are binding and fixed exogenous outside options of retailers $(\overline{\Pi}^r)$ being unknown, one cannot identify fixed fees because it leads to

$$
\sum_{s \in S_r} F_s = \sum_{s \in S_r} [(p_s - w_s - c_s) s_s(p)] - \overline{\Pi}^r
$$

where $\overline{\Pi}^r$ is unknown. In this case, analyzed in Bonnet and Dubois (2010), the identification of fixed fees is never possible and only "variable" margins (as opposed to margins obtained from fixed fees) and marginal costs can possibly be identified. Profits of retailers and manufacturers are not identified up to a constant exogenous to the horizontal and vertical competition.

***

Voilà ce qu'il me faut : pour l'instant on va regarder juste la valeur des fixed fees dans le cadre du modèle préféré (c'est ausis el cas le plus simple ou je pense que ca marchera car le cas avec rpm ou les w sont estimes est plus risqué vu la faible precision probable de l'estimation des w)

Je voudrais donc dans un fichier avec une ligne par produit et periode, en plus de tout ce qu on a deja (dont la retailer margin et la market sahre de chaque produit) :

- la market share de chaque produit pour chaque paire (f,r), ca fait **F*R** variables ! mais c est assez simple, il suffit de calculer (par simulation de l integrale) avec la formule du mixed logit la market share de chaque produit s lorsque les prix de produits fr sont à + l infini : $s_s(\widetilde{p}^{fr})$ (tu mets des zeros ou des valeur manquante comme tu veux pour les s appartenant à G_{fr})

- la marge de détail $(\widetilde{p}_s^{fr} - w_s - c_s)$ pour tous les produits s n'appartenant pas à G_{fr} pour chaque paire fr, c est a dire aussi **F*R** variables, où cette marge de détail est obtenue par la formule habituelle du retailer poru tout r'$\neq r$

$$\gamma \equiv p - w - c = -\left(I_r S_p I_r\right)^{-1} I_r s(\widetilde{p}^{fr})$$

Rappel, tu peux surement utiliser les programmes existant ou il y a quelque part deja ces quantités puisqu'elle interviennent dans le calcul de la marge d'equilibre... il y a les $\widetilde{p}^{fr}$ quelque part dans les programmes, il "suffit" d'appliquer la formule...
***

4 Identification and Econometric Method

4.1 A Random Coefficients Logit Demand Model

The estimation of price-cost margins under the different models previously considered requires the observation of the market structure and of the demand shape. As in Villas-Boas (2007) or Bonnet and Dubois (2010), we use the demand and structural equation to infer margins. A careful

demand estimation is thus important. The market demand is derived using a standard discrete choice model of consumer behavior that follows the work of Berry (1994), Berry, Levinsohn and Pakes (1995) and estimated on individual choices as in Revelt and Train (1998). We use a random-coefficients logit model which is a very flexible general model (McFadden and Train, 2000). Contrary to the standard logit model, the random-coefficients logit model imposes very few restrictions on the demand own and cross-price elasticities. This flexibility makes it the most appropriate model to get consistent estimates of the demand parameters required in the computation of the price-cost margins.

As in Bonnet and Dubois (2010), we use a random coefficient logit model but allow a more flexible specification of random utility with more heterogeneity of preferences and estimate the demand on individual purchase choices instead of aggregate data (we also use more recent data using the year 2006 instead of 1998-2000).

The basic specification of the direct utility function of a consumer i buying product j at t is

$$U_{ijt} = \beta_{b(j)} + \beta_{r(j)} + \delta_i X_j - \alpha_i p_{jt} + \varepsilon_{ijt} \tag{19}$$

where $\beta_{b(j)}$ represents a brand specific effect on utility capturing time invariant brand characteristics, $\beta_{r(j)}$ represents a retailer specific effect capturing time invariant retailer characteristics, X_j is a dummy variable which is equal to 1 if the product j is a mineral water and 0 otherwise, p_{jt} is the price of product j at period t, and ε_{ijt} is a separable additive random shock to utility. The random coefficient α_i represents the unobserved marginal disutility of price for consumer i. We assume that $\alpha_i = \alpha + \sigma^\alpha v_i^\alpha$ where v_i^α is an unobserved consumer characteristic and σ^α characterizes how consumer marginal disutility of price deviates form the mean disutility of price α with this unobserved characteristic. We also assume that consumers have different tastes for the mineral water versus spring water characteristic. Hence, we write $\delta_i = \delta + \sigma^\delta v_i^\delta$ where v_i^δ represents unobserved consumer characteristic and δ the mean taste for that product characteristic.

The model is completed by the inclusion of an outside good, denoted good zero, allowing consumer i not to buy one of the J marketed products. The mean utility of the outside good

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is normalized to zero implying that the consumer indirect utility of choosing the outside good is $U_{i0t} = \varepsilon_{i0t}$.

Then, doing the usual parametric assumption on ε_{ijt} would allow to write a closed form solution for the probability for a consumer i to buy a product j at a given period. However, more than the parametric assumption required to obtain a logit form conditional probability, it requires that ε_{ijt} be uncorrelated with price and thus that no unobserved heterogeneity of products be correlated with consumer tastes and with price. As some product characteristics might be omitted in the specification of utility (19), like for instance, product advertising, and be correlated with the prices of products, Petrin and Train (2010) propose a control function approach to solve this endogeneity problem of prices. This method consists in estimating a first stage regression of prices on observed cost shifters as follows :

$$p_{jt} = \lambda_{b(j)} + \lambda_{r(j)} + \gamma W_{jt} + \eta_{jt}$$

where $\lambda_{b(j)}$ and $\lambda_{r(j)}$ are brand specific and retailer specific effects and W_{jt} represents a vector of cost shifters like input prices and η_{jt} is a random shock defined as the residual of the orthogonal projection of p_{jt} on $\lambda_{b(j)}, \lambda_{r(j)}, W_{jt}$. Then, introducing the estimated term $\widehat{\eta}_{jt}$ in the specification of the consumer utility U_{ijt} makes the assumption of orthogonality of the residual consumer utility deviations (denoted u_{ijt}) with price more plausible. This method amounts to assume that the consumer utility can be written as follows : $U_{ijt} = \beta_{b(j)} + \beta_{r(j)} + \delta_i X_j - \alpha_i p_{jt} + \tau \widehat{\eta}_{jt} + u_{ijt}$ where by definition $u_{ijt} = \varepsilon_{ijt} - \tau \widehat{\eta}_{jt}$ with the maintained assumption that u_{ijt} is orthogonal to p_{jt}. With this random utility, we assume that consumer i chooses alternative $j(i, t)$ if $U_{ij(i,t)t} \geq U_{ijt}$ for all $j = 1, .., J$ and $U_{ij(i,t)t} > U_{ijt}$ for some j.

This method allows to estimate consistently the demand price elasticities even if time varying unobserved characteristics (correlated with $\widehat{\eta}_{jt}$) affect consumer tastes and are correlated with price (like advertising), provided that the residual or the projection of these unobservables on $\widehat{\eta}_{jt}$ be uncorrelated with the price p_{jt}. Remark that such specification also implies that policy simulations have to be taken cautiously. Actually, the endogenous determination of this unobserved

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heterogeneity is not modelled and is thus unknown under possible counterfactual situations to be simulated (for example like a merger), unless we maintain that this unobserved heterogeneity does not change in the counterfactual situation.

Then, instead of making a parametric assumption on ε_{ijt}, we assume that the idiosyncratic taste shocks u_{ijt} are independently and identically distributed according to a Gumbel (extreme value type 1) distribution, so that the probability L_{ijt} of buying j for consumer i at period t conditional on α_i and δ_i can be written :

$$L_{ijt}(\alpha_i, \delta_i) = \frac{\exp(V_{ijt})}{1 + \sum_{k=1}^{J} \exp(V_{ikt})}$$

where $V_{ijt} = \beta_{b(j)} + \beta_{r(j)} + \delta_i X_j - \alpha_i p_{jt} + \tau \widehat{\eta}_{jt}$.

For simplicity, we assume that $\left(v_i^\delta, v_i^\alpha\right)$ are independent and normalize their variance to one and mean to zero. Denoting f the standard normal probability distribution function, the unconditional probability of the observed sequence of T choices for consumer i is then

$$P_i(\alpha, \sigma^\alpha, \beta, \delta, \sigma^\delta) = \int \left(\prod_{t=1}^{T} L_{ij(i,t)t}(\alpha_i, \delta_i)\right) f(\alpha_i|\alpha, \sigma^\alpha) f(\delta_i|\delta, \sigma^\delta) d\alpha_i d\delta_i.$$

where β is the vector of all β_b and β_r parameters in (19), $j(i,t)$ is the chosen alternative by consumer i at period t and $f(\alpha_i|\alpha, \sigma)$ and $f(\delta_i|\delta, \sigma^\delta)$ are the p.d.f. of the random coefficients α_i and δ_i respectively.

Then, the log likelihood of the sample of choices over N individuals is :

$$\sum_{i=1}^{N} \ln \left[P_i(\alpha, \sigma^\alpha, \beta, \delta, \sigma^\delta)\right].$$

The probability of the observed sequence of choice for consumer i is approximated with simulation for any given value of $\left(\alpha, \sigma^\alpha, \beta, \delta, \sigma^\delta\right)$ and can be written :

$$SP_i(\alpha, \sigma^\alpha, \beta, \delta, \sigma^\delta) = \frac{1}{R} \sum_{r=1}^{R} \left(\prod_{t=1}^{T} L_{ij(i,t)t}(\alpha^r, \delta^r)\right)$$

where R is the number of simulations, α^r and δ^r are the rth Halton draws of the distributions $f(\alpha_i|\alpha, \sigma)$ and $f(\delta_i|\delta, \sigma^\delta)$ respectively.

Then, the model parameters are estimated by maximizing the simulated likelihood (Train, 2009) which is

$$SLL(\alpha, \sigma^\alpha, \beta, \delta, \sigma^\delta) = \sum_{i=1}^{N} \ln \left[SP_i(\alpha, \sigma^\alpha, \beta, \delta, \sigma^\delta) \right]$$

with respect to $\alpha, \sigma^\alpha, \beta, \delta, \sigma^\delta$.

The random-coefficients logit model generates a flexible pattern of substitutions between products. Consumers have different price disutilities that will be averaged to a mean price sensitivity and cross-price elasticities are not constrained by the individual level logit assumption. Once the individual demand parameters have been estimated, the aggregate market shares and price elasticities of the demand can be recomputed by simulation in order to be used for the estimation of price-cost margins using the different supply models presented in section 3. Expressions for own and cross-price elasticities are given in Appendix 7.4.

4.2 Identification and Tests Across Supply Models

Let's consider in this section the problem of identification of retail or wholesale margins and test across the different supply models with a known demand function and market shares and observed retail prices for a set of T markets. The different supply models of section 3 give different restrictions on the supply side and in particular on wholesale and retail price-cost margin vectors denoted Γ and γ respectively. Depending on the model, the implied restrictions do not lead to the same degree of identification or underidentification of price-cost margins.

4.2.1 *Linear pricing models*

In the case of linear pricing between manufacturers and retailers, both manufacturer level and retailer level price-cost margins are straightforwardly identified with (2) and (4).

4.2.2 *Two-Part Tariffs contracts without RPM*

In the case of two part tariffs contracts without RPM between manufacturers and retailers, we have seen in section 3.2.2 that both the manufacturer level and retailer level price-cost margins are identified, whether there is endogenous buyer power or not.

4.2.3 Two-Part Tariffs contracts with RPM

In the case of two part tariffs contracts with RPM, multiple equilibria prevent the full identification of price-cost margins without further restriction. Actually, given that we have J products and T markets, we have potentially JT marginal costs of distribution and JT marginal costs of production, or equivalently JT retailer margins and JT manufacturer margins, to identify. Identifying the JT retailer level and JT manufacturer level price-cost margins implies that $2JT$ parameters have to be identified while our structural model generally gives a system of JT equations. These equations can be written as equations linking the vector of total margins $(\Gamma_t + \gamma_t)$, for market (period) t, as a function of the vector of wholesale margins (Γ_t) of the form

$$(\Gamma_t + \gamma_t) = H(\Gamma_t)$$

where $H(.)$ is the known function (15) depending on the demand shape and the structure of the industry in terms of products ownership at the retailing and manufacturing levels.

As retail prices and the correspondence $H(.)$ are known, there exists a one to one correspondence between the vector of unknown JT parameters Γ_{jt} and the vector of unknown JT total marginal costs denoted C_{jt} because

$$C_{jt} = \mu_{jt} + c_{jt} = p_{jt} - \left(\Gamma_{jt} + \gamma_{jt}\right) = p_{jt} - H_j(\Gamma_t) \text{ for all } j = 1, .., J \text{ and } t = 1, .., T$$

where H_j denotes the jth row of H.

The degree of underidentification is thus at most equal to the dimension of the vectors of wholesale prices (or wholesale margins Γ_t), that is JT. Then, identification cannot be obtained unless additional restrictions are imposed.

We consider several possible restrictions, from very strong ones (the ones considered in Bonnet and Dubois, 2010) imposing zero wholesale or retail margins to a general case with a less restrictive one.

Zero wholesale margins : Fixing the vector of wholesale margins Γ_t to zero is sufficient to get

identification of total margins and thus also retail and wholesale margins which are zero in this

case. This

This corresponds to the particular equilibrium where wholesale prices are such that $w_{st}^* = \mu_{st}$

for all s, t that is $\Gamma_t = 0$, $\forall t$. Simplifying (15), it implies that

$$\gamma_t = - \left(\sum_r I_r S_p' \widetilde{I}_r S_p I_r + \sum_f S_p' I_f S_p \right)^{-1} \left(\sum_r I_r S_p' \widetilde{I}_r + \sum_f S_p' I_f \right) s(p_t) \tag{20}$$

Remark that in the absence of private label products, this expression would simplify to the case

where the total profits of the integrated industry are maximized, that is

$$\gamma_t = -S_p^{-1} s(p_t) \tag{21}$$

because then $\sum_f I_f = I$ and $\widetilde{I}_r = 0$.

This shows that two part tariffs contracts with RPM allow to maximize the full profits of the

integrated industry if retailers have no private label products, the buyer power of retailers shifting

simply the rent between parties. Rey and Vergé (2010) showed that, among the continuum of

possible equilibria, the case where wholesale prices are equal to the marginal costs of production

is the equilibrium that would be selected if retailers can provide a retailing effort that increases

demand. In this case, if the manufacturer allows the retailer to be the residual claimant of his

retailing effort, it leads to select wholesale prices equal to marginal costs of production.

Zero retail margins : When wholesale prices are such that the retailer's price-cost margins are

zero $(p_{st}^*(w_{st}^*) - w_{st}^* - c_{st} = 0$ that is $\gamma_{ft} = 0$ for all f), then the first order conditions give the

simplified expression of wholesale margins as

$$\Gamma_{ft} = (p_t - \mu_t - c_t) = -(I_f S_p I_f)^{-1} I_f s(p_t) \tag{22}$$

for all $f = 1, .., F$. For private label products, denoting $\gamma_{rt}^{pl} + \Gamma_{rt}^{pl}$ the vector of total price-cost

margins of private labels of retailer r, we have

$$\gamma_{rt}^{pl} + \Gamma_{rt}^{pl} = -(\widetilde{I}_r S_p \widetilde{I}_r)^{-1} \widetilde{I}_r s(p_t)$$

All margins are then identified.

General case : A less restrictive identification method may consist in adding restrictions on the vectors of marginal costs and margins. Actually, the total marginal cost C_{jt} of product j being the sum of the marginal cost of production μ_{jt} and of distribution c_{jt}, we will consider the following assumption to get identification of retail and wholesale margins in two-part tariffs models :

Identification assumption :

$$C_{jt} = \mu_{jt} + c_{jt} = f(\lambda_{b(j)} + \Lambda_{r(j)})p_{jt} \text{ for all } j = 1, .., J \text{ and } t = 1, .., T \tag{23}$$

where $b(j)$ denotes the brand of product j, $r(j)$ the retailer of product j, and $f(.)$ is a function to be specified.

This assumption means that total marginal cost C_{jt} is a positive share of retail price p_{jt} which is non time varying, brand and retailer specific. It introduces some restrictions between the $J \times T$ unknown marginal costs C_{jt} and the $(B + R) \times T$ unknown parameters λ_b and Λ_r (where $B + R < J = B \times R$ and B is the number of brands and R the number of retailers). In practice, we impose $f(x) = \frac{1}{1+\exp(x)}$ which proved to be the preferred specification among several tested ones in terms of tractability of empirical estimation.

Then, this identification assumption implies that

$$p_{jt} - H_j(\Gamma_t) = f(\lambda_{b(j)} + \Lambda_{r(j)})p_{jt} \text{ for all } j = 1, .., J \text{ and } t = 1, .., T$$

which reduces the degree of underidentification since it adds $J \times T$ restrictions and only $(B + R)$ additional unknown parameters. The true degree of underidentification will depend on the properties of the non linear function $H(.)$.

The identification of margins will thus depend on the set S^h of vectors of wholesale margins $\Gamma = (\Gamma_1, .., \Gamma_T)$ solutions to the identification restrictions (23). This set can be described as the set S^h defined by

$$S^h = \left\{ \Gamma \in \mathbb{R}^{JT} \mid \epsilon_{jt}^h(\Gamma) = 0, \forall j, \forall t \right\}$$

with $\epsilon_{jt}^h(\Gamma_t) = p_{jt} - H_j(\Gamma_t) - f(\hat{\lambda}_{b(j)}(\Gamma_t) + \hat{\Lambda}_{r(j)}(\Gamma_t))p_{jt}$ where the parameters $\left\{\hat{\lambda}_b(\Gamma_t), \hat{\Lambda}_r(\Gamma_t)\right\}$ are solutions to the following minimization problem

$$\min_{\{\lambda_b,\Lambda_r\}_{b=1,..,B,r=1,..,R}} \sum_{j,t} \left[p_{jt} - H_j(\Gamma_t) - f(\lambda_{b(j)} + \Lambda_{r(j)})p_{jt} \right]^2$$

Writing the identification problem in this way allows to more simply find a lower bound on the degree of underidentification. Indeed, it could be that S^h is not an empty set for many different vectors of $\{\lambda_b, \Lambda_r\}_{b=1,..,B,r=1,..,R}$ and not only the one that minimize the criterion above. However, in practice, this will not happen in our empirical application and we prefer to present here this weaker result which is sufficient to explain our method.

Thus, the degree of underidentification of the supply model depends on $card(S^h)$. The vector of margins is underidentified if $card(S^h) > 1$, and overidentified if $S^h = \varnothing$. As remarked above, the case of just-identification does not necessarily correspond to $card(S^h) = 1$, because S^h defined as above is a lower bound of the "identification set".

In practice, we will see that the demand shape is such that we always get overidentification and we will consider the solution

$$\Gamma^* = \{\Gamma_t^*\}_{t=1,..,T} = \arg \min_{\{\Gamma_t\}_{t=1,..,T}} \sum_{j=1,...,J}^{t=1,..,T} \epsilon_{jt}^h(\Gamma_t)^2 \tag{24}$$

as the equilibrium solution.

4.2.4 *Testing across different models*

Then, in order to test between alternative models once we have estimated the demand model and obtained the different price-cost margins estimates according to their expressions obtained in section 3, we apply non nested tests *à la* Vuong (1989) exactly as in Bonnet and Dubois (2010). The tests allow to draw some inference between any two alternative models for which we obtained total marginal costs. The tests statistics are based on the difference between lack-of-fit criterion of each cost equation that can be estimated for each model once price-cost margins are obtained. Details on the specification of these cost equations will be given in the next section.

5 Econometric Estimation and Test Results

5.1 Demand Estimation Results

Using the data described in section 2.2, we have constructed observations of the households choices of bottles of water over 13 periods of 4 weeks in 2006 using each purchase and an arbitrary rule consisting in assuming that the household product is the one purchased in the largest quantity during each period. Doing such aggregation is however not essential for the results found. Using other time periods or drawing at random a purchase event for each period did not change significantly the results. The household purchase data finally allows to construct a sample of 2 836 households present over the whole 13 periods that is 36 868 observations. We have removed households not present in the survey for some periods in 2006 in order to obtain a balancer panel data set and also removed observations for which missing values exist in some variables. On this sample, we estimated the demand model presented in section 4, as well as a standard multinomial logit model. The estimates[6] of the random-coefficients logit model and the simple multinomial logit are in Table 2.

Coefficients (Std. error)	Multinomial Logit (1)	Random Coefficients Logit (2)
Price $(-\alpha)$	-18.76 (0.003)	-20.33 (0.004)
Price (σ^α)		6.42 (0.002)
Mineral water (δ)	1.28 (0.001)	3.48 (0.001)
Mineral water (σ^δ)		3.83 (0.001)
Control $\widehat{\eta}_{jt}$ (τ)	17.06 (0.004)	15.85 (0.005)
Brand 1	3.00 (0.007)	3.20 (0.001)
Brand 2	5.08 (0.001)	5.48 (0.001)
Brand 3	1.86 (0.001)	1.99 (0.001)
Brand 4	0.97 (0.001)	1.28 (0.001)
Brand 5	2.25 (0.001)	2.81 (0.001)
Brand 6	0.88 (0.000)	0.69 (0.001)
Retailer 1	0.15 (0.000)	0.36 (0.000)
Retailer 2	0.69 (0.000)	0.92 (0.000)
Retailer 3	0.02 (0.001)	0.25 (0.001)
Retailer 4	0.45 (0.000)	0.62 (0.000)
Retailer 5	0.90 (0.000)	0.11 (0.000)
Retailer 6	-0.17 (0.001)	0.03 (0.001)

Table 2 : Estimation Results of Demand Models

[6] Remark that we cannot provide the names of brand and retailer chains because of a confidentiality agreement with TNS World Panel who provided us the data.

The results show that the price coefficient has the correct sign. In the case of the random coefficient logit model, the price coefficient has a distribution with mean equal to 20.33 and standard deviation σ^α equal to 6.42 which means that only 0.07% of the distribution of the coefficient α_i has the wrong sign. The mean taste of the mineral characteristic is positive which means that consumers like mineral waters. Only 17.6% do not like it. In the multinomial or random coefficient logit model, the parameter τ of the control term $\widehat{\eta}_{jt}$ (obtained from a first stage price regression shown in appendix 7.3) is significantly positive showing that, on one hand, some correlation existed between prices and unobserved product characteristics included in the error term ε_{ijt} and these unobserved characteristics would enter positively in the utility function. We would expect that product advertising increases the consumer utility and is also positively correlated with price, giving an interpretation to this control function approach as in Petrin and Train (2010).

Finally, once we obtained our structural demand estimates, we can compute price elasticities of demand for these differentiated products. Table 3 presents the different average elasticities obtained with the estimates of the random-coefficients logit model. Although the data are more recent and the demand model more flexible and estimated on individual data, we obtain that mineral waters are more sensitive to price variation than spring waters as in Bonnet and Dubois (2010).

Average Own-price Elasticities (E_{jk})	
	Mean (Std. Dev.)
All	-5.80 (1.68)
Mineral water	-6.70 (0.63)
Spring water	-3.09 (0.63)

Table 3 : Estimated Elasticities under **Random Coefficients Logit**

5.2   Estimation of Price-Cost Margins and Non Nested Tests

Once one has estimated the demand parameters, we can use the formulas obtained in section 3 to compute the price-cost margins at the retailer and manufacturer levels, for all products, under the various classes of models considered. Under some models, wholesale, retail or total margins are not identified without additional restrictions that we will thus impose. Empirically, we are able to solve the minimization problem (24) using the additional restriction (23).

We present the estimation results of several models that seem worth of consideration with some variants on the behavior of manufacturers or retailers. Table 4 then shows the averages of the estimates of product level price-cost margins under the different models considered[7]. Price-cost margins are lower for mineral water than for spring water in percentage of retail price but are larger in absolute value. Model 1 concerns the case of linear pricing. In order to save space, variants of linear pricing models with different interaction between manufacturers and retailers are not presented although they have been estimated. As in Sudhir (2001), we estimated variants of the linear pricing model by assuming collusion between manufacturers and/or retailers or assuming that retailers act as pass-through agents of marginal cost of production. All these models are finally strongly rejected (as in Bonnet and Dubois, 2010, for older data) and thus not shown. We also consider several non linear contracting models with exogenous or endogenous buyer power. Models 2, 3, 4 and 5 correspond to two part tariffs contracts with resale price maintenance. Remind that, in this case, whether the retailers can use competing offers to increase their buyer power when dealing with manufacturers does not change the pricing equilibrium but only the unobserved and unidentified fixed fees which determine the sharing of the rent in the vertical structure. Thus, these estimation results are consistent with a model where either the buyer power is endogenous or exogenous in the vertical relationship. Model 2 is the general case (15) where the equilibrium wholesale margins are estimated using an additional restriction (23) on total margins across products and markets as described in 4.2. Model 3 corresponds to the case where no wholesale price discrimination is imposed. In this model, manufacturers are prevented to sell a given product to different retailers at different prices which implies that the wholesale price of any product j depends only on its brand $b(j)$ and not on the retailers identity $r(j)$. These restrictions are incorporated in the estimation of margins using the same method as in (24) where the vector of unknowns Γ is constrained to uniform wholesale pricing. The results of the estimation of models 2 and 3 show

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[7]Note that the average price-cost margin at the retailer level plus the average price-cost margin at the manufacturer level do not sum to the total price cost margin because of the private labels products for which no price cost margin at the manufacturer level is computed, the retailer price cost margin being then equal to the total price cost margin.

retail, wholesale and total margins obtained from this estimation (remind that for private labels total margins are equal to retail margin by convention and thus on average total margins are lower than the sum of average retail and wholesale margins). In Model 4, we assume that wholesale prices are equal to the marginal cost of production. It corresponds to the case of equation (20). Model 5 is the case where the wholesale prices are such that the retailers' margins are zero. Finally, models 6 and 7 are the case of two part tariffs contracts without resale price maintenance either without endogenous buyer power (model 6) or with endogenous buyer power (model 7).

Price-Cost Margins (% of retail price p_{jt})		Mineral Water		Spring Water	
		Mean	Std.	Mean	Std.
Linear Pricing (Double Marginalization)					
Model 1	Retailers	17.04	2.24	36.26	7.14
	Manufacturers	23.02	3.77	43.72	6.16
	Total	36.23	8.17	58.12	27.43
Two part Tariffs with RPM					
Model 2	General wholesale prices (w_{jt}) with restriction (23)				
	Retailers	33.82	23.44	30.45	35.95
	Manufacturers	12.44	25.77	57.14	49.76
	Total	44.19	11.13	59.03	27.64
Model 3	No wholesale price discrimination ($w_{b(j)t}$) with restriction (23)				
	Retailers	28.15	33.74	22.05	26.16
	Manufacturers	21.13	33.61	75.13	33.61
	Total	45.76	12.04	59.62	28.49
Model 4	Manufacturer marginal cost pricing ($w = \mu$)	66.05	19.27	77.14	40.82
Model 5	Zero retail margin ($p = w + c$)	25.70	4.96	44.03	15.35
Two-part Tariffs without RPM					
Exogenous Retail Buyer Power					
Model 6	Retailers	17.04	2.24	36.26	7.14
	Manufacturers	19.22	3.96	26.65	4.23
	Total	33.06	6.77	49.58	18.75
Endogenous Retail Buyer Power					
Model 7	Retailers	17.04	2.24	36.26	7.14
	Manufacturers	22.66	5.50	54.10	7.32
	Total	35.93	8.47	63.31	32.60

Table 4 : Estimation Results of Price-Cost Margins (averages by groups)

After estimating the different price-cost margins for the models considered, one can recover the total marginal cost C_{jt}^h and then estimate cost equations allowing to implement the non nested tests across the different models. For such tests, we specify cost equations as follows, for $h = 1, ..., 7$:

$$\ln C_{jt}^h = \omega_{b(j)}^h + \omega_{r(j)}^h + W_{jt}\lambda_g + \ln \eta_{jt}^h$$

where variables W_{jt} include wages, diesel oil, and plastic price variables and ω_b^h, ω_r^h are brand and retailer specific effects. Actually, it is likely that labor cost, plastic price (which is the major component of bottles and packaging) and oil prices (which affect transportation costs) are important determinants of variable costs. Also, the relatively important variations of all these price indices over time suggests a potentially good identification of our cost equations. Table 5 presents the results of these cost equations estimated by OLS for the 7 different models.

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wage	2.09	-1.02	-1.90	-4.48	3.02	1.90	2.07
(Std. err.)	(0.72)	(0.73)	(0.75)	(0.75)	(0.78)	(0.74)	(0.64)
Plastic	0.03	2.77	3.95	5.10	-0.48	0.25	0.04
(Std. err.)	(0.69)	(0.70)	(0.72)	(0.72)	(0.74)	(0.70)	(0.64)
Diesel oil	0.58	0.12	-0.18	-0.09	0.71	0.64	0.63
(Std. err.)	(0.33)	(0.34)	(0.35)	(0.35)	(0.36)	(0.34)	(0.30)
ω_b^h, ω_r^h not shown							
F test $\left\{\omega_b^h = 0\right\}$	796.57	646.20	554.26	471.66	872.82	773.86	962.38
(p val.)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
F test $\left\{\omega_r^h = 0\right\}$	10.32	6.44	7.21	8.43	6.36	3.00	6.69
(p val.)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)

Table 5 : Cost Equations for the Random Coefficients Logit Model

These cost equations are useful mostly in order to test which model fits best the data. We thus performed the non nested test of Rivers and Vuong (2002) which gives the same inference as the Vuong (1989) test. Results of the tests are provided in Table 6. Each matrix element gives the test statistic of testing the hypothesis H_1 in column in favor of the hypothesis H_2 in row. When the test statistic is negative and below the critical value chosen (-1.64 for a 5% test), it means that we reject H_1 in favor of H_2. When the test statistic is positive and above the critical value chosen (1.64 for a 5% test), it means that we reject H_2 in favor of H_1. When the test statistic is between the two critical values (-1.64,1.64), it means that we cannot distinguish statistically H_1 from H_2.

$T_n \rightarrow N(0,1)$						
	H_2					
H_1	2	3	4	5	6	**7**
1	0.86	2.39	2.21	3.68	1.22	**-2.54**
2		3.00	3.57	4.33	0.05	**-2.10**
3			0.36	2.50	-0.99	**-2.66**
4				1.68	-1.11	**-2.68**
5					-2.05	**-3.02**
6						**-2.76**

Table 6 : Non Nested Tests Across Models

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The statistics of test T_n show that the best model appears to be the model 7. Thus, our empirical evidence shows that, manufacturers and retailers use two part tariffs contracts without resale price maintenance (RPM) and that the buyer power of retailers is affected endogenously by their outside opportunities.

Concerning this inference on the vertical relationship, other variants tested were also rejected. For example, all the variants of two part tariffs contracts without RPM where uniform wholesale pricing is imposed were also rejected, as well as models of collusion between manufacturers or between retailers.

Let's comment more on the preferred model. This is a model with two part tariff contract, and no RPM, which contrasts with what was found in Bonnet and Dubois (2010) on the 1998-2000 period where RPM was found. It is interesting because in 2005, the Galland act was removed and replaced by another law in order to redefine resale at loss by retailers and prevent the use of high list wholesale prices to implement RPM. Actually, RPM is in principle forbidden in France but the evidence found in Bonnet and Dubois (2010) was consistent with the worries of the competition authority that the Galland act (in force between 1996 and 2005) allowed manufacturers to implement RPM equilibrium. Indeed, the definition of thresholds for resale at loss did not take into account backward margins and only wholesale unitary list prices which could be set as high as wanted to enforce minimum retail prices, while compensating retailers with backward margins. After 2005, this became impossible because the definition of minimum retail prices to define resale at loss did include part of the backward margins. It seems that the change in the law did succeed in avoiding manufacturers to mimic RPM.

Also, for this preferred model, Table 4 shows that the average price-cost margins are of 35.9% for mineral water and 63.3% for spring water. In absolute values, the price-cost margins are on average 0.13 for mineral water and 0.09 for spring water because mineral water is on average more expensive. For this best model, the average total price-cost margins for national brands is 48.2% while it is of 26.4% for private labels. Remark that the high average margin for national brands is

largely due to the only spring water national brand for which the total margin is much larger than others[8]. Otherwise, national brands mineral water have an average total margin of 39.05% with 16.39% for the retail margin and 22.66% for the wholesale margin.

Comparing models 6 and 7, it seems that the fact that the retail buyer power of retailers is endogenous, meaning that retailers can use the competing offers of manufacturers in the contracting decision with a given manufacturer, raises the total margin compared to the case where the retailer buyer power is exogenous. Indeed, wholesale margins are larger with endogenous buyer power because manufacturers have to leave some additional "endogenous" rent to retailers through the use of fixed fees that we can interpret as backward margins for retailers. Manufacturers' reaction seems thus to back up into higher wholesale prices the buyer's capacity to recover backward margins. By difference between models 6 and 7, we can see that on average these additional backward margins represent 3.44% of retail price for mineral water and 18.32% for spring water. Industry structure is thus very important for determining margins. Taking into account the endogeneity of retailers' buyer power in the vertical relationships and price-setting games is crucial for the consistent evaluation of markups. The horizontal competition between manufacturers of bottles of water allows retailers to obtain additional "endogenous" backward margins which raise the wholesale prices offered by manufacturers.

6 Conclusion

In this paper, we presented the first empirical estimation of a structural model taking into account explicitly the endogenous buyer power of downstream retailers in two part tariffs contracts between manufacturers and retailers. We show how to estimate different structural models embedding the strategic relationships of upstream and downstream players, using demand estimates and the industry structure. We consider several alternative models of competition between manufacturers and retailers on a differentiated product market and test between these alternatives. We

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[8]There is a unique spring water national brand on the market for which total margins are relatively large. This spring water comes from many springs located in different places in the country and is known to have thus low transportation costs, and to use low quality low price packaging.

study in particular several types of non linear pricing relationships with two part tariffs contracts allowing retailers to enjoy some endogenous buyer power, and where RPM may be used or not. The method is implemented on the market for bottles of water in France in 2006 and estimates of demand parameters using micro-data allow us to recover price-cost margins at the manufacturer and retailer levels as well as fixed fees of non linear contracts for different models. We then test between the different models. Our empirical evidence allows to conclude that manufacturers and retailers use two part tariffs contracts without RPM and that the buyer power of retailers is endogenously determined by the upstream horizontal competition between manufacturers. The buyer power of retailers is thus affected endogenously by their offers from other manufacturers. Remark that the endogeneity of the buyer power of retailers that we take into account does not come from the retailers production of private labels but only from their strategic role in retailing and the competing manufacturers making also offers. With a different modelling, Meza and Sudhir (2009) study how private labels affect the bargaining power of retailers. In the present paper, the set of brands and products is taken as given including private labels. Endogenizing entry of private labels is more complicated and out of the scope of this paper.

Finally, remark that the contracts considered here between manufacturers and retailers are "bundling" contracts where manufacturers make take-it-or-leave-it offers to retailers for their multiple products. Considering unbundled contracts is also possible in our methodology even if more demanding in terms of estimation. However, this alternative model is likely to reinforce the buyer power of retailers, allowed to accept part of the brands of a manufacturer instead of the whole bundle, a situation which would thus go even more in the direction found and the evidence that retailers enjoy additional buyer power in front of their upstream competing providers. Endogenizing the bundles of goods offered to retailers as well a the possible foreclosure effects in this industry is thus an interesting research direction (Rey and Stiglitz, 1995, Rey and Tirole, 2007). The markets for bottles of water in France does not seem to be importantly affected by such strategies but other markets are (Asker, 2005) and further work needs to be done in this direction.

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7 Appendix

7.1 Detailed resolution of system of equations

Generically we have systems of equations to be solved of the form

$$\begin{cases} A_f(\gamma + \Gamma) + B_f = 0 \\ \quad \text{for } f = 1, .., G \end{cases}$$

where A_f and B_f are some given matrices.

Solving this system amounts to solve the following minimization problem

$$\min_{\gamma + \Gamma} \sum_{f=1}^{G} \left[A_f(\gamma + \Gamma) + B_f \right]' \left[A_f(\gamma + \Gamma) + B_f \right]$$

leads to the first order conditions

$$\left(\sum_{f=1}^{G} A_f' A_f \right) (\gamma + \Gamma) - \sum_{f=1}^{G} A_f' B_f = 0$$

that allow to find the following expression for its solution

$$(\gamma + \Gamma) = \left(\sum_{f=1}^{G} A_f' A_f \right)^{-1} \sum_{f=1}^{G} A_f' B_f$$

7.2 Detailed proof of the manufacturers profit expression under two-part tariffs

We use the theoretical results due to Rey and Vergé (2010) applied to our context with F firms and R retailers. The participation constraint (9) being binding, we have for all r $\sum_{s \in S_r} [(p_s - w_s - c_s)s_s(p) - F_s] = \overline{\Pi}^r$ which implies that

$$\sum_{s \in S_r} F_s = \sum_{s \in S_r} (p_s - w_s - c_s)s_s(p) - \overline{\Pi}^r$$

and thus

$$\begin{aligned} \sum_{j \in G_f} F_j + \sum_{j \notin G_f} F_j &= \sum_{j=1,..,J} F_j = \sum_{r=1,..,R} \sum_{s \in S_r} F_s \\ &= \sum_{r=1,..,R} \sum_{s \in S_r} (p_s - w_s - c_s)s_s(p) - \sum_{r=1,..,R} \overline{\Pi}^r = \sum_{j=1,..,J} (p_j - w_j - c_j)s_j(p) - \sum_{r=1,..,R} \overline{\Pi}^r \end{aligned}$$

so that

$$\sum_{j \in G_f} F_j = \sum_{j=1,...,J} (p_j - w_j - c_j)s_j(p) - \sum_{j \notin G_f} F_j - \sum_{r=1,..,R} \overline{\Pi}^r$$

Then, the firm f profits are

$$
\begin{aligned}
\Pi^f &= \sum_{s \in G_f} (w_s - \mu_s) s_s(p) + \sum_{s \in G_f} F_s \\
&= \sum_{s \in G_f} (w_s - \mu_s) s_s(p) + \sum_{j=1,..,J} (p_j - w_j - c_j) s_j(p) - \sum_{j \notin G_f} F_j - \sum_{r=1,..,R} \overline{\Pi}^r
\end{aligned}
$$

Since, producers fix the fixed fees given the ones of other producers, we have that under resale price maintenance :

$$
\begin{aligned}
\max_{\{F_i, p_i\}_{i \in G_f}} \Pi^f &\Leftrightarrow \max_{\{p_i\}_{i \in G_f}} \sum_{s \in G_f} (w_s - \mu_s) s_s(p) + \sum_{j=1,..,J} (p_j - w_j - c_j) s_j(p) \\
&\Leftrightarrow \max_{\{p_i\}_{i \in G_f}} \sum_{s \in G_f} (p_s - \mu_s) s_s(p) + \sum_{s \notin G_f} (p_s - w_s - c_s) s_s(p)
\end{aligned}
$$

and with no resale price maintenance

$$
\begin{aligned}
\max_{\{F_i, w_i\}_{i \in G_f}} \Pi^f &\Leftrightarrow \max_{\{w_i\}_{i \in G_f}} \sum_{s \in G_f} (w_s - \mu_s) s_s(p) + \sum_{j=1,..,J} (p_j - w_j - c_j) s_j(p) \\
&\Leftrightarrow \max_{\{w_i\}_{i \in G_f}} \sum_{s \in G_f} (p_s - \mu_s) s_s(p) + \sum_{s \notin G_f} (p_s - w_s - c_s) s_s(p)
\end{aligned}
$$

Then the first order conditions of the different two part tariffs models can be derived very simply.

7.3 First stage estimation

Dependent variable : p_{jt}	Coefficient	Std. Error
Wage index	0.0037	0.0008
Plastic price	-0.0003	0.0008
Diesel oil price	0.0007	0.0004
$\lambda_{b(j)}, \lambda_{r(j)}$ are not shown		
N	728	
R^2	0.98	

Table 7 : First stage regression OLS regression of prices

7.4 Additional formula for the demand model (not for publication)

Remind that the average choice probability of buying j at period t is :

$$
\begin{aligned}
s_{jt} &= \frac{1}{N} \sum_{i=1}^{N} P_{ijt} \\
&= \frac{1}{N} \sum_{i=1}^{N} \int L_{ijt}(\alpha_i) f(\alpha_i) d\alpha_i
\end{aligned}
$$

The theoretical cross-price elasticity of demand of product j with respect to price of product k is then

$$
\begin{aligned}
E_{jk} &= \frac{\partial s_j}{\partial p_k} \frac{p_k}{s_j} = \frac{p_k}{s_j} \left(\frac{1}{N} \sum_{i=1}^{N} \frac{\partial P_{ij}}{\partial p_k} \right) \\
&= \frac{p_k}{s_j} \left(\frac{1}{N} \sum_{i=1}^{N} \left(\int \alpha_i L_{ijt}(\alpha_i) L_{ikt}(\alpha_i) f(\alpha_i) d\alpha_i \right) \right)
\end{aligned}
$$

which can be simulated using

$$
SE_{jk} = \frac{p_k}{s_j} \left[\frac{1}{N} \sum_{i=1}^{N} \left(\frac{1}{R} \sum_{r=1}^{R} \alpha^r L_{ijt}(\alpha^r) L_{ikt}(\alpha^r) \right) \right]
$$

Similarly, the theoretical own price elasticity is

$$
\begin{aligned}
E_{jj} &= \frac{\partial s_j}{\partial p_j} \frac{p_j}{s_j} = -\frac{p_j}{s_j} \left(\frac{1}{N} \sum_{i=1}^{N} \frac{\partial P_{ij}}{\partial p_j} \right) \\
&= -\frac{p_j}{s_j} \left(\frac{1}{N} \sum_{i=1}^{N} \left(\int \alpha_i L_{ijt}(\alpha_i) \left(1 - L_{ijt}(\alpha_i) \right) f(\alpha_i) d\alpha_i \right) \right)
\end{aligned}
$$

which is simulated using

$$
SE_{jj} = -\frac{p_j}{s_j} \left[\frac{1}{N} \sum_{i=1}^{N} \left(\frac{1}{R} \sum_{r=1}^{R} \alpha^r L_{ijt}(\alpha^r) \left(1 - L_{ijt}(\alpha^r) \right) \right) \right]
$$