Essays on vertical relationships, bargaining power, and competition policy

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Contents

*This chapter is co-authored with Céline Bonnet and Zohra Bouamra-Mechemache.

†This chapter is co-authored with Claire Chambolle.

Introduction

Economic environments in which firms deal with intermediaries to supply their products or services to final consumers are ubiquitous. Examples include grocery markets in which food manufacturers deal with supermarket chains who have direct access to final consumers; pharmaceutical industries where manufacturers distribute their drugs through pharmacies and drugstores; multichannel television industries where cable channels sell their programs to multichannel video program distributors who then charge fees to consumers; health care sectors in which medical providers (e.g., hospitals) form agreements with insurers to have access to patients. One particular feature of these industries is that they are often characterized by a bilateral oligopolistic structure in which a small number of firms operate on both sides of the market, which generates complex interactions in the supply chain. Contracting externalities are often present because the value generated by an agreement and shared between a manufacturer and a retailer generally depends on the contracting decisions of other firms operating on the market. A number of practices, commonly referred to as vertical restraints, may also arise such as exclusive dealing, bundling and tying, resale price maintenance, or quantity discounts. Furthermore, trading terms are mostly determined through a bargaining process between upstream and downstream firms rather than being fixed by one-side of the market.

Vertical relationships have a long history in antitrust laws. Since 1914 and the Section 2 of the Clayton Act which attempted to prohibit price discrimination to protect small businesses against big-box retailers, competition authorities and policy makers have devoted particular attention to firms' behavior in distribution channels. This interest has been increasing over the past decades given the rise of large retailers (e.g., Walmart, Carrefour, Toys 'R' Us, Amazon). Most antitrust agencies seem to have recognized the procompetitive effects by which large retail chains are able to counteract the market power of manufacturers and reduce prices paid by final consumers.[1] In practice, however, the policy treatment of retail concentration and countervailing power remain a contentious area and authorities lack clear guidelines. What are the determinants of countervailing power? Does retail concentration enhance countervailing power to the benefit of final consumers, or does it simply increase market power for retailers? Do big-box retailers change the analysis of vertical restraints? How do they affect the upstream market structure and manufacturers' incentive to innovate?

[1] Galbraith (1952) was the first to highlight this effect.

The oldest studies of vertical structures in industrial organization date back to the double marginalization problem of Spengler (1950), and the hold-up externality that was brought forward by Oliver E. Williamson in the 1970's. Most of the literature on vertical restraints (e.g., Mathewson and Winter, 1984; Rey and Tirole, 1986) and vertical integration (e.g., Hart and Tirole, 1990) was developed during the 1980's and 1990's. However, these papers have mainly considered contracts as a coordination device to maximize industry profit rather than a tool to divide surplus within the vertical chain. In line with the growing dominance of large retailers in many industries and the greater attention of antitrust agencies on this topic, the analysis of countervailing power has gained further interest over the last twenty years in the economic literature. On the theoretical side, the modern theory of bargaining combined with new equilibrium concepts (e.g., Crémer and Riordan, 1987; Horn and Wolinsky, 1988) has laid the groundwork for studying vertically related markets with powerful retailers and interlocking relationships.[2] On the empirical side, progress in computer power, advances in econometric techniques, and access to rich data on market outcomes have opened up new opportunities to analyze strategic interactions between firms in imperfectly competitive markets (e.g., Berry, Levinsohn and Pakes, 1995). Based on explicit economic theories and statistical methods, empirical researchers in industrial organization have recently developed structural econometric models to analyze vertical relationships between manufacturers and retailers (e.g., Villas-Boas, 2007; Bonnet and Dubois, 2010).

The purpose of this dissertation is to analyze competitive forces at play in bilateral oligopolistic structures and provide further insights on the ability of retailers to exert a countervailing power that benefits consumers. More specifically, this dissertation focuses on three economic issues related to market structure changes (Chapter 1 and 2) and vertical restraints (Chapter 3).

Chapter 1, co-authored with Céline Bonnet and Zohra Bouamra Mechemache, investigates the effects of downstream competition on the bargaining power of firms and prices paid by final consumers. One of this chapter's primary contributions is to elaborate a structural framework of demand and supply to analyze manufacturer-retailer relationships in bilateral oligopolies with differentiated products. The model incorporates a vertical structure in which (i) upstream and downstream firms engage in bilateral bargains to determine wholesale prices of products, and (ii) retailers subsequently compete in prices for final consumers. We focus on the French soft drink industry which is of particular interest given the existence of large food companies operating on different segment of the market (e.g., cola, ice-tea). Our approach is particularly appealing because we can estimate both marginal costs of products and bargaining power

[2] E.g., Dobson and Waterson (1997, 2007).

of firms to determine the surplus division in the distribution channel without data on wholesale contracts. Furthermore, we propose an algorithm to evaluate counterfactual policy experiments (here, the removal of one retailer). After recomputing a new bargaining equilibrium and downstream price equilibrium, we find that a downstream consolidation leads to further countervailing power. However, this effect is dominated by the increase in market power of retailers which has detrimental implications for final consumers.

In Chapter 2, I investigate the economic effects of another change in market structure by which retailers form alliances to negotiate common trading terms with manufacturers. The main contribution of this chapter is to shed new light on two effects working in opposite directions. On the one hand, joining forces deteriorates the outside options of manufacturers in negotiations, which weakens their bargaining position vis-à-vis retailers. On the other hand, the fact that members of an alliance receive nondiscriminatory trading terms lessens the ease to obtain price concessions from manufacturers and reduces the bargaining power of retailers. Considering the difficulty to derive sharp theoretical predictions on the effects generated by buyer alliances, I use household-level scanner data on bottled water purchases to estimate a structural model closely related to the one described in the previous chapter. In contrast with prior empirical works on bilateral oligopolies I use conditional moment restrictions that approximate optimal instruments to recover the bargaining power of firms. I then perform simulations to study the economic effects of three buyer alliances that have been formed by competing retailers in the French food retail sector in 2014. Results differ from Galbraith's countervailing buyer power theory and show that the bargaining power of retailers is weakened, total industry profit decreases, and final consumers face higher prices.

In Chapter 3, co-authored with Claire Chambolle, we build a theoretical model to examine the case of full-line forcing contracts as a foreclosure strategy in vertically related markets. Selling products in packages to retailers is a convenient device for manufacturers who seek to impose their brand portfolio on the market. Our setting considers a multi-product manufacturer that offers a leading brand and a secondary brand for which it competes with a more efficient single-product firm. In equilibrium, the retailer always offers the leading brand but may favor the secondary brand of the multi-product manufacturer for buyer power motive. Such equilibrium harms welfare. Moreover, multi-product manufacturer's full-line forcing strategy may, by affecting threat points in the bargaining, facilitate the emergence of this inefficient outcome. We show that full-line forcing arises in equilibrium under three conditions (i) the leading brand of the multi-product firm is strong enough, (ii) the inefficiency on the secondary brand is not too severe, and (iii) the rival supplier is powerful enough in its bargaining with the retailer.

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Chapter 1

The Downstream Competition Effects in Bilateral Oligopolies: A Structural Bargaining Approach with Limited Data*

1 Introduction

How firms interact in vertically related markets is of great interest for public authorities since it can either affect prices or have adverse effects on investment in innovation, which in both cases may undermine consumer welfare. This concern is particularly acute in agro-food industries where negotiations between manufacturers and retailers often lead to fierce political debates. Over the course of these last decades, the food retail sector has known a significant consolidation, leading to the rise of large retailers owning important share of domestic retail sales. In particular, the use of mergers or buyer alliances by retailers has become a common practice over the past years.[1] For instance, the six largest retail groups in the French food retail sector in 2016 are Groupe Carrefour (21.1%), Groupe Leclerc (20.7%), ITM Entreprises (14.1%), Groupe Casino (11.4%), Groupe Auchan (11.4%), and Groupe Système U (10.1%).[2] In addition, the share of private labels introduced by food retailers has increased in almost all EU Member States, stimulating the competition between national brands of food manufacturers.[3] Nonetheless, in some markets, retailers face strong upstream firms with must-have brands, seeking to extract profits and being able to challenge their buyer countervailing power. As a result, the surplus division may become diffi-

*This chapter is co-authored with Céline Bonnet and Zohra Bouamra-Mechemache.

[1]More recently, the formation of buyer alliances has raised concern in France (see Autorité de la concurrence, 2015).

[2]Kantar Worldpanel 2016: http://www.kantarworldpanel.com/fr/grocery-market-share/france.

[3]Private labels exceed 30% of market share in several Member States (e.g., UK, Germany, France) (see European Commission, 2011, p. 78).

cult to determine, which in turn prevents policy makers from a clearer understanding of the main driving forces in the vertical chain.

In this article, we design a structural model of demand and supply to estimate the division of surplus in bilateral oligopolies with differentiated products. The framework includes a static model of bilateral bargaining with secret offers between multiple manufacturers and retailers as well as a price-setting game in which retailers compete for final consumers. Our setting allows to grasp three potential sources of bargaining power. A firm is able to obtain better trading terms because (i) it has greater status quo payoffs than its trading partner if the negotiation breaks, (ii) it faces lower bargaining costs (e.g., high patience in negotiations, low fear of bargaining breakdown), or (iii) it bears strong costs of making price concessions (i.e., an agreement to accept less favorable trading terms). Using household-level scanner data, our analysis focuses on the annual negotiations in the French soft drink industry, which are of particular interest given the existence of large food companies operating in different segment of the market.[4] Our findings show that the bargaining power lies in the retailers' hands which are able to capture more than 60 percent of the surplus generated by bilateral contracts with manufacturers. This result is mainly explained by their ability to secure higher outside options in negotiations as well as by the large costs they incur from making price concessions to manufacturers which lessen the ease to raise wholesale prices.

Using estimates of our structural model, we investigate the effects of downstream concentration on the bargaining power of firms and prices paid by final consumers. According to the countervailing buyer power theory of Galbraith (1952), further consolidation of retail sectors would lead to lower wholesale prices that can be passed on into retail prices and benefit final consumers. However, the modelling of consumer demand and the pass-through rate from wholesale to retail prices play a key role on the emergence of this outcome (Gaudin, 2017). Our results show that downstream consolidation through the removal of one retailer effectively leads to lower wholesale prices paid to manufacturers in most cases. However, we find that the market power effect generated by the decrease in downstream competitors dominates the buyer power effect, resulting in higher prices for final consumers.

Related literature and Contributions. This paper is in line with the empirical literature on bilateral oligopoly and multilateral vertical relations. A first stream of articles

[4]In its recent study, the European Commission has pointed out that the French soft drink market belongs to the most concentrated industries in the agro-food sector (see European Commission, 2014, p. 306). Additionally, "the top fifty global brands include seven food products, mainly beverages." (European Commission, 2007, p. 34).

has considered vertical contracting in noncooperative games with upstream take-it-or-leave-it offers. Downstream competition in the context of vertically related markets was first introduced by Villas-Boas (2007) who analyzes the contractual forms used between manufacturers and retailers in the U.S. yogurt industry. Ho (2009) investigates the determinants that affect relationships between hospitals and health insurers and focuses on the strategic decision of the later to select and include hospitals in their insurance plans. Using the theoretical setting of interlocking relationships developed by Rey and Vergé (2010), Bonnet and Dubois (2010) extend the analysis of Villas-Boas (2007) to nonlinear pricing contracts such as two-part tariffs with (and without) resale price maintenance in the French bottled water market.[5] In accordance with institutional details of the French soft drink industry and the growing consolidation of the retail sector, our empirical approach to model vertical relationships builds on an emerging literature that allows for balanced bargaining power and contracting externalities. Draganska, Klapper and Villas-Boas (2010) develop a supply model of bilateral oligopoly to study the surplus division between manufacturers and retailers in the German market for coffee. In their application, they estimate the bargaining power of firms under the timing assumption that wholesale and retail prices are determined simultaneously (i.e., retailers do no adjust their pricing behavior according to unanticipated changes in wholesale prices). Although it dramatically simplifies the computation of the model, this timing assumption imposes restrictions on the pass-through rate in the vertical chain. Instead, Crawford and Yurukoglu (2012) propose an empirical framework with sequential moves in which vertical contracts are negotiated before the downstream competition. To estimate the bargaining power of firms in the U.S. multichannel television industry, they take advantage of the absence of marginal cost to produce or distribute programs and directly match observed prices paid to channels by distributors with those predicted by their bargaining model. Empirical frameworks of bargaining have also been widely used to analyze buyer-seller relationships in the health care sector. For instance, Grennan (2013) examines bilateral bargains between medical device manufacturers and hospitals in the U.S. coronary stent industry and Gowrisankaran, Nevo and Town (2015) study the effects of hospital mergers on prices negotiated by health insurers. Their modelling approach, however, does not consider a bilaterally oligopolistic structure with downstream competition but instead assume that hospitals (resp. insurers) directly negotiate on behalf

[5] See also papers that use structural models to study price discrimination (Villas-Boas, 2009) or cost pass-through (Goldberg and Hellerstein, 2013; Bonnet et al., 2013) in vertically related markets.

of their patients (resp. enrollees).[6] In contrast, Ho and Lee (2017) consider a setting of insurer-hospital bargaining where insurers also engage in bilateral negotiations on a downstream market with large employers. Using the timing assumption of Draganska, Klapper and Villas-Boas (2010), they investigate the welfare effects of market structure changes through the removal of one insurer on equilibrium outcomes.

In this article, we contribute to the literature and develop a game-theoretic framework with sequential moves as in Crawford and Yurukoglu (2012) where we consider that differentiated products offered on markets are costly to produce and distribute. Our methodology is particularly attractive since we are able to estimate the bargaining power of firms without any information on wholesale prices paid to manufacturers by particular retailers. The empirical approach can be described as follows. We first use data on soft drink purchases to estimate a demand model and obtain the degree of consumer substitutability between products. To this end, we specify a random coefficient logit model which incorporates unobserved heterogeneity in consumer preferences and allows for realistic substitution patterns. We then consider the supply-side of the French soft drink industry which is modelled as a bilaterally oligopolistic structure. Under the assumption that retailers compete in prices for final consumers, we use demand estimates and the set of first-order conditions that describes their pricing behavior to back out price-cost margins and marginal costs of retailers for each product. Considering manufacturer-retailer relationships, we express the marginal cost of retailers as a function of two components to estimate the surplus division in the supply chain. First, variations in retail marginal costs depend on differences in operational costs of products (i.e., cost of production or distribution). The second component that explains retail costs relates to the ability of manufacturers to exert their market power in the vertical chain and charge wholesale prices above their marginal costs of production. By using a linear function of cost shifters and unobservables to proxy the operational costs and a functional form implied by our bargaining framework to capture the market power of manufacturers, we are able to estimate bargaining and cost parameters with a conditional moment restriction model. Using estimated parameters of our structural model, we can derive upstream price-cost margins, recover the surplus division between manufacturers and retailers, and perform simulations to evaluate counterfactual policy experiments.

This article is organized as follows. In Section 2, we describe our data used to estimate the empirical model. Section 3 presents the demand model that captures the

[6]In a robustness analysis, Gowrisankaran, Nevo and Town (2015) consider a calibrated version of their model similar to Crawford and Yurukoglu (2012) which incorporates downstream price competition between insurers for enrollees.

consumers behavior on the French soft drink industry. In Section 4, we introduce the supply model devoted to the analysis of the balance of power between manufacturers and retailers in the vertical chain. Section 5 provides empirical results of our structural model of demand and supply. Counterfactual simulations are presented in Section 6 and Section 7 concludes.

2 Data and Institutional Details

Soft drinks include colas, other sodas, ice-tea as well as fruit juices. Colas and sodas represent 40 percent of total sales in value while juices represent around 30 percent (Xerfi-France). We use household-level scanner data on soft drink purchases in France collected by Kantar WorldPanel from April 2005 to September 2005.[7] This dataset is composed of $265,998$ purchases for home consumption and provide information about retail prices as well as brand and store names of purchased items. Four main manufacturers operate on the French soft drink market, namely The Coca-Cola Company, PepsiCo, Orangina-Schweppes and Unilever. Each beverage company is leader in one of the four soft drink segment (i.e., colas, other sodas, ice-tea, juices and nectars). The cola segment is extremely concentrated with the leading firm representing 70 percent of total sales (cf. Table 1). The segment of other sodas is less concentrated but also includes leading brands such as Fanta and Schweppes. The juice and nectar segment is more competitive even if some well-known brands such as Tropicana are offered to final consumers. Private labels (or store brands) represent on average 42% of market share in our sample.[8] While they compete with strong national brands on the cola segment (e.g., Coca-Cola or Pepsi), they represent respectively 45 percent and 55 percent of purchase frequency on the other sodas and ice-tea segments, and their penetration rate reaches 85 percent of purchase frequency on the juice and nectar segment. Therefore, retailers are likely to play an important role in the allocation of margins within the distribution channel as they potentially benefit from a large outside option through private labels at least for three over four soft drink categories.[9]

On the downstream market, we consider purchases at the main grocery store chains in France which differ in term of services they provide to consumers. Five main retailers

[7]We decided to conduct our analysis over this sample period because soft drink sales are sensitive to weather conditions. Therefore, we select the most favorable time period for soft drink consumption in which we observe the largest number of purchases.

[8]The market share of product j is defined as the sum of the purchased quantities of product j divided by the total quantities purchased.

[9]We consider that private labels are either produced by retailers themselves or by a competitive fringe. In both cases, retailers purchase their private labels at marginal cost.

Table 1: Descriptive statistics of the brands

Brand	Upstream ownership	Purchase frequency	Retail price (€/liter)
Cola			
PL	Manufacturer 5	4.12%	0.32 (0.05)
Brand 13	Manufacturer 2	1.08%	0.69 (0.07)
Brand 22	Manufacturer 1	0.14%	0.96 (0.06)
Brand 23	Manufacturer 1	11.82%	0.87 (0.04)
Total		17.15%	0.71 (0.01)
Other soda			
PL	Manufacturer 5	7.42%	0.40 (0.05)
Brand 5	Manufacturer 2	0.10%	0.77 (0.06)
Brand 10	Manufacturer 4	1.74%	0.83 (0.08)
Brand 11	Manufacturer 4	1.73%	0.97 (0.09)
Brand 14	Manufacturer 4	2.27%	1.06 (0.06)
Brand 15	Manufacturer 2	0.35%	0.71 (0.07)
Brand 16	Manufacturer 1	0.41%	0.73 (0.06)
Brand 17	Manufacturer 4	0.78%	1.08 (0.06)
Brand 19	Manufacturer 4	0.02%	0.71 (0.02)
Brand 20	Manufacturer 4	0.08%	0.96 (0.03)
Brand 21	Manufacturer 4	0.13%	3.33 (0.12)
Brand 24	Manufacturer 1	1.20%	0.94 (0.15)
Total		16.20%	0.64 (0.01)
Juice & Nectar			
PL	Manufacturer 5	29.70%	0.82 (0.09)
Brand 8	Manufacturer 1	0.27%	1.62 (0.28)
Brand 12	Manufacturer 4	0.85%	1.69 (0.11)
Brand 18	Manufacturer 2	3.38%	2.01 (0.16)
Brand 25	Manufacturer 1	0.33%	1.39 (0.13)
Total		34.53%	0.94 (0.01)
Ice-Tea			
PL	Manufacturer 5	2.35%	0.51 (0.07)
Brand 6	Manufacturer 3	1.92%	1.01 (0.09)
Brand 7	Manufacturer 3	0.12%	1.25 (0.13)
Brand 9	Manufacturer 1	0.23%	0.89 (0.06)
Total		4.62%	0.71 (0.02)
Outside good		27.49%	

Standard deviation in parenthesis refers to variation across retailers and periods. "PL" corresponds to *private label*. Retail prices for each row *Total* have been weighted by market shares of brands and their standard deviation in parenthesis refers to variation across periods. Remark that we are not permitted to reveal names of the brands, manufacturers and retailers due to confidentiality regarding Kantar WorldPanel data.

operate in the French retail sector. Among them, three retailer chains are characterized by large outlets, while the two other chains have intermediate-sized outlets. In addition, we define two aggregates: an aggregate of discounters that are typically small to intermediate sized, provide only basic services, and offer the lowest variety of products, and an aggregate of the remaining retailers. These retailers are assumed to be national chains which are present in all regions in France. Therefore, consumers based in different local regions face similar product assortments when shopping at a given retailer. We define a market as all purchases of soft drink for home consumption in France within a month. Our analysis considers the 21 top selling national brands in term of purchase frequency plus all private labels aggregated with respect to their category (colas, other sodas, ice-tea, juices and nectars). We define a product as a combination of one brand and one retailer.[10] As a result, we have 157 differentiated products representing 74.58% of the total sales of soft drink. All remaining national brands of carbonated soft drinks, juices and nectars, and flavored waters, are aggregated in an outside good. Average retail prices across categories of soft drinks are similar except for the juices and nectars which are more expensive. However, retail prices within each segment are very heterogeneous. For instance, national brands are twice more expensive than private labels in the cola segment.

3 Consumers Demand for Soft Drinks

To analyze vertical relationships between manufacturers and retailers, the demand model is a key issue. We use a random coefficient logit model that allows assessing flexible substitution patterns across products.

3.1 The Demand Model

Utility. We consider a choice set $\mathcal{J} = \{0, 1, \ldots, J\}$ of differentiated products available to consumers. This choice set could vary across the T time periods and a consumer faces the set of products $\mathcal{J}_t$ during the time period t. We assume that consumers can only choose one unit of a product belonging to the choice set $\mathcal{J}_t$ in each period. Following the discrete-choice literature (Berry, Levinsohn and Pakes, 1995; Nevo, 2001; Train, 2009), we consider that the utility derived by consumer i from purchasing product j in period t is specified as follows

$$U_{ijt} = \delta_{b(j)} + \delta_{r(j)} - \alpha_{ij} p_{jt} + \xi_{jt} + e_{ijt}$$

where $\delta_{b(j)}$ and $\delta_{r(j)}$ are brand and retail fixed effects that capture respectively the mean utility in the population generated by unobserved time invariant brands characteristics and unobserved time invariant retailers' characteristics, α_{ij} is the disutility of

[10]For instance, one liter of Coca-Cola sold by Carrefour and by Auchan correspond to two different products.

consumer i for the price of product j, ξ_{jt} is a product-period specific error term that represents the utility derived from unobserved (to the econometrician) products characteristics, e_{ijt} captures the consumer-specific error.

Allowing for heterogeneous consumer price disutilities, we assume that α_{ij} varies across consumers as follows

$$\alpha_{ij} = \exp(\alpha_{nb(j)} + \alpha_{pl(j)} + \sigma \nu_i) \quad \text{where } \nu_i \sim \mathcal{N}(0,1)$$

where $\alpha_{nb(j)}$, $\alpha_{pl(j)}$ and σ are parameters to be estimated of the log normal distribution of the price coefficient.

Outside option. In order to give the possibility to consumers not to purchase any products among the J_t alternatives from our choice set, an outside good has been introduced and we assume the utility from purchasing this outside good is normalized to $U_{i0t} = e_{i0t}$.

Market share. Assuming that e_{ijt} is independently and identically distributed from the standard Gumbel distribution (also known as type I extreme value distribution), the individual market share of product $j \in \mathcal{J}_t$ in period t can be written as follows

$$s_{ijt} = \int_0^{+\infty} \frac{\exp(\delta_{b(j)} + \delta_{r(j)} - \alpha_{ij} p_{jt} + \xi_{jt})}{1 + \sum_{k=1}^{J_t} \exp(\delta_{b(k)} + \delta_{r(k)} - \alpha_{ik} p_{kt} + \xi_{kt})} f(\alpha_{ij}) \, \mathrm{d}\alpha_{ij}$$

where $f(.)$ corresponds to the density function of the log-normal distribution.

Elasticity. The random coefficient logit model generates a flexible pattern of substitution between products by taking into account differences in consumer price disutilities and is not subject to the IIA assumption unlike the multinomial logit model or the nested logit model. Own-price elasticities and cross-price elasticities can be written as follows

$$\varepsilon_{jkt} = \begin{cases} -\frac{p_{jt}}{s_{jt}} \int_0^{+\infty} \alpha_{ij} s_{ijt} \left(1 - s_{ijt}\right) f(\alpha_{ij}) \mathrm{d}\alpha_{ij} & \text{if } j = k \\ \frac{p_{jt}}{s_{jt}} \int_0^{+\infty} \alpha_{ij} s_{ijt} s_{ikt} f(\alpha_{ij}) \mathrm{d}\alpha_{ij} & \text{if } j \neq k \end{cases}$$

Willingness-to-pay per consumer. From the consumer-level data and the distribution of the marginal disutility of retail prices in the population $f(\alpha_{ij} \mid \Theta_{\alpha_j})$, where

$\boldsymbol{\theta}_{\boldsymbol{\alpha}_j} \equiv (\bar{\alpha}_j, \sigma_\alpha)^\top$ with $\bar{\alpha}_j$ denotes the mean and σ_α the standard deviation, it is possible to infer the marginal disutility of retail prices for each individual consumer in the sample (e.g., Train, 2009, ch. 11).[11][12] Indeed, it can be shown that the distribution of this disutility in the subpopulation of consumers who have purchased product j in period t is

$$f(\alpha_{ij} \mid y_{ijt} = 1, \boldsymbol{\theta}_{\boldsymbol{\alpha}_j}) = \frac{s_{ijt|\alpha_{ij}}\, f(\alpha_{ij} \mid \boldsymbol{\theta}_{\boldsymbol{\alpha}_j})}{\int_0^{+\infty} s_{ijt|\alpha_{ij}}\, f(\alpha_{ij} \mid \boldsymbol{\theta}_{\boldsymbol{\alpha}_j})\, \mathrm{d}\alpha_{ij}} \tag{1}$$

where $s_{ijt|\alpha_{ij}} \equiv \frac{\exp(\delta_{b(j)}+\delta_{r(j)}+\delta_{pl(j)}-\alpha_{ij}p_{j,t}+\xi_{j,t})}{1+\sum_{k=1}^{J}\exp(\delta_{b(k)}+\delta_{r(k)}+\delta_{pl(k)}-\alpha_{ik}p_{k,t}+\xi_{k,t})}$ denotes the individual market share of product j in period t conditionnal on α_{ij} and y_{ijt} indicates if consumer i has chosen product j in period t. Using (1), the (expected) marginal disutility of the retail price for each consumer having purchased product j in period t is given by:

$$\frac{\int_0^{+\infty} \alpha_{ij}\, s_{ijt|\alpha_{ij}}\, f(\alpha_{ij} \mid \boldsymbol{\theta}_{\boldsymbol{\alpha}_{ij}})\, \mathrm{d}\alpha_{ij}}{\int_0^{+\infty} s_{ijt|\alpha_{ij}}\, f(\alpha_{ij} \mid \boldsymbol{\theta}_{\boldsymbol{\alpha}_{ij}})\, \mathrm{d}\alpha_{ij}} \tag{2}$$

Hence, the willingness-to-pay of each consumer for a particular product attribute is obtained as the ratio of the attribute's parameter to the marginal disutility of retail price given by (2). In our model, we are able to evaluate the willingness-to-pay for brand and retailer fixed effects that will capture the addtional price that the consumer is willing to pay for choosing the brand or retailer with respect to the brand and retailer references. In practice, for each product j purchased by the consumer i in our sample, we compute the willingness-to-pay for buying a product in the retailer r as $WTP_i^{r(j)} = \frac{\delta_{r(j)}}{\alpha_{ij}}$ and a product of brand b as $WTP_i^{b(j)} = \frac{\delta_{b(j)}}{\alpha_{ij}}$.

3.2 Identification and Estimation of the Demand Model

Identification assumptions. The identification of demand parameters rests on the assumption that the explanatory variables are independent of the error disturbance ξ_{jt}. Some omitted product characteristics, included in ξ_{jt} and not observed by the econometrician, could be correlated with the price of the product j at period t (Berry, 1994). For instance, we do not know the amount of advertising that firms invest each

[11]For the log-normal distribution, $\bar{\alpha}_j = \exp(\alpha_j + \frac{\sigma^2}{2})$ and $\sigma_\alpha = \bar{\alpha}_j\left(\exp(\sigma^2)-1\right)^{\frac{1}{2}}$. When the consumer buys a national brand product, $\alpha_j = \alpha_{nb(j)}$. When the consumer buys a private label product, $\alpha_j = \alpha_{pl(j)}$.

[12]Throughout the paper we will use boldface to distinguish between vectors (or matrices) and scalars.

month for their brand or the display on shelves in stores. This is then included in the error term because the publicity could be a determining factor in the choice process of households. As advertising is a non negligible part of the cost of soft drink products, it is obviously correlated with prices. To solve the endogeneity problem of prices and obtain consistent estimates of demand parameters $\theta^d = (\alpha_{nb(j)}, \alpha_{pl(j)}, \sigma, \delta_{b(j)}, \delta_{r(j)})^\top$, we use a two-stage residual inclusion approach, also called control function approach, as in Terza, Basu and Rathouz (2008) or Petrin and Train (2010). We then regress prices on instrumental variables $\mathbf{Z}^d_{jt}$ as well as the exogenous variables of the baseline utility function, $\delta_{b(j)}$ and $\delta_{r(j)}$:

$$p_{jt} = \delta_{b(j)} + \delta_{r(j)} + \zeta \mathbf{Z}^d_{jt} + u_{jt} \tag{3}$$

where ζ is a vectors of parameters, and u_{jt} represents the error term containing all unobserved variables that explain p_{jt}.

The estimated error term $\hat{u}_{jt}$ of the first-stage includes omitted variables as advertising variations or displays that explain both prices and the choice of the product. Introducing this term in the utility U_{ijt} allows capturing unobserved characteristics and then correlation between ξ_{jt} and p_{jt}. We then write

$$U_{ijt} = \delta_{b(j)} + \delta_{r(j)} - \alpha_{ij} p_{jt} + \rho \hat{u}_{jt} + \tilde{e}_{ijt}$$

The new error term $\tilde{e}_{ijt} = -\rho \hat{u}_{jt} + \xi_{jt} + e_{ijt}$ is now uncorrelated with the price p_{jt}.

In practice, for excluded instruments, we use some cost shifters such as the input price of sugar interacted by the quantity of added sugar content of each brand, the input price of orange juice for pure juice products, the input price of aluminum interacted by the average percentage of cans sold for each product in the other periods and the input price of plastic. Input prices are valid instruments since they explain prices, and the soft drink industry represents only a very small share of the demand of these inputs, which justifies the absence of correlation between input prices and unobserved determinants of the demand for soft drink products. To introduce product variation in those input prices, we use the sugar content of each brand. We also use the percentage of cans sold in other periods for each product. As we think that packaging material of products (can or plastic bottle) could affect both prices and demand, we use the average percentage of cans sold in other periods as a proxy of cost shifters between products, assuming that demand is independant across periods (Hausman, 1996).

Estimation procedure. We estimate the vector of demand parameters θ^d by maximizing the simulated log-likelihood function given by

$$\mathrm{SLL}(\theta^d) = \sum_t \sum_i \sum_j \mathbb{1}_{\{y_{i,j,t}=1\}} \ln(\check{s}_{i,j,t})$$

where $\check{s}_{ijt}$ represents the individual simulated market share of product j in market t written as follows

$$\check{s}_{ijt} = \frac{1}{ns}\sum_{h=1}^{ns} \frac{\exp(\delta_{b(j)} + \delta_{r(j)} - \exp(\alpha_{nb(j)} + \alpha_{pl(j)} + \sigma\nu_i)\, p_{jt} + \rho\hat{u}_{jt})}{1 + \sum_{k=1}^{J_t} \exp(\delta_{b(k)} + \delta_{r(k)} - \exp(\alpha_{nb(k)} + \alpha_{pl(k)} + \sigma\nu_i)\, p_{kt} + \rho\hat{u}_{kt})}$$

with ns corresponds to the total number of Halton draws for each consumer i.[13]

4 The Supply Model

Setup. The French soft drink industry in period t is modelled as a bilateral oligopoly with F manufacturers, R retailers, and $J_t + 1$ differentiated products. Let $\mathcal{J}_{ft}$ denotes the set of products owned by manufacturer f and $\mathcal{J}_{rt}$ the set of products distributed by retailer r in period t such that $\bigcup_{f=1}^{F} \mathcal{J}_{ft} = \bigcup_{r=1}^{R} \mathcal{J}_{rt} = \mathcal{J}_t \backslash \{0\}$. The (per-period) profit function of manufacturer f is written as follows

$$\pi_{ft} = \sum_{j \in \mathcal{J}_{ft}} \left(w_{jt} - \mu_{jt}\right) M_t\, s_{jt}(\mathbf{p}_t; \theta^d)$$

and the (per-period) profit function of retailer r is given by

$$\pi_{rt} = \sum_{j \in \mathcal{J}_{rt}} \left(p_{jt} - w_{jt} - c_{jt}\right) M_t\, s_{jt}(\mathbf{p}_t; \theta^d)$$

where p_{jt} is the retail price of product j in period t, w_{jt} is the wholesale price of product j in period t, μ_{jt} and c_{jt} are respectively the (constant) marginal cost of production and distribution for product j in period t, M_t is the total number of quantity purchased on the market (commonly called the "market size"), and s_{jt} represents the predicted market share of product j in period t as a function of retail prices — denoted by the J_t-dimensional vector $\mathbf{p}_t$ — and demand parameters.

Timing, information and solution concept. Interactions between manufacturers and retailers on the French soft drink market are described by the following two-stage game:

[13] In order to obtain each ν_i, we use Halton sequence. More precisely, based on Train (2000), we use 100 Halton draws per individual in the subsample to obtain the smallest simulation variance in the estimation of the random parameters.

- **Stage 1:** Manufacturers and retailers bargain bilaterally and simultaneously over linear wholesale prices of products.[14] We assume that wholesale contracts are secret (i.e., contracting parties bargain without being able to observe trading terms of transactions they do not participate).
- **Stage 2:** Retail prices are determined simultaneously by retailers competing on the downstream market for final consumers.

In this bilateral oligopoly setting with bargaining and contracting externalities, we employ the "Nash-in-Nash" bargaining solution (Horn and Wolinsky, 1988; Collard-Wexler, Gowrisankaran and Lee, 2017) to determine the division of surplus between manufacturers and retailers. This refinement of the Perfect Bayesian equilibrium concept refers to a bargaining model with a delegated negotiator structure in which delegates are sent by up- and downstream firms to negotiate trading terms on their behalf in each bilateral negotiation.[15] Based on the Nash's axiomatic theory of bilateral bargaining (Nash, 1950), each pair of delegates determines the division of surplus given its conjectures about trading terms reached in all other bilateral negotiations. As a result, the "Nash-in-Nash" bargaining solution corresponds to a Nash equilibrium of a game in which players are pairs of delegated negotiators.[16] In this respect, our bargaining model relates to an environment in which contracts are binding, negotiators have *passive beliefs* (McAfee and Schwartz, 1994) — i.e., when an unexpected outcome arises from a bilateral negotiation delegates involved in the transaction do not revise their beliefs about other secret deals — and firms behave schizophrenically.[17] Such a semi-cooperative mechanism for division of surplus has been extensively employed in recent empirical models of bargaining with contracting externalities (see Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran, Nevo and Town, 2015; Ho and

[14]Nonlinear contracts (e.g., two-part tariffs) are more efficient than linear tariffs since they allow to coordinate the distribution channel to avoid the double marginalization distortion and therefore maximize the industry profits. However, as pointed out by Dobson and Waterson (2007), there may be some reasons to lean toward linear tariffs, in particular when firms meet unfrequently (e.g., annual negotiations) and demand is uncertain. Such simple payment scheme have already been employed in theoretical setting to model vertical relationships (Dobson and Waterson, 1997; Inderst and Valletti, 2009; O'Brien, 2014), as well as in most prior empirical models of bargaining (Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran, Nevo and Town, 2015; Ho and Lee, 2017).

[15]More precisely, each firm allocates one delegated agent to one bilateral negotiation it is involved.

[16]This solution concept — also called *bargaining equilibrium* (O'Brien and Shaffer, 1994, 2005) — is similar in spirit to the concept of *contract equilibrium* pioneered by Crémer and Riordan (1987) (see also O'Brien and Shaffer, 1992).

[17]We refer to the notion of schizophrenia since delegates coming from the same firm are unable to communicate with one another during the bargaining process.

Lee, 2017). In the downstream market, we consider that retailers compete in prices with *interim unobservability* (Rey and Vergé, 2004).[18] This setting refers to a situation in which each retailer sets its retail prices conditioning on the outcomes of bilateral negotiations it was involved in and on its beliefs about the outcomes of other deals. Hence, any (secret) change in wholesale prices of one retailer does not affect the pricing behavior of other retailers. Finally, we assume complete information about the (constant) marginal cost of production and distribution of each product. Proceeding backwards, we first start from the last stage by considering the price competition between retailers.

4.1 Stage 2: Downstream price competition

We consider the downstream competition between retailers and assume that retail prices observed in our sample are determined in a pure-strategy Nash equilibrium where retailers hold (rational) conjectures about wholesale contracts of their rivals.[19] In this setting, the maximization problem of retailer r is written as follows

$$\max_{\{p_{jt}\}_{j\in\mathcal{J}_{rt}}} \sum_{j\in\mathcal{J}_{rt}} \left(p_{jt} - w_{jt} - c_{jt}\right) M_t \, s_{jt}(\mathbf{p}_{rt}, \mathbf{p}^*_{-rt}; \theta^d)$$

where $\mathbf{p}_{rt}$ denotes the retail price vector set by the retailer r and $\mathbf{p}^*_{-rt}$ the (anticipated) equilibrium retail price vector set by its competitors at period t. The first-order condition of this maximization problem for product $k \in \mathcal{J}_{rt}$ is given by

$$s_{kt}(\mathbf{p}_{rt}, \mathbf{p}^*_{-rt}; \theta^d) + \sum_{j\in\mathcal{J}_{rt}} \left(p_{jt} - w_{jt} - c_{jt}\right) \frac{\partial s_{jt}}{\partial p_{kt}}(\mathbf{p}_{rt}, \mathbf{p}^*_{-rt}; \theta^d) = 0 \tag{4}$$

From the system of first-order conditions of all product $k \in \mathcal{J}_{rt}$, we can express the price-cost margins of retailer r in vector-matrix form

$$\gamma^*_{rt} \equiv \mathbf{p}^*_{rt} - \mathbf{w}_{rt} - \mathbf{c}_{rt} = -\left(\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{rt}\right)^{+} \mathbf{I}_{rt}\mathbf{s}_t \tag{5}$$

where $\mathbf{s}_t$ represents the J_t-dimensional vector of market shares when retail prices are at the equilibrium level $\mathbf{p}^*_t$, $\mathbf{I}_{rt}$ corresponds to the $J_t \times J_t$ ownership matrix of retailer r in period t where the jth diagonal element is equal to 1 if retailer r sells product j and 0 otherwise (the off-diagonal elements being equal to 0). The mathematical symbol + corresponds to the unique Moore-Penrose pseudoinverse operator, and $\mathbf{S}_{\mathbf{p}_t}$ is a $J_t \times J_t$

[18] This framework is also called *unobservable contracts* (O'Brien and Shaffer, 1992), or *unobservability game* (McAfee and Schwartz, 1994).

[19] We follow the empirical literature on oligopoly pricing with differentiated products and assume existence of a Nash equilibrium in pure strategies (Berry, Levinsohn and Pakes, 1995; Nevo, 2001).

matrix consisting of the first derivatives of all market shares with respect to all retail prices

$$\mathbf{S}_{\mathbf{p}_t} = \begin{pmatrix} \frac{\partial s_{1t}}{\partial p_{1t}}(\mathbf{p}_t;\theta^d) & \cdots & \frac{\partial s_{Jt}}{\partial p_{1t}}(\mathbf{p}_t;\theta^d) \\ \vdots & \ddots & \vdots \\ \frac{\partial s_{1t}}{\partial p_{Jt}}(\mathbf{p}_t;\theta^d) & \cdots & \frac{\partial s_{Jt}}{\partial p_{Jt}}(\mathbf{p}_t;\theta^d) \end{pmatrix}$$

From (5), the J_t-dimensional vector of equilibrium retail price-cost margins in perion t can be computed as follows $\boldsymbol{\gamma}_t^* = -\sum_r \left(\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{rt}\right)^+ \mathbf{I}_{rt}\mathbf{s}_t$. Finally, the J_t-dimensional vector of retail marginal costs for each product $j \in \mathcal{J}_t \backslash \{0\}$ in period t is given by $\mathbf{w}_t^* + \mathbf{c}_t = \mathbf{p}_t^* - \boldsymbol{\gamma}_t^*$, which will be used as a key ingredient to estimate the bargaining power of firms and determine the surplus division in the vertical chain.

4.2 Stage 1: Bargaining between manufacturers and retailers

We model bilateral negotiations between manufacturers of soft drinks and food retailers. As previously described, the allocation of surplus between firms is assumed to be determined according to the "Nash-in-Nash" bargaining solution. This solution specifies that the wholesale price of a product owned by a manufacturer and distributed by a retailer solves the Nash bargaining problem for that manufacturer-retailer pair conditioning on all other wholesale prices. Such a sharing rule implies that each bilateral contract is a best-response from one another on the equilibrium path, but it relies on the assumption that trading terms of every agreement remain unchanged in case of an out-of-equilibrium event (e.g., a bargaining breakdown).[20]

Bargaining between manufacturer f and retailer r over w_{jt}. We consider the bilateral negotiation between manufacturer f and retailer r over the wholesale price of product $j \in \mathcal{J}_{ft} \cap \mathcal{J}_{rt}$ in period t. Let $\mathbf{w}_{-jt}^*$ be the (anticipated) equilibrium wholesale price vector determined in all other bilateral bargains. Payoffs of manufacturer f and

[20] In other words, it is assumed that firms' representatives conjecture the equilibrium outcomes for other bilateral negotiations in all circumstances. This is motivated by the fact that other delegates cannot react to an out-of-equilibrium event they are not able to observe. An alternative specification allowing for non-binding contracts and immediate renegotiation ("from scratch") following a bargaining breakdown has been considered in the theoretical literature on vertical contracting (Stole and Zwiebel, 1996; de Fontenay and Gans, 2014). Under this framework, the bargaining game is a function of the buyer-seller network and outside options of firms in their negotiations are equilibrium objects themselves. However, the recursive structure of this bargaining protocol remains dramatically complex and computationally burdensome to solve in applied work (see for instance Yurukoglu, 2008; Dranove, Satterthwaite and Sfekas, 2011).

retailer r if an agreement over w_{jt} is formed are respectively given by

$$\begin{aligned}\pi_{ft} &= \left(w_{jt}-\mu_{jt}\right) M_t s_{jt}(\mathbf{p}_{rt}(w_{jt},\mathbf{w}^*_{-jt}),\mathbf{p}^*_{-rt};\theta^d) + \sum_{k\in\mathcal{J}_{ft}\setminus\{j\}} \left(w^*_{kt}-\mu_{kt}\right) M_t s_{kt}(\mathbf{p}_{rt}(w_{jt},\mathbf{w}^*_{-jt}),\mathbf{p}^*_{-rt};\theta^d)\\ \pi_{rt} &= \left(p_{jt}(w_{jt},\mathbf{w}^*_{-jt})-w_{jt}-c_{jt}\right) M_t s_{jt}(\mathbf{p}_{rt}(w_{jt},\mathbf{w}^*_{-jt}),\mathbf{p}^*_{-rt};\theta^d)\\ &\quad+\sum_{k\in\mathcal{J}_{rt}\setminus\{j\}} \left(p_{kt}(w_{jt},\mathbf{w}^*_{-jt})-w^*_{kt}-c_{kt}\right) M_t s_{kt}(\mathbf{p}_{rt}(w_{jt},\mathbf{w}^*_{-jt}),\mathbf{p}^*_{-rt};\theta^d)\end{aligned}$$

Status quo positions of firms in case of a bargaining breakdown over w_{jt} are determined following our bargaining protocol which assumes that wholesale prices of other products remain unchanged. Futhermore, the information structure specified in the downstream price competition (i.e., interim unobservability) implies that only retailer r is able to observe this disagreement and adjust its retail prices accordingly. Therefore, we derive the status quo payoffs of manufacturer f and retailer r as follows

$$\begin{aligned}d^{-j}_{ft} &= \sum_{k\in\mathcal{J}_{ft}\setminus\{j\}} \left(w^*_{kt}-\mu_{kt}\right) M_t \tilde{s}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_t;\theta^d)\\ d^{-j}_{rt} &= \sum_{k\in\mathcal{J}_{rt}\setminus\{j\}} \left(\tilde{p}^{-j}_{k,t}-w^*_{kt}-c_{kt}\right) M_t \tilde{s}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_t;\theta^d)\end{aligned}$$

where $\tilde{\mathbf{p}}^{-j}_t$ denotes the J_t-dimensional vector of out-of-equilibrium retail prices when product j is no longer offered on the market with $\tilde{\mathbf{p}}^{-j}_t[k,1] = \begin{cases} +\infty & \text{if } j=k\\ \tilde{p}^{-j}_{k,t} & \text{if } j\neq k \text{ and } j,k\in\mathcal{J}_{rt}\\ p^*_{k,t} & \text{otherwise}\end{cases}$ (computational details are given in Appendix C), and $\tilde{s}^{-j}_{kt}$ is the market share of each product k remaining on the market. This market share is computed as follows

$$\tilde{s}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_t;\theta^d) = \begin{cases} \int_0^{+\infty} \frac{\exp(\tilde{V}^{-j}_{ikt})}{\sum_{l\in\mathcal{J}_{rt}\setminus\{j\}}\exp(\tilde{V}^{-j}_{ilt}) + \sum_{m\in\mathcal{J}_t\setminus\mathcal{J}_{rt}}\exp(V_{imt})} f(\alpha_{ij})\,\mathrm{d}\alpha_{ij} & \text{if } k\in\mathcal{J}_{rt}\setminus\{j\}\\ \int_0^{+\infty} \frac{\exp(V_{ikt})}{\sum_{l\in\mathcal{J}_{rt}\setminus\{j\}}\exp(\tilde{V}^{-j}_{ilt}) + \sum_{m\in\mathcal{J}_t\setminus\mathcal{J}_{rt}}\exp(V_{imt})} f(\alpha_{ij})\,\mathrm{d}\alpha_{ij} & \text{otherwise}\end{cases}$$

where $V_{ikt}\equiv\delta_{b(k)}+\delta_{r(k)}-\alpha_{ij}p_{kt}+\rho\hat{u}_{kt}$ and $\tilde{V}^{-j}_{ikt}\equiv\delta_{b(k)}+\delta_{r(k)}-\alpha_{ij}\tilde{p}^{-j}_{kt}+\rho\hat{u}_{kt}$.

Nash bargaining problem. Following Horn and Wolinsky (1988), the (asymmetric) Nash product of the bilateral negotiation between manufacturer f and retailer r over the wholesale price w_{jt} — taking $\mathbf{w}^*_{-jt}$ as given — is defined as follows

$$\mathrm{NP}_{jt}(w_{jt},\mathbf{w}^*_{-jt}) \equiv \left(\pi_{ft}(w_{jt},\mathbf{w}^*_{-jt})-d^{-j}_{ft}(\mathbf{w}^*_{-jt})\right)^{1-\lambda_{fr}} \left(\pi_{rt}(w_{jt},\mathbf{w}^*_{-jt})-d^{-j}_{rt}(\mathbf{w}^*_{-jt})\right)^{\lambda_{fr}} \tag{6}$$

where $\lambda_{fr} \in [0,1]$ denotes the Nash bargaining weight of retailer r in its negotiation with manufacturer f. The equilibrium wholesale price of this bilateral negotiation is the argument that maximizes (6), that is

$$w^*_{jt} \equiv \underset{w_{jt}}{\operatorname{argmax}} \; \mathrm{NP}_{jt}(w_{jt}, \mathbf{w}^*_{-jt}) \tag{7}$$

The division of surplus generated by the bilateral contract between manufacturer f and retailer r for product j is characterized by the first-order condition $\frac{\partial \mathrm{NP}_{jt}}{\partial w_{jt}} = 0$ which can be derived as follows

$$\underbrace{\lambda_{fr}\Big(\pi_{ft}(w_{jt}, \mathbf{w}^*_{-jt}) - d^{-j}_{ft}(\mathbf{w}^*_{-jt})\Big)\frac{\partial \pi_{rt}}{\partial w_{jt}}}_{\text{Retailer } r\text{'s bargaining power}} + \underbrace{\Big(1-\lambda_{fr}\Big)\Big(\pi_{rt}(w_{jt}, \mathbf{w}^*_{-jt}) - d^{-j}_{rt}(\mathbf{w}^*_{-jt})\Big)\frac{\partial \pi_{ft}}{\partial w_{jt}}}_{\text{Manufacturer } f\text{'s bargaining power}} = 0 \tag{8}$$

Three sources of bargaining power can be identified from (8). Terms $\pi_{ft}(w_{jt}, \mathbf{w}^*_{-jt}) - d^{-j}_{ft}(\mathbf{w}^*_{-jt})$ and $\pi_{rt}(w_{jt}, \mathbf{w}^*_{-jt}) - d^{-j}_{rt}(\mathbf{w}^*_{-jt})$ represent the incremental gains from trade obtained by each firm given that all other bilateral contracts have been formed. The higher the gains from trade of a firm, the greater will be its losses from not reaching an agreement which, in turn, reinforces the bargaining power of its trading partner. A second source of bargaining power is embedded in $\frac{\partial \pi_{rt}}{\partial w_{jt}}$ and $\frac{\partial \pi_{ft}}{\partial w_{jt}}$ which refer to the cost incurred by retailer r (resp. manufacturer f) from making a price concession to manufacturer f (resp. retailer r). A high concession cost lessens the ease to obtain a price concession from a bargainer which, in turn, increases its bargaining power in the bilateral negotiation. A last source of bargaining power is grasped by the Nash bargaining weight λ_{fr} which attempts to capture some imprecisely defined asymmetries in the bargaining power of firms (Binmore, Rubinstein and Wolinsky, 1986). Using the agreement payoffs and status quo positions of firms, we re-write (8) as follows

$$\begin{aligned}
&\left(\Gamma^*_{jt} s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{ft}\setminus\{j\}} \Gamma^*_{kt}\left(s_{kt}(\mathbf{p}^*_t;\theta^d) - \tilde{s}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_{rt};\theta^d)\right)\right)\left(\sum_{k\in\mathcal{J}_{rt}} \frac{\partial p_{kt}}{\partial w_{jt}} s_{kt}(\mathbf{p}^*_t;\theta^d) - s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{rt}} \gamma^*_{kt} \sum_{l\in\mathcal{J}_{rt}} \frac{\partial s_{kt}}{\partial p_{lt}} \frac{\partial p_{lt}}{\partial w_{jt}}\right) \\
&+ \frac{1-\lambda_{fr}}{\lambda_{fr}}\left(\gamma^*_{jt} s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{rt}\setminus\{j\}} \gamma^*_{kt} s_{kt}(\mathbf{p}^*_t;\theta^d) - \tilde{\gamma}_{kt}\tilde{s}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_{rt};\theta^d)\right)\left(s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{ft}} \Gamma^*_{kt} \sum_{l\in\mathcal{J}_{rt}} \frac{\partial s_{kt}}{\partial p_{lt}} \frac{\partial p_{lt}}{\partial w_{jt}}\right) = 0
\end{aligned}$$

where $\Gamma^*_{jt} \equiv w^*_{jt} - \mu_{jt}$, $\gamma^*_{jt} \equiv p^*_{jt} - w^*_{jt} - c_{jt}$, and $\tilde{\gamma}_{kt} \equiv \tilde{p}^{-j}_{kt} - w^*_{kt} - c_{kt}$.

From the set of first-order conditions of each Nash bargaining problem involving manufacturer f, we are able to recover its price-cost margins vector as follows (see Appendix A for computational details)

$$\boldsymbol{\Gamma}^*_{ft} \equiv \mathbf{w}^*_{ft} - \boldsymbol{\mu}_{ft} = -\left(\left(\mathbf{V}_{ft}\boldsymbol{\iota}^\top\right)\circ \mathbf{M}_{ft} + \left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft}\right)\boldsymbol{\iota}^\top\right)\circ \tilde{\mathbf{M}}_{ft}\right)^{+}\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft} \circ \mathbf{s}_t\right) \tag{9}$$

where $\mathbf{V}_{ft}$ and $\tilde{\mathbf{V}}_{ft}$ are two J_t-dimensional vectors defined as follows

$$\mathbf{V}_{ft} \equiv \sum_{r=1}^{R} \mathbf{I}_{ft}\mathbf{I}_{rt}\left(\left(\mathbf{P}_{\mathbf{w}_t} - \mathbf{I}_t\right)\mathbf{I}_{rt}\mathbf{s}_t + \mathbf{P}_{\mathbf{w}_t}\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{rt}\boldsymbol{\gamma}_t^*\right)$$
$$\tilde{\mathbf{V}}_{ft} \equiv \sum_{r=1}^{R} \mathbf{I}_{ft}\mathbf{I}_{rt}\left(\iota\mathbf{s}_t^\top\mathbf{I}_{rt}\boldsymbol{\gamma}_t^* + \left(\left(\left(\tilde{\mathbf{S}}_{\Delta t} - \iota\mathbf{s}_t^\top\right)\mathbf{I}_{rt}\right)\circ\tilde{\boldsymbol{\gamma}}_t^\top\right)\iota\right)$$

the $J_t \times J_t$ matrices $\mathbf{M}_{ft}$ and $\tilde{\mathbf{M}}_{ft}$ are defined as

$$\mathbf{M}_{ft} \equiv \mathbf{I}_{ft}\tilde{\mathbf{S}}_{\Delta t}\mathbf{I}_{ft} \quad \text{and} \quad \tilde{\mathbf{M}}_{ft} \equiv \sum_{r=1}^{R} \mathbf{I}_{ft}\mathbf{I}_{rt}\mathbf{P}_{\mathbf{w}_t}\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{ft}$$

and $\boldsymbol{\Gamma}_{ft}^*$ is a J_t-dimensional vector with $\boldsymbol{\Gamma}_{ft}^*[k,1] = \begin{cases} w_{kt}^* - \mu_{kt} & \text{if } k \in \mathcal{J}_{ft} \\ 0 & \text{otherwise} \end{cases}$. The mathematical symbol $\circ$ represents the Hadamard product operator (also known as the element-by-element multiplication). Furthermore, the J_t-dimensional vectors $\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}$ and ι, and the $J_t \times J_t$ matrices $\mathbf{P}_{\mathbf{w}_t}$, $\tilde{\mathbf{S}}_{\Delta t}$ and $\tilde{\boldsymbol{\gamma}}_t$ are defined as follows. $\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}$ corresponds to a column vector of Nash bargaining weight ratio with $\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}[j,1] = \frac{1-\lambda_{fr}}{\lambda_{fr}}$ if $j \in \mathcal{J}_{ft} \cap \mathcal{J}_{rt}$. ι denotes the all-ones vector (i.e., every element is equal to one). $\mathbf{P}_{\mathbf{w}_t}$ is the matrix of the first derivatives of retail prices with respect to wholesale prices where $\mathbf{P}_{\mathbf{w}_t}[j,k] = \frac{\partial p_{kt}}{\partial w_{jt}}$ if $j,k \in \mathcal{J}_{rt}$ and 0 otherwise. $\tilde{\mathbf{S}}_{\Delta t}$ is a matrix of equilibrium market shares and changes in market shares following a bargaining breakdown, that is,

$$\tilde{\mathbf{S}}_{\Delta t} = \begin{pmatrix} s_{1,t}(\mathbf{p}_t^*;\theta^d) & -\Delta\tilde{s}_{2,t}^{-1}(\tilde{\mathbf{p}}_t^{-1};\theta^d) & \cdots & -\Delta\tilde{s}_{J,t}^{-1}(\tilde{\mathbf{p}}_t^{-1};\theta^d) \\ -\Delta\tilde{s}_{1,t}^{-2}(\tilde{\mathbf{p}}_t^{-2};\theta^d) & s_{2,t}(\mathbf{p}_t^*;\theta^d) & \cdots & -\Delta\tilde{s}_{J,t}^{-2}(\tilde{\mathbf{p}}_t^{-2};\theta^d) \\ \vdots & \vdots & \ddots & \vdots \\ -\Delta\tilde{s}_{1,t}^{-J}(\tilde{\mathbf{p}}_t^{-J};\theta^d) & -\Delta\tilde{s}_{2,t}^{-J}(\tilde{\mathbf{p}}_t^{-J};\theta^d) & \cdots & s_{Jt}(\mathbf{p}_t^*;\theta^d) \end{pmatrix}$$

The matrix $\tilde{\boldsymbol{\gamma}}_t$ includes equilibrium and out-of-equilibrium retail margins. We refer to Appendix A for further details.

From (9), we can obtain the J_t-dimensional vector of upstream price-cost margins in period t as follows $\boldsymbol{\Gamma}_t^* = \sum_f \boldsymbol{\Gamma}_{ft}^*$.

4.3 Identification and Estimation of Bargaining Stage

In this subsection, we introduce the econometric model, our identification strategy, and the estimation procedure to recover the vector of Nash bargaining weights in (9).

Econometric model. Upstream price-cost margins can be recovered up to the unknown vector of Nash bargaining weights $\boldsymbol{\lambda}$. To estimate $\boldsymbol{\lambda}$, we proceed by rewriting the marginal cost of retailers for each product $j \in \mathcal{J}_t \backslash \{0\}$ obtained from stage 2 as follows

$$w_{jt} + c_{jt} \quad = \quad \underbrace{(w_{jt} - \mu_{jt})}_{\text{upstream market power}} \quad + \quad \underbrace{(c_{jt} + \mu_{jt})}_{\text{operational costs}}$$

Our empirical strategy relies on the fact that differences in marginal costs of retailers across products are explained by variations in costs of production and distribution as well as asymmetries in the bargaining power of firms.

The contribution of manufacturers' market power to marginal costs of retailers is grasped by the expression (9) derived from the "Nash-in-Nash" bargaining solution which corresponds to a nonlinear function of data and unknown parameters λ_{fr}. However, without additional information on the marginal cost of products, we have a system of $\sum_t J_t$ equations with $(F \times R) + \sum_t J_t$ unknowns. We thus need to impose further structure on the cost of products. We follow the approach of Gowrisankaran, Nevo and Town (2015) by assuming that the constant marginal cost of product $j \in \mathcal{J}_t \backslash \{0\}$ is specified as $c_{jt} + \mu_{jt} = \mathbf{v}_{jt}\boldsymbol{\kappa} + \omega_{jt}$, where $\mathbf{v}_{jt}$ is a $1 \times K$ vector of cost shifters, $\boldsymbol{\kappa}$ is a $K \times 1$ vector of cost parameters, and ω_{jt} denotes an additive error term which captures unobserved cost factors (e.g., unobserved productivity of firms).[21] In our empirical application $\mathbf{v}_{jt}$ includes brand and retailer fixed effects, the (monthly) input price of sugar interacted with the sugar content of each brand, and the (monthly) input price of aluminum interacted with the average percentage of cans sold for each product. Under these assumptions, the J_t-dimensional vector of retail marginal costs in period t is given by

$$\mathbf{w}_t^* + \mathbf{c}_t = \boldsymbol{\Gamma}_t(\boldsymbol{\lambda}, \mathbf{p}_t^*, \mathbf{s}_t, \tilde{\mathbf{p}}_t^{-1}, \tilde{\mathbf{s}}_t^{-1}, \ldots, \tilde{\mathbf{p}}_t^{-J}, \tilde{\mathbf{s}}_t^{-J}) + \mathbf{v}_t\boldsymbol{\kappa} + \boldsymbol{\omega}_t \tag{10}$$

where $\boldsymbol{\theta}^s \equiv (\boldsymbol{\lambda}^\top, \boldsymbol{\kappa}^\top)^\top$ is the vector of supply-side parameters to be estimated. Our framework includes a special case when $\boldsymbol{\lambda}$ is a J_t-dimensional all-ones vector, that is, retailers make take-it-or-leave-it offers to manufacturers in all bilateral transactions. Under this situation, price-cost margins of manufacturers over each product would be

[21] Other approaches have been considered in the empirical literature on bilateral negotiations with externalities. For instance, Crawford and Yurukoglu (2012) take advantage of the fact that in the multichannel television industry the marginal cost of production is commonly known to be zero. Grennan (2013) adopts an alternative specification where he represents costs only in terms of data and parameters (i.e., without unobservables) which allows him to estimate the full distribution of the Nash bargaining weights.

$\Gamma_{jt} = 0$ (e.g., manufacturers are fully integrated with the retailers) and (10) would boil down to $\mathbf{w}_t^* + \mathbf{c}_t = \mathbf{v}_t\boldsymbol{\kappa} + \boldsymbol{\omega}_t$. This case shows how our empirical setting relates to the seminal work of Berry, Levinsohn and Pakes (1995) in the absence of upstream market power.

Identification assumptions. Estimation of (10) is performed over the full sample (i.e., using the T periods). However, identification of $\boldsymbol{\theta}^s$ can be jeopardized by the presence of variables (e.g., retail prices, predicted market shares of products) in (9) that are likely to be correlated with the unobserved cost factors $\boldsymbol{\omega}$. Indeed, a price endogeneity problem arises as long as firms observe marginal costs of products (including ω_{jt}) before setting wholesale and retail prices. Furthermore, the control function variable $\hat{u}_{jt}$ which is used as a proxy for the unobserved product characteristics ξ_{jt} and enters into market shares is also likely to be correlated with the unobserved cost factors ω_{jt}. To tackle this endogeneity issue, we use a GMM estimator based on the following conditional moment restriction $\mathbb{E}[\boldsymbol{\omega}(\boldsymbol{\theta}^s) \mid \mathbf{Z}^s] = 0$ where $\mathbf{Z}^s$ is a $L \times \sum_t J_t$ matrix of instrumental variables. Four sets of (assumed) exogenous variables are included in $\mathbf{Z}^s$. The first set of variables serves to identify the vector of cost parameters $\boldsymbol{\kappa}$ and includes all cost shifters in $\mathbf{v}$. The three remaining sets of instrumental variables are used to identify the vector of Nash bargaining weights. One of these sets includes the average willingness-to-pay for time-invariant brand *b(j)* characteristics of consumers who have purchased product j in period t and an interaction of this variable with retailer fixed effects. We also use a variable that measures the "distance" of the retail price of each product with the retail price of all other products $\sum_{k \in \mathcal{J}_t \setminus \{0\}} (p_{jt} - p_{kt})^2$. These two sets of instrumental variables aim at providing a measure of product differentiation in each market. Intuitively, such a measure should help to identify the bargaining parameters since a firm with close competitors in the willingness-to-pay or characteristics space is expected to engage in a fiercer competition on the wholesale and downstream markets, thereby reducing its bargaining power vis-à-vis trading partners.[22] Denote by $\mathcal{J}_{f(j)t}$ and $\mathcal{J}_{r(j)t}$ the sets of products owned respectively by the manufacturer and the retailer of product j in period t. We finally use a set of variables that contains the sum of market shares of other products sold by the same retailer $\sum_{k \in \mathcal{J}_{r(j)t} \setminus \{j\}} s_{kt}$, the sum of mar-

[22]For instance, heterogeneity in willingness-to-pay of consumers for brand characteristics can reflect differences in consumer preferences which, in turn, may explain variations in (observed) retail prices of products and should help to identify the bargaining power of retailers vis-à-vis upstream manufacturers. See also Gowrisankaran, Nevo and Town (2015) and Ho and Lee (2017) for the use of instrumental variables based on consumer willingness-to-pay in supply-side estimations.

ket shares of other products owned by the same manufacturer $\sum_{k \in \mathcal{J}_{f(j)t} \setminus \{j\}} s_{kt}$, and the sum of market shares of all products offered by rival retailers $\sum_{k \in \mathcal{J}_t \setminus \mathcal{J}_{r(j)t}} s_{kt}$. The intuition for these instruments is that the size of its other products should enable a firm to leverage bargaining power in bilateral negotiations (e.g., through its status quo payoffs). Note that each element in our instrument set is a function of endogenous variables (e.g., retail prices, market shares). To construct valid instruments, we use the fitted value of a linear projection of retail prices on exogenous variables (brand and retailer fixed effects, cost shifters) instead of observed retail prices.[23] Moreover, we remove from the market share expression the control function variable which is used as a proxy for unobserved product characteristics.

Since we need as many orthogonality conditions as we have parameters, we impose the following restriction $\lambda_{fr} = \lambda_f + \lambda_r$ (see Gowrisankaran, Nevo and Town, 2015; Ho and Lee, 2017, for a related assumption). This parameterization implies that the Nash bargaining weight of retailer r vis-à-vis manufacturer f is a combination of its (average) weight in negotiations with upstream firms and the (average) weight of manufacturer f in negotiations with downstream firms.

Estimation procedure. Our GMM estimator is defined as follows

$$\hat{\theta}^s \equiv \underset{\theta^s}{\operatorname{argmin}} \, (\mathbf{Z}^s \boldsymbol{\omega}(\theta^s))^\top \mathbf{A}^{-1} \mathbf{Z}^s \boldsymbol{\omega}(\theta^s)$$

subject to the parameter constraints $\lambda_{fr} \in [0,1]$ and where $\mathbf{A} \equiv \mathbf{Z}^s(\mathbf{Z}^s)^\top$. In the absence of any prior information for starting values, we employ a multi-start algorithm to solve this minimization problem.[24]

5 Empirical results

This section first presents the results of the random coefficients logit demand model, which allows to capture consumer behavior in the French soft drink market. Using demand estimates, we then compute price-cost margins of each retailer. Given the estimated retail margins and demand substitution patterns, we finally estimate the

[23] This approach is similar in spirit to Reynaert and Verboven (2014) who also propose to regress observed prices over product characteristics and cost shifters to obtain exogenous estimates and construct instrumental variables (see also Gandhi and Houde, 2016).

[24] We first randomly draw 10,000 vectors of potential starting values. Then, we evaluate our GMM objective function for each draw and pick the ones that give the twenty smallest values. Finally, we start a local optimization algorithm for our twenty vectors of starting values and take the estimated vector of parameters that gives the smallest GMM objective function.

Table 2: Results of the random coefficient logit model

Parameters	Value	**Parameters**	Value
α_{pl}	2.24 (0.63)		
α_{nb}	1.05 (0.20)		
σ	0.81 (0.29)		
ρ	3.77 (1.16)		
Retail fixed effect $\delta_{r(j)}$			
R_1	0.99 (0.61)	R_5	0.24 (0.59)
R_2	0.32 (0.61)	R_6	0.65 (0.16)
R_3	0.87 (0.61)	R_7	ref.
R_4	0.87 (0.61)		
Brand fixed effect $\delta_{b(j)}$			
Cola			
B_{23} (PL)	0.49 (1.01)	B_9	-1.89 (1.39)
B_5	1.13 (1.65)	B_4	-2.83 (1.77)
Other soda			
B_{25} (PL)	1.93 (1.00)	B_{14}	-0.95 (1.60)
B_3	-2.71 (1.45)	B_{15}	-0.45 (1.77)
B_6	-0.93 (1.72)	B_{17}	0.14 (1.89)
B_7	-0.59 (2.20)	B_{19}	-3.35 (1.81)
B_8	-4.12 (1.52)	B_{20}	1.81 (3.20)
B_{10}	-2.95 (1.46)	B_{21}	-4.84 (1.40)
Juice & Nectar			
B_{22} (PL)	6.24 (0.25)	B_1	-0.07 (2.42)
B_{11}	2.89 (2.64)	B_{18}	-0.81 (1.90)
B_{16}	0.94 (2.44)		
Ice-Tea			
B_{24} (PL)	1.70 (0.97)	B_{12}	-0.20 (1.82)
B_2	-2.58 (1.65)	B_{13}	-2.13 (2.09)
Log-likelihood			-230,690
Number of observations			66,518

Standard errors are in parenthesis are computed by using the asymptotic formula of Karaca-Mandic and Train (2003) which takes into account of the sampling variance in the first-stage estimates of our control function approach. "PL" corresponds to *private label*.

Nash bargaining weights of each retailer-manufacturer pair, and recover the surplus division between firms.

5.1 Demand Side

The estimated parameters of the random coefficient logit model are given in Table 2. They are estimated on a subsample of $66,518$ purchase observations, which corre-

Table 3: Own and cross-price elasticities aggregated by category of beverages

Category	Elasticities*			
	Cola	Other Soda	Juice & Nectar	Ice-Tea
Cola	-2.29	0.83	1.36	0.24
Other Soda	0.74	-2.62	1.60	0.23
Juice & Nectar	0.24	0.34	-1.80	0.12
Ice-Tea	0.66	0.72	1.78	-3.37

*The values should be read as follows: if the prices of all cola's products increase by 1%, the demand of ice-tea products would increase by 0.87%.

sponds to 25 percent of our sample. On average, consumers appear to be more sensitive to price variation for private labels than for national brands. Furthermore, our estimates show indicates heterogeneity among consumers regarding the marginal price disutility. Retail and brand fixed effect estimates show that preferences are heterogeneous with respect to brands and retail chains, which is consistent with the study published by the European Commission (2007).

Own and cross-price elasticites for each product can be computed from the estimated parameters of the demand model. Elasticities per firm and categories range between -2.82 and -4.07 (cf. Table 5]. Our estimates are consistent with Bonnet and Requillart (2013) who find an average own-price elasticity of -3.52 in the French soft drink market for the year 2005. On the cola segment, they are also consistent with Dubé (2005) who use a multiple-discrete choice model. His estimated own-price elasticities for cola's products range between -3.10 to -5.76 in the Denver area in the 90's. They are slightly higher than ours since he considered more disaggregated products (disaggregation according to the packaging type). Gasmi, Laffont and Vuong (1992) estimate a linear demand model and find own-price elasticities varying between -1.71 to -1.97 for cola's products in the U.S. soft drink market from 1968 to 1986. Their estimates are lower than ours but this can be explained because they do not consider substitution between retailers.

Table 3 depicts the own and cross-price elasticities aggregated by soft drink categories. The own-price elasticity for the juices and nectars at the category level is much lower compared to the own-price elasticities at the firm level, which is not true for the other categories. This finding suggests that it might exist an important substitutability between brands in the juice and nectar segment. Overall, we can notice some substitutability across categories of soft drink. This is particularly the case for ice-tea products for which the elasticity at the aggregate level is evaluated at -3.4 while they vary between -3.2 and -3.8 at the firm level, which indicates that ice-tea products are

Table 4: Results of the Bargaining Estimates

Cost parameters		*Bargaining parameters* ($\lambda_{fr} = \lambda_r + \lambda_f$)			
Parameter	**Estimates**	**Parameter**	**Estimates**	**Parameter**	**Estimates**
Intercept	0.018	λ_{M_1}	0.255	λ_{R_1}	0.188
Can × Aluminium	0.003	λ_{M_2}	0.171	λ_{R_2}	0.159
Sugar content	0.001	λ_{M_3}	0.261	λ_{R_3}	0.270
Brand fixed effect not shown		λ_{M_4}	0.289	λ_{R_4}	0.067
Retailer fixed effect not shown				λ_{R_5}	0.131
				λ_{R_6}	0.453
				λ_{R_7}	0.275
GMM	0.359				
Number of observations	920				

mainly substituted with non ice-tea products.

5.2 Supply Side

Using the results of the demand model presented in the previous subsection, we are able to recover retail margins from equation (4) and to estimate the Nash bargaining weights of firms within the vertical chain as well as the total marginal costs for each product. Using these estimates, we can then compute manufacturers' margins and investigate the division of surplus between firms.

Price-cost margins

We have parameterized the Nash bargaining weight in each bilateral transaction as the sum of a manufacturer fixed effect and a retailer fixed effect. Table 4 reports our estimates. They differ greatly between manufacturers and retailers. We can see that the heterogeneity is larger across retailers than manufacturers. Indeed, estimated parameters for retailers vary between 0.067 and 0.453 whereas the range of parameters for manufacturers is between 0.171 to 0.28 only. As a result, the estimated Nash bargaining weights per manufacturer-retailer pair range between 0.3 and 0.75. Those estimates allow recovering price-cost margins of manufacturers for each product as well as marginal cost which are shown in Table 5.

As expected, marginal costs are higher for products in the juice and nectar category because of their content in fruits. Moreover, marginal costs are much lower for private labels than for national brands in all soft drink categories. Given observed prices, total price-cost margins for national brands are quite high in the cola segment with

Table 5: Supply-side results

Categories	Price (€/liter)	Own-price elasticities	Marginal Cost (€/liter)	Price-cost margins (%)		
				Upstream	Downstream	Total
Manufacturer 1						
Cola	0.92	-3.05	0.42	19.61	35.13	54.73
Other Soda	0.94	-3.13	0.43	19.83	35.30	55.14
Juice & Nectar	1.63	-3.86	0.92	15.47	28.34	43.81
Ice-Tea	0.91	-3.17	0.43	19.27	35.00	54.27
Manufacturer 2						
Cola	0.73	-2.76	0.28	21.06	39.89	60.95
Other Soda	0.75	-2.82	0.31	20.07	39.21	59.28
Juice & Nectar	2.17	-4.07	1.30	13.70	26.26	39.96
Manufacturer 3						
Ice-Tea	1.08	-3.35	0.57	14.31	32.80	47.11
Manufacturer 4						
Other Soda	1.08	-3.29	0.57	15.08	33.41	48.49
Juice & Nectar	1.79	-3.96	1.09	11.90	27.36	39.26
Private label						
Cola	0.31	-3.20	0.18	-	41.88	41.88
Other Soda	0.40	-3.53	0.25	-	36.52	36.52
Juice & Nectar	0.85	-3.84	0.60	-	28.79	28.79
Ice-Tea	0.50	-3.83	0.33	-	33.62	33.62

values around 55 to 60 percent. There results are slightly higher but in line with Dubé (2005) who estimates a price-cost margins of 50 to 60 percent for pepsi products and 40 percent for cokes. In the juice and nectar segment where products are less differentiated, price-cost margins are lower than 50 percent. As expected, total price-cost margins for private labels are lower than for national brands in all soft drink category. They are the highest in the cola segment (42 percent) and the lowest in the juice and nectar segment (29 percent).

On average, total price-cost margins are not evenly split between upstream and downstream. Indeed, upstream margins are lower than downstream ones in most cases. Estimated Nash bargaining weights cannot explain this result since they are more in favor of upstream firms. A deeper investigation of the profit sharing between firms will thus help understanding the source of bargaining power.

Table 6: Ratio of the disagreements payoffs in bilateral bargains (d_{rt}^{-j}/d_{ft}^{-j})

	Manuf. 1	Manuf. 2	Manuf. 3	Manuf. 4
Retailer 1	1.66	3.68	15.35	3.59
Retailer 2	0.93	2.04	8.38	2.02
Retailer 3	0.79	1.71	6.91	1.70
Retailer 4	1.40	3.10	12.96	3.02
Retailer 5	0.89	1.98	8.53	1.96
Retailer 6	1.18	2.62	10.42	2.57
Retailer 7	0.55	1.21	4.85	1.20

Division of Surplus

The *split-the-difference rule* for nontransferable utility games governs the division of surplus for each bilateral transaction in our framework. Derived from the first-order condition of the Nash product, this rule establishes that the slice captured by each player in a bilateral negotiation corresponds to its disagreement payoffs (d_{ft}^{-j} or d_{rt}^{-j}) plus a fraction of the gains from trade generated by the agreement as reflected in equations (11) and (12):

$$\pi_{ft} = d_{ft}^{-j} + \left(1-\lambda_{fr}\right)\left[-\left(\frac{\partial\pi_{ft}/\partial w_{jt}}{\partial\pi_{rt}/\partial w_{jt}}\right)\left(\pi_{rt} - d_{rt}^{-j}\right) + \pi_{ft} - d_{ft}^{-j}\right] \tag{11}$$

$$\pi_{rt} = d_{rt}^{-j} + \lambda_{fr}\left[-\left(\frac{\partial\pi_{rt}/\partial w_{jt}}{\partial\pi_{ft}/\partial w_{jt}}\right)\left(\pi_{ft} - d_{ft}^{-j}\right) + \pi_{rt} - d_{rt}^{-j}\right] \tag{12}$$

From Subsection 4.2, we have seen that our setting allows to capture three sources of bargaining power: (i) the Nash bargaining weights of retailers vis-à-vis manufacturers (i.e., λ_{fr}); (ii) the gains from trade obtained by each bargainer from a bilateral agreement (i.e., $\pi_{rt}-d_{rt}^{-j}$ and $\pi_{ft}-d_{ft}^{-j}$); and (iii) the concession cost of firms (i.e., $\partial\pi_{rt}/\partial w_{jt}$ and $\partial\pi_{ft}/\partial w_{jt}$). From Table 6, we can observe that disagreement payoffs of manufacturers are generally lower than for retailers, except for manufacturer 1. Indeed, the disagreement payoff of manufacturer 1 is on average higher in bilateral transactions involving four retailers among the seven available downstream. As a result, retailers leverage more bargaining power from the size of their outside options in negotiations than manufacturers, except when they deal with manufacturer 1.

Firms' concession costs in their bargaining are shown in Table 7. Again, we can see that costs of making price concessions are higher for downstream firms, which means that a retailer can get higher profit from a lower wholesale price than what a manufacturer will loose. The disagreement and concession cost effects explain why retailers

Table 7: Ratio of firms' concession costs in bilateral bargains ($\frac{|\partial\pi_{rt}/\partial w_{jt}|}{\partial\pi_{ft}/\partial w_{jt}}$)

	Manuf. 1	Manuf. 2	Manuf. 3	Manuf. 4
Retailer 1	2.37	3.12	2.48	2.29
Retailer 2	2.61	3.45	2.67	2.48
Retailer 3	2.03	2.53	2.07	1.95
Retailer 4	3.36	4.83	3.47	3.17
Retailer 5	2.69	3.72	2.84	2.58
Retailer 6	1.42	1.71	1.48	1.40
Retailer 7	2.01	2.50	2.04	1.93

Table 8: Average share captured by manufacturers in bilateral bargains (%)

	Manuf. 1	Manuf. 2	Manuf. 3	Manuf. 4
Retailer 1	35.87	34.45	30.50	31.39
Retailer 2	38.10	36.30	32.81	33.52
Retailer 3	34.64	33.10	29.12	29.81
Retailer 4	40.01	38.11	34.81	35.63
Retailer 5	38.69	37.19	33.64	34.49
Retailer 6	26.42	25.51	20.11	20.67
Retailer 7	34.84	33.33	29.30	29.94

are on average able to capture a larger pie of the surplus generated by bilateral agreements. The division of surplus between manufacturers and retailers in the French soft drink market is depicted in Table 8. Overall, the bargaining power lies in the retailers' hands who capture the main share of the industry profits. Only manufacturer 1 is able to get more than 40 percent of the surplus. Moreover, we can observe that the slice captured by each manufacturer is sensitive to its trading partner.

6 Counterfactual Experiments

In this section, we use estimated parameters of our structural model of demand and supply to analyze the impact of an increase in downstream concentration on equilibrium outcomes. In order to conduct such an experiment, we remove retailer 1 from markets and simulate the effects on retail prices, price-cost margins, market shares, and profit of firms. Such a simulation will lead to two effects. First, when removing retailer 1, purchases in its stores will be substituted towards purchases in other retailers' stores, which will have an indirect effect on final prices. Second, further concentration will enable retailers to increase their market power and thus retail prices. We want to capture this second effect as the first effect is artificial and exists because we need to find a implementable counterfactual from the existing data. To get the desirable effect only, we simulate a second counterfactual that removes the quantity effect from withdrawing one retailer. We are thus able to get the net effect of increasing concentration in the retail market. We first present our counterfactual experiment methodology and then discuss simulation results.

To perform simulations of counterfactual policy experiments in bilateral oligopolies, we need to take into account changes in the bargaining environment between manufacturers and retailers, effects on the pricing behavior of retailers, and consumer response to retail price changes. To this end, we develop an algorithm that allows to recompute a new bargaining equilibrium as well as a new downstream price equilibrium following a market structure change (e.g., the removal of a retailer). Under the assumptions that simulations do not affect: (i) marginal cost of production and distribution, (ii) the Nash bargaining weights of firms, (iii) consumer preferences, and (iv) the buyer-seller network structure,[25] our algorithm consists in finding the J_t-dimensional vector of retail prices $\mathbf{p}_t^{\text{post}}$ that solves the following system of J_t equations

$$\underbrace{\mathbf{p}_t^{\text{post}} - (\boldsymbol{\gamma}_t^{\text{post}} + \boldsymbol{\Gamma}_t^{\text{post}})}_{\mathbf{c}_t + \boldsymbol{\mu}_t} - \underbrace{\mathbf{p}_t^{*} - (\boldsymbol{\gamma}_t^{*} - \boldsymbol{\Gamma}_t^{*})}_{\mathbf{c}_t + \boldsymbol{\mu}_t} = \mathbf{0}$$

We refer to Appendix D for technical details to construct elements of this system, especially for the $J_t \times 1$ vector $\boldsymbol{\Gamma}_t^{\text{post}}$ which depends on counterfactual out-of-equilibrium retail prices.

To evaluate the effect of downstream competition on bilateral negotiations, we simulate the impact of removing retailer 1 with and without price adjustment and present the results of the difference between the two simulations. We can then evaluate the net effect on bilateral negotiations by removing the quantity effect due to the transfer of market share to other retailers. Results on retail prices, price-cost margins, market shares, and profit of firms are presented in Table 9. More concentration on the dowstream market relaxes competition between retailers and leads to higher final prices for both national brands and private labels. The price-cost margins of retailers increase significantly (from 4 to 6 percent) while the impact on upstream margins is heterogeneous and negative for most manufacturers. This result indicates that the decrease in downstream competition gives more power to retailers in their negotiations with manufacturers. With less retailers available on the downstream market, manu-

[25]Ad-hoc changes in marginal cost of products or in the Nash bargaining weights of firms remain possible.

Table 9: Net impact of removing retailer 1, percentage variation with respect to the baseline model

	Δ Retail price	Δ Price-cost margin	Δ Market share	Δ Profit
Manufacturers				
M1	2.04	-17.18	0.28	0.05
M2	2.60	23.82	1.03	1.68
M3	1.84	-16.81	0.58	0.35
M4	1.78	-8.18	0.78	0.66
PLs	2.73	-	-2.52	-
Retailers				
R1	-	-	-	-
R2	2.20	5.33	-0.87	6.39
R3	1.82	4.81	0.37	7.02
R4	2.64	6.24	-3.83	5.21
R5	2.79	6.30	-2.25	6.08
R6	2.20	6.13	-2.35	6.73
R7	1.63	4.24	1.87	7.44

Values refer to variations in percentage with respect to the equilibrium outcome of our baseline model.

facturers' outside options may be reduced. Finally, retailers' profits increase from 5 to 7.5 percent while the profits of manufacturers are increasing only slightly, reflecting the fact that the reduction in dowstream competition benefit much more retailers than manufacturers.

We can thus conclude that our results confirm only partly the countervailing buyer power effect discussed in Galbraith (1952). According to this theory, a concentrated downstream sector with large retailers should be able to mitigate the market power of manufacturers by reducing the level of wholesale prices. These cost savings should then be passed on into retail prices such that the buyer power effect is supposed to compensate for the market power effect generated by greater concentration on the downstream market. In our exercise, we find that downstream consolidation effectively leads to lower wholesale prices paid to manufacturers in most cases. However, this benefit obtained by retailers is not sufficient to outweigh the increase in retail market power, leaving final consumers with higher retail prices.

Our results are in line with recent theoretical papers such as Gaudin (2017) or in a different context Caprice and Shekhar (2017). They are also in line with recent findings in the health care sector (Ho and Lee, 2017). Ho and Lee (2017) find empirical evidence that when removing one major health insurer hospital prices are reduced but premium prices paid by enrollees increase. As in our setting, insurers' outside options play a key role in the equilibrium outcome since changes in competition impact bargaining positions between hospitals and insurers when negotiating prices.

7 Concluding remarks

We develop a structural model to analyze bilateral oligopolies with product differentiation. Our empirical framework allows to account for heterogeneity in consumer preferences, downstream price competition between retailers, and manufacturer-retailer bargaining on the wholesale market. Products offered by firms may be costly to produce or distribute and our setting incorporates three distinct sources of bargaining power. Applied to the French soft drink industry, we find that retailers are able to extract more than 60 percent of the surplus generated by bilateral agreements in the vertical chain.

Using our estimates, we perform counterfactual simulations to investigate the effects of retail consolidation through the removal of one downstream competitor on the bargaining power of firms and prices paid by final consumers. While retailers are able to secure lower trading terms, our findings show that these cost savings are not sufficient to mitigate their gain in market power, leading to higher retail prices paid by final consumers.

Although we focus on the French soft drink industry, we believe that our methodology can be easily applied to other settings or economic issues that require the modelling of bilateral oligopolies. Indeed, one of the main advantage is that our empirical approach to estimating the surplus division between firms does not necessitate the use of extensive data with information on vertical contracts (e.g., wholesale prices) or cost of firms which are rarely available in practice, especially for all market participants.

Appendix

A Price-cost margins of the manufacturers

In the current section, we solve in detail the bilateral negotiation between manufacturer f and retailer r over wholesale price of product j.

Agreement payoffs. The agreement payoffs of manufacturer f (retailer r respectively) are written as follows

$$\begin{aligned}
\pi_{ft} &= \left(w_{jt} - \mu_{jt}\right) M_t\, s_{jt}(\mathbf{p}_{rt}(w_{jt}, \mathbf{w}^*_{-jt}), \mathbf{p}^*_{-rt}; \theta^d) \;\; + \sum_{k \in \mathcal{J}_{ft}\setminus\{j\}} \left(w^*_{kt} - \mu_{kt}\right) M_t\, s_{kt}(\mathbf{p}_{rt}(w_{jt}, \mathbf{w}^*_{-jt}), \mathbf{p}^*_{-rt}; \theta^d) \\
\pi_{rt} &= \left(p_{jt}(w_{jt}, \mathbf{w}^*_{-jt}) - w_{jt} - c_{jt}\right) M_t\, s_{jt}(\mathbf{p}_{rt}(w_{jt}, \mathbf{w}^*_{-jt}), \mathbf{p}^*_{-rt}; \theta^d) \\
&\quad + \sum_{k \in \mathcal{J}_{rt}\setminus\{j\}} \left(p_{kt}(w_{jt}, \mathbf{w}^*_{-jt}) - w^*_{kt} - c_{kt}\right) M_t\, s_{kt}(\mathbf{p}_{rt}(w_{jt}, \mathbf{w}^*_{-jt}), \mathbf{p}^*_{-rt}; \theta^d)
\end{aligned}$$

Disagreement payoffs. Let $\tilde{\mathbf{p}}_t^{-j}$ and $\tilde{s}_{kt}^{-j}$ be respectively the J_t-dimensional vector of out-of-equilibrium retail prices set by retailer r and the market share of product k at period t given that product j is no longer offered.[26] The disagreement payoffs of manufacturer f and retailer r are respectively derived as follows

$$\begin{aligned}
d_{ft}^{-j} &= \sum_{k \in \mathcal{J}_{ft}\setminus\{j\}} \left(w^*_{kt} - \mu_{kt}\right) M_t \tilde{s}_{kt}^{-j}(\tilde{\mathbf{p}}_t^{-j}; \theta^d) \\
d_{rt}^{-j} &= \sum_{k \in \mathcal{J}_{rt}\setminus\{j\}} \left(\tilde{p}_{k,t}^{-j} - w^*_{kt} - c_{kt}\right) M_t \tilde{s}_{kt}^{-j}(\tilde{\mathbf{p}}_t^{-j}; \theta^d)
\end{aligned}$$

Nash bargaining problem. The (asymmetric) Nash product of the bilateral negotiation between manufacturer f and retailer r over the wholesale price w_{jt} — taking $\mathbf{w}^*_{-jt}$ as given — is written as follows

$$\mathrm{NP}_{jt} \equiv \left(\pi_{ft}(w_{jt}, \mathbf{w}_{-jt}) - d_{ft}^{-j}(\mathbf{w}_{-jt})\right)^{1-\lambda_{fr}} \left(\pi_{rt}(w_{jt}, \mathbf{w}^*_{-jt}) - d_{rt}^{-j}(\mathbf{w}^*_{-jt})\right)^{\lambda_{fr}}$$

The vector of equilibrium wholesale price w^*_{jt} is defined as the term that maximizes the Nash product, that is

$$w^*_{jt} \equiv \underset{w_{jt}}{\operatorname{argmax}}\ \mathrm{NP}_{jt}$$

The first-order condition of this maximization problem governs the division of surplus between firms and is written as follows

$$\lambda_{fr}\left(\pi_{ft} - d_{ft}^{-j}\right)\frac{\partial \pi_{rt}}{\partial w_{jt}} + \left(1 - \lambda_{fr}\right)\left(\pi_{rt} - d_{rt}^{-j}\right)\frac{\partial \pi_{ft}}{\partial w_{jt}} = 0$$

[26] Note that $\tilde{\mathbf{p}}_t^{-j}[k,1] = \begin{cases} +\infty & \text{if } j = k \\ \tilde{p}_{k,t}^{-j} & \text{if } j \neq k \text{ and } j,k \in \mathcal{J}_{rt} \\ p^*_{k,t} & \text{otherwise} \end{cases}$.

$$\Leftrightarrow \quad \left(\Gamma^*_{jt} s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{ft}\setminus\{j\}} \Gamma^*_{kt}\left(s_{kt}(\mathbf{p}^*_t;\theta^d) - \tilde{s}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_{rt};\theta^d)\right)\right)\left(\sum_{k\in\mathcal{J}_{rt}} \frac{\partial p_{kt}}{\partial w_{jt}} s_{kt}(\mathbf{p}^*_t;\theta^d) - s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{rt}} \gamma^*_{kt} \sum_{l\in\mathcal{J}_{rt}} \frac{\partial s_{kt}}{\partial p_{lt}} \frac{\partial p_{lt}}{\partial w_{jt}}\right)$$

$$+ \frac{1-\lambda_{fr}}{\lambda_{fr}}\left(\gamma^*_{jt} s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{rt}\setminus\{j\}} \gamma^*_{kt} s_{kt}(\mathbf{p}^*_t;\theta^d) - \tilde{\gamma}_{kt}(\tilde{\mathbf{p}}^{-j}_{rt})\tilde{s}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_{rt};\theta^d)\right)\left(s_{jt}(\mathbf{p}^*_t;\theta^d) + \sum_{k\in\mathcal{J}_{ft}} \Gamma^*_{kt} \sum_{l\in\mathcal{J}_{rt}} \frac{\partial s_{kt}}{\partial p_{lt}} \frac{\partial p_{lt}}{\partial w_{jt}}\right) = 0$$

with $\Gamma^*_{jt} \equiv w^*_{jt} - \mu_{jt}$; $\gamma^*_{jt} \equiv p^*_{jt} - w^*_{jt} - c_{jt}$; $\tilde{\gamma}_{kt} \equiv \tilde{p}^{-j}_{kt} - w^*_{kt} - c_{kt}$.

For all products owned by manufacturer f on the market, the system of first-order conditions can be written in vector-matrix notation as follows

$$\left(\mathbf{I}_{ft}\tilde{\mathbf{S}}_{\Delta t}\mathbf{I}_{ft}\mathbf{\Gamma}^*_{ft}\right)\circ\left(\sum_{r=1}^{R}\mathbf{I}_{ft}\mathbf{I}_{rt}\left(\left(\mathbf{P}_{\mathbf{w}_t}-\mathbf{I}_t\right)\mathbf{I}_{rt}\mathbf{s}_t + \mathbf{P}_{\mathbf{w}_t}\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{rt}\boldsymbol{\gamma}^*_t\right)\right)$$

$$+\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}\circ\left(\sum_{r=1}^{R}\mathbf{I}_{ft}\mathbf{I}_{rt}\left(\iota\mathbf{s}_t^\top\mathbf{I}_{rt}\boldsymbol{\gamma}^*_t + \left(\left(\left(\tilde{\mathbf{S}}_{\Delta t}-\iota\mathbf{s}_t^\top\right)\mathbf{I}_{rt}\right)\circ\tilde{\boldsymbol{\gamma}}_t^\top\right)\iota\right)\right)\circ\left(\mathbf{s}_t + \left(\sum_{r=1}^{R}\mathbf{I}_{ft}\mathbf{I}_{rt}\mathbf{P}_{\mathbf{w}_t}\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{ft}\right)\mathbf{\Gamma}^*_{ft}\right) = \mathbf{0} \tag{13}$$

where the $J_t \times J_t$ matrices $\tilde{\mathbf{S}}_{\Delta t}$, $\tilde{\boldsymbol{\gamma}}_t$, and $\mathbf{P}_{\mathbf{w}_t}$ are constructed as follows

- $\tilde{\mathbf{S}}_{\Delta t} = \begin{pmatrix} s_{1,t}(\mathbf{p}^*_t;\theta^d) & -\Delta\tilde{s}^{-1}_{2,t}(\tilde{\mathbf{p}}^{-1}_t;\theta^d) & \cdots & -\Delta\tilde{s}^{-1}_{J,t}(\tilde{\mathbf{p}}^{-1}_t;\theta^d) \\ -\Delta\tilde{s}^{-2}_{1,t}(\tilde{\mathbf{p}}^{-2}_t;\theta^d) & s_{2,t}(\mathbf{p}^*_t;\theta^d) & \cdots & -\Delta\tilde{s}^{-2}_{J,t}(\tilde{\mathbf{p}}^{-2}_t;\theta^d) \\ \vdots & \vdots & \ddots & \vdots \\ -\Delta\tilde{s}^{-J}_{1,t}(\tilde{\mathbf{p}}^{-J}_t;\theta^d) & -\Delta\tilde{s}^{-J}_{2,t}(\tilde{\mathbf{p}}^{-J}_t;\theta^d) & \cdots & s_{Jt}(\mathbf{p}^*_t;\theta^d) \end{pmatrix}$

  with $-\Delta\tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t;\theta^d) = s_{k,t}(\mathbf{p}^*_t;\theta^d) - \tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t;\theta^d)$ and $\tilde{\mathbf{p}}^{-j}_t[k,1] = \begin{cases} +\infty & \text{if } k=j \\ \tilde{p}^{-j}_{k,t} & \text{if } j\neq k \text{ and } j,k\in\mathcal{J}_r \\ p^*_{k,t} & \text{otherwise} \end{cases}$ denotes the vector of out-of-equilibrium retail prices when product j is no longer offered on the market.

- $\tilde{\boldsymbol{\gamma}}_t[k,j] = \begin{cases} +\infty & \text{if } k=j \\ \tilde{\gamma}^{-j}_{kt} = \tilde{p}^{-j}_{kt} + \gamma_{kt} - p_{kt} & \text{if } k\neq j \text{ and } j,k\in\mathcal{J}_{rt} \\ \gamma^*_{kt} & \text{otherwise} \end{cases}$

  (see Appendix C for computational details of out-of-equilibrium prices)

- $\mathbf{P}_{\mathbf{w}_t} = \sum_{r=1}^{R}\mathbf{I}^*_r\mathbf{S}^\top_{\mathbf{p}_t}\mathbf{I}_{rt}\left(\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{rt} + \mathbf{I}_{rt}\mathbf{S}^\top_{\mathbf{p}_t}\mathbf{I}_{rt} + \mathbf{I}_{rt}\mathbf{S}^{\mathbf{p}}_{\mathbf{p}_t}\right)^+$ (see our Web Appendix for further details)

Let us define
$$\mathbf{V}_{ft} \equiv \sum_{r=1}^{R}\mathbf{I}_{ft}\mathbf{I}_{rt}\left(\left(\mathbf{P}_{\mathbf{w}_t}-\mathbf{I}_t\right)\mathbf{I}_{rt}\mathbf{s}_t + \mathbf{P}_{\mathbf{w}_t}\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{rt}\boldsymbol{\gamma}^*_t\right)$$
$$\mathbf{M}_{ft} \equiv \mathbf{I}_{ft}\tilde{\mathbf{S}}_{\Delta t}\mathbf{I}_{ft}$$
$$\tilde{\mathbf{V}}_{ft} \equiv \sum_{r=1}^{R}\mathbf{I}_{ft}\mathbf{I}_{rt}\left(\iota\mathbf{s}_t^\top\mathbf{I}_{rt}\boldsymbol{\gamma}^*_t + \left(\left(\left(\tilde{\mathbf{S}}_{\Delta t}-\iota\mathbf{s}_t^\top\right)\mathbf{I}_{rt}\right)\circ\tilde{\boldsymbol{\gamma}}_t^\top\right)\iota\right)$$
$$\tilde{\mathbf{M}}_{ft} \equiv \sum_{r=1}^{R}\mathbf{I}_{ft}\mathbf{I}_{rt}\mathbf{P}_{\mathbf{w}_t}\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_{ft}$$

and re-write the system of equations (13) as follows

$$\mathbf{V}_{ft}\circ\left(\mathbf{M}_{ft}\mathbf{\Gamma}^*_{ft}\right) + \frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}\circ\tilde{\mathbf{V}}_{ft}\circ\mathbf{s}_t + \frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}\circ\tilde{\mathbf{V}}_{ft}\circ\left(\tilde{\mathbf{M}}_{ft}\mathbf{\Gamma}^*_{ft}\right) = \mathbf{0} \tag{14}$$

To derive equilibrium margins of manufacturer f for period t we introduce the following Lemma.

Lemma (Associative property). *Let* $\mathbf{V}$, $\boldsymbol{\Gamma}$, *and* $\boldsymbol{\iota}$ *be three J-dimensional vectors where every element of* $\boldsymbol{\iota}$ *is equal to* 1. *Consider a* $J \times J$ *matrix denoted* $\mathbf{M}$. *If we define* $\mathbf{C} \equiv \mathbf{V} \circ (\mathbf{M}\boldsymbol{\Gamma})$ *and* $\mathbf{D} \equiv ((\mathbf{V}\boldsymbol{\iota}^\top) \circ \mathbf{M})\boldsymbol{\Gamma}$, *then*

$$\mathbf{C} \equiv \mathbf{D}.$$

Proof. See Appendix B.

From (14) and the above Lemma, we derive the equilibrium price-cost margins of manufacturer f as follows

$$\begin{aligned} &\left(\left(\mathbf{V}_{ft}\boldsymbol{\iota}^\top\right) \circ \mathbf{M}_{ft}\right)\boldsymbol{\Gamma}^*_{ft} + \frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft} \circ \mathbf{s}_t + \left(\left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft}\right) \boldsymbol{\iota}^\top\right) \circ \tilde{\mathbf{M}}_{ft}\right)\boldsymbol{\Gamma}^*_{ft} = \mathbf{0} \\ \Leftrightarrow \quad & \boldsymbol{\Gamma}^*_{ft} = -\left(\left(\mathbf{V}_{ft}\boldsymbol{\iota}^\top\right) \circ \mathbf{M}_{ft} + \left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft}\right) \boldsymbol{\iota}^\top\right) \circ \tilde{\mathbf{M}}_{ft}\right)^+ \left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft} \circ \mathbf{s}_t\right) \end{aligned} \tag{15}$$

We finally denote $\boldsymbol{\Gamma}^*_t \equiv \sum_{f=1}^{F} \boldsymbol{\Gamma}^*_{ft}$ and recover the vector of equilibrium upstream margins as follows

$$\boldsymbol{\Gamma}^*_t = -\sum_{f=1}^{F}\left(\left(\mathbf{V}_{ft}\boldsymbol{\iota}^\top\right) \circ \mathbf{M}_{ft} + \left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft}\right) \boldsymbol{\iota}^\top\right) \circ \tilde{\mathbf{M}}_{ft}\right)^+ \left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft} \circ \mathbf{s}_t\right)$$

B Proof of Lemma

Lemma (Associative property).[27] *Let* $\mathbf{V}$, $\boldsymbol{\Gamma}$, *and* $\boldsymbol{\iota}$ *be three J-dimensional vectors where every element of* $\boldsymbol{\iota}$ *is equal to* 1. *Consider a* $J_t \times J_t$ *matrix denoted* $\mathbf{M}$. *If we define* $\mathbf{C} \equiv \mathbf{V} \circ (\mathbf{M}\boldsymbol{\Gamma})$ *and* $\mathbf{D} \equiv ((\mathbf{V}\boldsymbol{\iota}^\top) \circ \mathbf{M})\boldsymbol{\Gamma}$, *then*

$$\mathbf{C} = \mathbf{D}.$$

Proof. The ith element of the vector $\mathbf{C}$ can be computed as follows

$$\begin{aligned} & [\mathbf{C}]_i = [\mathbf{V} \circ (\mathbf{M}\boldsymbol{\Gamma})]_i \\ \Leftrightarrow \quad & [\mathbf{C}]_i = [\mathbf{V}]_i \sum_{j=1}^{J} [\mathbf{M}]_{ij} [\boldsymbol{\Gamma}]_j \quad \text{where } [\mathbf{M}]_{ij} \text{ denotes the element at the } i\text{th row and } j\text{th column of } \mathbf{M}. \end{aligned}$$

Similarly, the ith element of the vector $\mathbf{D}$ is derived as follows

$$\begin{aligned} & [\mathbf{D}]_i = \left[\left(\left(\mathbf{V}\boldsymbol{\iota}^\top\right) \circ \mathbf{M}\right)\boldsymbol{\Gamma}\right]_i \\ \Leftrightarrow \quad & [\mathbf{D}]_i = \sum_{j=1}^{J} [\mathbf{V}]_i [\mathbf{M}]_{ij} [\boldsymbol{\Gamma}]_j \\ \Leftrightarrow \quad & [\mathbf{D}]_i = [\mathbf{V}]_i \sum_{j=1}^{J} [\mathbf{M}]_{ij} [\boldsymbol{\Gamma}]_j \end{aligned}$$

Then, we have shown that $\forall i,\ [\mathbf{D}]_i = [\mathbf{C}]_i \quad \Rightarrow \quad \mathbf{C} = \mathbf{D}$.

[27] We are grateful to Olivier de Mouzon for his valuable help on this issue.

Illustration: Without loss of generality, let us define $\mathbf{V} = \begin{pmatrix} v_{11} \\ v_{21} \\ v_{31} \end{pmatrix}$, $\mathbf{M} = \begin{pmatrix} m_{11} & m_{12} & m_{13} \\ m_{21} & m_{22} & m_{23} \\ m_{31} & m_{32} & m_{33} \end{pmatrix}$, $\iota = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$, and $\mathbf{\Gamma} = \begin{pmatrix} \Gamma_{11} \\ \Gamma_{21} \\ \Gamma_{31} \end{pmatrix}$.

The second element of each vector $\mathbf{C}$ and $\mathbf{D}$ can be respectively derived as follows

$$[\mathbf{C}]_2 = v_{21}\left(m_{21}\Gamma_{11} + m_{22}\Gamma_{21} + m_{23}\Gamma_{31}\right) \quad \text{and} \quad [\mathbf{D}]_2 = v_{21}m_{21}\Gamma_{11} + v_{21}m_{22}\Gamma_{21} + v_{21}m_{23}\Gamma_{31}$$

As a result, we have $[\mathbf{C}]_2 = [\mathbf{D}]_2$.

C Estimation of the out-of-equilibrium retail prices.

In this section, we derive the out-of-equilibrium retail prices following a disagreement over a product. Let us assume that, for a given period t, product $j \in \mathcal{J}_{rt}$ is no longer offered on the market. Under the assumption that wholesale prices and distribution costs of other products remain unchanged,[28] the equilibrium margins (γ^*_{kt}) and out-of-equilibrium margins ($\tilde{\gamma}^{-j}_{kt}$) of product $k \in \mathcal{J}_{rt} \backslash j$ are written as follows

$$\gamma^*_{kt} = p^*_{kt} - w^*_{kt} - c_{kt} \quad \text{and} \quad \tilde{\gamma}^{-j}_{kt} = \tilde{p}^{-j}_{kt} - w^*_{kt} - c_{kt}$$

We can see from these margins that the following equality holds

$$\tilde{p}^{-j}_{kt} - \tilde{\gamma}^{-j}_{kt} - \left(p^*_{kt} - \gamma^*_{kt}\right) = 0 \quad \forall k \in \mathcal{J}_{rt} \backslash j$$

Hence, we can define a system of J_t nonlinear equations

$$\mathbf{f}_j(\tilde{\mathbf{p}}^{-j}_t) \equiv \tilde{\mathbf{p}}^{-j}_t - \tilde{\boldsymbol{\gamma}}^{-j}_t - (\mathbf{p}^*_t - \boldsymbol{\gamma}^*_t) = \mathbf{0} \tag{16}$$

where $\mathbf{0}$ is a J_t-dimensional vector with all entries being equal to 0,

$$\tilde{\boldsymbol{\gamma}}^{-j}_t[k,1] = \begin{cases} +\infty & \text{if } k = j \\ \tilde{\boldsymbol{\gamma}}^{-j}_{rt}[k,1] & \text{if } j,k \in \mathcal{J}_{rt} \quad \text{with } \tilde{\boldsymbol{\gamma}}^{-j}_{rt} = -\left(\mathbf{I}_{rt}\mathbf{S}_{\mathbf{p}_t}(\tilde{\mathbf{p}}^{-j}_t)\mathbf{I}_{rt}\right)^+ \mathbf{I}_{rt}\mathbf{s}_t(\tilde{\mathbf{p}}^{-j}_t) \\ \gamma^*_{kt} & \text{otherwise} \end{cases}$$

and $\tilde{\mathbf{p}}^{-j}_t$ is given by $\tilde{\mathbf{p}}^{-j}_t[k,1] = \begin{cases} +\infty & \text{if } j = k \\ \tilde{p}^{-j}_{kt} & \text{if } k \in \mathcal{J}_{rt} \\ p^*_{kt} & \text{if } k \notin \mathcal{J}_{rt} \end{cases}$.

To solve the system (16) and recover the out-of-equilibrium retail prices we employ a trust-region dogleg method.[29] Equilibrium retail prices are used as an initial guess for the out-of-equilibrium retail prices parameters, i.e., $\tilde{\mathbf{p}}^{-j,(0)}_t = \mathbf{p}^*_t$.

D Counterfactual algorithm

To estimate the vector of equilibrium retail prices in the counterfactual world, we have to resolve a new bargaining equilibrium and downstream price equilibrium for each market. In the resolution of the

[28] In our bargaining protocol, a breakdown in a bilateral negotiation has no effect on wholesale prices of products determined in the remaining negotiations (see Section 4 for details).

[29] The search for a numerical root is performed with the MATLAB *fsolve* function.

new bargaining equilibrium, new status quo payoffs of firms involved in bilateral negotiations need to be constructed. In particular, we have to identify all vectors of out-of-equilibrium retail prices resulting from a bargaining breakdown. Hence, the problem can be seen as a large system of nonlinear equations for which $\theta^{\text{post}} \equiv ((\mathbf{p}_t^{\text{post}})^\top, (\tilde{\mathbf{p}}_t^{-1,\text{post}})^\top, \dots (\tilde{\mathbf{p}}_t^{-J,\text{post}})^\top)^\top$ is a vector of dimension $J_t + \sum_j \mid \mathcal{J}_{r(j)t} \backslash \{j\} \mid$ that solves the system described as follows

$$\mathbf{F}(\theta^{\text{post}}) = \begin{cases} \mathbf{f}_1(\tilde{\mathbf{p}}_t^{-1,\text{post}}, \mathbf{p}_t^{\text{post}}) & = \mathbf{0} \\ \vdots & \vdots \\ \mathbf{f}_J(\tilde{\mathbf{p}}_t^{-J,\text{post}}, \mathbf{p}_t^{\text{post}}) & = \mathbf{0} \\ \mathbf{g}(\mathbf{p}_t^{\text{post}}, \tilde{\mathbf{p}}_t^{-1,\text{post}}, \dots, \tilde{\mathbf{p}}_t^{-J,\text{post}}) & = \mathbf{0} \end{cases} \tag{17}$$

In (17), each $\mathbf{f}_j(\tilde{\mathbf{p}}_t^{-j,\text{post}}, \mathbf{p}_t^{\text{post}}) = \mathbf{0}$ with $j \in \mathcal{J}_{rt}$ represents a sub-system of $\mid \mathcal{J}_{rt} \mid -1$ nonlinear equations which characterize the out-of-equilibrium behavior of retailers in the event of a bargaining breakdown (here, over product j in market t). The last sub-sytem $\mathbf{g}(\mathbf{p}_t^{\text{post}}, \tilde{\mathbf{p}}_t^{-1,\text{post}}, \dots, \tilde{\mathbf{p}}_t^{-J,\text{post}}) = \mathbf{0}$ comprises J nonlinear equations which characterize the equilibrium behavior of firms on the market (i.e., the bargaining between manufacturers and retailers and the dowstream price competition). Since it would be computationally cumbersome to solve for the whole nonlinear system (17), we decide to decompose the problem in sub-systems and employ a *Gauss-Seidel*-type algorithm.

Iterative Estimation Algorithm. The iterative algorithm we employ to perform our counterfactual experiment is described as follows. For each period t in the sample, we assume that total marginal costs of products remain similar to our estimates in the baseline model. For expositional convenience, we drop the label "post".

1. *Initialization*: Parameters to be estimated are the J_t-dimensional vector of counterfactual equilibrium retail prices in period t (i.e., $\mathbf{p}_t$), and each $\mid \mathcal{J}_{rt} \backslash \{j\} \mid$-dimensional vector of counterfactual out-of-equilibrium retail prices when product $j \in \mathcal{J}_{rt}$ is removed (i.e., $\tilde{\mathbf{p}}_t^{-j}$). We use the (observed) vector of equilibrium retail prices from the baseline model as an initial guess for the vector of counterfactual equilibrium retail prices: $\mathbf{p}_t^{(0)} = \mathbf{p}_t^*$. Starting values for each vector of counterfactual out-of-equilibrium retail prices when product j is removed from period t is equal to its counterpart from the baseline model: $\tilde{\mathbf{p}}_t^{-j,(0)} = \tilde{\mathbf{p}}_t^{-j}\ \forall j \in \mathcal{J}_t \backslash \{0\}$.

2. At the ith iteration, we make a guess of each vector of counterfactual out-of-equilibrium retail prices $\tilde{\mathbf{p}}_t^{-j,(i)}$ by solving the following system of nonlinear equations

$$\underbrace{\tilde{\mathbf{p}}_t^{-j,(i)} - \tilde{\boldsymbol{\gamma}}_t^{-j,(i)}}_{\mathbf{w}_t^{(i)} - \mathbf{c}_t} - (\underbrace{\mathbf{p}_t^{(i-1)} - \boldsymbol{\gamma}_t^{(i-1)}}_{\mathbf{w}_t^{(i-1)} - \mathbf{c}_t}) = \mathbf{0} \tag{18}$$

   where $\boldsymbol{\gamma}_t^{(i-1)} = -\sum_{r=1}^{R} \left(\mathbf{I}_r \mathbf{S}_{\mathbf{p}}(\mathbf{p}_t^{(i-1)}) \mathbf{I}_r\right)^+ \mathbf{I}_r \mathbf{s}_t(\mathbf{p}_t^{(i-1)})$ and $\tilde{\boldsymbol{\gamma}}_t^{-j,(i)}[k,1] = \begin{cases} \tilde{\boldsymbol{\gamma}}_{rt}^{-j,(i)}[k,1] & \text{if } j,k \in \mathcal{J}_{rt} \\ \boldsymbol{\gamma}_t^{(i-1)}[k,1] & \text{otherwise} \end{cases}$
   with $\tilde{\boldsymbol{\gamma}}_{rt}^{-j,(i)} = -\left(\mathbf{I}_r \mathbf{S}_{\mathbf{p}}(\tilde{\mathbf{p}}_t^{-j,(i)}) \mathbf{I}_r\right)^+ \mathbf{I}_r \mathbf{s}_t(\tilde{\mathbf{p}}_t^{-j,(i)})$
   The system of equations (18) relates to the sub-system of equations $\mathbf{f}_j(\tilde{\mathbf{p}}_t^{-1,\text{post}}, \mathbf{p}_t^{\text{post}}) = \mathbf{0}$ in (17). Note that before each iteration $\tilde{\mathbf{p}}_t^{-j,(i)}$ is updated using $\tilde{\mathbf{p}}_t^{-j,(i-1)}$ as starting point.

3. Given the guess of each out-of-equilibirum retail prices (and, in turn, retail margins) from step 2 and $\mathbf{p}_t^{(i-1)}$, we construct the $J \times J$ matrices $\mathbf{P}_{\mathbf{w}_t}^{(i)}$ and $\tilde{\mathbf{S}}_{\Delta t}^{(i)}$.

4. The vector of counterfactual equilibrium retail prices $\mathbf{p}_t^{(i)}$ is the solution to the following system of nonlinear equations

$$\underbrace{\mathbf{p}_t^{(i)} - (\boldsymbol{\gamma}_t^{(i)} + \boldsymbol{\Gamma}_t^{(i)})}_{\mathbf{c}_t + \boldsymbol{\mu}_t} - \underbrace{\mathbf{p}_t^{*} - (\boldsymbol{\gamma}_t^{*} - \boldsymbol{\Gamma}_t^{*})}_{\mathbf{c}_t + \boldsymbol{\mu}_t} = \mathbf{0} \tag{19}$$

where $\boldsymbol{\Gamma}_t^{(i)} \equiv -\sum_{f=1}^{F} \left(\left(\mathbf{V}_{ft}^{(i)} \boldsymbol{\iota}^\top \right) \circ \mathbf{M}_{ft}^{(i)} + \left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft}^{(i)} \right) \boldsymbol{\iota}^\top \right) \circ \tilde{\mathbf{M}}_{ft}^{(i)} \right)^{+} \left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{ft}^{(i)} \circ \mathbf{s}_t^{(i)} \right)$

The system of equations (19) relates to the sub-system of J_t equations $\mathbf{g}(\mathbf{p}_t^{\text{post}}, \tilde{\mathbf{p}}_t^{-1,\text{post}}, \ldots, \tilde{\mathbf{p}}_t^{-J,\text{post}}) = \mathbf{0}$ in (17). Note that before each iteration, $\mathbf{p}_t^{(i)}$ is updated using $\mathbf{p}_t^{(i-1)}$ as starting point.

5. We iteratively apply steps 2. to 4. until convergence, i.e. $\|\mathbf{p}_t^{(i)} - \mathbf{p}_t^{(i-1)}\| < \epsilon$.[30]

[30] Simulations are performed with $\epsilon = 10^{-06}$.

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Chapter 2

Buyer Alliances in Vertically Related Markets

1 Introduction

Alliances of multiple buyers to deal with their suppliers is a widespread phenomenon in vertical markets. Examples include group purchasing organizations that negotiate tariffs with medical device manufacturers on behalf of hospitals; independent drugstores who join buyer groups to negotiate wholesale contracts with drug manufacturers (e.g., Numark in the U.K., Giphar in France); advertisers in the online ads industry who delegate their bidding campaigns to specialized agencies in order to get advertisement space on search engines and social networks (Decarolis, Goldmanis and Penta, 2017); buyer alliances formed by food retailers to negotiate trading terms with their suppliers (e.g., Dobson et al., 1999).[1]

In practice, the competition concerns about buyer alliances (or buyer groups) have long been analyzed with a strong presumption of legality by antitrust agencies (Carstensen, 2010). At first glance, alliances may generate better trading terms for buyers resulting in cost savings which could then be passed on to final consumers without generating any potential market power effects as opposed to horizontal mergers. However, recent investigations conducted by competition authorities have noticed risks of adverse effects such as collusive behavior between retailers due to exchanges of information, and have claimed for further control of such practices.[2]

The main contribution of this paper is to shed light on a new mechanism emerging from the inability of suppliers to price discriminate between the members of a buyer alliance. I show that, in the absence of such discrimination, theoretical predictions

[1] Buyer alliances are also used by health insurers (Sorensen, 2003), in the U.S. cable television industry, in the U.S. retail hardware market, as well as in the Aircraft sector (Dana, 2012).

[2] The French competition authority advocates for the introduction of a legal obligation to notify any new buyer alliances before they come into force (Autorité de la concurrence, 2015). See also recent inquiries on the food retail sector conducted by the Bundeskartellamt (2014) or by the Italian competition authority (see Sciaudone and Caravá, 2015, for further details).

about the effects of buyer alliances on the bargaining power of firms and prices paid by final consumers are ambiguous. To gain further insights, I consider the issue from an empirical perspective using homescan data on bottled water purchases in France for the year 2013. The empirical framework builds on Bonnet, Bouamra-Mechemache and Molina (2017) who develop a structural model of demand and supply to recover the division of surplus in bilateral oligopolies with differentiated products (see Chapter 1). I first estimate consumer demand to measure the degree of product differentiation which drives the pricing behavior of firms in the French bottled water market. On the supply side, I consider a setting of vertical contracting between multiple manufacturers and retailers which allows for balanced bargaining power and takes into account the impact of (negotiated) wholesale tariffs on the downstream price competition between retailers. Bargaining power of firms are recovered based on new conditional moment restrictions which approximate Chamberlain (1987) optimal instruments. Using estimated parameters of the structural model, I perform simulations to analyze the economic effects of buyer alliances. My focus is on three alliances that have been formed between competing retailers on the French food retail sector in 2014, namely: Carrefour (21.8%) and Cora (3.3%), Groupe Auchan (11.3%) and Système U (10.3%), ITM Entreprises (14.4%) and Groupe Casino (11.5%).[3] Empirical results contrast with the standard intuition that alliances generate more beneficial trading terms for retailers. The results show that buyer alliances weaken the bargaining power of retailers and allow upstream manufacturers to increase their price-cost margins by 2.80%. I find that the increase in wholesale prices is passed on to final consumers and reduces industry profit by 0.69%.

This article relates to the literature on buyer power in vertically related markets which, dating back to Galbraith (1952, 1954) and his concept of countervailing buyer power, analyzes the potential for large buyers to obtain lower trading terms and pass on the resulting benefit to final consumers. Whether consumers should welcome big retailers has been a controversial issue in the economic literature (e.g., Stigler, 1963; Hunter, 1958) and remains subject to ongoing research. Large buyers are often considered being able to secure lower input prices from their upstream providers because they have better outside options — e.g., credible threats of vertical integration (Katz, 1987) — or they act as gatekeepers due to the absence of rivalry on the market. It has also been emphasized that whether big buyers obtain more favorable trading terms depends on the curvature of suppliers' profit functions (Chipty and Snyder, 1999; Normann, Ruffle and Snyder, 2007). Effects of retail concentration on both upstream and

[3]Estimated market share (in euro) of each retailer on the downstream market are in parenthesis (source: Autorité de la concurrence, 2015).

downstream markets (e.g., horizontal mergers, entry or exit of rival retailers) have also been extensively analyzed in the literature (Dobson and Waterson, 1997; Iozzi and Valletti, 2014; Gaudin, 2017). However, instead of considering consolidation on both sides of the market, my paper focuses on the case in which retailers form alliances on the upstream market but remain competitors at the downstream level.

In this respect, several articles have pointed out that such alliances can be used by buyers to coordinate their purchasing policy and stimulate upstream competition by reducing the number of suppliers to deal with (Inderst and Shaffer, 2007; Dana, 2012; Chen and Li, 2013).[4] By contrast, my article considers that buyer alliances do not directly modify the buyer-seller network but enable downstream firms to affect threat points in negotiations by precipitating bargaining breakdowns with multiple retailers at the same time as in Caprice and Rey (2015). Prior to the empirical analysis, I present the main insights in a stylized model of vertical relationships with one upstream manufacturer and two downstream retailers. In this setting, firms operate under constant returns to scale, per-unit wholesale prices are determined through bilateral bargains, and retailers compete in prices on a downstream market. I show that a buyer alliance which aims at maximizing total profit of its members and securing nondiscriminatory trading terms via centralised negotiations generates two main effects on the bargaining power of firms. On the one hand, joining forces deteriorates the outside option of the manufacturer which strengthens the bargaining position of retailers. On the other hand, this increase in bargaining power can be mitigated by the fact that the buyer alliance provides similar trading terms for both retailers. Initially pointed out by O'Brien (2014) in the context of banning price discrimination in intermediate good markets, I show that this effect lessens the ability of retailers to extract price concessions from the manufacturer and undermines their bargaining power.

On the empirical side, my framework is in line with the literature on structural models of vertical relationships and bilateral oligopolies. One strand of this literature has analyzed vertical contracting in settings where multiple upstream players make (simultaneous) take-it-or-leave-it offers to downstream players (Villas-Boas, 2007, 2009; Ho, 2009; Bonnet and Dubois, 2010; Bonnet et al., 2013; Goldberg and Hellerstein, 2013). Since powerful firms operate on both sides of the French bottled water market, my structural modeling approach follows a recent stream of articles which develop empirical models of bargaining to analyze buyer-seller interactions with contracting externalities (Draganska, Klapper and Villas-Boas, 2010; Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran, Nevo and Town, 2015; Ho and Lee,

[4]Sorensen (2003) and Ellison and Snyder (2010) provide empirical evidence in support of this theory.

2017). Grennan (2013) is of particular interest since he simulates the formation of a group purchasing organization that negotiates with medical device manufacturers on behalf of hospitals in the U.S. coronary stent industry. His findings show that such an alliance may increase prices in favor of manufacturers, thereby reducing the bargaining power of hospitals. However, the fact that hospitals behave as local monopolists and do not strategically compete with one another on a downstream market implies that his framework differs from mine in many aspects.[5]

The rest of this article is organized as follows. In Section 2, I develop a stylized model of vertical relationships to shed light on the main economic forces at play when two retailers form a buyer alliance. Section 3 presents the data, the structural model of demand and supply, and the results. Simulations of buyer alliances are considered in Section 4, and Section 5 concludes.

2 Theoretical Insights

In this section, I design a stylized model of vertical relationships to provide insights on the main effects generated by a buyer alliance on the bargaining power of firms and final prices paid by consumers.

Setup. Consider an upstream manufacturer A which produces a brand and sells it to two symmetric retailers, R_1 and R_2, competing for consumers on a downstream market. The two retailers are supposed to be differentiated, reflecting differences in their sales services or location. There are two differentiated products on the market, indexed by $j = 1, 2$ (a product is defined as a brand-retailer combination). For each product, the marginal cost of production incurred by the upstream manufacturer and the marginal cost of distribution for the retailers are assumed to be constant and normalized to zero for the sake of convenience. The product distributed by R_j is sold to consumers at price p_j and its competitor at price p_{-j}. I suppose that consumer utility functions and budget constraints lead to the following demand function $q_j(p_j, p_{-j})$ for R_j's product which is assumed to be twice continuously differentiable with $\frac{\partial q_j}{\partial p_j} < 0$ and $\frac{\partial q_j}{\partial p_{-j}} > 0$ for $q_j > 0$.

[5]Mechanisms that are at play in Grennan (2013) are more related to the literature on price discrimination in oligopoly markets (e.g., Armstrong, 2006; Stole, 2007). In settings where buyers subsequently compete on a downstream market, additional issues such as ex-post observability of rivals' contracts arise. Moreover, the fact that hospitals are local monopolists rules out effects of buyer alliances on disagreement payoffs of medical device manufacturers.

Timing, solution concept and information. I consider a two-stage game in which the upstream manufacturer and the two downstream retailers interact as follows:

- **Stage 1**: The upstream firm engages simultaneously in a bilateral bargaining with each retailer on the wholesale market. Contracts are secret and consist of a per-unit wholesale price paid by the retailers.
- **Stage** 2: Retailers engage in a simultaneous price-setting competition on the downstream market.

This two-stage game is solved by using a refinement of the Perfect Bayesian equilibrium concept. In the upstream market, I employ a semi-cooperative approach pioneered by Horn and Wolinsky (1988) to determine the surplus division between the manufacturer and its retailers: the "Nash-in-Nash" bargaining solution. This bargaining protocol corresponds to a delegated agents model in which separate representatives are (simultaneously) sent by firms to every bilateral negotiations in order to bargain over trading terms on their behalf. Because each delegated agent participates only in one bilateral negotiation and cannot communicate with their counterparts (even those coming from the same firm), it is assumed that firms' delegates hold "passive-beliefs" over deals reached elsewhere (McAfee and Schwartz, 1994).[6] Therefore, this bargaining model exhibits a setting in which contracts are binding, firms behave schizophrenically, and negotiators have "passive-beliefs".[7] In the downstream market, competition between retailers is modeled as a Nash pricing game with interim observability (Rey and Vergé, 2004), that is, wholesale prices negotiated with the upstream firm are fully revealed to retailers before they set their prices.[8]

The purpose of this simple model is to illustrate the effects of a buyer alliance formed by R_1 and R_2 on the equilibrium retail and wholesale prices. First, I study a benchmark setting in which R_1 and R_2 negotiate separately their wholesale tariff with

[6] A bargainer is said to have "passive-beliefs" about outcomes of other negotiations when he holds the same conjectures in all circumstances (i.e., even in a bargaining breakdown).

[7] Each bilateral negotiation being determined from the Nash axiomatic model of bargaining (Nash, 1950) given agents' conjectures about the division of the gains from trade in all other bilateral negotiations, this solution casts a Nash equilibrium in Nash bargains and is commonly referred to as the "Nash-in-Nash" bargaining solution (Collard-Wexler, Gowrisankaran and Lee, 2017).

[8] The interim observability assumption is mainly used for convenience and considerably simplifies the analysis by ruling out any effects related to a change in the information structure (e.g., by forming an alliance, wholesale tariffs which could be unobserved by rival retailers are revealed). Adding such effects in the analysis would reinforce the ambigous impact of buyer alliances (more details are available upon request). Nonetheless, I make use of an alternative information structure with unobservable contracts in the empirical framework which best fits with the institutional details.

the upstream firm. Then, I investigate the case in which R_1 and R_2 negotiate together through a buyer group. Proceeding backwards, I consider beforehand the downstream price competition between the two retailers.

2.1 Downstream Price Competition

Retail price equilibrium. In the second stage of the game, R_1 and R_2 are assumed to compete in prices with interim observability. Hence, each retailer sets its price p_j so as to maximize profit given all wholesale prices determined in the bargaining stage and the strategy played by its rival. The maximization problem of R_j is written as

$$\max_{p_j} \pi_{R_j}(p_j, p_{-j})$$

where $\pi_{R_j}(p_j, p_{-j}) \equiv \left(p_j - w_j\right) q_j(p_j, p_{-j})$ and w_j denotes the wholesale price of product j. The first-order condition of this maximization problem, that is $\frac{\partial \pi_{R_j}}{\partial p_j} = 0$, characterizes R_j's pricing behavior on the downstream market and is derived as follows

$$q_j(p_j, p_{-j}) + \left(p_j - w_j\right) \frac{\partial q_j}{\partial p_j}(p_j, p_{-j}) = 0 \tag{1}$$

The downstream price equilibrium is defined by the retail prices $(p_1, p_2) = (p_1^*, p_2^*)$ such that $\frac{\partial \pi_{R_1}}{\partial p_1}(p_1^*, p_2^*) = 0$ and $\frac{\partial \pi_{R_2}}{\partial p_2}(p_1^*, p_2^*) = 0$. Technical conditions to ensure existence and uniqueness of the equilibrium are reported in Appendix A.1.

Retail pass-through rate. To infer the extent to which a change in wholesale prices is passed on to final consumers, I derive the following pass-through rates which are obtained by differentiating (1) with respect to w_j (see Appendix A.2 for computational details)

$$\frac{\partial p_j}{\partial w_j} = \frac{\frac{\partial^2 \pi_{R_{-j}}}{\partial p_{-j}^2} \frac{\partial q_j}{\partial p_j}}{\frac{\partial^2 \pi_{R_j}}{\partial p_j^2} \frac{\partial^2 \pi_{R_{-j}}}{\partial p_{-j}^2} - \frac{\partial^2 \pi_{R_j}}{\partial p_j \partial p_{-j}} \frac{\partial^2 \pi_{R_{-j}}}{\partial p_{-j} \partial p_j}} \quad \text{and} \quad \frac{\partial p_{-j}}{\partial w_j} = -\frac{\frac{\partial^2 \pi_{R_{-j}}}{\partial p_{-j} \partial p_j} \frac{\partial q_{-j}}{\partial p_{-j}}}{\frac{\partial^2 \pi_{R_j}}{\partial p_j^2} \frac{\partial^2 \pi_{R_{-j}}}{\partial p_{-j}^2} - \frac{\partial^2 \pi_{R_j}}{\partial p_j \partial p_{-j}} \frac{\partial^2 \pi_{R_{-j}}}{\partial p_{-j} \partial p_j}}$$

From the assumptions which ensure existence and uniqueness of the downstream price equilibrium, it turns out that $\frac{\partial p_j}{\partial w_j} > 0$. Moreover, since retail prices are strategic complements, that is $\frac{\partial^2 \pi_{R_{-j}}}{\partial p_{-j} \partial p_j} > 0$, I obtain that $\frac{\partial p_{-j}}{\partial w_j} > 0$. As a result, an alliance of retailers will benefit (resp. harm) final consumers if and only if it induces a decrease (resp. increase) in wholesale prices. This issue is addressed in the following subsections.

2.2 Manufacturer-Retailer Bargaining

Bargaining between A and R_j over w_j. In what follows, I consider the bilateral negotiation between the upstream firm and retailer R_j over w_j. Denoting by w^*_{-j} the (anticipated) wholesale price determined in the other negotiation, I define the agreement payoffs of A and R_j respectively as follows

$$\begin{aligned}
\pi_A(w_j, w^*_{-j}) &= w_j q_j(p_j(w_j, w^*_{-j}), p_{-j}(w_j, w^*_{-j})) + w^*_{-j} q_{-j}(p_j(w_j, w^*_{-j}), p_{-j}(w_j, w^*_{-j})) \\
\pi_{R_j}(w_j, w^*_{-j}) &= \left(p_j(w_j, w^*_{-j}) - w_j\right) q_j(p_j(w_j, w^*_{-j}), p_{-j}(w_j, w^*_{-j}))
\end{aligned}$$

where p^*_{-j} corresponds to the price set by R_{-j} when it pays w^*_{-j}. Taking into account that bargaining breakdowns are observable by retailers before the downstream competition, I specify the disagreement payoffs of A and R_j as follows

$$\begin{aligned}
d_A^{-R_j} &= w^*_{-j} \tilde{q}_{-j}(\tilde{p}_{-j}(w^*_{-j})) \\
d_{R_j}^{-A} &= 0
\end{aligned}$$

where $\tilde{q}_{-j}$ and $\tilde{p}_{-j}$ are respectively the out-of-equilibrium quantity and price of the good sold by R_j's rival.

Nash bargaining problem. Following Horn and Wolinsky (1988), the equilibrium wholesale price w^*_j maximizes the (asymmetric) Nash product, taking as given the (anticipated) wholesale price w^*_{-j}, that is

$$w^*_j \equiv \underset{w_j \in \Theta}{\operatorname{argmax}} \; \mathrm{NP}_j(w_j, w^*_{-j})$$

where $\Theta \equiv \{(w_j, w_{-j}) \in \mathbb{R}^2_+ : \pi_A(w_1, w_2) \geq d_A^{-R_j}(w_{-j}) \text{ and } \pi_{R_j}(w_1, w_2) \geq d_{R_j}^{-A}\}$ and $\mathrm{NP}_j(w_j, w^*_{-j}) \equiv \left(\pi_A(w_j, w^*_{-j}) - d_A^{-R_j}(w^*_{-j})\right)^{1-\lambda} \left(\pi_{R_j}(w_j, w^*_{-j}) - d_{R_j}^{-A}\right)^{\lambda}$ with $\lambda \in [0,1]$ which denotes the Nash bargaining weight of the retailer in its negotiation with the upstream manufacturer.

First-order condition and sources of bargaining power. The first-order condition of the above Nash bargaining problem, that is $\frac{\partial \mathrm{NP}_j}{\partial w_j} = 0$, is derived as follows

$$\underbrace{\lambda\left(\pi_A(w_j, w^*_{-j}) - d_A^{-R_j}(w^*_{-j})\right)\frac{\partial \pi_{R_j}}{\partial w_j}}_{R_j\text{'s bargaining power}} + \underbrace{(1-\lambda)\left(\pi_{R_j}(w_j, w^*_{-j}) - d_{R_j}^{-A}\right)\frac{\partial \pi_A}{\partial w_j}}_{A\text{'s bargaining power}} = 0 \tag{2}$$

This first-order condition defines firms behavior in the bilateral negotiation over w_j. A bargaining equilibrium is such that $(w_1, w_2) = (w^*_1, w^*_2)$ solves $\frac{\partial \mathrm{NP}_1}{\partial w_1} = 0$ and $\frac{\partial \mathrm{NP}_2}{\partial w_2} = 0$. I refer to Appendix A.1 for technical issues regarding existence and uniqueness of the equilibrium.

I now discuss the sources of bargaining power identified in this bargaining model. A first source of bargaining power is embedded in $\pi_{R_j} - d_{R_j}^{-A}$ and $\pi_A - d_A^{-R_j}$ which refer respectively to the incremental gains from trade obtained by the retailer and the manufacturer given that other bilateral negotiations have succeeded. The higher are these gains, the larger are the losses from not reaching an agreement which, in turn, weakens the bargaining power of the firm in its negotiation. A second source of bargaining power grasped by the bargaining model is included in the terms $\frac{\partial \pi_{R_j}}{\partial w_j}$ and $\frac{\partial \pi_A}{\partial w_j}$. They refer to the cost of making a price concession to its trading partner, that is, the marginal effect of agreeing upon a higher (resp. lower) wholesale price on the retailer's profit (resp. manufacturer's profit).[9] An increase in the (absolute) value of a firm's concession cost makes it stronger in its negotiation. The purpose of the subsequent subsection is to determine the effects of a buyer alliance on these different sources of bargaining power. The last source of firms' bargaining power is captured by the bargaining parameter λ.[10] An upward shift (resp. downward shift) in λ increases the bargaining power of the retailer (resp. manufacturer).

2.3 Manufacturer-Retailer Bargaining with a Buyer Group

Assume that R_1 and R_2 decide to form a buyer group, denoted by R_1R_2, in order to jointly negotiate wholesale tariffs with the upstream manufacturer.

Bargaining between A and R_1R_2 over w.

Being members of a common buyer group, I assume that R_1 and R_2 benefit from the same trading terms with the upstream manufacturer. Consequently, there is a unique wholesale price w to be determined through a bargaining process between A and R_1R_2. Following previous assumptions, parties' profits resulting from an agree-

[9]The concession cost relates to the Zeuthen's theory of bargaining (Zeuthen, 1930; Harsanyi, 1956). Indeed, the Zeuthen criterion for concession corresponds to the ratio of the concession cost over the gains from trade and captures the maximum risk that a bargainer is willing to take in order to achieve a better trading term.

[10]Such a parameter is often considered as embedding some imprecisely (exogenous) bargaining power of bargainers. Binmore, Rubinstein and Wolinsky (1986) provide economic grounding to incorporate asymmetries in bargaining power through the Nash bargaining weights (e.g., an asymmetric impatience of bargainers or asymmetric probabilities of making an offer at each bargaining period).

ment are given by

$$\pi_A(w_1,w_2) = \sum_{j=1}^{2} w_j q_j(p_1(w_1,w_2), p_2(w_1,w_2))$$

$$\pi_{R_1R_2}(w_1,w_2) = \sum_{j=1}^{2} \Big(p_j(w_1,w_2) - w_j\Big) q_j(p_1(w_1,w_2), p_2(w_1,w_2))$$

with $w_1 = w_2 = w$. Because there is only one negotiation, the upstream manufacturer has no alternative retailer to supply its product on the market. As a result, disagreement payoffs of parties are straightforwardly given by $d_A^{-R_1R_2} = 0$ for the upstream manufacturer and $d_{R_1R_2}^{-A} = 0$ for the buyer group.

Nash bargaining problem. The equilibrium wholesale price after the buyer alliance, denoted by w^{post}, is determined by maximizing the (asymmetric) Nash product as follows

$$w^{\text{post}} \equiv \underset{w\in\Theta}{\operatorname{argmax}}\ \text{NP}_{12}(w,w)$$

where $\Theta \equiv \{w \in \mathbb{R}_+ : \pi_A \geq 0 \text{ and } \pi_{R_1R_2} \geq 0\}$ and $\text{NP}_{12} \equiv (\pi_A - 0)^{1-\lambda}\Big(\pi_{R_1R_2} - 0\Big)^{\lambda}$. Note that without clear microfoundations about how the buyer alliance should affects the Nash bargaining weight, I make the simplifying assumption that it remains unchanged.

The first-order condition of this Nash bargaining problem, that is $\frac{\partial \text{NP}_{12}}{\partial w} = 0$, is given by

$$\lambda\,(\pi_A(w,w) - 0)\left(\frac{\partial \pi_{R_1R_2}}{\partial w_1} + \frac{\partial \pi_{R_1R_2}}{\partial w_2}\right) + (1-\lambda)\Big(\pi_{R_1R_2}(w,w) - 0\Big)\left(\frac{\partial \pi_A}{\partial w_1} + \frac{\partial \pi_A}{\partial w_2}\right) = 0 \qquad (3)$$

Buyer group effects. To analyze the effects of a buyer group formation on the wholesale maket, I follow an approach similar to O'Brien (2014) by rewriting (3) with respect to the first-order conditions (2) which characterize the equilibrium wholesale tariffs in the benchmark setting. Relying on the assumptions about the quasi-concavity of NP_{12} in w and the second-order conditions which ensure the existence and uniqueness of a bargaining equilibrium, the sign of (3) evaluated at the equilibrium wholesale prices (w_1^*, w_2^*) can be used to determine the global effect of a buyer alliance formed by R_1 and R_2 on the bargaining power of firms. After some algebra, it can be shown that (3) evaluated at (w_1^*, w_2^*) can be derived as follows (see Appendix A.3 for computational details)

$$\frac{\partial \text{NP}_{12}}{\partial w}(w_1^*, w_2^*) = \frac{\partial \text{NP}_1}{\partial w_1}(w_1^*, w_2^*) + \frac{\partial \text{NP}_2}{\partial w_2}(w_1^*, w_2^*) + \Delta_{12}(w_1^*, w_2^*)$$

By definition of the bargaining equilibrium in the benchmark setting, the first-order conditions (2) evaluated at (w_1^*, w_2^*) equal zero, that is $\frac{\partial \mathrm{NP}_1}{\partial w_1}(w_1^*, w_2^*) = \frac{\partial \mathrm{NP}_2}{\partial w_2}(w_1^*, w_2^*) = 0$. Consequently, the global effect of a buyer alliance with respect to the benchmark situation is determined by $\Delta_{12}(w_1^*, w_2^*)$. More precisely, its sign suffices to infer the effects on wholesale and retail prices. Indeed, a positive (resp. negative) $\Delta_{12}(w_1^*, w_2^*)$ means that $\frac{\mathrm{dNP}_{12}}{\mathrm{d}w}(w_1^*, w_2^*)$ is positive (resp. negative), thereby inducing an increase (resp. decrease) in wholesale prices to satisfy (3). From the retail pass-through rates, an increase (resp. decrease) in wholesale prices would generate an increase (resp. decrease) in retail prices, which unambiguously harms (resp. benefits) final consumers.
It can be shown that $\Delta_{12}(w_1^*, w_2^*)$ can be decomposed in three terms

$$\begin{aligned}\Delta_{12}(w_1^*, w_2^*) \;=\; & \left(\sum_{j=1}^{2} \left\{ \lambda \left(\pi_A - d_A^{-R_j} \right) \frac{\partial \pi_{R_j}}{\partial w_{-j}} + (1-\lambda) \left(\pi_{R_j} - 0 \right) \frac{\partial \pi_A}{\partial w_{-j}} \right\} \right. \\ & \left. + \left\{ \lambda \left(\pi_A - 0 - (\pi_A - d_A^{-R_j}) \right) \frac{\partial \pi_{R_j}}{\partial w_j} \right\} + \left\{ \lambda \left(\pi_A - 0 - (\pi_A - d_A^{-R_j}) \right) \frac{\partial \pi_{R_j}}{\partial w_{-j}} \right\} \right)\end{aligned}$$

Non discrimination effect. The alliance of R_1 and R_2 generates a non discrimination effect since both retailers benefit from similar trading terms when dealing with the upstream manufacturer. This effect, captured in the first curly braces of Δ_{12}, only impacts the concession costs of firms in their bargaining.[11] The term $\lambda \left(\pi_A - d_A^{-R_j} \right) \frac{\partial \pi_{R_j}}{\partial w_{-j}}$ captures the (additional) effect of increasing w_j (and hence w_{-j}) on R_j's profit (i.e., when R_j concedes a higher price to A, its downstream rival must also bears the concession). Similarly, the term $(1-\lambda)\left(\pi_{R_j} - 0 \right) \frac{\partial \pi_A}{\partial w_{-j}}$ corresponds to the (additional) effect of increasing w_j (and hence w_{-j}) on A's profit. Evaluated at (w_1^*, w_2^*), both terms are positive. On the one hand, the non discrimination effect increases the concession cost of A since a price reduction should be concede to both retailers. On the other hand, it lowers the concession cost of each retailer which knows that its rival will obtain the same trading terms. Overall, this effect reinforces the bargaining power of A, which increases equilibrium wholesale prices and, in turn, retail prices.

Status quo effect. Another effect captured in the second curly braces relates to the decrease in disagreement payoffs of the upstream manufacturer. This change in A's disagreement payoffs is caused by the fact that retailers bargain jointly through the buyer group. Straightforwardly, this effect increases the gains from trade of A when dealing with the buyer group, which reduces its strength in the bilateral negotiation,

[11] Note that this expression is similar to the term in curly braces in equation 9 p.101 of O'Brien (2014).

decreases equilibrium wholesale prices and, in turn, retail prices.[12]

Cross effect. Given that previous effects play simultaneously when a buyer alliance is formed, this gives rise to a cross effect which is captured in the last curly braces. Interpretation of this cross effect is given as follows. As previously demonstrated, the status quo effect induces a decrease in wholesale prices. Nonetheless, by the non discrimination effect, such a decrease shall be provided to both retailers which lessens the ease to obtain a price concession from A. As a result, the cross effect dampens the status quo effect at the expense of retailers.[13]

Summary. Shedding light on the main economic forces at play, this theoretical analysis shows that a buyer alliance of two competing retailers has an ambiguous impact on the bargaining power of firms: the non discrimination effect reinforces the bargaining power of the upstream manufacturer while the status quo effect reduces its strength. It is worth noting that this preliminary exercise has some limitations and that additional effects are expected to come at work in a general framework with multiple upstream and downstream firms.[14] Nonetheless, even in a very stylized setting, buyer alliances generate complex effects on the bargaining power of firms which suggests to tackle this issue from an empirical perspective for further guidance.

3 Empirical Analysis

I consider a generalized version of the above model with multiple upstream manufacturers and downstream retailers. Firms are asymmetric and offer multiple differentiated products on the market. I first describe the data used to estimate parameters of the structural model. I then present the demand-side of my framework which mod-

[12]In a setting with an alternative (inefficient) supplier, Caprice and Rey (2015) also emphasize that joining forces through a buyer group allows downstream firms to enhance their disagreement payoffs in negotiations with a leading supplier. The intuition is that a bargaining breakdown which also involves other downstream firms becomes less harmful for a retailer since none of its rivals would be able to take advantage of this failure on the downstream market (e.g., larger product variety, lower costs). This is similar in spirit to the non discrimination effect on the concession costs discussed previously.

[13]However, since $\left|\frac{\partial \pi_{R_j}}{\partial w_j}\right| > \frac{\partial \pi_{R_j}}{\partial w_{-j}}$ (i.e., direct effects dominate indirect effects), the cross effect never outweights the status quo effect.

[14]In particular, the growth of one buyer (e.g., through a merger or a buyer alliance) can affect the trading terms paid by other buyers. Such a mechanism, often called "waterbed" or "anti-waterbed" effect (e.g., Dobson and Inderst, 2009), would add more complexity regarding the impact of buyer group formations and a formal analysis is beyond the scope of this article.

els consumers choice of bottles of water in supermarket chains. Finally, I turn to the supply-side which considers a setting of bilateral oligopoly with differentiated products.

3.1 Data and Industry Background

Bottled water industry. Bottled water consumption has considerably evolved over the last decade. In 2015, the worldwide total volume of sales reached 310 billion litres, accounting for 183 billion of dollars (Brei, 2017). In 2016, bottled water consumption has outpaced that of carbonated soft drinks for the first time in the United States and in the United Kingdom.[15] France belongs to the top ten largest bottled water market in the world with more than 8 billion litres of bottled water sold and where 80% of these sales are made in supermarket chains. There are two major segments in the bottled water industry: mineral water and spring water. Mineral water is naturally pure, extracted directly from an underground source, and protected from pollution risks. The consistency and stability of the mineral content must be ensured and are continuously verified through lab tests. These minerals (e.g., calcium, magnesium) are usually praised for their health benefits and may affect the taste of water. Spring water is also obtained from an underground source which is protected against pollution. However, no requirement about its mineral composition must be satisfied. Both types of water must fit for human consumption at the source and cannot be subjected to any treatment, except carbonation.

Consumer-level data on bottled water purchases. The data source used in this empirical application is household-level scanner data which includes 287,016 purchases of bottled water in France collected by Kantar WorldPanel from March to December 2013. Data consist of a panel of households representative of the French population who record their grocery purchases for home consumption. Recorded informations for each purchased item include the quantity bought, the per-unit price of the item (henceforth referred to as the retail price), and some of its main attributes such as the brand name, the package size and its type, the type of water (e.g., spring or mineral, still or sparkling) and whether it is flavoured or not. Furthermore, the data also provide informations about the store from which each item was purchased such as the store name, its size area, its type (e.g., traditional food store, supermaket, hypermarket). The date of each shopping trip is also recorded in the dataset.

I focus the analysis on purchases in stores with a size area above four hundred

[15] This was also the case in France for the year 2015.

square metres and which belong to one of the eight biggest retailers, namely: Carrefour, Leclerc, ITM Entreprises, Groupe Auchan, Système U, Groupe Casino, Cora, and an aggregate of hard discounters. Within these stores, I select the 11 biggest national brands according to the number of purchases in the data and I distinguish private labels (store brands) according to four types of water, that is, mineral or spring water and still or sparkling water. All other purchases are lumped together under the label "outside option" (or "outside good").

Following the theoretical model described in Section 2, I define a product as a brand-retailer combination (e.g., a national brand or a private label sold by two retailers correspond to two separate products).[16] Consequently, I have a total of 118 differentiated products which account for 67.55% of the purchases in the data, plus the outside good which includes flavoured water, national brands of bottled water with a small purchased frequency, and bottled water purchased at small stores. On the upstream market, the 11 selected national brands are produced by 3 manufacturers, namely: Nestlé who owns 5 brands (i.e., brand 1 to 5), Danone who produces 4 brands (i.e., brand 6 to 9), and Groupe Alma who supplies 2 brands (i.e., brands 10 and 11). National brand manufacturers compete with private label producers which are assumed to be vertically integrated with the retailers.[17]

As it is the case with most revealed-preference data on consumer choice, I have no information on alternatives other than that purchased by each consumer during his shopping trip (i.e., the choice set available to him). To address this issue, I define a market as corresponding to all purchases of bottled water for home consumption in France within a month, and I compute an average retail price for each product by using the observed purchases in each month. Such a procedure allows to obtain retail prices for each of the 118 products in each market.

Table 1 depicts some descriptive statistics about the market share of each manufacturer and retailer as well as the average retail price of products they supply on markets. First of all, there is an important heterogeneity in the average market shares of retailers, ranging from 1.90% for the smallest to 15.93% for the leading retailer. Market shares of up- and downstream firms across markets are mostly stable, with some variations for retailer 2 and 5 (from 1.63% to 2.18% and 8.76% to 11.69% respectively). Retail prices of private labels are on average less expensive than that of national brands produced by manufacturer 1 and 2. However, retail prices of manufacturer 3's products are the cheapest which highlights a strong heterogeneity between

[16] Nonetheless, items sold at a retail store under the same brand name but with different package size are considered as a single product (i.e., I aggregate different package size).

[17] A similar assumption would be to consider that private labels are produced by a competitive fringe.

Table 1: Descriptive Statistics for Manufacturers and Retailers

	Market shares (%)				Retail prices (€/liter)			
	mean	s.d.	min	max	mean	s.d.	min	max
Manufacturers								
Manufacturer 1	16.86	1.02	15.63	18.62	0.52	0.18	0.22	0.98
Manufacturer 2	11.73	0.50	10.59	12.46	0.45	0.14	0.25	0.94
Manufacturer 3	14.03	0.67	13.03	15.26	0.15	0.06	0.12	0.39
Private labels	24.95	0.64	23.70	26.02	0.22	0.07	0.09	0.42
Retailers								
Retailer 1	15.93	0.27	15.53	16.36	0.34	0.20	0.12	0.86
Retailer 2	1.90	0.18	1.63	2.18	0.33	0.19	0.13	0.98
Retailer 3	7.90	0.40	7.37	8.61	0.33	0.21	0.13	0.90
Retailer 4	5.29	0.25	4.81	5.67	0.37	0.19	0.12	0.83
Retailer 5	9.56	0.81	8.76	11.69	0.33	0.18	0.12	0.81
Retailer 6	5.10	0.15	4.89	5.37	0.36	0.19	0.13	0.82
Retailer 7	15.43	0.66	14.42	16.86	0.30	0.18	0.12	0.84
Retailer 8	6.46	0.15	6.19	6.66	0.19	0.13	0.09	0.91
Outside good	32.43	0.78	31.17	33.76	-	-	-	-

Notes: $N = 287,016$. Market shares are in frequency of purchases and their standard deviations refer to variation across markets. Standard deviations of the retail prices refer to variation across brands, retailers and markets for the manufacturers, and variation across brands and markets for the retailers. Remark that I am not permitted to reveal names of manufacturers and retailers due to confidentiality regarding Kantar WorldPanel data.

manufacturers in the retail price dimension. In contrast, there is little variation in the average retail price of products across retailers, except for retailer 8 whose total sales are composed at 87% of private labels.

Further descriptive statistics are provided in Table 2 which presents the average market shares and retail prices for the different types of water and brands sold on markets. There is clearly a large heterogeneity in the retail prices of products across the different types of water, in which for instance one liter of spring-still water is on average three times cheaper than one liter of sparkling-mineral water. Such heterogeneity is also depicted across brands where, for instance, products of brand 5 are almost six times more expenssive than products of brand 10. Besides, there is also some within brand variation. For example, the minimum retail price for a product of brand 1 is

Table 2: Retail Prices and Market Shares of Brands in Sample

			Market shares (%)				Retail prices (€/liter)			
	Mineral	Sparkling	mean	s.d.	min	max	mean	s.d.	min	max
Types of water										
Type 1	No	No	27.28	0.77	26.64	29.18	0.15	0.04	0.09	0.36
Type 2	No	Yes	0.70	0.07	0.59	0.80	0.26	0.08	0.17	0.39
Type 3	Yes	No	22.42	1.03	20.74	24.68	0.36	0.09	0.22	0.91
Type 4	Yes	Yes	17.17	1.25	15.53	19.11	0.52	0.20	0.20	0.98
National brands										
Brand 1	Yes	Yes	4.71	0.75	3.76	6.10	0.71	0.08	0.49	0.98
Brand 2	Yes	No	3.68	0.26	3.24	4.15	0.36	0.03	0.24	0.43
Brand 3	Yes	No	3.46	0.33	2.85	4.02	0.53	0.04	0.41	0.91
Brand 4	Yes	No	3.45	0.34	2.88	3.96	0.31	0.04	0.22	0.41
Brand 5	Yes	Yes	1.56	0.36	1.15	2.28	0.73	0.06	0.46	0.90
Brand 6	Yes	No	3.76	0.26	3.35	4.19	0.40	0.04	0.25	0.52
Brand 7	Yes	No	2.73	0.36	2.33	3.59	0.32	0.02	0.27	0.41
Brand 8	Yes	Yes	2.72	0.17	2.44	3.03	0.41	0.02	0.34	0.44
Brand 9	Yes	Yes	2.52	0.35	1.84	3.01	0.70	0.05	0.53	0.94
Brand 10	No	No	12.48	0.57	11.78	13.70	0.13	0.01	0.12	0.17
Brand 11	Yes	No	1.55	0.16	1.26	1.78	0.31	0.02	0.25	0.39
Private labels										
PL 1	No	No	14.80	0.55	13.79	15.64	0.18	0.05	0.09	0.36
PL 2	No	Yes	0.70	0.07	0.59	0.80	0.26	0.08	0.17	0.39
PL 3	Yes	No	3.78	0.22	3.47	4.18	0.27	0.02	0.22	0.32
PL 4	Yes	Yes	5.67	0.27	5.32	6.07	0.29	0.06	0.20	0.42

Notes: $N = 287{,}016$. Market shares are in number of purchases and their standard deviation refer to variation across markets. They do not add up to 100% because I omit the outside good. Standard deviation of the retail prices refer to variation across products and markets for the segments of bottled waters, and variation across retailers and markets for the brands. Remark that I am not permitted to reveal names of the brands due to confidentiality regarding Kantar WorldPanel data.

0.49 euro per liter, while its maximum retail price is up to 0.98 euro per liter, which suggests that there is some heterogeneity across retailers and markets.

3.2 Consumer Demand for Bottled Water

Because firms behavior is driven by the degree of consumer substitutability between their own products and those sold by their rivals, a demand model that flexibly estimates consumer behavior in the bottled water industry needs to be considered before analyzing strategic interactions between firms.

Demand Model

The demand system is derived from a standard discrete choice model of consumer behavior. More specifically, I consider a random coefficient logit model to accommodate rich and flexible substitution patterns across products (McFadden and Train, 2000).[18]

Choice set. Suppose that each consumer in the sample chooses among $J+1$ alternatives indexed from $j \in \{0,\ldots,J\} = \mathcal{J}$ at each shopping trip.[19] Alternative $j = 0$ is referred to as the composite "outside good", while other alternatives correspond to J differentiated products called "inside goods".[20] Each inside good j is associated to a brand $b = 1,\ldots,B$ — where $b(j)$ labels the brand of good j — and is sold by a retailer $r = 1,\ldots,R$ — where $r(j)$ denotes the retailer which distributes good j.

Consumer utility. The indirect utility function of consumer i from purchasing inside good j in market t is specified as follows

$$U_{i,j,t} = \delta_{b(j)} + \delta_{r(j)} + \delta_{pl(j)} - \alpha_i p_{j,t} + \delta_{\text{mineral}(j)} + \delta_{\text{sparkling}(j)} + \xi_{j,t} + e_{i,j,t}$$

The terms $\delta_{b(j)}$, $\delta_{r(j)}$, $\delta_{pl(j)}$, $\delta_{\text{mineral}(j)}$ and $\delta_{\text{sparkling}(j)}$ denote respectively brands, retailers, private label, mineral water and sparkling water fixed effects which capture the mean utility in the population of time-invariant brands characteristics, retailers' characteristics, private label characteristics, mineral water characteristics and sparkling water characteristics. $\xi_{j,t}$ embeds the mean utility generated by product characteristics observed by consumers and firms but unobserved by the econometrician, and

[18] See also Villas-Boas (2007, 2009); Bonnet and Dubois (2010); Bonnet et al. (2013); Goldberg and Hellerstein (2013) who use random coefficient logit models to estimate consumer behavior in supermarket chains. Some papers have instead considered discrete-continuous choice models (e.g., Smith, 2004; Jódar-Rosell and Dubois, 2010) or, more recently, multiple-discrete-continuous choice models in which consumers can visit multiple stores and buy multiple items within each product category (Thomassen et al., 2017). Including this type of demand modeling into a bilateral oligopoly framework with balanced bargaining power is well beyond the scope of this article.

[19] $|\mathcal{J}| = 119$ in my empirical application. This value can vary across markets but I omit this dependence in the notations.

[20] Terms "good" and "product" are used interchangeably and refer to alternatives in the choice set $\mathcal{J}$.

$e_{i,j,t}$ is a stochastic term which captures unobserved (to the econometrician) consumer-specific preferences. The coefficient α_i measures the marginal disutility of retail prices in the population and is specified as follows

$$\alpha_i = \exp(\alpha + \sigma \nu_i) \quad \text{where } \nu_i \sim \mathcal{N}(0,1)$$

where α and σ are parameters of a log-normal distribution. This specification allows to incorporate unobservable heterogeneity in consumer disutility for retail prices. This disutility is assumed to vary in the population according to a log-normal distribution.[21]

Finally, each consumer may decide not to choose any of the J inside goods. The indirect utility that consumer i receives from choosing the outside good is specified as follows $U_{i,0,t} = e_{i,0,t}$.

Predicted market share. Assuming that each consumer in the sample is a rational utility maximizer (i.e., they choose one unit of the good which gives them the highest utility) and that $e_{i,j,t}$ is independently and identically distributed from the standard Gumbel distribution (also known as type I extreme value distribution), the probability that consumer i selects product $j \in \mathcal{J}$ in market t is derived as follows

$$s_{i,j,t} = \begin{cases} \int_0^{+\infty} \frac{1}{1+\sum_{k=1}^{J} \exp(\delta_{k,t}-\alpha_i p_{k,t})} f(\alpha_i) \, \mathrm{d}\alpha_i & \text{if } j = 0 \\ \int_0^{+\infty} \frac{\exp(\delta_{j,t}-\alpha_i p_{j,t})}{1+\sum_{k=1}^{J} \exp(\delta_{k,t}-\alpha_i p_{k,t})} f(\alpha_i) \, \mathrm{d}\alpha_i & \text{otherwise} \end{cases} \tag{4}$$

where $\delta_{j,t} \equiv \delta_{b(j)} + \delta_{r(j)} + \delta_{pl(j)} + \delta_{\text{mineral}(j)} + \delta_{\text{sparkling}(j)} + \xi_{j,t}$ and $f(\alpha_i)$ denotes the probability density function of the log-normal distribution.

Willingness-to-pay per consumer. From the consumer-level data and the distribution of the marginal disutility of retail prices in the population $f(\alpha_i \mid \boldsymbol{\theta}_{\boldsymbol{\alpha}})$, where $\boldsymbol{\theta}_{\boldsymbol{\alpha}} \equiv (\bar{\alpha}, \sigma_\alpha)^\top$ with $\bar{\alpha}$ denoting the mean and σ_α the standard deviation,[22] it is possible to infer the disutility of retail prices for each individual consumer in the sample (e.g., Train, 2009, ch. 11).[23] Indeed, it can be shown that the distribution of this disutility in the subpopulation of consumers who have purchased product j in market t

[21] The log-normal distribution is particularly convenient in this case since it imposes that demand is downward sloping for all consumers.

[22] For the log-normal distribution, $\bar{\alpha} = \exp(\alpha + \frac{\sigma^2}{2})$ and $\sigma_\alpha = \bar{\alpha}\left(\exp(\sigma^2) - 1\right)^{\frac{1}{2}}$.

[23] In what follows, I will use boldface to distinguish between vectors (or matrices) and scalars. Furthermore, I will use the mathematical symbol "$\top$" to denote the transpose operator.

is

$$f(\alpha_i \mid y_{i,j,t} = 1, \theta_{\boldsymbol{\alpha}}) = \frac{s_{i,j,t|\alpha_i} \, f(\alpha_i \mid \theta_{\boldsymbol{\alpha}})}{\int_0^{+\infty} s_{i,j,t|\alpha_i} \, f(\alpha_i \mid \theta_{\boldsymbol{\alpha}}) \, \mathrm{d}\alpha_i} \tag{5}$$

where $s_{i,j,t|\alpha_i} \equiv \frac{\exp(\delta_{j,t} - \alpha_i p_{j,t})}{1 + \sum_{k=1}^{J} \exp(\delta_{k,t} - \alpha_i p_{k,t})}$ corresponds to the individual market share of product j in market t conditionnal on α_i, and $y_{i,j,t}$ indicates if consumer i has chosen product j in market t. Using (5), the expected marginal disutility of retail prices for each consumer having purchased product j in market t is given by

$$\frac{\int_0^{+\infty} \alpha_i \, s_{i,j,t|\alpha_i} \, f(\alpha_i \mid \theta_{\boldsymbol{\alpha}}) \, \mathrm{d}\alpha_i}{\int_0^{+\infty} s_{i,j,t|\alpha_i} \, f(\alpha_i \mid \theta_{\boldsymbol{\alpha}}) \, \mathrm{d}\alpha_i} \tag{6}$$

Hence, the willingness-to-pay of each consumer for a particular product attribute is obtained as the ratio of the attribute's parameter to the marginal disutility of retail price given by (6).

Identification and Estimation of Consumer Demand

Identification assumptions. Estimation of the demand model consists in identifying the demand parameters α, σ, $\delta_{b(j)}$, $\delta_{r(j)}$, $\delta_{pl(j)}$, $\delta_{\text{mineral}(j)}$, and $\delta_{\text{sparkling}(j)}$. However, identification of consumer preferences can be jeopardized by the classical endogeneity problem of the retail price variable (e.g., Berry, 1994). Indeed, as long as downstream firms observe the realization of $\xi_{j,t}$ before choosing retail prices, the variable $p_{j,t}$ is correlated with $\xi_{j,t}$. To address this endogeneity issue and obtain consistent estimates of the demand parameters, I use a control function approach (e.g., Petrin and Train, 2010; Wooldridge, 2015).[24] In a first step, I specify a reduced-form pricing equation given by

$$p_{j,t} = \delta_{b(j)} + \delta_{r(j)} + \delta_{pl(j)} + \delta_{\text{mineral}(j)} + \delta_{\text{sparkling}(j)} + \mathbf{Z}_{j,t}^{d} \boldsymbol{\psi} + u_{j,t} \tag{7}$$

[24]An alternative way to handle the endogeneity issue of the retail price variable would be to rely on the seminal approach of Berry, Levinsohn and Pakes (1995). Nonetheless, the consistency of their GMM estimator relies on the assumption that a sufficiently large number of consumers must have purchased each product such that there is no sampling error in (observed) market shares or no zero market shares (e.g., Berry, Linton and Pakes, 2004). This condition is violated in my application since I may observe a small number of purchases for some products (e.g., national brands sold by hard discounters).

where ψ is a $K\times 1$ vector of parameters and $\mathbf{Z}^d_{j,t}$ a $1\times K$ vector of instrumental variables. The error term $u_{j,t}$ captures any unobserved factors that affect retail prices and can be used as a proxy variable to pin down the correlated part of $p_{j,t}$ with $\xi_{j,t}$. To this end, I estimate the parameters of (7) by ordinary least squares and compute the residuals of the model: $\hat{u}_{j,t} = p_{j,t} - \hat{\delta}_{b(j)} - \hat{\delta}_{r(j)} - \hat{\delta}_{pl(j)} - \hat{\delta}_{\text{mineral}(j)} - \hat{\delta}_{\text{sparkling}(j)} - \mathbf{Z}^d_{j,t}\hat{\psi}$. In a second step, $\hat{u}_{j,t}$ is added to the indirect utility function as follows

$$U_{i,j,t} = \delta_{b(j)} + \delta_{r(j)} + \delta_{pl(j)} - \alpha_i p_{j,t} + \delta_{\text{mineral}(j)} + \delta_{\text{sparkling}(j)} + \rho\hat{u}_{j,t} + e_{i,j,t}$$

where ρ is the parameter associated to the control function variable $\hat{u}_{j,t}$.

The control function procedure described above relies on two sets of instrumental variables. First, I use the number of products sold by each retailer in each market, and an interaction of this variable with a private label fixed effect. These instruments refer to the so-called "BLP instruments" (in reference to Berry, Levinsohn and Pakes, 1995) and are motivated by the fact that the pricing behavior of a firm is affected by the number of products it offers on the market.[25] These variables are complemented with a cost-based instrument corresponding to the (monthly) price index for plastic.

Estimation procedure. The integral in (4) which defines the market share of products as a function of demand parameters has no closed form solution. Consequently, the vector of demand parameters $\theta^d \equiv (\alpha, \sigma, \rho, \delta_{b(j)}, \delta_{r(j)}, \delta_{pl(j)}, \delta_{\text{mineral}(j)}, \delta_{\text{sparkling}(j)})^\top$ is estimated by maximizing the simulated log-likelihood function described as follows

$$\text{SLL}(\theta^d) = \sum_t \sum_i \sum_j \mathbb{1}_{\{y_{i,j,t}=1\}} \ln(\check{s}_{i,j,t})$$

where $\check{s}_{i,j,t}$ denotes the individual simulated market share written as follows

$$\check{s}_{i,j,t} = \frac{1}{ns} \sum_h^{ns} \frac{\exp(V^h_{i,j,t})}{1 + \sum_{k=1}^{J} \exp(V^h_{i,k,t})}$$

with $V^h_{i,j,t} \equiv \delta_{b(j)} + \delta_{r(j)} + \delta_{pl(j)} - \exp(\alpha + \sigma\nu^h_i)p_{j,t} + \delta_{\text{mineral}(j)} + \delta_{\text{sparkling}(j)} + \rho\hat{u}_{j,t}$ and ns being the number of random draws from the standard normal distribution.[26]

[25]The validity of these instruments rely on the identification assumption that they are not correlated with unobserved demand factors (i.e., $\xi_{j,t}$). The decision to introduce or to remove a product from the market can reasonably be considered as a long-run strategy and is unlikely to be correlated with short-run demand shocks.

[26]In the estimation procedure I use 100 Halton draws per consumer in the sample (Train, 2000).

3.3 Downstream Competition and Manufacturer-Retailer Bargaining

The French bottled water market is modeled as a bilateral oligopoly with product differentiation. In each market, there are F manufacturers which deal with R retailers to supply their products to final consumers. Let $\mathcal{J}_f$ be the set of products owned by manufacturer f and $\mathcal{J}_r$ the set of products distributed by retailer r such that $\bigcup_{f=1}^{F} \mathcal{J}_f = \bigcup_{r=1}^{R} \mathcal{J}_r = \mathcal{J} \backslash \{0\}$. Denote the (per-market) profit function of manufacturer f as follows

$$\pi_{f,t} = \sum_{j \in \mathcal{J}_f} \Big(w_{j,t} - \mu_{j,t} \Big) M_t s_{j,t}(\mathbf{p}_t, \theta^d)$$

and the (per-market) profit function of retailer r as follows

$$\pi_{r,t} = \sum_{j \in \mathcal{J}_r} \Big(p_{j,t} - w_{j,t} - c_{j,t} \Big) M_t s_{j,t}(\mathbf{p}_t, \theta^d)$$

where $w_{j,t}$ is the wholesale price of product j in market t, $\mu_{j,t}$ and $c_{j,t}$ are respectively the constant marginal cost of production and distribution for product j in market t, M_t denotes the total number of quantity purchased on the market (i.e., "market size"), and $s_{j,t}$ is the predicted market share of product j in market t written as a function of retail prices — denoted by the J-dimensional vector $\mathbf{p}_t$ — and demand parameters.

Timing, equilibrium concept and information. I consider a two-stage game similar to Section 2. In the first stage, upstream and downstream firms engage in simultaneous and secret bilateral negotiations over linear wholesale prices of products. In the second stage, downstream retailers engage in a downstream price competition for final consumers. I employ the "Nash-in-Nash" bargaining solution to determine the division of surplus between manufacturers and retailers in the wholesale market (see also Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran, Nevo and Town, 2015; Ho and Lee, 2017, for a similar use of this solution concept in empirical work). In the downstream market, I assume that retailers engage in a price competition with interim unobservability, that is, retailers are not able to observe wholesale contracts of their rivals before choosing retail prices (Rey and Vergé, 2004).[27] Furthermore, I

[27] This assumption contrasts with the information structure used in Section 2 which was used for expositional convenience. Indeed, the interim unobservability assumption reflects a situation in which wholesale contracts are kept secret by downstream firms which seems to best fit with the industry practices under study.

assume complete information about the cost of production and distribution for each product in the choice set. As in Section 2, I work backwards to solve the two-stage game.

Stage 2: Downstream Competition

I assume that (observed) retail prices in each market are determined in a pure-strategy Nash equilibrium where each retailer hold beliefs about wholesale prices paid by its rivals.[28] Given the previous assumptions, the maximization problem of retailer r in market t is defined as follows

$$\max_{\{p_{j,t}\}_{j\in\mathcal{J}_r}} \pi_{r,t} = \sum_{j\in\mathcal{J}_r} \left(p_{j,t} - w_{j,t} - c_{j,t}\right) M_t\, s_{j,t}(\mathbf{p}_{r,t}, \mathbf{p}^*_{-r,t}; \theta^d)$$

where $\mathbf{p}_{r,t}$ denotes the retail price vector set by the retailer r and $\mathbf{p}^*_{-r,t}$ the (anticipated) equilibrium retail price vector set by its rivals in market t.
The first-order condition which drives retailer r's pricing behavior for product $k \in \mathcal{J}_r$ is derived as follows

$$s_{k,t}(\mathbf{p}_{r,t}, \mathbf{p}^*_{-r,t}; \theta^d) + \sum_{j\in\mathcal{J}_r} \left(p_{j,t} - w_{j,t} - c_{j,t}\right) \frac{\partial s_{j,t}}{\partial p_{k,t}}(\mathbf{p}_{r,t}, \mathbf{p}^*_{-r,t}; \theta^d) = 0 \tag{8}$$

From the system of first-order conditions with respect to all product $k \in \mathcal{J}_r$, I can express the price-cost margins of retailer r in vector-matrix form as follows

$$\boldsymbol{\gamma}^*_{r,t} \equiv \mathbf{p}^*_{r,t} - \mathbf{w}^*_{r,t} - \mathbf{c}_{r,t} = -\left(\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_r\right)^+ \mathbf{I}_r \mathbf{s}_t \tag{9}$$

where $\mathbf{s}_t$ denotes the J-dimensional vector of market shares when retail prices are at the equilibrium level $\mathbf{p}^*_t$, $\mathbf{I}_r$ is the $J \times J$ ownership matrix of retailer r where $\mathbf{I}_r[j,j] = 1$ if retailer r distributes product j and 0 otherwise (the off-diagonal elements being equal to 0). The mathematical symbol + denotes the unique Moore-Penrose pseudoinverse operator, and $\mathbf{S}_{\mathbf{p}_t}$ is the $J \times J$ matrix of the first derivatives for all market shares with respect to all retail prices, that is

$$\mathbf{S}_{\mathbf{p}_t} = \begin{pmatrix} \frac{\partial s_{1,t}}{\partial p_{1,t}}(\mathbf{p}^*_t; \theta^d) & \cdots & \frac{\partial s_{J,t}}{\partial p_{1,t}}(\mathbf{p}^*_t; \theta^d) \\ \vdots & \ddots & \vdots \\ \frac{\partial s_{1,t}}{\partial p_{J,t}}(\mathbf{p}^*_t; \theta^d) & \cdots & \frac{\partial s_{J,t}}{\partial p_{J,t}}(\mathbf{p}^*_t; \theta^d) \end{pmatrix}$$

Finally, the J-dimensional vector of downstream price-cost margins can be computed from (9) as follows $\boldsymbol{\gamma}^*_t = -\sum_r \left(\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_r\right)^+ \mathbf{I}_r \mathbf{s}_t$. Using observed retail prices, identification of retailers' marginal costs for each product $j \in \mathcal{J}\backslash\{0\}$ is straightforwardly

[28] As in prior empirical works on oligopoly pricing with differentiated products (e.g., Berry, Levinsohn and Pakes, 1995), the existence of a Nash equilibrium in retail prices is assumed.

achieved by computing $\mathbf{w}_t^* + \mathbf{c}_t = \mathbf{p}_t - \boldsymbol{\gamma}_t^*$. As shown below, it turns out that retailers' marginal costs are key ingredients to the identification of firms' bargaining power in the vertical chain.

Stage 1: Manufacturer-Retailer Bargaining

Bargaining between manufacturer f and retailer r over $w_{j,t}$. Consider the bilateral negotiation between manufacturer f and retailer r over the wholesale price $w_{j,t}$, where $j \in \mathcal{J}_f \cap \mathcal{J}_r$. Denote $\mathbf{w}_{-j,t}^*$ the (anticipated) equilibrium wholesale price vector of products negotiated elsewhere, that is, all products $k \in \mathcal{J}\backslash\{0,j\}$. Given previous assumptions, the payoffs of firms if an agreement over $w_{j,t}$ is reached are derived as follows

$$\begin{aligned}
\pi_{f,t} &= \left(w_{j,t} - \mu_{j,t}\right) M_t s_{j,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}_{-j,t}^*), \mathbf{p}_{-r,t}^*; \theta^d) \\
&\quad + \sum_{k \in \mathcal{J}_f \backslash \{j\}} \left(w_{k,t}^* - \mu_{k,t}\right) M_t s_{k,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}_{-j,t}^*), \mathbf{p}_{-r,t}^*; \theta^d) \\
\pi_{r,t} &= \left(p_{j,t}(w_{j,t}, \mathbf{w}_{-j,t}^*) - w_{j,t} - c_{j,t}\right) M_t s_{j,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}_{-j,t}^*), \mathbf{p}_{-r,t}^*; \theta^d) \\
&\quad + \sum_{k \in \mathcal{J}_r \backslash \{j\}} \left(p_{k,t}(w_{j,t}, \mathbf{w}_{-j,t}^*) - w_{k,t}^* - c_{k,t}\right) M_t s_{k,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}_{-j,t}^*), \mathbf{p}_{-r,t}^*; \theta^d)
\end{aligned}$$

However, if the bilateral negotiation fails, the disagreement payoffs of manufacturer f and retailer r are determined as follows

$$\begin{aligned}
d_{f,t}^{-j} &= \sum_{k \in \mathcal{J}_f \backslash \{j\}} \left(w_{k,t}^* - \mu_{k,t}\right) M_t \tilde{s}_{k,t}^{-j}(\tilde{\mathbf{p}}_t^{-j}; \theta^d) \\
d_{r,t}^{-j} &= \sum_{k \in \mathcal{J}_r \backslash \{j\}} \left(\tilde{p}_{k,t}^{-j}(\mathbf{w}_{-j,t}^*) - w_{k,t}^* - c_{k,t}\right) M_t \tilde{s}_{k,t}^{-j}(\tilde{\mathbf{p}}_t^{-j}; \theta^d)
\end{aligned}$$

where $\tilde{\mathbf{p}}_t^{-j}[k,1] = \begin{cases} +\infty & \text{if } k = j \\ \tilde{p}_{k,t}^{-j} & \text{if } j \neq k \text{ and } j,k \in \mathcal{J}_r \\ p_{k,t}^* & \text{otherwise} \end{cases}$ denotes the J-dimensional vector of out-of-equilibrium retail prices when product j is no longer offered on the market (computational details are given in Appendix B.1), and $\tilde{s}_{k,t}^{-j}$ is the market share of each product k remaining on the market. This market share is computed as follows

$$\tilde{s}_{k,t}^{-j}(\tilde{\mathbf{p}}_t^{-j}; \theta^d) = \begin{cases} \displaystyle\int_0^{+\infty} \frac{\exp(\tilde{V}_{i,k,t}^{-j})}{\sum\limits_{l \in \mathcal{J}_r \backslash \{j\}} \exp(\tilde{V}_{i,l,t}^{-j}) + \sum\limits_{m \in \mathcal{J} \backslash \mathcal{J}_r} \exp(V_{i,m,t})} f(\alpha_i)\, \mathrm{d}\alpha_i & \text{if } k \in \mathcal{J}_r \backslash \{j\} \\ \displaystyle\int_0^{+\infty} \frac{\exp(V_{i,k,t})}{\sum\limits_{l \in \mathcal{J}_r \backslash \{j\}} \exp(\tilde{V}_{i,l,t}^{-j}) + \sum\limits_{m \in \mathcal{J} \backslash \mathcal{J}_r} \exp(V_{i,m,t})} f(\alpha_i)\, \mathrm{d}\alpha_i & \text{otherwise} \end{cases}$$

with $\tilde{V}_{i,k,t}^{-j} \equiv \delta_{b(k)} + \delta_{r(k)} + \delta_{pl(k)} - \alpha_i \tilde{p}_{k,t}^{-j} + \delta_{\text{mineral}(k)} + \delta_{\text{sparkling}(k)} + \rho \hat{u}_{k,t}$.

Nash bargaining problem. Taking $\mathbf{w}^*_{-j,t}$ as given, the equilibrium wholesale price $w^*_{j,t}$ determined by manufacturer f and retailer r satisfies the following Nash bargaining problem

$$w^*_{j,t} \equiv \underset{w_{j,t}}{\operatorname{argmax}}\ \mathrm{NP}_{j,t}(w_{j,t}, \mathbf{w}^*_{-j,t}) \tag{10}$$

where $\mathrm{NP}_{j,t} \equiv \left(\pi_{f,t} - d^{-j}_{f,t}\right)^{1-\lambda_{f,r}} \left(\pi_{r,t} - d^{-j}_{r,t}\right)^{\lambda_{f,r}}$ with $\lambda_{f,r} \in [0,1]$ corresponding to the bargaining weight of retailer r in its negotiations with manufacturer f.

From the first-order conditions of each Nash bargaining problem involving manufacturer f, that is $\frac{\partial \mathrm{NP}_{j,t}}{\partial w_{j,t}} = 0$ for all $j \in \mathcal{J}_f$, it is possible to derive its "bargaining reaction funtions" and formulate its price-cost margins in vector-matrix form as follows (see Appendix B.2 for computational details)

$$\boldsymbol{\Gamma}^*_{f,t} \equiv \mathbf{w}^*_{f,t} - \boldsymbol{\mu}_{f,t} = -\left(\left(\mathbf{V}_{f,t}\boldsymbol{\iota}^\top\right) \circ \mathbf{M}_{f,t} + \left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t}\right) \boldsymbol{\iota}^\top\right) \circ \tilde{\mathbf{M}}_{f,t}\right)^+ \left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t} \circ \mathbf{s}_t\right) \tag{11}$$

where $\mathbf{V}_{f,t}$ and $\tilde{\mathbf{V}}_{f,t}$ are two J-dimensional vectors defined as

$$\mathbf{V}_{f,t} \equiv \sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \left(\left(\mathbf{P}_{\mathbf{w}_t} - \mathbf{I}\right)\mathbf{I}_r \mathbf{s}_t + \mathbf{P}_{\mathbf{w}_t}\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t}\mathbf{I}_r \boldsymbol{\gamma}^*_t\right)$$

$$\tilde{\mathbf{V}}_{f,t} \equiv \sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \left(\boldsymbol{\iota}\mathbf{s}_t^\top \mathbf{I}_r \boldsymbol{\gamma}^*_t + \left(\left(\left(\tilde{\mathbf{S}}_{\boldsymbol{\Delta}t} - \boldsymbol{\iota}\mathbf{s}_t^\top\right)\mathbf{I}_r\right) \circ \tilde{\boldsymbol{\gamma}}_t^\top\right)\boldsymbol{\iota}\right)$$

and $\mathbf{M}_{f,t}$ and $\tilde{\mathbf{M}}_{f,t}$ are two $J \times J$ matrices defined as

$$\mathbf{M}_{f,t} \equiv \mathbf{I}_f \tilde{\mathbf{S}}_{\boldsymbol{\Delta}t}\mathbf{I}_f \quad \text{and} \quad \tilde{\mathbf{M}}_{f,t} \equiv \sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \mathbf{P}_{\mathbf{w}_t}\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t}\mathbf{I}_f$$

The mathematical symbol $\circ$ denotes the Hadamard product operator (also known as the element-by-element multiplication). The J-dimensional vectors $\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}$ and $\boldsymbol{\iota}$, and the $J \times J$ matrices $\mathbf{P}_{\mathbf{w}_t}$, $\tilde{\mathbf{S}}_{\boldsymbol{\Delta}t}$, $\tilde{\boldsymbol{\gamma}}_t$ are defined as follows. $\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}$ is a vector of firms' bargaining weight ratio where $\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}[j,1] = \frac{1-\lambda_{f,r}}{\lambda_{f,r}}$ if $j \in \mathcal{J}_f \cap \mathcal{J}_r$. $\boldsymbol{\iota}$ denotes the all-ones vector (i.e., every element is equal to one). $\mathbf{P}_{\mathbf{w}_t}$ is the matrix of the first derivatives of retail prices with respect to wholesale prices, that is, $\mathbf{P}_{\mathbf{w}_t}[j,k] = \frac{\partial p_{k,t}}{\partial w_{j,t}}$ if $j,k \in \mathcal{J}_r$ and 0 otherwise. $\tilde{\mathbf{S}}_{\boldsymbol{\Delta}t}$ is a matrix of equilibrium market shares and changes in market shares following a bargaining breakdown, that is,

$$\tilde{\mathbf{S}}_{\boldsymbol{\Delta}t} = \begin{pmatrix} s_{1,t}(\mathbf{p}^*_t;\boldsymbol{\theta}^d) & -\Delta\tilde{s}^{-1}_{2,t}(\tilde{\mathbf{p}}^{-1}_t;\boldsymbol{\theta}^d) & \cdots & -\Delta\tilde{s}^{-1}_{J,t}(\tilde{\mathbf{p}}^{-1}_t;\boldsymbol{\theta}^d) \\ -\Delta\tilde{s}^{-2}_{1,t}(\tilde{\mathbf{p}}^{-2}_t;\boldsymbol{\theta}^d) & s_{2,t}(\mathbf{p}^*_t;\boldsymbol{\theta}^d) & \cdots & -\Delta\tilde{s}^{-2}_{J,t}(\tilde{\mathbf{p}}^{-2}_t;\boldsymbol{\theta}^d) \\ \vdots & \vdots & \ddots & \vdots \\ -\Delta\tilde{s}^{-J}_{1,t}(\tilde{\mathbf{p}}^{-J}_t;\boldsymbol{\theta}^d) & -\Delta\tilde{s}^{-J}_{2,t}(\tilde{\mathbf{p}}^{-J}_t;\boldsymbol{\theta}^d) & \cdots & s_{Jt}(\mathbf{p}^*_t;\boldsymbol{\theta}^d) \end{pmatrix}$$

The matrix $\tilde{\boldsymbol{\gamma}}_t$ incorporates equilibrium and out-of-equilibrium retail margins. Further details are provided in Appendix B.2.

Using (11), the J-dimensional vector of upstream price-cost margins in market t derived from the "Nash-in-Nash" bargaining solution is given by $\boldsymbol{\Gamma}_t^* = \sum_f \boldsymbol{\Gamma}_{f,t}^*$.

Identification and Estimation of Bargaining Stage

This subsection describes the identification strategy and the estimation procedure to recover the vector of Nash bargaining weights in (11) which allows to derive upstream price-cost margins and compute the division of surplus in the industry.

Econometric model. Price-cost margins of manufacturers $\boldsymbol{\Gamma}_t^*$ are identified up to the vector of bargaining weights $\boldsymbol{\lambda}$. To estimate $\boldsymbol{\lambda}$, I rely on the empirical framework developed by Bonnet, Bouamra-Mechemache and Molina (2017) which makes use of the variation in retailers' marginal costs for each product $j \in \mathcal{J}\backslash\{0\}$ offered in each market $t = 1, \ldots, T$, that is $w_{j,t} + c_{j,t}$. The empirical strategy is to decompose retailers' marginal costs as follows

$$w_{j,t} + c_{j,t} = \underbrace{(w_{j,t} - \mu_{j,t})}_{\text{upstream market power}} + \underbrace{(c_{j,t} + \mu_{j,t})}_{\text{operational costs}}$$

where $w_{j,t} - \mu_{j,t}$ has a known parametric form implied by the first-order conditions of the "Nash-in-Nash" bargaining model and described in (11). Hence, heterogeneity in retailers' marginal costs for each product may be explained by differences in production or distribution costs and asymmetries in the ability of each retailer to mitigate the market power of manufacturers. Without any information on the cost of firms, I need to impose further restrictions. In particular, I assume that the total marginal cost of the industry for product j in market t has the following specification $c_{j,t} + \mu_{j,t} = \mathbf{v}_{j,t}\boldsymbol{\kappa} + \omega_{j,t}$, where $\mathbf{v}_{j,t}$ denotes a $1 \times K$ vector of cost shifters, $\boldsymbol{\kappa}$ is a $K \times 1$ vector of cost parameters, and $\omega_{j,t}$ corresponds to an additive error term of unobserved cost factors (e.g., unobserved productivity). $\mathbf{v}_{j,t}$ includes brand, retailer, mineral, and sparkling fixed effects as well as the bottle size for each product and its interaction with the input price index for plastic.[29] Given these assumptions, the J-dimensional vector of retailers' marginal costs in market t is written as

$$\mathbf{w}_t^* + \mathbf{c}_t = \boldsymbol{\Gamma}(\boldsymbol{\lambda}, \mathbf{p}_t^*, \mathbf{s}_t, \tilde{\mathbf{p}}_t^{-1}, \tilde{\mathbf{s}}_t^{-1}, \ldots, \tilde{\mathbf{p}}_t^{-J}, \tilde{\mathbf{s}}_t^{-J}) + \mathbf{v}_t\boldsymbol{\kappa} + \boldsymbol{\omega}_t \tag{12}$$

[29]The bottle size of product j in market t is obtained by computing an average of the size of each bottled water purchased by consumers in the homescan panel data.

with $\theta^s \equiv (\boldsymbol{\lambda}^\top, \boldsymbol{\kappa}^\top)^\top$ being the vector of supply parameters to be estimated. Note that when $\boldsymbol{\lambda} = \mathbf{1}$, it turns out that $\boldsymbol{\Gamma}_t = \mathbf{0}$ (i.e., manufacturers compete à la Bertrand on the wholesale market) and (12) becomes $\mathbf{w}_t^* + \mathbf{c}_t = \mathbf{v}_t\boldsymbol{\kappa} + \boldsymbol{\omega}_t$ (with $\mathbf{w}_t^* = \boldsymbol{\mu}_t$). As emphasized by Bonnet, Bouamra-Mechemache and Molina (2017), this shows how the empirical setting relates to the seminal work of Berry, Levinsohn and Pakes (1995) in the special case where manufacturers have no bargaining power (e.g., they are fully integrated with the retailers).

Identification assumptions. Equation (12) over the full sample (i.e., the T markets) forms the basis for the estimation of θ^s. However, as long as manufacturers and retailers observe $\boldsymbol{\omega}$ and $\boldsymbol{\xi}$ before setting prices, retail prices and market shares that enter nonlinearly into (12) are likely to be correlated with unobserved cost factors. To account for this endogeneity issue, I estimate θ^s with a GMM estimator relying on the following conditional moment restriction $\mathbb{E}[\boldsymbol{\omega}(\theta^s) \mid \mathbf{Z}^s \in \mathcal{I}] = 0$ where $\mathbf{Z}^s$ is a $JT \times L$ matrix of instrumental variables which belongs to an information set $\mathcal{I}$ orthogonal to the vector of unobserved cost factors. As it is commonly assumed in the empirical literature, any demand shifter such as observed characteristics of products or the ownership structure of firms can be considered as an adequate instrument (Berry, Levinsohn and Pakes, 1995).[30] Predicted willingness-to-pay of consumers for product characteristics have also been considered as instruments for endogenous prices in supply-side estimations (e.g., Gowrisankaran, Nevo and Town, 2015).

Since any function of these (assumed) exogenous variables can be used as instruments, the empirical difficulty is to construct a matrix $\mathbf{Z}^s$ such that the GMM estimator is efficient (i.e., with the smallest asymptotic covariance matrix). Chamberlain (1987) showed that the optimal instruments are expressed as follows

$$\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \theta^s}(\theta^s) \mid \mathbf{Z}^s\right]^\top \mathbb{E}\left[\boldsymbol{\omega}(\theta^s)\boldsymbol{\omega}(\theta^s)^\top \mid \mathbf{Z}^s\right]^{-1}$$

where in this application I consider the homoskedastic case in which $\mathbb{E}[\boldsymbol{\omega}\boldsymbol{\omega}^\top \mid \mathbf{Z}^s]$ is the $JT \times JT$ identity matrix. Because the matrix of cost shifters $\mathbf{v}$ is assumed to be an element of $\mathbf{Z}^s$, straightfoward instruments that allow to identify cost parameters are given by $\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\kappa}}(\theta^s) \mid \mathbf{Z}^s\right] = -\mathbf{v}$. However, the choice of instrumental variables to identify the vector of bargaining weights $\boldsymbol{\lambda}$ is trickier, particularly because $\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\lambda}}(\theta^s) \mid \mathbf{Z}^s\right]$ is very difficult, if not impossible, to compute (see Appendix B.3 for more details). I will

[30] The main motivation for the exogeneity of such variables, often referred to as the BLP instruments, is that they are difficult to adjust in the short-run which prevents firms from adapting them according to unobserved (to the econometrician) cost shocks. Nonetheless, these variables affect equilibrium retail prices as shown by the first-order condition (8).

proceed by considering two specifications in which I construct instrumental variables that should closely correlate with this conditional expectation. In each specification, I impose the following restriction $\lambda_{f,r} = \lambda_f$ which aims at reducing the number of orthogonality conditions.[31]

In a first specification, I use a second-order polynomial of two sets of crude instruments.[32] The first set of instrumental variables includes the average willingness-to-pay for time-invariant brand *b(j)* characteristics of consumers who have purchased product j in market t, and the average willingness-to-pay for time-invariant retailer *r(j)* characteristics of consumers who have purchased product j in market t. The second set of instruments contains the sum of market shares of other products sold by retailer *r(j)* $\sum_{k \in \mathcal{J}_r \setminus \{j\}} s_{kt}$, and the sum of market shares of products sold by other retailers $\sum_{k \in \mathcal{J} \setminus \mathcal{J}_r} s_{kt}$. Note that elements of these two set of instrumental variables are function of endogenous retail prices $p_{j,t}$ and unobserved product characteristics $\xi_{j,t}$. To construct valid instruments, I use the fitted value of a linear projection of retail prices on exogenous variables (brand and retailer fixed effects, observed product characteristics and cost shifters) in place of endogenous retail prices.[33] Furthermore, the control function variable which is used as a proxy of the unobserved product characteristics is dropped from the market shares. The first set of instruments aims at measuring the willingness-to-pay of consumers for exogenous product characteristics which is assumed to be uncorrelated with unobserved cost factors but should affect the pricing behavior of firms and explain differences in retail prices and market shares of products. Furthermore, the conditional expectation of $\frac{\partial \omega}{\partial \lambda}(\theta^s)$ is a function of market shares of all products offered on each market. As a result, the second set of instrumental variables includes sums of market shares with a distinction between products sold by the same retailer and those distributed by its competitors since they affect differently bargaining outcomes (e.g., the size of retailer's other products can proxy its status quo payoffs) and the pricing behavior of retailers (see equation (8)). To complement these two set of

[31]This restriction, also used in Gowrisankaran, Nevo and Town (2015) and Ho and Lee (2017), imposes that the Nash bargaining weights of retailers when they deal with a manufacturer are similar. In other words, I estimate an average Nash bargaining weight for each manufacturer in the supply chain.

[32]Low-order polynomials of exogenous variables have often been considered in estimation of nonlinear models with endogenous variables since the seminal papers of Kelejian (1971) and Amemiya (1974). A more direct approximation of $\mathbb{E}\left[\frac{\partial \omega}{\partial \theta^s}(\theta^s) \,|\, \mathbf{Z}^s\right]$ would be to use the fitted value obtained from the regression of $\frac{\partial \omega}{\partial \theta^s}(\theta^s)$ on a low-order polynomial as suggested by Amemiya (1983) and Newey (1990). This approach would be considered in a later version of this paper.

[33]This approach is similar in spirit to Reynaert and Verboven (2014) who use product characteristics and cost shifters to obtain exogenous estimates of observed prices and construct instruments in an oligopolistic supply setting with perfect competition (i.e., price equals marginal cost).

instrumental variables, I also include the BLP-type instruments used to control for the retail price endogeneity in the demand model, that is, the number of products sold by each retailer and its interaction with a private label fixed effect.

In a second specification, I use a more direct approximation to the optimal instruments based on Berry, Levinsohn and Pakes (1999).[34] To do so, I propose an extension of their algorithm for estimating $\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\theta}^s}(\boldsymbol{\theta}^s) \mid \mathbf{Z}^s\right]$ in bilateral oligopolies with manufacturer-retailer negotiations (see Appendix B.3 for further details). Despite its computational complexity, such a procedure takes explicitly into account the functional forms implied by the first-order conditions of the supply model to obtain exogenous estimates of retail prices and market shares, and identify the vector of parameters $\boldsymbol{\lambda}$.

Estimation procedure. I estimate vectors of Nash bargaining weights $\boldsymbol{\lambda}$ and cost parameters $\boldsymbol{\kappa}$ by solving the following minimization problem

$$\hat{\boldsymbol{\theta}}^s \equiv \underset{\boldsymbol{\theta}^s}{\operatorname{argmin}} \, (\mathbf{Z}^s \boldsymbol{\omega}(\boldsymbol{\theta}^s))^\top \mathbf{A}^{-1} \mathbf{Z}^s \boldsymbol{\omega}(\boldsymbol{\theta}^s) \tag{13}$$

subject to the parameter constraints $\lambda_f \in [0,1]$ and where $\mathbf{A} \equiv \mathbf{Z}^s(\mathbf{Z}^s)^\top$ is a $L \times L$ weighting matrix. To minimize the GMM criterion function defined in (13), I employ a multistart algorithm.[35]

3.4 Results

Consumer Demand Estimates

Table 3 presents parameter estimates of the demand model for bottled water consumption. For tractability motives, the estimation has been performed over a subsample of 143,539 purchases representative of the full dataset. Similar to Bonnet and Dubois (2010), I find that consumers positively value mineral water products. The coefficient which captures the mean taste in the population for sparkling water is also positive and significant. Moreover, results indicate some heterogeneity in the utility generated across brands of bottled water, which can be due to brand differentiation (e.g., packaging quality) or differences in advertising intensity. The coefficient ρ has a significant

[34] See also Goeree (2008) and Reynaert and Verboven (2014) for different versions of the Berry, Levinsohn and Pakes (1999) algorithm in oligopolistic markets.

[35] I first start by generating 10,000 vectors of pseudo-random draws. Then, I evaluate the GMM objective function for each draw, pick the ones that give the twenty smallest values, and use them as starting points to a local optimization algorithm. The estimator $\hat{\boldsymbol{\theta}}^s$ is the vector of parameters that corresponds to the smallest value of the GMM criterion function.

Table 3: Random Coefficient Logit Demand Estimates

Variable	Value ($\hat{\theta}^d$)	S.E.
Retail price (α)	3.34*	0.16
Retail price (σ)	0.18*	0.07
Control function (ρ)	22.02*	5.02
Mineral	1.33*	0.32
Sparkling	0.57*	0.25
Brand fixed effect: $\delta_{b(j)}$		
Brand 1	11.70*	2.70
Brand 2	3.35*	0.97
Brand 3	7.96*	1.93
Brand 4	2.07*	0.79
Brand 5	11.35*	2.81
Brand 6	4.67*	1.26
Brand 7	2.25*	0.84
Brand 8	3.75*	1.00
Brand 9	10.74*	2.61
Brand 10	-0.43	0.25
Brand 11	1.32	0.78
Private label	1.62*	0.59
Retail fixed effect: $\delta_{r(j)}$		
Retailer 1	2.07*	0.42
Retailer 2	0.46	0.48
Retailer 3	1.57*	0.42
Retailer 4	0.90*	0.41
Retailer 5	1.54*	0.42
Retailer 6	1.36*	0.48
Retailer 7	1.64*	0.37
Retailer 8	ref.	ref.
First stage F-test *(excluded instruments)*	12.86*	
Simulated log-likelihood	-511,407	
Number of observations	143,539	
$g^{\top}(H)^{-1}g$	3.95×10^{-05}	

Notes: * indicates significance at the 5% level. Standard errors are computed following the asymptotic formula of Karaca-Mandic and Train (2003) which accounts for the sampling variance in the first-stage estimates.

Table 4: Estimates of Own-price Elasticitiy of Demand

Types of water	Value	S.E.
All	-8.36	0.79
Still spring water	-4.48	0.44
Sparkling spring water	-7.40	0.69
Still mineral water	-9.75	0.91
Sparkling mineral water	-12.73	1.36

Notes: Own-price elasticities of demand are averaged across products using quantity weights. Parametric bootstrap standard errors using 100 draws from the asymptotic distribution of demand parameters in Table 3.

and positive impact on consumer utility, which implies that unobserved product attributes correlated with the retail price variable are valued positively by consumers (e.g., marketing campaigns). Without correction for this correlation, results indicate that the retail price sensitivity would be underestimated.[36] In the population, the marginal disutility of the retail price has a lognormal distribution with parameters α and σ, which are both significantly different from zero. The average disutility of retail prices equals 28.79 and more than 46% of consumers have a price sensitivity above this mean (see Figure C.1 in Appendix C for the estimated distribution of the marginal disutility of retail prices in the population). Finally, the convergence criterion $g^\top(H)^{-1}g$, where g and H denote respectively the score vector and the Hessian matrix, is close to 0 which is always the case when a maximum is reached (e.g., Ruud, 2000, p. 362).[37]

Table 4 reports the own-price elasticity of demand for each type of water. On average, the estimated own-price elasticity is -8.63. Nonetheless, there is an important variation in price sensitivity across products. Indeed, the own-price elasticity of demand for mineral water products is twice higher than that of spring water products, which is consistent with Bonnet and Dubois (2010) who find an average own-price elasticity of -6.64 for spring water products and -11.38 for mineral water products. This difference is also present between still water and sparkling water where consumers are on average more sensitive to a change in retail prices of sparkling water products (see Figure C.2 in Appendix C for the estimated density of the own-price elasticity of demand).

[36]See Table C.1 in Appendix C for results of the first-stage.

[37]The Hessian matrix is computed by using the BHHH estimator.

Table 5: Bargaining Parameter Estimates

Parameter	Specification 1 Value ($\hat{\theta}^s$)	Specification 1 S.E.	Specification 2 Value ($\hat{\theta}^s$)	Specification 2 S.E.
Bargaining parameters λ				
Retailers vs. Manufacturer 1	0.071	.	0.255	.
Retailers vs. Manufacturer 2	0.504	.	0.436	.
Retailers vs. Manufacturer 3	0.513	.	0.449	.
Cost shifter parameters ν				
Mineral	0.052	.	0.051	.
Sparkling	0.055	.	0.055	.
Bottle size	-0.395	.	-0.399	.
Bottle cost	0.002	.	0.002	.
Brand 1	0.598	.	0.610	.
Brand 2	0.406	.	0.415	.
Brand 3	0.518	.	0.528	.
Brand 4	0.360	.	0.369	.
Brand 5	0.647	.	0.659	.
Brand 6	0.444	.	0.442	.
Brand 7	0.423	.	0.421	.
Brand 8	0.396	.	0.394	.
Brand 9	0.637	.	0.634	.
Brand 10	0.252	.	0.250	.
Brand 11	0.385	.	0.383	.
Private label	0.327	.	0.327	.
Retail fixed effects not shown				
GMM objective function value	0.393		0.012	
Number of observations	1,125		1,125	

Notes: Bootstrap standard errors [TO BE COMPLETED].

Downstream Competition and Bargaining Estimates

Table 5 contains results of the bargaining model described in (12). Specifications 1 and 2 differ according to the moment restrictions employed to estimate coefficients. In specification 1, I use a second-order polynomial of two sets of crude instruments based on the consumer willingness-to-pay for product characteristics and on sums of (exogenous) market shares. Specification 2 uses a modified version of the algorithm proposed by Berry, Levinsohn and Pakes (1999) to directly approximate optimal instruments. Estimates of the cost parameters are similar in both specifications. Mineral and sparkling fixed effects contribute positively to marginal costs of products and results indicate differences in the estimated brands fixed effects, suggesting some heterogeneity in the marginal costs of bottled water products across brands. However, the two specifications provide different estimates of the Nash bargaining parameters. Under specification 1, estimated Nash bargaining weights of retailers when they negotiate with manufacturers 2 and 3 are slightly higher than that of specification 2. However, the Nash bargaining weight of retailers vis-à-vis manufacturer 1 in the first specification is close to its lower bound 0, which corresponds to a situation in which manufacturer 1 makes take-it-or-leave-it offers. In contrast, specification 2 is more in line with a situation where terms of trade in the wholesale market are determined through negotiations. For the rest of the paper, I use estimates from specification 2 which uses a more direct approximation of the optimal instruments.

Table 6 reports the price-cost margins and marginal costs of products for each type of water and each retailer. Results show that price-cost margins of firms over spring water products are higher than over mineral water products. Similar findings are obtained between still and sparkling water products. On average, price-cost margins of retailers are higher than that of manufacturers which vary between 9.12% and 10.93% of retail prices. There is also an important variation in the total marginal cost of products. Indeed, the marginal cost of production and distribution for a spring-still water product is on average four times lower than the cost of a sparkling-mineral water product. Marginal costs of retailers are also heterogeneous with a variation from 0.329 euro per liter for retailer 4 to 0.160 euro per liter for retailer 8, which mainly distributes private labels. Such an heterogeneity may be due to differences in bargaining power or in distribution costs (e.g., trucking costs, logistics costs) and is exploited to identify coefficients in Table 5.

Division of surplus. The estimated surplus division between manufacturers and retailers is given in Table 7. This table depicts the average share captured by each retailer in its bilateral negotiations with each manufacturer. The sharing varies between retailers and manufacturers which indicates that firms' bargaining power differ according to their trading partner. Downstream firms capture on average 48.61% to 52.99% of the surplus generated by a bilateral contract when they deal with manufacturer 1, which is smaller than when they bargain with other manufacturers. Overall, I find

Table 6: Price-Cost Margins and Marginal Costs of the Baseline Model

	Price-Cost Margins (%)			Marginal Costs (€/liter)	
	Retailers	Manufacturers	Total	Retail $(w + c)$	Total $(c + \mu)$
Types of water					
Still spring water	25.430	16.232	32.859	0.116	0.107
	(.)	(.)	(.)	(.)	(.)
Sparkling spring water	16.008	-	16.008	0.225	0.225
	(.)	-	(.)	(.)	(.)
Still mineral water	11.785	8.321	18.702	0.321	0.295
	(.)	(.)	(.)	(.)	(.)
Sparkling mineral water	9.603	6.013	13.628	0.479	0.454
	(.)	(.)	(.)	(.)	(.)
Retailers					
Retailer 1	16.938	10.273	24.750	0.295	0.273
	(.)	(.)	(.)	(.)	(.)
Retailer 2	14.194	10.579	22.443	0.295	0.273
	(.)	(.)	(.)	(.)	(.)
Retailer 3	16.133	10.926	25.015	0.286	0.263
	(.)	(.)	(.)	(.)	(.)
Retailer 4	12.676	8.833	18.402	0.329	0.310
	(.)	(.)	(.)	(.)	(.)
Retailer 5	14.776	8.042	18.741	0.292	0.276
	(.)	(.)	(.)	(.)	(.)
Retailer 6	13.211	9.119	19.177	0.325	0.305
	(.)	(.)	(.)	(.)	(.)
Retailer 7	18.099	10.713	25.231	0.261	0.242
	(.)	(.)	(.)	(.)	(.)
Retailer 8	23.981	9.365	25.192	0.160	0.155
	(.)	(.)	(.)	(.)	(.)
Total	16.781	10.015	23.100	0.278	0.260
	(.)	(.)	(.)	(.)	(.)

Notes: Average price-cost margins in percentage of retail prices and average marginal costs are calculated using quantity weights. Bootstrap standard errors are reported in parenthesis [TO BE COMPLETED].

Table 7: Average Shares of the Retailers in Bilateral Contracts

	Manufacturer 1	Manufacturer 2	Manufacturer 3
Retailer 1	52.90	64.54	64.83
Retailer 2	48.61	60.23	60.75
Retailer 3	50.45	62.02	62.75
Retailer 4	49.84	61.15	62.08
Retailer 5	51.08	62.44	63.16
Retailer 6	49.62	61.09	60.02
Retailer 7	52.99	64.16	64.70
Retailer 8	50.31	61.10	62.64

Notes: Shares are expressed in percentage of the surplus generated by bilateral contracts.

that retailers are able to obtain more than 50% of the industry profit in the French bottled water market, which implies that their bargaining power is higher than that of manufacturers.

To gain further insights on the division of surplus in the vertical chain, I employ the split-the-difference rule for non-transferable utility games. From the first-order condition of the "Nash-in-Nash" described in (2), the profit obtained by manufacturer f and retailer r in their negotiation for product j is written as follows

$$\pi_f = d_f^{-j} + \left(1-\lambda_{f,r}\right)\left(-\frac{\frac{\partial \pi_f}{\partial w_j}}{\frac{\partial \pi_r}{\partial w_j}}\left(\pi_r - d_r^{-j}\right) + \left(\pi_f - d_f^{-j}\right)\right)$$

$$\pi_r = d_r^{-j} + \lambda_{f,r}\left(-\frac{\frac{\partial \pi_r}{\partial w_j}}{\frac{\partial \pi_f}{\partial w_j}}\left(\pi_f - d_f^{-j}\right) + \left(\pi_r - d_r^{-j}\right)\right)$$

The split-the-difference rule allows to decompose the profit captured by a firm involved in a bilateral negotiation in two components: its disagreement payoffs and the share it extracts from the incremental surplus generated by the contract. Table 8 reports mean ratios of firms' disagreement payoffs and concession costs. As described in Section 2 and by the split-the-difference rule, disagreement payoffs and concession costs of firms are two sources of bargaining power that explain the surplus division. Results show that, except for retailer 1 and 7 which are the strongest retailers according to Table 7, disagreement payoffs of manufacturers are higher than that of retailers. This is particularly the case for manufacturer 1 whose disagreement payoffs are twice higher than most retailers. Nonetheless, the concession costs of retailers offset the bar-

Table 8: Ratio of Disagreement Payoffs and Concession Costs

	Disagreement Payoffs (d_r^{-j}/d_f^{-j})			Concession Costs ($\frac{\partial \pi_r}{\partial w_j}/\frac{\partial \pi_f}{\partial w_j}$)		
	Manuf. 1	**Manuf. 2**	**Manuf. 3**	**Manuf. 1**	**Manuf. 2**	**Manuf. 3**
Retailer 1	0.96	2.35	2.46	4.04	2.32	2.22
Retailer 2	0.09	0.22	0.22	4.06	2.33	2.24
Retailer 3	0.42	1.02	1.02	4.05	2.32	2.23
Retailer 4	0.27	0.65	0.65	4.05	2.32	2.24
Retailer 5	0.52	1.26	1.27	4.05	2.32	2.23
Retailer 6	0.26	0.63	0.63	4.05	2.32	2.24
Retailer 7	0.90	2.20	2.30	4.05	2.32	2.22
Retailer 8	0.31	0.73	0.76	4.06	2.33	2.24

gaining strength of manufacturers obtained from their disagreement payoffs. Indeed, Table 8 indicates that the retailers' concession costs are on average two to three times higher than the concession costs of manufacturers. This comparison emphasizes the important role of firms' concession costs in the division of surplus and helps to explain why downstream firms are able to capture a larger slice of the industry profit.

4 Simulations of Buyer Alliances Formed by Downstream Competitors

Since 2013, food retailers in France have claimed to engage in a price war to attract final consumers, thereby exerting downward pressure on their price-cost margins.[38] In this context, some retailers have decided to join forces on the wholesale market to reduce their input costs, maintain their margins, and benefit from competitive advantages on the downstream market. As a result, three buyer alliances have been formed before the 2014-2015 annual negotiations. Système U and Groupe Auchan have first announced their partnership to purchase national brands and improve their competitiveness on the downstream market. Following this declaration, ITM Entreprises and Groupe Casino have decided to form a similar alliance for the purchase of national brands. Initiated by Cora who claimed not to be able to survive to further competition, a third buyer alliance has been formed involving Carrefour, the leading retailer

[38]Price war allegations on the downstream market were reported by the French competition authority (see Autorité de la concurrence, 2015). Empirical evidence of such a change in retailers' pricing behavior is out of the scope of the current analysis.

on the market.

In this section, I use estimates of the baseline model to perform simulations of buyer alliances and analyze their effects on the French bottled water market. Two counterfactual exercises are considered. A first simulation focuses on joint listing decisions as in Caprice and Rey (2015). This setting assumes that bilateral negotiations remain separate and secret for each product, even between retailers which have formed a buyer alliance. However, each member of an alliance is endowed with a veto power, that is, a bargaining breakdown with one member precipitates a bargaining breakdown with all alliance members. In a second counterfactual exercise, I consider a setting similar to the model described in Section 2 in which buyer alliances centrally negotiate trading terms for their members.

All simulations assume that buyer alliances do not affect: (i) total marginal cost of products, (ii) Nash bargaining weights of firms, (iii) the buyer-seller network structure, (iv) the nature of downstream competition between retailers (i.e., simultaneous price-setting game), and (v) consumer preferences. In each exercise, I recompute a new bargaining equilibrium and downstream price equilibrium following the formation of a buyer alliance by retailers 1 and 2, retailers 3 and 4, and retailers 5 and 6.

Simulation 1: Buyer alliances with joint listing decision. The framework is similar to the baseline model except that a bargaining breakdown with one retailer belonging to a buyer group implies a bargaining breakdown with all group members.[39] Results are reported in Table 9. I find that buyer alliances have a negative effect on the profit of manufacturers which are reduced on average by 1%. In contrast, the formation of buyer alliances increases the profit of retailers by 0.17%, which suggests that they have gained buyer power vis-à-vis manufacturers. This finding is in line with the theoretical insights of the model described in Section 2 which shows that a joint listing decision allows to deteriorate the disagreement points of manufacturers in their negotiations and render a bargaining breakdown costlier.[40] However, Table 9 also indicates that retailers 7 and 8 which have not formed any buyer alliance with their downstream rivals are harmed. This result can be explained by the fact that buyer alliances have conferred a competitive advantage to their rivals through more favourable trading terms which have been passed on to final consumers as shown in the first column. Overall, I find that buyers alliances have a moderate impact on retail prices with an average

[39]The counterfactual algorithm employed to solve for the new equilibrium is similar in spirit to simulation 2 which is described in Appendix D.3.

[40]These findings can also be complemented by Caprice and Rey (2015) who highlight that a joint listing decision renders a bargaining breakdown less painful for retailers.

Table 9: Buyer Alliances with Joint Listing Decisions

	Δ Retail price	Δ Market share	Δ Margins		Δ Profit	
			Retailers	Manuf.	Retailers	Manuf.
Retailer 1	-0.120	0.233	-0.034	-1.551	0.136	-0.969
	(.)	(.)	(.)	(.)	(.)	(.)
Retailer 2	-0.199	0.593	-0.044	-2.183	0.412	-1.092
	(.)	(.)	(.)	(.)	(.)	(.)
Retailer 3	-0.229	0.893	-0.003	-2.596	0.688	-1.200
	(.)	(.)	(.)	(.)	(.)	(.)
Retailer 4	-0.151	0.639	-0.012	-2.673	0.742	-1.204
	(.)	(.)	(.)	(.)	(.)	(.)
Retailer 5	-0.099	0.350	0.028	-2.749	0.768	-1.255
	(.)	(.)	(.)	(.)	(.)	(.)
Retailer 6	-0.174	0.750	-0.009	-2.921	0.869	-1.248
	(.)	(.)	(.)	(.)	(.)	(.)
Retailer 7	-0.038	-0.400	-0.131	-0.254	-0.541	-0.640
	(.)	(.)	(.)	(.)	(.)	(.)
Retailer 8	-0.018	-0.504	-0.064	-0.292	-0.561	-0.722
	(.)	(.)	(.)	(.)	(.)	(.)
Total	-0.110	0.193	-0.043	-1.724	0.171	-1.006
	(.)	(.)	(.)	(.)	(.)	(.)

Notes: Percentage changes in retail prices, market shares, margins, and profits are calculated using quantity weights. Bootstrap standard errors are reported in parenthesis [TO BE COMPLETED].

decrease of 0.11%.

Simulation 2: Buyer alliances with centralised bargaining. Simulation 2 considers a framework similar to the model described in Section 2 in which members of a buyer alliance obtain the same trading terms for each brand, that is, manufacturers are no longer able to price discriminate between alliance members. I refer to Appendix D.1 for computational details of upstream margins in such a setting and to Appendix D.3 for a description of the algorithm used to compute the new equilibrium. (Preliminary) results are reported in Table 10. I find that upstream margins increase by 2.77% which implies that on average manufacturers are able to secure more favourable trading terms than without buyer alliances. This result is in sharp contrast with simulation 1 and the common wisdom that buyer alliances lower wholesale prices at the expense

Table 10: Buyer Alliances with Centralised Bargaining

			Δ Margins		Δ Profit	
	Δ Retail price	**Δ Market share**	**Retailers**	**Manufacturers**	**Retailers**	**Manufacturers**
Total	0.122	-0.119	-0.351	2.773	-0.750	-0.680
	(.)	(.)	(.)	(.)	(.)	(.)

Notes: Percentage changes in retail prices, market shares, margins, and profits are calculated using quantity weights. Bootstrap standard errors are reported in parenthesis [TO BE COMPLETED].

of upstream firms. As pointed out in Section 2, effects of a change in disagreement payoffs of firms which strenghten the bargaining power of retailers (e.g., simulation 1) seem to be mitigated by changes in firms' concessions costs. The double marginalization problem implies that retail prices increase on average by 0.12%. Overall, profits of upstream and downstream firms are reduced by 0.68% and 0.75% respectively.

5 Concluding Remarks

This article studies the economic effects of buyer alliances formed by competing retailers to negotiate wholesale prices with manufacturers. I characterize the emergence of two main economic forces working in opposite directions. First, the formation of a buyer alliance strengthens the bargaining position of retailers by decreasing the status quo payoffs of manufacturers which face the threat to break negotiations with multiple retailers at the same time. Second, I show that the absence of price discrimination between alliance members reinforces the bargaining power of manufacturers vis-à-vis retailers by increasing their concession costs.[41]

I employ a structural model of demand and supply to measure economic forces at play. Using homescan data on bottled water purchases, I estimate model parameters and simulate three buyer alliances formed by competing retailers on the French food retail sector in 2014. My empirical results contrast with the theory of countervailing buyer power and show that buyer alliances increase price-cost margins of manufacturers by 2.77% as well as retail prices paid by final consumers by 0.12%. Furthermore, profits of both manufacturers and retailers are reduced by 0.68% and 0.75% respectively. While my empirical application focuses on a specific product category (i.e., bottled water), this article sheds new light on adverse effects generated by buyer alliances which can offset their benefits for retailers and consumers.

An important limitation of my simulations is that Nash bargaining weights of firms

[41] While it is less harmful for a retailer to make a price concession if at least one of its rival also grants the concession, it is costlier for a manufacturer to concede a lower price to multiple retailers.

remain unaffected by the operations. Ad-hoc changes of Nash bargaining weights as in Grennan (2013) could be considered in a future version of this paper to evaluate their effects on the division of surplus between firms and retail prices.[42]

[42]The determinants of Nash bargaining weights remain an open question and are subject to ongoing research in the empirical literature (e.g., Lewis and Pflum, 2015; Doudchenko and Yurukoglu, 2016).

Appendix

A Theoretical Insights on Buyer Alliances

This section aims at providing further details about the resolution of the two-stage game of vertical relationships developed in Section 2. Subsection A.1 exhibits the conditions which ensure the existence and uniqueness of a downstream price equilibrium and a bargaining equilibrium. Subsection A.2 is devoted to the derivation the retail pass-through rates. Subsection A.3 exhibits computational details about the approach employed to assess the buyer group effects.

A.1 Conditions for Existence and Uniqueness

Existence and Uniqueness of the Downstream Price Equilibrium

The existence of a Nash equilibrium in prices is ensured when π_{R_j} is quasi-concave in p_j. Such an assumption is satisfied when q_j^{-1} is convex in p_j (Caplin and Nalebuff, 1991). This condition called (-1)-concavity refers to a weaker requirement than concave demand systems and allows to encompass the multinomial logit model (see Anderson, De Palma and Thisse, 1992, p. 163). Furthermore, the contraction condition $\frac{\partial^2 \pi_{R_j}}{\partial p_j^2} + \left| \frac{\partial^2 \pi_{R_j}}{\partial p_j \partial p_{-j}} \right| < 0$ can be used to assure uniqueness (e.g., Vives, 2001, ch. 6).

Existence and Uniqueness of the Bargaining Equilibrium

[TO BE COMPLETED]

A.2 Retail Pass-through

Rewrite (1) as

$$q_j(p_j(w_j, w_{-j}), p_{-j}(w_j, w_{-j})) \left(\frac{\partial q_j}{\partial p_j} \right)^{-1} + p_j(w_j, w_{-j}) = w_j \tag{14}$$

By differentiating (14) with respect to w_j, I obtain

$$\begin{aligned} &\left(\frac{\partial q_j}{\partial p_j} \frac{\partial p_j}{\partial w_j} + \frac{\partial q_j}{\partial p_{-j}} \frac{\partial p_{-j}}{\partial w_j} \right) \left(\frac{\partial q_j}{\partial p_j} \right)^{-1} - q_j \left(\frac{\partial q_j}{\partial p_j} \right)^{-2} \left(\frac{\partial^2 q_j}{\partial p_j^2} \frac{\partial p_j}{\partial w_j} + \frac{\partial^2 q_j}{\partial p_j \partial p_{-j}} \frac{\partial p_{-j}}{\partial w_j} \right) + \frac{\partial p_j}{\partial w_j} = 1 \\ \Leftrightarrow \quad &\frac{\partial p_j}{\partial w_j} = \frac{\frac{\partial q_j}{\partial p_j} - \frac{\partial^2 \pi_{R_j}}{\partial p_j \partial p_{-j}} \frac{\partial p_{-j}}{\partial w_j}}{\frac{\partial^2 \pi_{R_j}}{\partial p_j^2}} \end{aligned} \tag{15}$$

Similarly, the first-order condition of R_{-j}'s maximization problem with respect to p_{-j} can be derived as follows

$$q_{-j}(p_j(w_j, w_{-j}), p_{-j}(w_j, w_{-j})) \left(\frac{\partial q_{-j}}{\partial p_{-j}} \right)^{-1} + p_{-j}(w_j, w_{-j}) = w_{-j} \tag{16}$$

By differentiating (16) with respect to w_j, I obtain

$$\left(\frac{\partial q_{-j}}{\partial p_j}\frac{\partial p_j}{\partial w_j}+\frac{\partial q_{-j}}{\partial p_{-j}}\frac{\partial p_{-j}}{\partial w_j}\right)\left(\frac{\partial q_{-j}}{\partial p_{-j}}\right)^{-1}-\,q_{-j}\left(\frac{\partial q_{-j}}{\partial p_{-j}}\right)^{-2}\left(\frac{\partial^2 q_{-j}}{\partial p_{-j}\partial p_j}\frac{\partial p_j}{\partial w_j}+\frac{\partial^2 q_{-j}}{\partial p_{-j}^2}\frac{\partial p_{-j}}{\partial w_j}\right)+\frac{\partial p_{-j}}{\partial w_j}=0$$

$$\Leftrightarrow\quad \frac{\partial p_{-j}}{\partial w_j}=-\frac{\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}\partial p_j}\frac{\partial p_j}{\partial w_j}}{\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}^2}} \tag{17}$$

Hence, from (15) and (17), the retail pass-through is given as follows

$$\frac{\partial p_j}{\partial w_j}=\frac{\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}^2}\frac{\partial q_j}{\partial p_j}}{\frac{\partial^2\pi_{R_j}}{\partial p_j^2}\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}^2}-\frac{\partial^2\pi_{R_j}}{\partial p_j\partial p_{-j}}\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}\partial p_j}}\quad\text{and}\quad \frac{\partial p_{-j}}{\partial w_j}=-\frac{\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}\partial p_j}\frac{\partial q_{-j}}{\partial p_{-j}}}{\frac{\partial^2\pi_{R_j}}{\partial p_j^2}\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}^2}-\frac{\partial^2\pi_{R_j}}{\partial p_j\partial p_{-j}}\frac{\partial^2\pi_{R_{-j}}}{\partial p_{-j}\partial p_j}}$$

A.3 Buyer Group Effects: Computational Details

The purpose of this subsection is to describe how (3) can be rewritten with respect to the first-order conditions for the "Nash-in-Nash" bargaining solution from the benchmark setting. Recall that $\frac{\partial \mathrm{NP}_{12}}{\partial w}$ is given by

$$\lambda(\pi_A(w,w)-0)\left(\frac{\partial\pi_{R_1R_2}}{\partial w_1}+\frac{\partial\pi_{R_1R_2}}{\partial w_2}\right)+(1-\lambda)\left(\pi_{R_1R_2}(w,w)-0\right)\left(\frac{\partial\pi_A}{\partial w_1}+\frac{\partial\pi_A}{\partial w_2}\right) \tag{18}$$

Since $\frac{\partial\pi_{R_1R_2}}{\partial w_1}=\frac{\partial\pi_{R_1}}{\partial w_1}+\frac{\partial\pi_{R_2}}{\partial w_1}$ and $\frac{\partial\pi_{R_1R_2}}{\partial w_2}=\frac{\partial\pi_{R_2}}{\partial w_2}+\frac{\partial\pi_{R_1}}{\partial w_2}$, (18) rewrites as follows

$$\begin{aligned}
\frac{\partial \mathrm{NP}_{12}}{\partial w} &= \lambda(\pi_A(w,w)-0)\left(\frac{\partial\pi_{R_1}}{\partial w_1}+\frac{\partial\pi_{R_2}}{\partial w_1}+\frac{\partial\pi_{R_1}}{\partial w_2}+\frac{\partial\pi_{R_2}}{\partial w_2}\right)+(1-\lambda)\left(\pi_{R_1R_2}(w,w)-0\right)\left(\frac{\partial\pi_A}{\partial w_1}+\frac{\partial\pi_A}{\partial w_2}\right)\\
\Leftrightarrow \frac{\partial \mathrm{NP}_{12}}{\partial w} &= \left\{\lambda\left(\pi_A(w,w)-d_A^{-R_1}\right)\frac{\partial\pi_{R_1}}{\partial w_1}+(1-\lambda)\left(\pi_{R_1}(w,w)-0\right)\frac{\partial\pi_A}{\partial w_1}\right\}\\
&\quad+\left\{\lambda\left(\pi_A(w,w)-d_A^{-R_1}\right)\frac{\partial\pi_{R_1}}{\partial w_2}+(1-\lambda)\left(\pi_{R_1}(w,w)-0\right)\frac{\partial\pi_A}{\partial w_2}\right\}\\
&\quad+\left\{\lambda\left(\pi_A(w,w)-d_A^{-R_2}\right)\frac{\partial\pi_{R_2}}{\partial w_2}+(1-\lambda)\left(\pi_{R_2}(w,w)-0\right)\frac{\partial\pi_A}{\partial w_2}\right\}\\
&\quad+\left\{\lambda\left(\pi_A(w,w)-d_A^{-R_2}\right)\frac{\partial\pi_{R_2}}{\partial w_1}+(1-\lambda)\left(\pi_{R_2}(w,w)-0\right)\frac{\partial\pi_A}{\partial w_1}\right\}\\
&\quad+\left\{\lambda d_A^{-R_1}\left(\frac{\partial\pi_{R_1}}{\partial w_1}+\frac{\partial\pi_{R_1}}{\partial w_2}\right)\right\}+\left\{\lambda d_A^{-R_2}\left(\frac{\partial\pi_{R_2}}{\partial w_2}+\frac{\partial\pi_{R_2}}{\partial w_1}\right)\right\}\\
\Leftrightarrow \frac{\partial \mathrm{NP}_{12}}{\partial w} &= \frac{\partial \mathrm{NP}_1}{\partial w_1}+\frac{\partial \mathrm{NP}_2}{\partial w_2}+\left\{\lambda\left(\pi_A-d_A^{-R_1}\right)\frac{\partial\pi_{R_1}}{\partial w_2}+(1-\lambda)\left(\pi_{R_1}-0\right)\left(\frac{\partial\pi_A}{\partial w_2}\right)\right\}\\
&\quad+\left\{\lambda\left(\pi_A-d_A^{-R_2}\right)\frac{\partial\pi_{R_2}}{\partial w_1}+(1-\lambda)\left(\pi_{R_2}-0\right)\left(\frac{\partial\pi_A}{\partial w_1}\right)\right\}\\
&\quad+\left\{\lambda\left(\pi_A-0-(\pi_A-d_A^{-R_1})\right)\frac{\partial\pi_{R_1}}{\partial w_1}\right\}+\left\{\lambda\left(\pi_A-0-(\pi_A-d_A^{-R_2})\right)\frac{\partial\pi_{R_2}}{\partial w_2}\right\}\\
&\quad+\left\{\lambda\left(\pi_A-0-(\pi_A-d_A^{-R_1})\right)\frac{\partial\pi_{R_1}}{\partial w_2}\right\}+\left\{\lambda\left(\pi_A-0-(\pi_A-d_A^{-R_2})\right)\left(\frac{\partial\pi_{R_2}}{\partial w_1}\right)\right\}
\end{aligned}$$

Therefore, it turns out that $\frac{\partial \mathrm{NP}_{12}}{\partial w} = \frac{\partial \mathrm{NP}_1}{\partial w_1} + \frac{\partial \mathrm{NP}_2}{\partial w_2} + \Delta_{12}$, where Δ_{12} can be described as follows

$$\begin{aligned}\Delta_{12}(w,w) &= \Bigg(\sum_{j=1}^{2}\left\{\lambda\Big(\pi_A - d_A^{-R_j}\Big)\frac{\partial \pi_{R_j}}{\partial w_{-j}} + (1-\lambda)\Big(\pi_{R_j} - 0\Big)\frac{\partial \pi_A}{\partial w_{-j}}\right\} \\ &\quad + \left\{\lambda\Big(\pi_A - 0 - (\pi_A - d_A^{-R_j})\Big)\frac{\partial \pi_{R_j}}{\partial w_j}\right\} + \left\{\lambda\Big(\pi_A - 0 - (\pi_A - d_A^{-R_j})\Big)\frac{\partial \pi_{R_j}}{\partial w_{-j}}\right\}\Bigg)\end{aligned}$$

B Empirical Bargaining Framework: Technical Issues

B.1 Computation of the Out-of-Equilibrium Retail Prices

In this subsection, I derive the out-of-equilibrium retail prices following a disagreement over the wholesale price of a product.

Let's assume that, for a given market t, product $j \in \mathcal{J}_r$ is no longer offered. Under the assumption that wholesale prices and distribution costs of other products remain unchanged, the equilibrium margins ($\gamma^*_{k,t}$) and out-of-equilibrium margins ($\tilde{\gamma}^{-j}_{k,t}$) of product $k \in \mathcal{J}_r \backslash \{j\}$ are written as follows

$$\gamma^*_{k,t} = p^*_{k,t} - w^*_{k,t} - c_{k,t} \quad \text{and} \quad \tilde{\gamma}^{-j}_{k,t} = \tilde{p}^{-j}_{k,t} - w^*_{k,t} - c_{k,t}$$

It is straightforward to see from these margins that the following equality holds

$$\tilde{p}^{-j}_{k,t} - \tilde{\gamma}^{-j}_{k,t} - \left(p^*_{k,t} - \gamma^*_{k,t}\right) = 0 \quad \forall k \in \mathcal{J}_r \backslash \{j\}$$

Hence, I can define a system of nonlinear equations

$$\mathbf{f}_j(\tilde{\mathbf{p}}^{-j}_t) \equiv \tilde{\mathbf{p}}^{-j}_t - \tilde{\boldsymbol{\gamma}}^{-j}_t - (\mathbf{p}^*_t - \boldsymbol{\gamma}^*_t) = \mathbf{0} \tag{19}$$

where $\mathbf{0}$ is a J-dimensional vector with all entries being equal to 0,

$$\tilde{\boldsymbol{\gamma}}_{-j,t}[k,1] = \begin{cases} +\infty & \text{if } k = j \\ \tilde{\boldsymbol{\gamma}}^{-j}_{r,t}[k,1] & \text{if } j,k \in \mathcal{J}_r \\ \gamma^*_{k,t} & \text{otherwise} \end{cases} \quad \text{with } \tilde{\boldsymbol{\gamma}}^{-j}_{r,t} = -\Big(\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t}(\tilde{\mathbf{p}}^{-j}_t)\mathbf{I}_r\Big)^{+}\mathbf{I}_r \mathbf{s}_t(\tilde{\mathbf{p}}^{-j}_t)$$

and $\tilde{\mathbf{p}}^{-j}_t$ is given by $\tilde{\mathbf{p}}^{-j}_t[k,1] = \begin{cases} +\infty & \text{if } j = k \\ \tilde{p}^{-j}_{k,t} & \text{if } k \in \mathcal{J}_r \\ p^*_{k,t} & \text{if } k \notin \mathcal{J}_r \end{cases}$

To solve the system (19) and recover the out-of-equilibrium retail prices I employ a trust-region dogleg method.[43] Equilibrium retail prices are used as an initial guess for the out-of-equilibrium retail prices parameters, i.e., $\tilde{\mathbf{p}}^{-j,(0)}_t = \mathbf{p}^*_t$.

B.2 Derivation of the Manufacturers' Price-Cost Margins

In the current subsection, I solve in detail the bilateral negotiation between manufacturer f and retailer r over the wholesale price of product j, that is, w_j.

[43] The search for a numerical root is performed with the MATLAB *fsolve* function.

Agreement payoffs. The agreement payoffs of manufacturer f (retailer r respectively) are written as follows

$$
\begin{aligned}
\pi_{f,t} =& \left(w_{j,t} - \mu_{j,t}\right) M_t\, s_{j,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}^*_{-j,t}), \mathbf{p}^*_{-r,t}; \theta^d) \;+ \sum_{k \in \mathcal{J}_f \setminus \{j\}} \left(w^*_{k,t} - \mu_{k,t}\right) M_t\, s_{k,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}^*_{-j,t}), \mathbf{p}^*_{-r,t}; \theta^d) \\
\pi_{r,t} =& \left(p_{j,t}(w_{j,t}, \mathbf{w}^*_{-j,t}) - w_{j,t} - c_{j,t}\right) M_t\, s_{j,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}^*_{-j,t}), \mathbf{p}^*_{-r,t}; \theta^d) \\
&+ \sum_{k \in \mathcal{J}_r \setminus \{j\}} \left(p_{k,t}(w_{j,t}, \mathbf{w}^*_{-j,t}) - w^*_{k,t} - c_{k,t}\right) M_t\, s_{k,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}^*_{-j,t}), \mathbf{p}^*_{-r,t}; \theta^d)
\end{aligned}
$$

Disagreement payoffs. Let $\tilde{s}^{-j}_{k,t}$ be respectively the market share of product k at period t given that product j is no longer offered. The disagreement payoffs of manufacturer f and retailer r are respectively derived as follows

$$
\begin{aligned}
d^{-j}_{f,t} &= \sum_{k \in \mathcal{J}_f \setminus \{j\}} \left(w^*_{k,t} - \mu_{k,t}\right) M_t\, \tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t; \theta^d) \\
d^{-j}_{r,t} &= \sum_{k \in \mathcal{J}_r \setminus \{j\}} \left(\tilde{p}^{-j}_{k,t}(\mathbf{w}^*_{-j,t}) - w^*_{k,t} - c_{k,t}\right) M_t\, \tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t; \theta^d)
\end{aligned}
$$

where the market share of each product k remaining on the market, that is $\tilde{s}^{-j}_{k,t}$, is computed as follows

$$
\tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t; \theta^d) =
\begin{cases}
\displaystyle\int_0^{+\infty} \frac{\exp(\tilde{V}^{-j}_{i,k,t})}{\sum_{l \in \mathcal{J}_r \setminus \{j\}} \exp(\tilde{V}^{-j}_{i,l,t}) + \sum_{m \in \mathcal{J} \setminus \mathcal{J}_r} \exp(V_{i,m,t})} f(\alpha_i)\, \mathrm{d}\alpha_i & \text{if } k \in \mathcal{J}_r \setminus \{j\} \\
\displaystyle\int_0^{+\infty} \frac{\exp(V_{i,k,t})}{\sum_{l \in \mathcal{J}_r \setminus \{j\}} \exp(\tilde{V}^{-j}_{i,l,t}) + \sum_{m \in \mathcal{J} \setminus \mathcal{J}_r} \exp(V_{i,m,t})} f(\alpha_i)\, \mathrm{d}\alpha_i & \text{otherwise}
\end{cases}
$$

with $\tilde{V}^{-j}_{i,k,t} = \delta_{b(k)} + \delta_{r(k)} + \delta_{pl(k)} - \alpha_i \tilde{p}^{-j}_{k,t} + \rho \hat{u}_{k,t}$.

Nash bargaining problem. The (asymmetric) Nash product of the bilateral negotiation between manufacturer f and retailer r over the wholesale price $w_{j,t}$ — taking $\mathbf{w}^*_{-j,t}$ as given — is written as follows

$$
\mathrm{NP}_{j,t} \equiv \left(\pi_{f,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}_{-j,t}), \mathbf{p}^*_{-r,t}) - d^{-j}_{f,t}\right)^{1-\lambda_{f,r}} \left(\pi_{r,t}(\mathbf{p}_{r,t}(w_{j,t}, \mathbf{w}^*_{-j,t}), \mathbf{p}^*_{-r,t}) - d^{-j}_{r,t}\right)^{\lambda_{f,r}}
$$

The equilibrium wholesale price $w^*_{j,t}$ is defined as the term that maximizes the Nash product, that is

$$
w^*_{j,t} \equiv \underset{w_{j,t}}{\operatorname{argmax}}\ \mathrm{NP}_{j,t}
$$

The first-order condition of this maximization problem governs the division of surplus between players and is derived as follows

$$
\begin{aligned}
& \lambda_{f,r}\left(\pi_{f,t} - d^{-j}_{f,t}\right)\left(\frac{\partial \pi_{r,t}}{\partial w_{j,t}}\right) + \left(1 - \lambda_{f,r}\right)\left(\pi_{r,t} - d^{-j}_{r,t}\right)\left(\frac{\partial \pi_{f,t}}{\partial w_{j,t}}\right) = 0 \\
\Leftrightarrow \quad & \left(\Gamma^*_{j,t}\, s_{j,t}(\mathbf{p}^*_t; \theta^d) + \sum_{k \in \mathcal{J}_f \setminus \{j\}} \Gamma^*_{k,t} \left(s_{k,t}(\mathbf{p}^*_t; \theta^d) - \tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t; \theta^d)\right)\right)\left(\sum_{k \in \mathcal{J}_r} \frac{\partial p_{k,t}}{\partial w_{j,t}} s_{k,t}(\mathbf{p}^*_t; \theta^d) - s_{j,t}(\mathbf{p}^*_t; \theta^d) + \sum_{k \in \mathcal{J}_r} \gamma^*_{k,t} \sum_{l \in \mathcal{J}_r} \frac{\partial s_{k,t}}{\partial p_{l,t}} \frac{\partial p_{l,t}}{\partial w_{j,t}}\right) \\
& + \frac{1 - \lambda_{f,r}}{\lambda_{f,r}} \left(\gamma^*_{j,t}\, s_{j,t}(\mathbf{p}^*_t; \theta^d) + \sum_{k \in \mathcal{J}_r \setminus \{j\}} \gamma^*_{k,t}\, s_{kt}(\mathbf{p}^*_t; \theta^d) - \tilde{\gamma}_{kt}(\tilde{\mathbf{p}}^{-j}_t) \tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t; \theta^d)\right)\left(s_{j,t}(\mathbf{p}^*_t; \theta^d) + \sum_{k \in \mathcal{J}_f} \Gamma^*_{k,t} \sum_{l \in \mathcal{J}_r} \frac{\partial s_{k,t}}{\partial p_{l,t}} \frac{\partial p_{l,t}}{\partial w_{j,t}}\right) = 0
\end{aligned}
$$

where $\quad \Gamma^*_{j,t} \equiv w^*_{j,t} - \mu_{jt}; \quad \gamma^*_{j,t} \equiv p^*_{j,t} - w^*_{j,t} - c_{j,t}; \quad \tilde{\gamma}_{k,t} \equiv \tilde{p}^{-j}_{k,t} - w^*_{k,t} - c_{k,t}.$

Let $\mathbf{I}_f$ be the $J \times J$ ownership matrix of manufacturer f where $\mathbf{I}_f[j,j] = 1$ if manufacturer f produces product j and 0 otherwise (the off-diagonal elements being equal to 0) and ι be an all-ones vector of dimension J (i.e., every element is equal to one). It can be shown that the left-hand side of the above first-order condition is the jth element of the following vector of "Nash-in-Nash" first-order conditions

$$\begin{aligned}
&\left(\mathbf{I}_f \tilde{\mathbf{S}}_{\Delta t} \mathbf{I}_f \boldsymbol{\Gamma}^*_{f,t}\right) \circ \left(\sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \left(\left(\mathbf{P}_{\mathbf{w}_t} - \mathbf{I}\right) \mathbf{I}_r \mathbf{s}_t + \mathbf{P}_{\mathbf{w}_t} \mathbf{I}_r \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_r \gamma^*_t \right) \right) \\
&+ \frac{\mathbf{1} - \boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \left(\sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \left(\iota \mathbf{s}_t^\top \mathbf{I}_r \gamma^*_t + \left(\left(\left(\tilde{\mathbf{S}}_{\Delta t} - \iota \mathbf{s}_t^\top \right) \mathbf{I}_r \right) \circ \tilde{\gamma}_t^\top \right) \iota \right) \right) \circ \left(\mathbf{s}_t + \left(\sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \mathbf{P}_{\mathbf{w}_t} \mathbf{I}_r \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_f \right) \boldsymbol{\Gamma}^*_{f,t} \right) = \mathbf{0}
\end{aligned} \tag{20}$$

where the $J \times J$ matrices $\tilde{\mathbf{S}}_{\Delta t}$, $\tilde{\gamma}_t$, and $\mathbf{P}_{\mathbf{w}_t}$ are described as follows

- $\tilde{\mathbf{S}}_{\Delta t} = \begin{pmatrix} s_{1,t}(\mathbf{p}^*_t;\theta^d) & -\Delta \tilde{s}^{-1}_{2,t}(\tilde{\mathbf{p}}^{-1}_t;\theta^d) & \cdots & -\Delta \tilde{s}^{-1}_{J,t}(\tilde{\mathbf{p}}^{-1}_t;\theta^d) \\ -\Delta \tilde{s}^{-2}_{1,t}(\tilde{\mathbf{p}}^{-2}_t;\theta^d) & s_{2,t}(\mathbf{p}^*_t;\theta^d) & \cdots & -\Delta \tilde{s}^{-2}_{J,t}(\tilde{\mathbf{p}}^{-2}_t;\theta^d) \\ \vdots & \vdots & \ddots & \vdots \\ -\Delta \tilde{s}^{-J}_{1,t}(\tilde{\mathbf{p}}^{-J}_t;\theta^d) & -\Delta \tilde{s}^{-J}_{2,t}(\tilde{\mathbf{p}}^{-J}_t;\theta^d) & \cdots & s_{Jt}(\mathbf{p}^*_t;\theta^d) \end{pmatrix}$

  with $-\Delta \tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t;\theta^d) = s_{k,t}(\mathbf{p}^*_t;\theta^d) - \tilde{s}^{-j}_{k,t}(\tilde{\mathbf{p}}^{-j}_t;\theta^d)$ and $\tilde{\mathbf{p}}^{-j}_t[k,1] = \begin{cases} +\infty & \text{if } k = j \\ \tilde{p}^{-j}_{k,t} & \text{if } j \neq k \text{ and } j,k \in \mathcal{J}_r \\ p^*_{k,t} & \text{otherwise} \end{cases}$ denotes the vector of out-of-equilibrium retail prices when product j is no longer offered on the market.

- $\tilde{\gamma}_t[k,j] = \begin{cases} +\infty & \text{if } k = j \\ \tilde{\gamma}^{-j}_{kt} = \tilde{p}^{-j}_{kt} + \gamma_{kt} - p_{kt} & \text{if } k \neq j \text{ and } j,k \in \mathcal{J}_r \\ \gamma^*_{kt} & \text{otherwise} \end{cases}$

  (see Appendix B.1 for computational details of out-of-equilibrium prices)

- $\mathbf{P}_{\mathbf{w}_t} = \sum_{r=1}^{R} \mathbf{I}^*_r \mathbf{S}^\top_{\mathbf{p}_t} \mathbf{I}_r \left(\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_r + \mathbf{I}_r \mathbf{S}^\top_{\mathbf{p}_t} \mathbf{I}_r + \mathbf{I}_r \mathbf{S}^{\mathbf{p}}_{\mathbf{p}_t} \right)^+$ (see the Web Appendix for further details)

Let us define
$$\begin{aligned}
\mathbf{V}_{f,t} &\equiv \sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \left(\left(\mathbf{P}_{\mathbf{w}_t} - \mathbf{I} \right) \mathbf{I}_r \mathbf{s}_t + \mathbf{P}_{\mathbf{w}_t} \mathbf{I}_r \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_r \gamma^*_t \right) \\
\mathbf{M}_{f,t} &\equiv \mathbf{I}_f \tilde{\mathbf{S}}_{\Delta t} \mathbf{I}_f \\
\tilde{\mathbf{V}}_{f,t} &\equiv \sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \left(\iota \mathbf{s}_t^\top \mathbf{I}_r \gamma^*_t + \left(\left(\left(\tilde{\mathbf{S}}_{\Delta t} - \iota \mathbf{s}_t^\top \right) \mathbf{I}_r \right) \circ \tilde{\gamma}_t^\top \right) \iota \right) \\
\tilde{\mathbf{M}}_{f,t} &\equiv \sum_{r=1}^{R} \mathbf{I}_f \mathbf{I}_r \mathbf{P}_{\mathbf{w}_t} \mathbf{I}_r \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_f
\end{aligned}$$

and re-write the system of equations (20) as follows

$$\mathbf{V}_{f,t} \circ \left(\mathbf{M}_{f,t} \boldsymbol{\Gamma}^*_{f,t} \right) + \frac{\mathbf{1} - \boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t} \circ \mathbf{s}_t + \frac{\mathbf{1} - \boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t} \circ \left(\tilde{\mathbf{M}}_{f,t} \boldsymbol{\Gamma}^*_{f,t} \right) = \mathbf{0} \tag{21}$$

Bonnet, Bouamra-Mechemache and Molina (2017) have shown that the equilibrium price-cost margins of manufacturer f can be derived as follows

$$\boldsymbol{\Gamma}^*_{f,t} = -\left(\left(\mathbf{V}_{f,t} \iota^\top \right) \circ \mathbf{M}_{f,t} + \left(\left(\frac{\mathbf{1} - \boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t} \right) \iota^\top \right) \circ \tilde{\mathbf{M}}_{f,t} \right)^+ \left(\frac{\mathbf{1} - \boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t} \circ \mathbf{s}_t \right) \tag{22}$$

I finally define $\boldsymbol{\Gamma}_t^* \equiv \sum_{f=1}^{F} \boldsymbol{\Gamma}_{ft}^*$ and recover the vector of equilibrium upstream margins in market t as follows

$$\boldsymbol{\Gamma}_t^* = -\sum_{f=1}^{F} \left(\left(\mathbf{V}_{f,t} \boldsymbol{\iota}^\top \right) \circ \mathbf{M}_{f,t} + \left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t} \right) \boldsymbol{\iota}^\top \right) \circ \tilde{\mathbf{M}}_{f,t} \right)^+ \left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}} \circ \tilde{\mathbf{V}}_{f,t} \circ \mathbf{s}_t \right)$$

B.3 Algorithm to Approximate the Optimal Instruments

Chamberlain (1987) optimal instruments are given by[44]

$$\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\theta}^s}(\boldsymbol{\theta}^s) \mid \mathbf{Z}^s \right]^\top \mathbb{E}\left[\boldsymbol{\omega}(\boldsymbol{\theta}^s) \boldsymbol{\omega}(\boldsymbol{\theta}^s)^\top \mid \mathbf{Z}^s \right]^{-1}$$

In this paper, I consider the homoskedastic case in which $\mathbb{E}[\boldsymbol{\omega}\boldsymbol{\omega}^\top \mid \mathbf{Z}^s]$ is the identity matrix. Construction of $\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\theta}^s}(\boldsymbol{\theta}^s) \mid \mathbf{Z}^s\right]$ differs across elements of $\boldsymbol{\theta}^s$. For cost parameters $\boldsymbol{\kappa}$ we have $\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\kappa}}(\boldsymbol{\theta}^s) \mid \mathbf{Z}^s\right] = \mathbb{E}[-\mathbf{v} \mid \mathbf{Z}^s] = -\mathbf{v}$ since $\mathbf{v}$ is assumed to belong to $\mathbf{Z}^s$. However, $\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\lambda}}(\boldsymbol{\theta}^s) \mid \mathbf{Z}^s\right]$ is particularly difficult (if not impossible) to calculate. Indeed, it corresponds to a conditional expectation of a nonlinear function of the true parameters $\boldsymbol{\theta}^s$ and of the following endogenous variables: unobserved product characteristics, equilibrium retail prices, and out-of-equilibrium retail prices which depend on the unobserved cost factors $\boldsymbol{\omega}$.[45] This conditional expectation can be written as follows

$$\mathbb{E}\left[\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\lambda}}(\boldsymbol{\theta}^s) \mid \mathbf{Z}^s \right] = \int \frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\lambda}}(\boldsymbol{\xi}(\boldsymbol{\omega}), \mathbf{p}(\boldsymbol{\xi}(\boldsymbol{\omega}), \boldsymbol{\omega}), \tilde{\mathbf{p}}^{-1}(\boldsymbol{\xi}(\boldsymbol{\omega}), \boldsymbol{\omega}), \ldots, \tilde{\mathbf{p}}^{-J}(\boldsymbol{\xi}(\boldsymbol{\omega}), \boldsymbol{\omega}), \boldsymbol{\theta}^s)\, f(\boldsymbol{\omega}) \mathrm{d}\boldsymbol{\omega} \tag{23}$$

where $f(\boldsymbol{\omega})$ denotes the density of the unobserved cost factors. A solution to compute (23) would be to obtain some initial estimates of $\boldsymbol{\theta}^s$ and to use Monte Carlo integration: (i) specify an appropriate density for $\boldsymbol{\omega}$ and generate draws from this density, (ii) recompute new unobserved product characteristics, equilibrium and out-of-equilibrium retail prices, and calculate the derivatives for each draw, (iii) average the results. However, such a procedure could be a formidable task given the important number of draws required to provide an accurate approximation of the integral. Instead, I follow Berry, Levinsohn and Pakes (1999) who evaluate derivatives at the expected value of the unobservable, that is $\frac{\partial \boldsymbol{\omega}}{\partial \boldsymbol{\theta}^s}(\boldsymbol{\theta}^s)\big|_{\xi=\omega=0}$. In the present paper, I propose an extension of their algorithm to construct such derivatives in bilateral oligopoly settings with bilateral bargains. The algorithm can be described as follows:

1. Estimate $\hat{\boldsymbol{\theta}}^s = (\hat{\boldsymbol{\lambda}}, \hat{\boldsymbol{\kappa}})$ in a first step using (crude) instruments. In this article, I use the estimates obtained from specification 1.
2. Compute 2.a, 2.b, and 2.c iteratively until convergence, i.e. $\|\hat{\mathbf{p}}_t^{(i)} - \hat{\mathbf{p}}_t^{(i-1)}\| < \epsilon$:[46]

   2.a At the ith iteration, use the functional forms of the retail and upstream price-cost margins implied by the model as well as the 1st step estimates of the total marginal costs to compute an exogenous estimate of the out-of-equilibrium retail prices from the removing of each $j \in \mathcal{J}\backslash\{0\}$ as follows

$$\hat{\tilde{\mathbf{p}}}_t^{-j,(i)} = \underbrace{\sum_r (\mathbf{I}_r \mathbf{S}_{\mathbf{p}}(\hat{\tilde{\mathbf{p}}}_t^{-j,(i)}) \mathbf{I}_r)^+ \tilde{\mathbf{s}}(\hat{\tilde{\mathbf{p}}}_t^{-j,(i)})}_{\tilde{\mathbf{p}}_t^{-j,(i)} - \mathbf{w}_t^{(i)} - \mathbf{c}_t} + \underbrace{\sum_f \boldsymbol{\Gamma}_{f,t}(\hat{\boldsymbol{\lambda}}, \hat{\mathbf{p}}_t^{(i-1)}, \hat{\tilde{\mathbf{p}}}_t^{-1,(i-1)}, \ldots, \hat{\tilde{\mathbf{p}}}_t^{-J,(i-1)})}_{\mathbf{w}_t^{(i-1)} - \boldsymbol{\mu}_t} + \underbrace{\mathbf{v}_t \hat{\boldsymbol{\kappa}}}_{\mathbf{c}_t + \boldsymbol{\mu}_t}$$

[44] See Newey (1990, 1993) or Arellano (2003) for further details on optimal instruments.

[45] Derivatives of the unobserved cost factors with respect to $\boldsymbol{\lambda}$ also depend on predicted market shares which include unobserved product characteristics. Note that these unobserved characteristics are proxied by using a control function approach.

[46] Simulations are performed with $\epsilon = 10^{-06}$.

This requires to solve a system of nonlinear equations with respect to the vector $\tilde{\mathbf{p}}_t^{-j}$ $\forall j \in \mathcal{J}\backslash\{0\}$ and all $t = 1,\ldots,T$.

2.b Given the exogenous estimates of each out-of-equilibrium retail prices and the exogenous estimates of the equilibrium retail prices at the $i-1$th iteration, I construct the $J \times J$ matrices $\tilde{\gamma}_t^{(i)}$, $\mathbf{P}_{\mathbf{w}_t}^{(i)}$ and $\tilde{\mathbf{S}}_{\Delta t}^{(i)}$ for all $t = 1,\ldots,T$.

2.c Computation of an exogenous estimate of the retail price variable $\hat{\mathbf{p}}_t^{(i)}$ is then obtained as follows

$$\hat{\mathbf{p}}_t^{(i)} = \underbrace{\sum_r (\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t}(\hat{\mathbf{p}}_t^{(i)})\mathbf{I}_r)^{+}\mathbf{s}_t(\hat{\mathbf{p}}_t^{(i)})}_{\mathbf{p}_t^{(i)}-\mathbf{w}_t^{(i)}-\mathbf{c}_t} + \underbrace{\sum_f \mathbf{\Gamma}_{f,t}(\hat{\boldsymbol{\lambda}}, \hat{\mathbf{p}}_t^{(i)}, \hat{\tilde{\mathbf{p}}}_t^{-1,(i)}, \ldots, \hat{\tilde{\mathbf{p}}}_t^{-J,(i)})}_{\mathbf{w}_t^{(i)}-\boldsymbol{\mu}_t} + \underbrace{\mathbf{v}_t\hat{\boldsymbol{\kappa}}}_{\mathbf{c}_t+\boldsymbol{\mu}_t}$$

This requires to solve a system of nonlinear equations with respect to $\mathbf{p}_t$, for all $t = 1,\ldots,T$. Such a procedure allows to obtain an exogenous estimate of retail prices as a function of exogenous product characteristics (including characteristics of competing products) and cost shifters. Hence, this avoids to rely on an ad-hoc notion of "distance" between products offered on the market and instead directly exploits the functional forms of the structural model.

3. Evaluate the unobserved cost components at the exogenous predictions: $\hat{\boldsymbol{\omega}}(\hat{\boldsymbol{\theta}}^s) = \boldsymbol{\omega}(\hat{\mathbf{p}}, \hat{\tilde{\mathbf{p}}}^{-1}, \ldots, \hat{\tilde{\mathbf{p}}}^{-J}, \hat{\boldsymbol{\lambda}}, \hat{\boldsymbol{\kappa}})\big|_{\xi=\omega=0}$. Then, compute the estimates of the optimal instruments $\frac{\partial \hat{\boldsymbol{\omega}}}{\partial \boldsymbol{\theta}^s}(\hat{\boldsymbol{\theta}}^s)$. Note that the derivatives with respect to $\boldsymbol{\lambda}$ must be computed numerically (e.g., centrale difference).

C Demand Results: Tables and Figures

Table C.1: First Stage Regression Control Function

Variable	Value ($\hat{\phi}$)	S.E.
# of products w/in retailer	−0.01	0.00
× Private label	0.01*	0.00
Plastic price	0.37*	0.11
F-statistic (p-value)		
Brand fixed effects	443.58* (0.00)	
Retail fixed effects	7.70* (0.00)	
Excluded instruments	12.86* (0.00)	
R^2 adjusted	0.98	
Number of observations	1,125	

Notes: * indicates significance at the 5% level.

Figure C.1: Marginal Disutility of the Retail Price in the Population

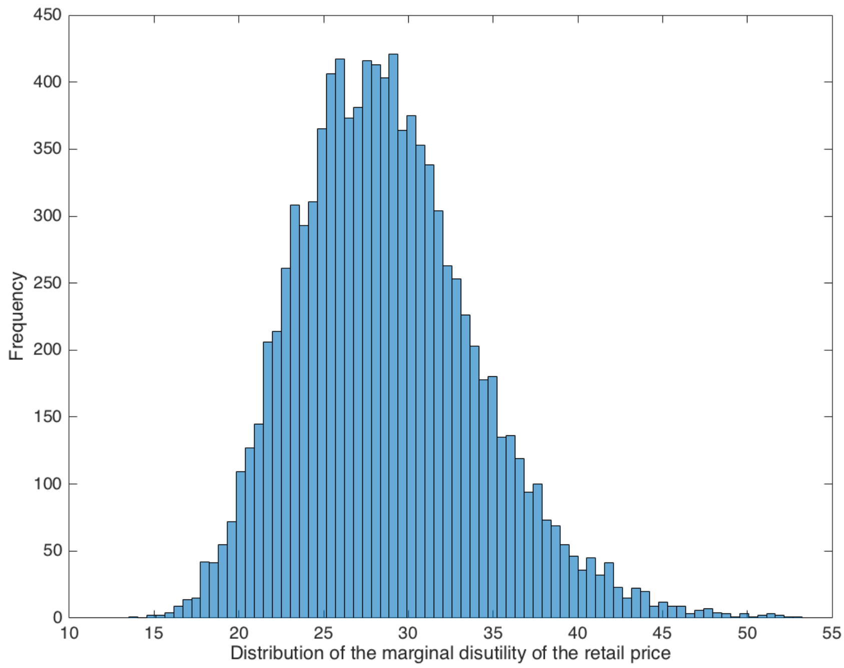
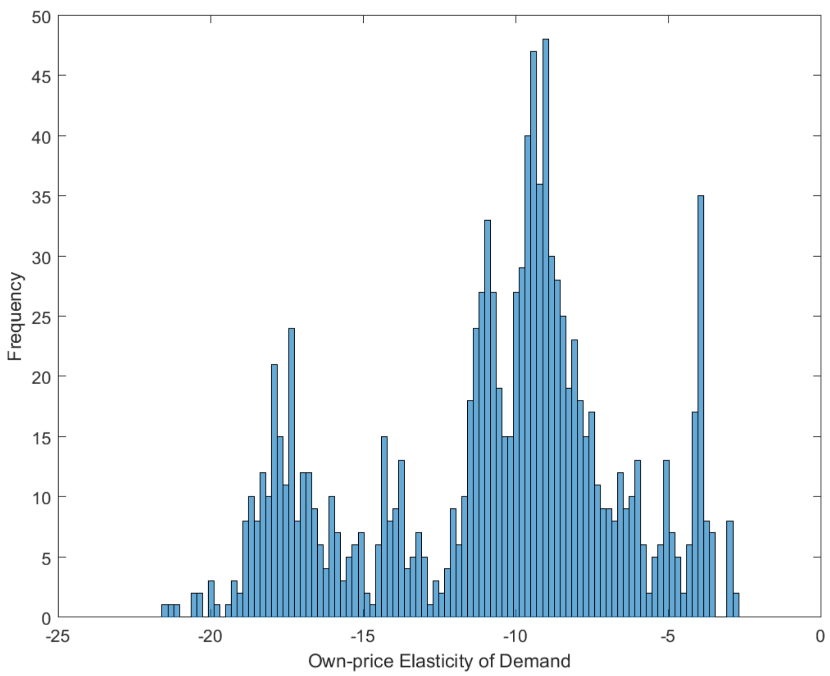


Figure C.2: Own-price Elasticity of Demand



D Simulations of Buyer Alliances: Technical Issues

This section describes each step used to perform simulations of buyer alliances. In Subsection D.1, upstream margins are derived in the case where buyer alliances are formed by some retailers to purchase their products. Subsection D.3 describes the algorithm used to compute the retail prices in the counterfactual simulations.

D.1 Ex-Post Upstream Margins

Let's consider a setting in which G buyer groups are formed by competing retailers to purchase their products on the wholesale market.[47] I introduce the following notations: $g(j)$ represents the group of retailers which purchases product j.[48] Furthermore, I denote by $\mathcal{J}_{g(j)}$ the set of products belonging to the buyer group which purchases product j, and by $\mathcal{J}_{b(j)}$ the set of products under the same brand name than product j.

Among these operations, assume that retailers r and r' have formed a buyer group and that product j is produced by manufacturer f and distributed by retailer r, that is $j \in \mathcal{J}_r \cap \mathcal{J}_f$. In what follows, I describe the bilateral bargaining between manufacturer f and the group of retailers $g(j)$ over $w_{g(j),b(j),t}$, that is the wholesale price of products belonging to the brand of product j and bought by the group of retailers $g(j)$ in market t. Because members of a buyer group pay a similar price for purchasing the same brand, it follows that $w_{g(j),b(j),t} = w_{g(i),b(i),t}$, $\forall i \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}$.

Agreement payoffs. Let $\mathbf{w}^{\text{post}}_{-g(j),b(j),t}$ be the (anticipated) equilibrium wholesale price vector of products other than those belonging to brand $b(j)$ and purchased by the group of retailers $g(j)$, $\mathbf{p}_{g(j),t}$ denotes the retail price vector set by members of the buyer group $g(j)$ and $\mathbf{p}^{\text{post}}_{-g(j),t}$ the retail price vector set by other retailers. Under the assumption that the buyer group $g(j)$ maximizes the joint profits of its members, the agreements payoffs of parties to the following bilateral negotiation are given by

$$\begin{aligned}
\pi_{f,t} =& \sum_{i \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} \left(w_{g(j),b(j),t} - \mu_{i,t} \right) M_t s_{i,t}(\mathbf{p}_{g(j),t}(w_{g(j),b(j),t}, \mathbf{w}^{\text{post}}_{-g(j),b(j),t}), \mathbf{p}^{\text{post}}_{-g(j),t}; \theta^d) \\
&+ \sum_{k \in \mathcal{J}_f \setminus \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} \left(w^{\text{post}}_{g(k),b(k),t} - \mu_{k,t} \right) M_t s_{k,t}(\mathbf{p}_{g(j),t}(w_{g(j),b(j),t}, \mathbf{w}^{\text{post}}_{-g(j),b(j),t}), \mathbf{p}^{\text{post}}_{-g(j),t}; \theta^d) \\
\pi_{g(j),t} =& \sum_{i \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} \left(p_{i,t}(w_{g(j),b(j),t}, \mathbf{w}^{\text{post}}_{-g(j),b(j),t}) - w_{g(j),b(j),t} - c_{i,t} \right) M_t s_{i,t}(\mathbf{p}_{g(j),t}(w_{g(j),b(j),t}, \mathbf{w}^{\text{post}}_{-g(j),b(j),t}), \mathbf{p}^{\text{post}}_{-g(j),t}; \theta^d) \\
&+ \sum_{k \in \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)}} \left(p_{k,t}(w_{g(j),b(j),t}, \mathbf{w}^{\text{post}}_{-g(j),b(j),t}) - w^{\text{post}}_{g(j),b(k),t} - c_{k,t} \right) M_t s_{k,t}(\mathbf{p}_{g(j),t}(w_{g(j),b(j),t}, \mathbf{w}^{\text{post}}_{-g(j),b(j),t}), \mathbf{p}^{\text{post}}_{-g(j),t}; \theta^d)
\end{aligned}$$

Disagreement payoffs. Let $\tilde{\mathbf{p}}_t^{-g(j),b(j)}$ and $\tilde{s}_{k,t}^{-g(j),b(j)}$ be respectively the out-of-equilibrium retail price vector and the market share of product k in market t given that products belonging to the brand $b(j)$ and purchased by the group of retailers $g(j)$ are no longer offered on the market. Profits of manufacturer f and buyer group $g(j)$ in case of a disagreement are respectively derived as follows

$$d_{f,t}^{-g(j),b(j)} = \sum_{k \in \mathcal{J}_f \cap \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)}} \left(w^{\text{post}}_{g(k),b(k),t} - \mu_{k,t} \right) M_t \tilde{s}_{k,t}^{-g(j),b(j)}(\tilde{\mathbf{p}}_t^{-g(j),b(j)}; \theta^d)$$

[47] I assume that a retailer can only belongs to one buyer group. If no buyer alliance is formed, G is normalized to R, the number of competing retailers.

[48] Note that if $j \in \mathcal{J}_r$ and that retailer r has not formed any buyer alliance with one of its rival, then $g(j) = r(j)$.

$$d_{g(j),t}^{-g(j),b(j)} = \sum_{k \in \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)}} \left(\tilde{p}_{k,t}^{-g(j),b(j)} - w_{g(j),b(k),t}^{\text{post}} - c_{k,t} \right) M_t \tilde{s}_{k,t}^{-g(j),b(j)} (\tilde{\mathbf{p}}_t^{-g(j),b(j)}; \theta^d)$$

with $\tilde{\mathbf{p}}_t^{-g(j),b(j)}[k,1] = \begin{cases} \tilde{p}_{k,t}^{-g(j),b(j)} & \text{if } k \in \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)} \\ p_{k,t}^{\text{post}} & \text{otherwise} \end{cases}$. Note that the market share of each product k which remains on the market is computed as follows

$$\tilde{s}_{k,t}^{-g(j),b(j)} (\tilde{\mathbf{p}}_t^{-g(j),b(j)}; \theta^d) = \begin{cases} \int_0^{+\infty} \frac{\exp(\tilde{V}_{i,k,t}^{-g(j),b(j)})}{\sum_{l \in \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)}} \exp(\tilde{V}_{i,l,t}^{-g(j),b(j)}) + \sum_{m \in \mathcal{J} \setminus \mathcal{J}_{g(j)}} \exp(V_{i,m,t})} f(\alpha_i) \, \mathrm{d}\alpha_i & \text{if } k \in \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)} \\ \int_0^{+\infty} \frac{\exp(V_{i,k,t})}{\sum_{l \in \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)}} \exp(\tilde{V}_{i,l,t}^{-g(j),b(j)}) + \sum_{m \in \mathcal{J} \setminus \mathcal{J}_{g(j)}} \exp(V_{i,m,t})} f(\alpha_i) \, \mathrm{d}\alpha_i & \text{otherwise} \end{cases}$$

where $\tilde{V}_{i,k,t}^{-g(j),b(j)} = \delta_{b(k)} + \delta_{r(k)} + \delta_{pl(k)} - \alpha_i \tilde{p}_{k,t}^{-g(j),b(j)} + \delta_{\text{mineral(k)}} + \delta_{\text{sparkling(k)}} + \rho \hat{u}_{k,t}$.

Nash bargaining problem. Taking the wholesale price vector $\mathbf{w}_{-g(j),b(j),t}^{\text{post}}$ as given, the maximization of the (asymmetric) Nash product of the bilateral negotiation between manufacturer f and the buyer group $g(j)$ over the wholesale price $w_{g(j),b(j),t}$ is written as

$$\max_{w_{g(j),b(j),t}} \text{NP}_{g(j),b(j),t}$$

where $\text{NP}_{g(j),b(j),t} \equiv \left(\pi_{f,t} - d_{f,t}^{-g(j),b(j)} \right)^{1-\lambda_{f,g(j)}} \left(\pi_{g(j),t} - d_{g(j),t}^{-g(j),b(j)} \right)^{\lambda_{f,g(j)}}$ with $\lambda_{f,g(j)} \in [0,1]$ denoted the bargaining weight of the buyer group $g(j)$ in its negotiations with manufacturer f.

The first-order condition of this Nash bargaining problem, that is $\frac{\partial \text{NP}_{g(j),b(j),t}}{\partial w_{g(j),b(j),t}} = 0$, governs the surplus division of this bilateral negotiation and is derived as follows

$$\begin{aligned}
& \lambda_{f,g(j)} \left(\pi_{f,t} - d_{f,t}^{-g(j),b(j)} \right) \left(\frac{\partial \pi_{g(j),t}}{\partial w_{g(j),b(j),t}} \right) + \left(1 - \lambda_{f,g(j)} \right) \left(\pi_{g(j),t} - d_{g(j),t}^{-g(j),b(j)} \right) \left(\frac{\partial \pi_{f,t}}{\partial w_{g(j),b(j),t}} \right) = 0 \\
\Leftrightarrow \quad & \left(\sum_{i \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} \Gamma_{g(j),b(j),t}^{\text{post}} s_{i,t}(\mathbf{p}_t^{\text{post}}; \theta^d) + \sum_{k \in \mathcal{J}_f \setminus \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} \Gamma_{g(k),b(k),t}^{\text{post}} \left(s_{k,t}(\mathbf{p}_t^{\text{post}}; \theta^d) - \tilde{s}_{k,t}^{-g(j),b(j)} (\tilde{\mathbf{p}}_t^{-g(j),b(j)}; \theta^d) \right) \right) \\
& \left(\sum_{i \in \mathcal{J}_{g(j)}} \frac{\partial p_{i,t}}{\partial w_{g(j),b(j),t}} s_{i,t}(\mathbf{p}_t^{\text{post}}; \theta^d) - \sum_{k \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} s_{k,t}(\mathbf{p}_t^{\text{post}}; \theta^d) + \sum_{k \in \mathcal{J}_{g(j)}} \gamma_{k,t}^{\text{post}} \sum_{l \in \mathcal{J}_{g(j)}} \frac{\partial s_{k,t}}{\partial p_{l,t}} \frac{\partial p_{l,t}}{\partial w_{g(j),b(j),t}} \right) + \frac{1 - \lambda_{f,g(j)}}{\lambda_{f,g(j)}} \\
& \left(\sum_{i \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} \gamma_{i,t}^{\text{post}} s_{i,t}(\mathbf{p}_t^{\text{post}}; \theta^d) + \sum_{k \in \mathcal{J}_{g(j)} \setminus \mathcal{J}_{b(j)}} \gamma_{k,t}^{\text{post}} s_{k,t}(\mathbf{p}_t^{\text{post}}; \theta^d) - \tilde{\gamma}_{k,t}^{-g(j),b(j)} \tilde{s}_{k,t}^{-g(j),b(j)} (\tilde{\mathbf{p}}_t^{-g(j),b(j)}; \theta^d) \right) \\
& \left(\sum_{i \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}} s_{i,t}(\mathbf{p}_t^{\text{post}}; \theta^d) + \sum_{k \in \mathcal{J}_f} \Gamma_{g(k),b(k),t}^{\text{post}} \sum_{l \in \mathcal{J}_{g(j)}} \frac{\partial s_{k,t}}{\partial p_{l,t}} \frac{\partial p_{l,t}}{\partial w_{g(j),b(j),t}} \right) = 0 \qquad (24)
\end{aligned}$$

I denote by $\mathbf{I}_g$ the $J \times J$ ownership matrix of the buyer group g, that is $\mathbf{I}_g = \mathbf{I}_r + \mathbf{I}_{r'}$ if retailers r and r' form the buyer group g, and $\mathbf{I}_g = \mathbf{I}_r$ if the retailer r does not participate to any buyer alliance. Moreover, let $\mathbf{I}_b$ be the $J \times J$ ownership matrix of the brand b where $\mathbf{I}_b[j,j] = 1$ if $b(j) = b$ and 0 otherwise (off-diagonal elements being equal to 0). It can be shown that the left-hand side of (24) is the jth element of the following vector of "Nash-in-Nash" first-order conditions

$$\left(\mathbf{I}_f \tilde{\mathbf{S}}_{\Delta t}^{\text{post}} \mathbf{I}_f \mathbf{\Gamma}_{f,t}^{\text{post}} \right) \circ \left(\sum_g \mathbf{I}_f \mathbf{I}_g \left(\mathbf{P}_{\mathbf{w}_t}^{\text{post}} \mathbf{I}_g \mathbf{s}_t^{\text{post}} - \sum_b \mathbf{I}_b \boldsymbol{\iota} (\mathbf{s}_t^{\text{post}})^\top \mathbf{I}_f \mathbf{I}_g \mathbf{I}_b \boldsymbol{\iota} + \mathbf{P}_{\mathbf{w}_t}^{\text{post}} \mathbf{I}_g \mathbf{S}_{\mathbf{p}_t} \mathbf{I}_g \boldsymbol{\gamma}_t^{\text{post}} \right) \right)$$

$$+\frac{1-\lambda}{\lambda}\circ\left(\sum_g \mathbf{I}_f\mathbf{I}_g\left(\iota(\mathbf{s}_t^{\text{post}})^\top\mathbf{I}_g\gamma_t^{\text{post}}+\left(\left(\left(\tilde{\mathbf{S}}_{\Delta t}^{\text{post}}-\iota(\mathbf{s}_t^{\text{post}})^\top\right)\mathbf{I}_g\right)\circ(\tilde{\gamma}_t^{\text{post}})^\top\right)\iota\right)\right)\circ\left(\sum_g \mathbf{I}_f\mathbf{I}_g\left(\sum_b \mathbf{I}_b\iota(\mathbf{s}_t^{\text{post}})^\top\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\iota\right.\right.$$
$$\left.\left.+\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_f\Gamma_{f,t}^{\text{post}}\right)\right) \tag{25}$$

where the $J\times J$ matrices $\tilde{\mathbf{S}}_{\Delta t}^{\text{post}}$, $\tilde{\gamma}_t^{\text{post}}$ and $\mathbf{P}_{\mathbf{w}_t}^{\text{post}}$ are built as follows

- $\tilde{\mathbf{S}}_{\Delta t}^{\text{post}}[j,k]=\begin{cases} s_{k,t}(\mathbf{p}_t^{\text{post}};\theta^d) & \text{if } k\in\mathcal{J}_{g(j)}\cap\mathcal{J}_{b(j)} \\ s_{k,t}(\mathbf{p}_t^{\text{post}};\theta^d)-\tilde{s}_{k,t}^{-g(j),b(j)}(\tilde{\mathbf{p}}_t^{-g(j),b(j)};\theta^d) & \text{otherwise}\end{cases}$,
- $\tilde{\gamma}_t^{\text{post}}[k,j]=\begin{cases}\tilde{\gamma}_t^{-g(j),b(j)}[k,1] & \text{if } k\in\mathcal{J}_{g(j)}\backslash\mathcal{J}_{b(j)} \\ \gamma_t^{\text{post}}[k,1] & \text{otherwise}\end{cases}$ with the $J\times 1$ vectors $\gamma_t^{\text{post}}=-\sum_r\left(\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}(\mathbf{p}_t^{\text{post}})\mathbf{I}_r\right)^+\mathbf{I}_r\mathbf{s}_t(\mathbf{p}_t^{\text{post}})$ and $\tilde{\gamma}_t^{-g(j),b(j)}=-\sum_r\left(\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}(\tilde{\mathbf{p}}_t^{-g(j),b(j)})\mathbf{I}_r\right)^+\mathbf{I}_r\mathbf{s}_t(\tilde{\mathbf{p}}_t^{-g(j),b(j)})$,
- $\mathbf{P}_{\mathbf{w}_t}^{\text{post}}=\sum_g\left(\sum_r\sum_b \mathbf{I}_b\Omega\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^\top\mathbf{I}_r\right)\left(\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\mathbf{I}_g(\sum_r\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^\top\mathbf{I}_r)+\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}\right)^+$ where Ω is a $J\times J$ ownership matrix with $\Omega[i,j]=1$ if products i and j are purchased by the same buyer group and 0 otherwise (see Appendix D.2 for further details).

I now define the following vectors and matrices

$$\mathbf{V}_{f,t}^{\text{post}}\equiv\sum_g\mathbf{I}_f\mathbf{I}_g\left(\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{s}_t^{\text{post}}-\sum_b\mathbf{I}_b\iota(\mathbf{s}_t^{\text{post}})^\top\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\iota+\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g\gamma_t^{\text{post}}\right)$$
$$\mathbf{M}_{f,t}^{\text{post}}\equiv\mathbf{I}_f\tilde{\mathbf{S}}_{\Delta t}^{\text{post}}\mathbf{I}_f$$
$$\tilde{\mathbf{V}}_{f,t}^{\text{post}}\equiv\sum_g\mathbf{I}_f\mathbf{I}_g\left(\iota(\mathbf{s}_t^{\text{post}})^\top\mathbf{I}_g\gamma_t^{\text{post}}+\left(\left(\left(\tilde{\mathbf{S}}_{\Delta t}^{\text{post}}-\iota(\mathbf{s}_t^{\text{post}})^\top\right)\mathbf{I}_g\right)\circ(\tilde{\gamma}_t^{\text{post}})^\top\right)\iota\right)$$
$$\tilde{\mathbf{M}}_{f,t}^{\text{post}}\equiv\sum_g\mathbf{I}_f\mathbf{I}_g\left(\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_f\right)$$

and I re-write the system of equations (25) as follows

$$\mathbf{V}_{f,t}^{\text{post}}\circ\left(\mathbf{M}_{f,t}^{\text{post}}\Gamma_{f,t}^{\text{post}}\right)+\frac{1-\lambda}{\lambda}\circ\tilde{\mathbf{V}}_{f,t}^{\text{post}}\circ\left(\sum_g\sum_b\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\iota(\mathbf{s}_t^{\text{post}})^\top\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\iota\right)+\frac{1-\lambda}{\lambda}\circ\tilde{\mathbf{V}}_{f,t}^{\text{post}}\circ\left(\tilde{\mathbf{M}}_{f,t}^{\text{post}}\Gamma_{f,t}^{\text{post}}\right)=\mathbf{0} \tag{26}$$

Based on the work developed in Bonnet, Bouamra-Mechemache and Molina (2017), it can be shown that the $J\times 1$ upstream margins vector is derived as follows

$$\Gamma_t^{\text{post}}=-\sum_{f=1}^F\left(\left(\mathbf{V}_{f,t}^{\text{post}}\iota^\top\right)\circ\mathbf{M}_{f,t}^{\text{post}}+\left(\left(\frac{1-\lambda}{\lambda}\circ\tilde{\mathbf{V}}_{f,t}^{\text{post}}\right)\iota^\top\right)\circ\tilde{\mathbf{M}}_{f,t}^{\text{post}}\right)^+\left(\frac{1-\lambda}{\lambda}\circ\tilde{\mathbf{V}}_{f,t}^{\text{post}}\circ\left(\sum_g\sum_b\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\iota(\mathbf{s}_t^{\text{post}})^\top\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\iota\right)\right)$$

D.2 Ex-Post Retail Pass-through

Let's assume that retailers r and r' have formed a group to purchase their products (also called buying group) denoted g, where $\mathcal{J}_g$ corresponds to the set of products owned by the group g. Furthermore, I denote by $\mathcal{J}_{b(l)}$ the set of products under the same brand than product l.

The first-order condition of retailer r which determines the vector of equilibrium retail prices ($\mathbf{p}_{r,t}^{\text{post}}$) is given by

$$s_{j,t}(\mathbf{p}_{r,t},\mathbf{p}_{-r,t}^{\text{post}};\theta^d)+\sum_{k\in\mathcal{J}_r}\left(p_{k,t}-w_{g,b(k),t}-c_{k,t}\right)\frac{\partial s_{k,t}}{\partial p_{j,t}}(\mathbf{p}_{r,t},\mathbf{p}_{-r,t}^{\text{post}};\theta^d)=0 \tag{27}$$

We can differentiate (27) with respect to the wholesale price of product $l\in\mathcal{J}_r$, that is $w_{g,b(l),t}$.[49]

$$\begin{aligned}
&\frac{\partial}{\partial w_{g(l),b(l),t}}\left(s_{j,t}(\mathbf{p}_{r,t},\mathbf{p}_{-r,t}^{\text{post}};\theta^d)\right)+\sum_{k\in\mathcal{J}_r}\frac{\partial}{\partial w_{g(l),b(l),t}}\left(p_{k,t}-w_{g(k),b(k),t}-c_{k,t}\right)\frac{\partial s_{k,t}}{\partial p_{j,t}}(\mathbf{p}_{r,t},\mathbf{p}_{-r,t}^{\text{post}};\theta^d)\\
&+\sum_{k\in\mathcal{J}_r}\left(p_{k,t}-w_{g(k),b(k),t}-c_{k,t}\right)\frac{\partial}{\partial w_{g(l),b(l),t}}\left(\frac{\partial s_{k,t}}{\partial p_{j,t}}(\mathbf{p}_{r,t},\mathbf{p}_{-r,t}^{\text{post}};\theta^d)\right)=0\\
\Leftrightarrow\quad&\sum_{k\in\mathcal{J}_r}\frac{\partial s_{j,t}}{\partial p_{k,t}}\frac{\partial p_{k,t}}{\partial w_{g(l),b(l),t}}+\sum_{k\in\mathcal{J}_r}\frac{\partial p_{k,t}}{\partial w_{g(l),b(l),t}}\frac{\partial s_{k,t}}{\partial p_{j,t}}-\sum_{i\in\mathcal{J}_r\cap\mathcal{J}_{b(l)}}\frac{\partial s_{i,t}}{\partial p_{j,t}}\\
&+\sum_{k\in\mathcal{J}_r}\sum_{s\in\mathcal{J}_{g(l)}}\left(p_{k,t}-w_{g(k),b(k),t}-c_{k,t}\right)\frac{\partial^2 s_{k,t}}{\partial p_{j,t}\partial p_{s,t}}\frac{\partial p_{s,t}}{\partial w_{g(l),b(l),t}}=0
\end{aligned}\tag{28}$$

Note that this differentiation must be similar $\forall k\in J_{g(l)}\cap J_{b(l)}$.
It can be shown that equation (28) corresponds to the $l\times j$ element of the following $J\times J$ matrix

$$\begin{aligned}
&\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\sum_r\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r-\sum_r\sum_b\mathbf{I}_b\boldsymbol{\Omega}\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r+\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}\\
\Leftrightarrow\quad&\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g(\sum_r\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r)-\sum_r\sum_b\mathbf{I}_b\boldsymbol{\Omega}\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r+\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}
\end{aligned}\tag{29}$$

where $\boldsymbol{\Omega}$ is a $J\times J$ ownership matrix with $\boldsymbol{\Omega}[i,j]=1$ if products i and j are purchased by the same buying group and 0 otherwise, $\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}$ refers to a $J\times J$ matrix with the kth column, $k\in\mathcal{J}_r$, being equals to $\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}[.,k]=\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p_k}}\mathbf{I}_r\gamma_t^{\text{post}}$ and

$$\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p_k}}=\begin{pmatrix}\frac{\partial^2 s_{1t}}{\partial p_{kt}\partial p_{1t}} & \cdots & \frac{\partial^2 s_{Jt}}{\partial p_{kt}\partial p_{1t}}\\ \vdots & \ddots & \vdots\\ \frac{\partial^2 s_{1t}}{\partial p_{kt}\partial p_{Jt}} & \cdots & \frac{\partial^2 s_{Jt}}{\partial p_{kt}\partial p_{Jt}}\end{pmatrix}$$

Then, starting from (29), we can obtain the matrix $\mathbf{P}_{\mathbf{w}_t}^{\text{post}}$ as follows

$$\begin{aligned}
&\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g(\sum_r\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r)-\sum_r\sum_b\mathbf{I}_b\boldsymbol{\Omega}\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r+\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}=\mathbf{0}\\
\Leftrightarrow\quad&\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}\left(\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\mathbf{I}_g(\sum_r\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r)+\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}\right)=\sum_r\sum_b\mathbf{I}_b\boldsymbol{\Omega}\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r\\
\Leftrightarrow\quad&\mathbf{I}_g\mathbf{P}_{\mathbf{w}_t}^{\text{post}}=\sum_r\sum_b\mathbf{I}_b\boldsymbol{\Omega}\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r\left(\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\mathbf{I}_g(\sum_r\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r)+\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}\right)^{+}\\
\text{Hence,}\quad&\mathbf{P}_{\mathbf{w}_t}^{\text{post}}=\sum_g\left(\sum_r\sum_b\mathbf{I}_b\boldsymbol{\Omega}\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r\right)\left(\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\mathbf{I}_g(\sum_r\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r)+\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}\right)^{+}
\end{aligned}$$

Note that if we assume that private labels are vertically integrated, we can derive the matrix $\mathbf{P}_{\mathbf{w}_t}$ as follows

$$\mathbf{P}_{\mathbf{w}_t}^{\text{post}}=\sum_g\left(\sum_r\sum_b\mathbf{I}_b\boldsymbol{\Omega}^*\mathbf{I}_r\mathbf{I}_b\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r\right)\left(\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}\mathbf{I}_g+\mathbf{I}_g(\sum_r\mathbf{I}_r\mathbf{S}_{\mathbf{p}_t}^{\top}\mathbf{I}_r)+\mathbf{I}_g\mathbf{S}_{\mathbf{p}_t}^{\mathbf{p}}\right)^{+}$$

[49] Note that a change in $w_{g(l),b(l),t}$ implies a similar change in $w_{g(i),b(i),t}$ $\forall i\in\mathcal{J}_{g(l)}\cap\mathcal{J}_{b(l)}$.

where $\mathbf{I}_g^*$ is the ownership matrix of buying group g's national brands, i.e.

$$\mathbf{I}_g^*[j,j] = \begin{cases} 1 & \text{if product } j \in \mathcal{J}_g \text{ is a national brand} \\ 0 & \text{otherwise} \end{cases}$$

D.3 Counterfactual Algorithm

This subsection describes the algorithm that simulates buyer alliances of retailers 1 and 2, retailers 3 and 4, and retailers 5 and 6. Following the operations, a new bargaining equilibrium emerges.

Iterative estimation algorithm. The iterative algorithm employed to perform the counterfactual experiment can be described as follows. For each market t in the sample, I compute a new vector of retail prices under the assumption that total marginal costs of products remain similar to the baseline model.

For expositional convenience, I drop the label "post".

1. *Initialization*: The parameters to be estimated are the vector of counterfactual price equilibrium ($\mathbf{p}_t$), and the vector of counterfactual out-of-equilibirum prices with respect to the brand of each product j purchased by each buyer group g ($\tilde{\mathbf{p}}_t^{-g(j),b(j)}$). I use the vector of equilibrium prices of the baseline model as an initial guess for the vector of counterfactual price equilibrium — i.e., $\mathbf{p}_t^{(0)} = \mathbf{p}_t^*$ — and for the vector of counterfactual out-of-equilibrium prices with respect to each product j — i.e., $\tilde{\mathbf{p}}_t^{-g(j),b(j),(0)} = \mathbf{p}_t^* \; \forall j \in \mathcal{J}\backslash\{0\}$.

2. At the ith iteration, we make a guess of the matrix of out-of-equilibrium prices — and, in turn, the matrix of out-of-equilibrium retail margins — by solving $B \times G$ systems of nonlinear equations, where B is the total number of brands and G is the total number of retailers (or group of retailers) which negotiate with upstream firms in the counterfactual setting. For instance, the vector of out-of-equilibrium retail prices when the group of retailers $g(j)$ fails in its negotiation over the wholesale price of brand $b(j)$ (i.e., $\tilde{\mathbf{p}}_t^{-g(j),b(j),(i)}$) solves the following system[50]

$$\underbrace{\tilde{\mathbf{p}}_t^{-g(j),b(j),(i)} - \tilde{\boldsymbol{\gamma}}_t^{-g(j),b(j),(i)}}_{\mathbf{w}_t^{(i)}-\mathbf{c}_t} - (\underbrace{\mathbf{p}_t^{(i-1)} - \boldsymbol{\gamma}_t^{(i-1)}}_{\mathbf{w}_t^{(i-1)}-\mathbf{c}_t}) = \mathbf{0}$$

where $\boldsymbol{\gamma}_t^{(i-1)} = -\sum_{r=1}^{R}\left(\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t}(\mathbf{p}_t^{(i-1)})\mathbf{I}_r\right)^+ \mathbf{I}_r \mathbf{s}_t(\mathbf{p}_t^{(i-1)})$, $\tilde{\boldsymbol{\gamma}}_t^{-g(j),b(j),(i)}[k,1] = \begin{cases} \tilde{\boldsymbol{\gamma}}_t^{-g(j),b(j),(i)}[k,1] & \text{if } k \in \mathcal{J}_{g(j)}\backslash\mathcal{J}_{b(j)} \\ \boldsymbol{\gamma}_t^{(i-1)}[k,1] & \text{otherwise} \end{cases}$

with $\tilde{\boldsymbol{\gamma}}_t^{-g(j),b(j),(i)} = -\sum_r \left(\mathbf{I}_r \mathbf{S}_{\mathbf{p}_t}(\tilde{\mathbf{p}}_t^{-g(j),b(j),(i)})\mathbf{I}_r\right)^+ \mathbf{I}_r \mathbf{s}_t(\tilde{\mathbf{p}}_t^{-g(j),b(j),(i)})$,

and $\tilde{\mathbf{p}}_t^{-g(j),b(j),(i)}[k,1] = \begin{cases} \tilde{p}_{k,t}^{-g(j),b(j),(i)} & \text{if } k \in \mathcal{J}_{g(j)}\backslash\mathcal{J}_{b(j)} \\ p_{k,t}^{(i-1)} & \text{otherwise} \end{cases}$.

Note that before each iteration $\tilde{\mathbf{p}}_t^{-g(j),b(j),(i)}$ is updated using $\tilde{\mathbf{p}}_t^{-g(j),b(j),(i-1)}$ as starting point $\forall j \in \mathcal{J}\backslash\{0\}$.

3. Given the guess of each out-of-equilibrium retail prices (and retail margins) from step 2 and $\mathbf{p}_t^{(i-1)}$, I construct the matrices $\mathbf{P}_{\mathbf{w}_t}^{(i)}$ and $\tilde{\mathbf{S}}_{\Delta t}^{(i)}$ (see Appendix D.1 and D.2 for computational details).

[50] Note that $\tilde{\mathbf{p}}_t^{-g(j),b(j)} = \tilde{\mathbf{p}}_t^{-g(k),b(k)} \; \forall k \in \mathcal{J}_{g(j)} \cap \mathcal{J}_{b(j)}$.

4. The vector of counterfactual equilibrium retail prices $\mathbf{p}_t^{(i)}$ is the solution to the following system of nonlinear equations

$$\underbrace{\mathbf{p}_t^{(i)} - (\gamma_t^{(i)} + \mathbf{\Gamma}_t^{(i)})}_{\mathbf{c}_t+\boldsymbol{\mu}_t} - \underbrace{\mathbf{p}_t^{*} - (\gamma_t^{*} - \mathbf{\Gamma}_t^{*})}_{\mathbf{c}_t+\boldsymbol{\mu}_t} = \mathbf{0}$$

where $\mathbf{\Gamma}_t^{(i)} \equiv -\sum_{f=1}^{F}\left(\left(\mathbf{V}_{f,t}^{(i)}\,\boldsymbol{\iota}^\top\right)\circ\mathbf{M}_{f,t}^{(i)} + \left(\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}\circ\tilde{\mathbf{V}}_{f,t}^{(i)}\right)\,\boldsymbol{\iota}^\top\right)\circ\tilde{\mathbf{M}}_{f,t}^{(i)}\right)^{+}\left(\frac{\mathbf{1}-\boldsymbol{\lambda}}{\boldsymbol{\lambda}}\circ\tilde{\mathbf{V}}_{f,t}^{(i)}\circ\left(\sum_{g}\sum_{b}\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\boldsymbol{\iota}(\mathbf{s}_t^{(i)})^\top\mathbf{I}_f\mathbf{I}_g\mathbf{I}_b\boldsymbol{\iota}\right)\right)$.[51]

Note that before each iteration, $\mathbf{p}_t^{(i)}$ is updated using $\mathbf{p}_t^{(i-1)}$ as starting point.

I iteratively apply steps 2 to 4 until convergence, i.e. $\|\mathbf{p}_t^{(i)} - \mathbf{p}_t^{(i-1)}\| < \epsilon$.[52]

[51] See Appendix D.1 for more details about $\mathbf{\Gamma}_t^{\text{post}}$.

[52] Simulations are performed with $\epsilon = 10^{-06}$.

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Chapter 3

Full-line Forcing Practices in Vertically Related Markets*

1 Introduction

Selling products in packages to retailers is a convenient device for multi-product manufacturers who seek to impose their brand portfolio on the market. Such a practice, often referred to as full-line forcing or bundling strategy, appears to be widely used in vertical chains of various industries as reported by many competition cases both in Europe and in the United States. In 2005, a commitment decision adopted by the European Commission against commercial practices of The Coca-Cola Company (TCCC) provided evidence that: "[...] TCCC and its bottlers refused to supply a customer with only one of their brands unless the customer was willing to carry other carbonated soft drinks (CSDs) [...]".[1] Similarly, in the U.S. case law *Cablevision v. Viacom* (2013), Cablevision complained against Viacom's commercial practices which consisted in forcing it to buy less popular channels in order to offer Viacom's popular channels to consumers.[2] Empirical studies have also revealed the use of such vertical practices. For instance, in the U.S. video rental industry, Ho, Ho and Mortimer (2012*a*,*b*) have analyzed the effects of contractual agreements requiring a rental store to buy all the release of a video distributor during the contract duration in exchange for a low per tape price.

From a competition policy perspective, the main concern about bundling strategies is the risk of rivals' foreclosure. As pointed out by the European Commission (§34) in the TCCC case presented above: "making the supply of the strongest TCCC brands conditional upon the purchase of less-selling CSDs and non-CSDs leads to foreclosure of rival suppliers [...] This reduces the variety for final consumers and avoid downward pressure on prices". The risk of foreclosure is indeed particularly worrisome when retailers are severely constrained in capacity.[3] Potential anticompetitive

*This chapter is co-authored with Claire Chambolle.

[1]See. Case COMP/A.39.116/B2 – Coca-Cola.

[2]See U.S. District Court 2013.

[3]Further at §35: "[...] this has the effect of making sales space in outlets harder to obtain for rival

bundling practices were also largely debated in several merger cases in Europe (e.g., Guiness/Grand Metropolitan, 1997; Procter and Gamble/Gillette, 2004; Pernod Ricard/Allied Domecq, 2004).[4]

This paper aims to analyze the role of bundling as a competitive tool to foreclose a rival in vertically related markets. We examine a setting with two competing manufacturers who supply their products through a monopolist retailer. The multi-product manufacturer owns two vertically differentiated products, that is, a leading brand and a secondary brand. Its goods are produced at a constant marginal cost with a higher cost for the leading brand than for the secondary brand. Its upstream rival, a single-product supplier, also produces the secondary brand but at a lower marginal cost than the multi-product manufacturer. We consider a model of vertical relationships in which wholesale contracts are determined through bilateral secret bargains and where the retailer strategically chooses its product assortment, i.e. which products to distribute on the market. In equilibrium, we find that the multi-product supplier always offers its leading brand on the retailer's shelves. However, we show that although the highest industry profit and consumer surplus is achieved through the sale of the leading brand and the rival's secondary brand, the retailer may choose the alternative inefficient assortment, i.e. selling the two brands of the multi-product supplier, for buyer power motive only. This arises in equilibrium if the quality gap between the leading brand and the secondary brands is high enough and when the retailer's bargaining power is limited. Moreover, we show that a full-line forcing strategy may enable the multi-product manufacturer to impose its secondary brand when instead the retailer would have preferred to sell the brand of its rival. In doing so, the multi-product supplier affects threat points in the bargaining by putting the retailer in the following position: distributing the secondary brand of the single-product manufacturer implies to give up selling the leading brand. We find that, in equilibrium, when the multi-product firm opts for a full-line forcing strategy, it facilitates the emergence of the inefficient outcome. We show that a full-line forcing arises in equilibrium if and only if the relative inefficiency of the multi-product firm on the secondary brand is no too strong and if the quality gap between the leading and the secondary brand is sufficient. We also show that this full-line forcing strategy is favored by the bargaining power of the single-product manufacturer.

Two main motives are generally advanced in the literature to explain bundling

suppliers and of raising sale space prices for those suppliers."

[4]Guiness/Grand Metropolitan (Case No IV/M.938); Procter and Gamble/Gillette (Case No COMP/M.3732); Pernod Ricard/Allied Domecq (Case No COMP/M.3779).

strategies: discrimination and exclusion.[5] A primary strand of literature analyses bundling strategies by firms who directly sell their products to final consumers. The seminal paper by Adams and Yellen (1976) has first shown how a monopolist could have an incentive to bundle its products to better discriminate among consumers by somehow reducing heterogeneity in their preferences for goods. Extending the analysis to competition, bundling for a discrimination motive can either relax competition (Chen, 1997) or intensify competition when products are complementary (Matutes and Regibeau, 1992). Whinston (1990) provided basis to the leverage theory in showing how a multi-product firm with a monopoly position on one of its goods can deter entry of a single-product rival on the other good by committing itself to offering a bundle. Nalebuff (2004) then showed that the bundling strategy could be used both to price discriminate and exclude a potential rival.[6]

Our paper is more closely related to a second strand of literature, far less developped, that analyses bundling strategies among producers who offer (imperfectly) substitute products on the market through a retail sector.[7]

Besides the usual motives of discrimination and exclusion, Shaffer (1991) shows in a bilateral monopoly framework that a multi-product manufacturer who sets a two-part tariff per brand fails to maximize industry profit whereas full-line forcing enables to restore efficiency.[8] O'Brien and Shaffer (2005) extend this result in a bargaining framework with an oligopoly of imperfectly competing suppliers.[9]

Regarding the discrimination and exclusionary motives, results highlighted in settings where producers directly sell to final consumers (e.g., Whinston, 1990; Nalebuff, 2004) are not straightforwardly transposable to vertically related markets. To our knowledge, only few papers have focused on the foreclosure effects of bundling practices within a vertical channel. Ide and Montero (2016) analyse a model in which a multi-product manufacturer compete with a single-product firm to sell its goods through a retail sector. They show that when the retail sector is monopolized, hetero-

[5]Other motives such as cost savings have also been put forward (e.g., Salinger, 1995).

[6]Several papers have extended these results to various settings: complementary products (Choi and Stefanadis, 2001), dynamic game (Carlton and Waldman, 2002), bundling by separated firms in an oligopolistic framework (Gans and King, 2006).

[7] Note that there also exist a few papers that have analysed vertical relationships between manufacturers and retailers in which retailers sells their products in bundle to final consumers (See Cao et al , 2015 or Bhargava, 2015).

[8]In a similar framework, Vergé (2001) further shows that full-line forcing not only restores optimal industry profit but also benefits consumers.

[9]They find that if two single product manufacturers merge, preventing the new entity from bundling its products leads to inefficient contracts and reduces consumer welfare whenever its bargaining power is large enough.

geneity in consumers' preferences is fully internalized and bundling strategies cannot be used for exclusionary motives. In the case of a competitive retail sector, however, such an heterogeneity is restored and bundling emerges as a market foreclosure strategy. In a slightly different spirit, Vergé (2002) extends the results of Carlton and Waldman (2002) to a setting of vertical relationships with (imperfectly) substitutable products and highlights the use of full-line forcing as a tool to deter entry.[10]

The main contribution of our article is to show that bundling is a suitable device to exclude a more efficient rival in a vertical channel setting, even when the retail sector is monopolized. This result contrasts with Ide and Montero (2016) but also more generally departs from the classic leverage theory which findings are based on heterogeneity in consumers' valuations. We also contribute to the quite abundant literature on exclusive dealing that followed the seminal paper by Aghion and Bolton (1987), because a bundling contract (combined to a retailer's capacity constraint) is equivalent to an exclusivity clause. Our paper however differs from this literature on several dimensions: the firm that adopts a full-line forcing strategy competes with an existing rival rather than a potential entrant, it cannot offer penalty clauses or up-front observable pay to stay fees which are classic features of exclusive dealing contracts. Here a full line forcing contract is such that the access to the leading brand of the multi-product firm becomes conditional to the sale of its secondary brand which may push the retailer to exclude the rival's product.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 analyses the subgame corresponding to a pure component strategy by the multi-product firm and Section 4 describes the subgame with a full line forcing strategy. Then, Section 5 highlights conditions in which a full line forcing equilibrium arises. Section 6 develops a simple illustration. Section 7 concludes.

2 The model

We consider a market structure in which two manufacturers $i = A, B$ compete to sell their products to a monopolist downstream firm, D, who resells to consumers. Goods are vertically differentiated and can either be of high or low quality denoted by $v = \{h, l\}$. The two manufacturers are differentiated as follows: A is a multi-product supplier who offers two goods A_h and A_l, while B is a single-product supplier who produces good B_l. D is assumed to face a capacity constraint and only distributes two

[10]Vergé (2002) shows in a two-period game that bundling a low-demand good from a competitive fringe with a high-demand good of a monopolist incumbent in the first period is an efficient entry-deterrence device and helps to preserve incumbent's monopoly position over the high-demand good.

products (among the three existing products) on the market.[11]

Industry profits. The primitives profit functions which represent the industry profit generated by each assortment of products are denoted as follows: Π_{A_h} when only A_h and Π_{i_l} when only i_l is offered on the market; $\Pi_{A_h i_l}$ when A_h and i_l are offered on the market; $\Pi_{A_l B_l}$ when A_l and B_l are sold on D's shelves. We make the following assumptions:

$$\Pi_{A_h i_l} > \Pi_{A_v} > 0 \quad \text{and} \quad \Pi_{A_h i_l} > \Pi_{B_v} > 0 \tag{1}$$

which implies that selling two products of different quality is always more profitable for the industry than selling only one product.

$$\Pi_{A_l B_l} = \Pi_{B_l} \tag{2}$$

which indicates that A_l generates no profit when competing against B_l,[12]

$$\Pi_{A_h B_l} > \Pi_{A_h A_l} \tag{3}$$

which means that the highest industry profit and consumers surplus is achieved when A_h and B_l are sold to final consumers. We describe in section 6 an illustration with an usual demand for vertically differentiated products under which the above assumptions hold.

Timing of the game. In what follows, we assume that A can use two selling strategies: a pure component strategy or a full-line forcing strategy. If A adopts a pure component strategy, it offers separately A_h and A_l to the retailer. If instead A chooses a full-line forcing strategy, it offers its products only in a single package. We present below a short form game with complete information about cost and quality of products.

- Stage 1: A chooses its selling strategy, that is whether or not to bundle its products.

- Stage 2: D bargains secretly with each manufacturer over a fixed fee F_{i_v}. We assume that D chooses its assortment strategy, i.e. the products to be sold in its shelves.

[11] Retailers face capacity constraint in practice: among all existing products, only a subset of products are usually present on the retailers' shelves and sold to consumers.

[12] This condition reflects a situation in which B_l is commonly preferred to A_l such that if both products coexist on D's shelves A_l has no demand. Relaxing this assumption would simply facilitate the practice of full-line forcing in our model.

Bargaining procedure. To determine the bargaining outcome of this game-theoretic framework, we employ the recursive bargaining protocol à la Stole and Zwiebel (1996). As in equilibrium the retailer can sell at most two products in its shelves, this bargaining procedure enables the remaining products that are unsold in equilibrium to plainly affect the equilibrium profit sharing.[13]

Contracts are secret. This bargaining model, whose solution refines the Perfect Bayesian equilibrium, refers to a "delegated agent" model in which firms send representatives to negotiate wholesale tariffs on their behalf and in which agents cannot communicate with one another (even those coming from the same firm) during the bargaining procedure.[14] Since negotiations are secret, we assume that each pair of delegates has passive beliefs over deals reached elsewhere, i.e. if an unexpected outcome arises from a bilateral agreement, delegates involved in the transaction do not revise their beliefs about all other secret deals (McAfee and Schwartz, 1994).[15] Each bilateral negotiation is modelled according to the Nash axiomatic approach (Nash, 1950).

Renegotiation. Failure or success of each bargaining pair is perfectly observable. In case of a disagreement between a manufacturer and the retailer, the bilateral negotiation is broken for ever and the remaining pairs renegotiate from scratch. To solve the bargaining game, we proceed in an iterative way and first consider the simplest network such that all negotiations have broken down except one. Then, we can solve all other negotiations up to the case in which all negotiations are successful.

Contracts are efficient. As mentioned above, this is a short form of a game. In a full version of the game, in the bargaining stage, the retailer would instead bargain over an efficient two-part tariff contract (w_{i_v}, F_{i_v}) with the manufacturers. In such full game, wholesale prices are efficiently set at marginal cost and quantities sold would maximize vertically integrated industry profits (as previously determined) regardless of the manufacturer's selling strategy.[16] Therefore, this full game is strictly equiva-

[13]Ho and Lee (2017) develop a new bargaining procedure called "Nash-in-Nash with threat of replacement" that could also be interesting to explore.

[14]More precisely, firms allocate one delegated agent to each bilateral negotiation.

[15]In other words, delegated agents conjecture equilibrium outcomes for all other deals in all circumstances.

[16]Our assumptions differ from Shaffer (1991) and O'Brien and Shaffer (2005), and wholesale prices are efficiently set at marginal cost when the multi-product firm bargains either for its components or for a bundle. Indeed, Shaffer (1991) and O'Brien and Shaffer (2005) adopt a specific setting in which the equilibrium contract also determines the outside option profits and, in that case, an upward distortion of wholesale prices can profitably raise the share of the (inefficient) industry profit that the manufac-

lent to the short form game just presented. In this short form game, the manufacturer and the retailer simply bargain over the lump-sum tariff to share the optimal industry profit.

Denote $\alpha \in [0,1]$ the bargaining weight of the retailer D in each bilateral negotiation with upstream firms, we proceed backwards and solve in each of the following sections the bargaining game when A respectively adopts a pure component strategy and a full-line forcing strategy. We also consider a more general case in which D's bargaining weight differs with respect to A and B (denoted respectively by α_A and α_B).

3 Pure component

In the pure component situation, A offers its two products separately. As mentioned above, D sells at most two of the three existing products: A_h, and A_l or B_l. Therefore the last negotiation for the low quality in each sequence plays only the role of an outside option. For instance, if the retailer chooses the assortment $\{A_h, B_l\}$, the retailer bargains first for A_h and B_l. It is only in case of a bargaining breakdown over the wholesale tariff of B_l that a negotiation between D and A for A_l arises. Instead, if the retailer chooses the assortment strategy $\{A_h, A_l\}$, D sends first delegates to bargain with A for the two products. Again, it is only in the event of a breakdown that D bargains with B for B_l. Bargaining outcomes differ with the assortment choice of D between $\{A_h, B_l\}$ and $\{A_h, A_l\}$. Indeed, in the first (resp. second) case B_l (resp. A_l) is targeted to be sold in equilibrium whereas, in the second (resp. first), it is only used as an outside option. Note also that, given our assumptions on the industry profits, any other assortment strategies consisting in selling only one product are dominated.

3.1 D chooses the assortment $\{A_h, B_l\}$

When D sends two delegates to bargain with A over the tariff F_{A_h} for A_h and with B over the tariff F_{B_l} for B_l, the order of these negotiations is irrelevant to the equilibrium outcome.[17] If these two negotiations succeed, the bargaining game stops as the retailer can offer at most two products and the bargaining between D and A_l never takes place. However, in case of a breakdown, a renegotiation phase takes place.

turer obtains.

[17]This result derives from Stole and Zwiebel (1996). As shown in Inderst and Wey (2003) sequential negotiations are here equivalent to a simultaneous negotiations over contingent contracts.

Bargaining between A and D for A_h and B and D for B_l. We determine the division of surplus of these bilateral transactions from the split-the-difference rule[18] for transferable utility games (Muthoo, 1999) and derive the equilibrium lump-sum transfers:

$$\begin{aligned}(1-\alpha)\left[\Pi_{A_hB_l} - F_{A_h} - F_{B_l} - \left(\Pi_{B_l} - \bar{F}_{B_l}\right)\right] &= \alpha F_{A_h} \\ (1-\alpha)\left[\Pi_{A_hB_l} - F_{A_h} - F_{B_l} - \left(\Pi_{A_hA_l} - \bar{F}_{A_hA_l}\right)\right] &= \alpha F_{B_l}\end{aligned} \tag{4}$$

in which $\bar{F}_{B_l}$ represents the out-of-equilibrium (renegotiated) fixed fee paid by D for B_l if the bilateral negotiation for A_h breaks, and $\bar{F}_{A_hA_l}$ denotes the out-of-equilibrium tariff determined by A and D for both the high and low quality good if the negotiation between B and D fails. We now recover $\bar{F}_{B_l}$ and $\bar{F}_{A_hA_l}$ by solving the corresponding renegotiation subgames.

- **Renegotiation between B and D over B_l if the negotiation between D and A_h fails.** If a bargaining breakdown between A and D for A_h occurs, our bargaining protocol specifies that the remaining pairs — here B and D — negotiate over their wholesale tariff following the new sequence $\{B_l, A_l\}$. Consequently, the split-the-difference rule of this bilateral negotiation can be derived as follows

  $$(1-\alpha)\left[\Pi_{B_l} - \bar{F}_{B_l} - \left(\Pi_{A_l} - \bar{\bar{F}}_{A_l}\right)\right] = \alpha \bar{F}_{B_l}$$

  in which $\bar{\bar{F}}_{A_l}$ is the lump-sum tariff determined by A and D for A_l if B and D fail to reach an agreement.[19] The out-of-equilibrium tariff for B_l is then inferred from the split-the-difference rule and derived as follows

  $$\bar{F}_{B_l} = (1-\alpha)\left[\Pi_{B_l} - \alpha \Pi_{A_l}\right]$$

Going back to the bilateral negotiation between A and D for A_h, the equilibrium tariff is given by

$$F_{A_h} = (1-\alpha)\left[\Pi_{A_hB_l} - \alpha\Pi_{B_l} - (1-\alpha)\alpha\Pi_{A_l} - F_{B_l}\right] \tag{5}$$

- **Renegotiation between A and D for A_h and A_l if the bargaining between D and B fails.** A bilateral bargaining per product is no longer relevant here. Indeed, there is only one pair of player $A-D$ who bargains, which implies that they

[18] The split-the-difference rule is derived from the maximization of the asymmetric Nash product.

[19] Under this last bargaining game, players have no status quo payoffs. Therefore this out-of-equilibrium fixed fee can be straightforwardly derived as follows: $\bar{\bar{F}}_{A_l} = (1-\alpha)\Pi_{A_l}$.

negotiate *de facto* over the bundle of goods A_h and A_l produced by A.[20] Moreover, there is no alternative player to bargain with in case of a breakdown, hence the division of surplus is fully determined through the Nash bargaining weight parameter as follows

$$(1-\alpha)\left(\Pi_{A_hA_l} - \bar{F}_{A_hA_l}\right) = \alpha \bar{F}_{A_hA_l}$$

in which $\bar{F}_{A_hA_l}$ represents the out-of-equilibrium fixed payment from D to A if no agreement has been reached between B and D. In this case, A obtains the following out-of-equilibrium profit

$$\bar{F}_{A_hA_l} = (1-\alpha)\Pi_{A_hA_l}$$

Equilibrium profits. Solving the system of equations (4), the equilibrium fixed fees are derived as follows

$$F_{A_h} = \left(\frac{1-\alpha}{2-\alpha}\right)\left[\Pi_{A_hB_l} - \Pi_{B_l} + (1-\alpha)\left(\Pi_{A_hA_l} - \Pi_{A_l}\right)\right]$$
$$F_{B_l} = \left(\frac{1-\alpha}{2-\alpha}\right)\left[\Pi_{A_hB_l} - \Pi_{A_hA_l} + (1-\alpha)\Pi_{B_l} + (1-\alpha)^2\Pi_{A_l}\right]$$

from which we can determine the equilibrium profit of firms

$$\pi_A = F_{A_h}; \quad \pi_B = F_{B_l}; \quad \pi_D = \Pi_{A_hB_l} - F_{A_h} - F_{B_l} \tag{6}$$

3.2 D chooses the assortment $\{A_h, A_l\}$.

D first sends a delegated agent to bargain with A for its two goods, and the negotiation between D and B for B_l occurs only in case of a bargaining breakdown. As previously stated, the negotiation for the two goods A_h and A_l involves the same players — i.e. A and D — which implies that they engage *de facto* in a bilateral negotiation over a unique tariff, denoted by $F_{A_hA_l}$, for the bundle of goods A_h and A_l. The equilibrium lump-sum transfer of this bargaining game is given by

$$F_{A_hA_l} = (1-\alpha)\left[\Pi_{A_hA_l} - \alpha\Pi_{B_l}\right]$$

from which we can derive equilibrium profits (see Appendix A for computational details)

$$\pi_D^{'} \;=\; \Pi_{A_hA_l} - F_{A_hA_l} \tag{7}$$

[20]Indeed, only the sum of tariffs paid for each good is relevant (which corresponds to the transfer negotiated for the bundle of goods). In particular, in case of a disagreement for A_h, D could still renegotiate with A for A_l and this would generate profit for both A and D: this profit constitutes an "inside" option. Inside options here, in contrast to outside options, do not affect the equilibrium sharing of profits.

$$\pi_A^{'} \;=\; F_{A_h A_l} \tag{8}$$

By comparing the profit of D in the alternative assortments, we obtain the following Proposition.

Proposition 1 *If A adopts a pure component selling strategy, D sells the assortment $\{A_h, B_l\}$ if and only if:*

$$\Pi_{B_l} < \frac{\Pi_{A_h B_l} - \Pi_{A_h A_l}}{(1-\alpha)^2} + \Pi_{A_l} \equiv \text{UB}$$

In that case, A obtains an equilibrium profit:

$$\pi_A = \left(\frac{1-\alpha}{2-\alpha}\right)\left[\Pi_{A_h B_l} - \Pi_{B_l} + (1-\alpha)\left(\Pi_{A_h A_l} - \Pi_{A_l}\right)\right]$$

Otherwise, when $\Pi_{A_h A_l} > \text{UB}$, D sells the assortment $\{A_h, A_l\}$ and obtains the equilibrium profit:

$$\pi_A^{'} = (1-\alpha)\left[\Pi_{A_h A_l} - \alpha \Pi_{B_l}\right]$$

if $\Pi_{B_l} \in [\text{UB}, \Pi_{A_h A_l}]$.

Proof. Straightforward from the comparison of equations (6) and (7). ■

Since $\Pi_{A_h B_l} > \Pi_{A_h A_l}$, D may opt for the assortment $\{A_h, A_l\}$ because it then obtains a larger share of a smaller industry profit. To understand this result, we now comment the inequality of Proposition 1 (by rearranging UB) which determines the choice between the two assortment strategies: $\Pi_{A_h B_l} - \Pi_{A_h A_l} > (1-\alpha)^2\left[\Pi_{B_l} - \Pi_{A_l}\right]$.

First, in the extreme case in which $\alpha = 1$, the retailer always prefers the assortment $\{A_h, B_l\}$ to $\{A_h, A_l\}$ because $\Pi_{A_h B_l} > \Pi_{A_h A_l}$ (from assumption (3)). More generally, if D has a strong bargaining weight α, it is mostly concerned by the size of the industry profit, i.e. the left hand side of the inequality, because it is able to capture a large share of it anyway. In contrast, when D has a small bargaining weight α, the right hand side of the inequality, which is strictly positive under assumption (3), now plays a key role. Indeed, it determines the relative strength of the outside options of D in the two product assortments: $\{A_h, B_l\}$ and $\{A_h, A_l\}$. The insight goes as follows. Π_{A_l} represents the ultimate outside option of D in the bargaining for $\{A_h, B_l\}$ whereas Π_{B_l} is its ultimate outside option in the bargaining for $\{A_h, A_l\}$. Therefore, the larger the difference $\Pi_{B_l} - \Pi_{A_l}$, the stronger the outside option of D in its bargaining for $\{A_h, A_l\}$ relatively to $\{A_h, B_l\}$, which can incite D not to deal with B in the first place. Note that when α becomes low, the outside options have a larger role to play than the industry profits. In the extreme case in which $\alpha \to 0$,[21] the inequality re-written as $\Pi_{A_hB_l} - \Pi_{B_l} > \Pi_{A_hA_l} - \Pi_{A_l}$ never holds.[22] Indeed, because products A_h and B_l are closer in terms of substitutability than A_h and A_l, the incremental value brought by the additional sale of A_h is lower when B_l is already sold on the market rather than A_l.

In Section 6, we provide an illustrative example with a uniform distribution of consumer's taste and $\alpha = 0.5$. We show that $\{A_h, A_l\}$ is chosen if the quality of the secondary product is low enough compared to that of the leading brand, which naturally tends to decrease the difference $\Pi_{A_hB_l} - \Pi_{A_hA_l}$.

4 Full-line forcing

In the full-line forcing strategy, A offers its two products only in package form. Therefore, D either distributes A_h and A_l or only B_l in its shelves. If D chooses the assortment $\{A_h, A_l\}$, its negotiation with B for B_l only occurs in the event of a bargaining breakdown with A.[23] Conversely, if D chooses to send a delegate to B for B_l, its negotiation with A for the bundle of goods only occurs in the event of a breakdown with B.

4.1 D chooses to sell the bundle $\{A_h, A_l\}$

We denote by $F^b_{A_hA_l}$ the equilibrium wholesale tariff negotiated between A and D for the bundle of goods A_h and A_l. As previously, this tariff is derived according to the split-the-difference rule

$$\begin{aligned} & (1-\alpha)\left[\Pi_{A_hA_l} - F^b_{A_hA_l} - \left(\Pi_{B_l} - \bar{F}^b_{B_l}\right)\right] = \alpha F^b_{A_hA_l} \\ \Leftrightarrow \quad & F^b_{A_hA_l} = (1-\alpha)\left[\Pi_{A_hA_l} - \Pi_{B_l} + \bar{F}^b_{B_l}\right] \end{aligned}$$

[21] D is indifferent between any product assortments when $\alpha = 0$ since it obtains no profit in the two cases.

[22] Note first that when $\Pi_{A_l} \to \Pi_{B_l}$, we also have $\Pi_{A_hA_l} \to \Pi_{A_hB_l}$ and the two sides of the inequality are just equal. If Π_{A_l} decreases, the difference $\Pi_{A_hA_l} - \Pi_{A_l}$ increases because the extra profit generated by the sale of both A_h and A_l compared to A_l alone gets larger. Therefore, the inequality never holds. In the extreme case where $\Pi_{A_l} \to 0$ the inequality is re-written as $\Pi_{A_hB_l} > \Pi_{B_l} + \Pi_{A_h}$ which never holds.

[23] Note that once D and A have reached an agreement over the bundle, D subsequently sells the optimal quantities corresponding to the full-line forcing contract signed. We thus rule out a deviation by D that would consist in, after agreeing upon a full-line forcing contract with A, bargaining with B and then replace product A_l with B_l. Formally, such a deviation could naturally be ruled out by quantity forcing contracts in which the delivery takes place simultaneously with the wholesale tariff. Such a deviation would then implies a prohibitive management cost for the unsold stock of product A_l.

in which $\bar{F}^b_{B_l}$ denotes the fixed fee negotiated between B and D if no agreement for the bundle is reached. Because B and D have no status quo in their bilateral negotiation, the out-of-equilibrium tariff is straightforwardly given by $\bar{F}^b_{B_l} = (1-\alpha)\Pi_{B_l}$. We thus determine the equilibrium tariff for the bundle of goods as follows

$$F^b_{A_hA_l} = (1-\alpha)\left[\Pi_{A_hA_l} - \alpha\Pi_{B_l}\right] \tag{9}$$

Equilibrium profits. From (9), the equilibrium profit of firms can be derived as follows

$$\pi^b_A = F^b_{A_hA_l}; \quad \pi^b_B = 0; \quad \pi^b_D = \Pi_{A_hA_l} - F^b_{A_hA_l} \tag{10}$$

4.2 D chooses to sell $\{B_l\}$

Similarly, we can determine the division of surplus and equilibrium profit of firms when D decides to sell B_l on its shelves (see Appendix B for computational details). The equilibrium tariff under this alternative assortment decision is given by

$$F^b_{B_l} = (1-\alpha)\left[\Pi_{B_l} - \alpha\Pi_{A_hA_l}\right]$$

and the equilibrium profit of D is derived as follows

$$\pi^{b'}_D = \Pi_{B_l} - F^b_{B_l} \tag{11}$$

Note that this equilibrium exists if and only if $\Pi_{B_l} > \alpha\Pi_{A_hA_l}$. Otherwise, no agreement is reached between B and D for B_l and D bargains with A for the bundle of goods without any outside option. In this latter case, D earns $\Pi_{A_hA_l} - \bar{F}^b_{A_hA_l}$ where $\bar{F}^b_{A_hA_l} = (1-\alpha)\Pi_{A_hA_l}$.

By comparing D's equilibrium profit under both product assortments, we obtain the following Proposition.

Proposition 2 *If A adopts a full-line forcing strategy, D always offers the bundle of goods in equilibrium. In that case, A's profit is given by:*

$$\pi^b_A = (1-\alpha)\left[\Pi_{A_hA_l} - \alpha\Pi_{B_l}\right].$$

Proof. Straightforward from the comparison of equations (10) and (11) as well as assumption (1). ■

Here, D always obtains more profit in its bargaining with A for the bundle of goods and the efficiency property always holds.

Note that $\pi_A^b = \pi_A^{'}$. As already explained, even in the pure component strategy, when D chooses the assortment $\{A_h, A_l\}$, it is *de facto* as if it was negotiating with A for the bundle of goods. In the next section we now solve the first stage of the game and determine the optimal strategy for the multi-product firm.

5 Full-line forcing *vs* pure component selling strategy

We now consider the first stage in which A decides whether to adopt a pure component or a full-line forcing strategy in its bargaining with D. Note first that, from Proposition 2, A always obtains a positive profit π_A^b because $\Pi_{A_hA_l} > \Pi_{B_l}$ (assumption (1)). We now determine the strategy that maximizes A's payoffs.

From Proposition 1, we know that if A has chosen the pure component strategy, D will always prefer to offer the assortment $\{A_h, B_l\}$ when

$$\Pi_{B_l} < \frac{\Pi_{A_hB_l} - \Pi_{A_hA_l}}{(1-\alpha)^2} + \Pi_{A_l} \equiv \text{UB}$$

Moreover, A prefers the pure component strategy when $\pi_A^b < \pi_A$, i.e.

$$\Pi_{B_l} < \frac{\Pi_{A_hB_l} - \Pi_{A_hA_l}}{(1-\alpha)^2} - \frac{\Pi_{A_l}}{1-\alpha} \equiv \text{LB}$$

Note that LB < UB which enables us to identify three potential intervals. First, when $\Pi_{B_l} \in [\Pi_{A_l}, \text{LB}]$, A always chooses a pure component selling strategy and obtains its equilibrium profit π_A. When $\Pi_{B_l} \in [Max[\Pi_{A_l}, \text{LB}], Min[\text{UB}, \Pi_{A_hA_l}]]$, A now opts for a full-line forcing strategy and obtains the equilibrium profit π_A^b. Finally, when $\Pi_{A_hA_l} >$ UB and $\Pi_{B_l} \in [\text{UB}, \Pi_{A_hA_l}]$, A obtains the full-line forcing profit whatever its selling strategy because $\pi_A^b = \pi_A^{'}$. Indeed, if A had chosen the pure component strategy, D itself would impose *de facto* the full-line forcing outcome by choosing the assortment $\{A_h, A_l\}$.

This comparison leads to the following proposition.

Proposition 3 *Under the full-line forcing regime, the interval in which the inefficient assortment* $\{A_h, A_l\}$ *arises in equilibrium is widened to any* $\Pi_{B_l} \in [Max[\Pi_{A_l}, \text{LB}], \Pi_{A_hA_l}]]$.

Proof. See equation (6) and Appendix A. Without full-line forcing, the assortment $\{A_h, A_l\}$ arises if and only if $\Pi_{B_l} \in [\text{UB}, \Pi_{A_hA_l}]$ while under the full-line forcing regime the interval widens to $\Pi_{B_l} \in [Max[\Pi_{A_l}, \text{LB}], \Pi_{A_hA_l}]$. ■

Asymmetric bargaining weights between manufacturers. Although we have considered that upstream firms have the same bargaining weight parameter $1-\alpha$ towards the retailer, it is insightful to examine an asymmetric case in which B would be a competitive fringe. In such a setting, D would accept to bargain with A for its bundle of goods if and only if the bundle generates a higher surplus than B_l, i.e. $\Pi_{A_hA_l} > \Pi_{B_l}$. Applying the split-the-difference rule, D would obtain a profit of $\Pi_{B_l} + \alpha(\Pi_{A_hA_l} - \Pi_{B_l})$ and A would get $(1-\alpha)(\Pi_{A_hA_l} - \Pi_{B_l})$. In the pure component case, B_l would always be sold on the market since it is less costly than A_l and D would be able to get it at the marginal cost level.[24] Thus, A and D would only bargain over A_h and, according to the split the difference rule, D would obtain a profit of $\Pi_{B_l} + \alpha(\Pi_{A_hB_l} - \Pi_{B_l})$ and A would get $(1-\alpha)(\Pi_{A_hB_l} - \Pi_{B_l})$. From the comparison of payoffs, it is straightforward to see that A would always obtain a higher profit in the pure component case which eliminates any potential full-line forcing strategy to arise in equilibrium. Generalizing our model to any (α_A, α_B), we derive the following static comparative results.

Proposition 4 *The single-product rival B must have a sufficient bargaining power towards the retailer to enable the multi-product firm to opt for a full-line forcing strategy in equilibrium.*

Proof. When α_A and α_B are respectively the Nash bargaining weights of the retailer vis-à-vis A and vis-à-vis B, we recompute the equilibrium in the pure component and in the full-line forcing regimes. We obtain the new thresholds $\text{LB} \equiv \frac{\alpha_B(\Pi_{A_hB_l} - \Pi_{A_hA_l})}{(1-\alpha_A)(1-\alpha_B)\alpha_B} - \frac{\alpha_A \Pi_{A_l}}{(1-\alpha_A)\alpha_B}$ and $\text{UB} \equiv \frac{\Pi_{A_hB_l} - \Pi_{A_hA_l}}{(1-\alpha_A)(1-\alpha_B)} + \Pi_{A_l}$. It is immediate to see that $\frac{\partial \text{LB}}{\partial \alpha_B} = \frac{(\Pi_{A_hB_l} - \Pi_{A_hA_l})}{(1-\alpha_A)(1-\alpha_B)^2} + \frac{\alpha_A \Pi_{A_l}}{(1-\alpha_A)\alpha_B^2} > 0$ and thus the full-line forcing equilibrium interval shrinks as α_B increases. ■

Interestingly, our results rely on the assumption that B has bargaining power in its negotiation with D, i.e. B must be a powerful rival. As shown above, if B is a competitive fringe that sells at marginal cost, a full-line forcing strategy by the multi-product supplier never appears in equilibrium. In the pure component case and when B has some bargaining power, A, B and D are all capturing a share of the industry profit $\Pi_{A_hB_l}$. In contrast, although the full-line forcing case generates a smaller industry profit $\Pi_{A_hA_l}$, A and D no longer leave any share of the industry profit to B, and this is the very reason why a full-line forcing strategy can arise in equilibrium.

Now, if B is a competitive fringe, it cannot get any share of the industry profit in either cases. Therefore, because A and D are sharing the highest industry profit in the pure component case, a full-line forcing strategy can no longer prevail. This result can

[24]In other words, D has all the bargaining power in its negotiation with B.

be related to the seminal paper by (Aghion and Bolton, 1987) on exclusive dealing. In their setting, the incumbent and the retailer form a coalition in signing an exclusive dealing contract that stipulates a price for an input and a penalty in case the retailer turns to the entrant. Together, the incumbent and the retailer prevent entry although the entrant would be more efficient than the incumbent, and they are both better off than if entry had occured. In our paper, the full-line forcing contract acts in a similar way because it triggers exclusion but also contains a kind of penalty represented by the threat of loosing the sales on product A_h.

6 Illustrative example

Let us now discuss the insights drawn from Propositions 3 and 4 in a simple setting of vertical product differentiation with standard assumptions on consumer behavior and production costs.

We consider that A_h is produced with a quality $v = h$ at constant marginal cost c_{A_h} and A_l with a quality $v = l$ at constant marginal cost c_{A_l}. We also consider that B_l is produced with a quality $v = l$ but at constant marginal cost c_{B_l}. We make the assumption that $0 \leq l < h$ and $0 \leq c_{B_l} < c_{A_l} < c_{A_h}$. As in the original vertical differentiation model of Mussa and Rosen (1978), each consumer purchases at most one unit of good. We specify the following linear consumer utility function: $U(\theta, v, p_v) = \theta v - p_v$, where θ denotes the marginal willingness-to-pay for quality which is assumed to be uniformly distributed over $[0,1]$, and p_v is the price of the purchased product.

Optimal industry profit. In what follows, we determine the optimal industry profit under each product assortment, i.e. the maximum profit for the vertically integrated structure.

- We define by $\Pi_{A_h}(\bar{q}_h)$ the optimal industry profit when only good A_h is sold to consumers, where
$$\bar{q}_h \equiv \underset{q_h}{\operatorname{argmax}} \left(p_h(q_h, 0) - c_{A_h}\right) q_h \tag{12}$$

- Similarly, we define by $\Pi_{i_l}(\bar{q}_l)$ the optimal industry profit when only the low quality good produced by manufacturer i is sold to consumers, where
$$\bar{q}_l \equiv \underset{q_l}{\operatorname{argmax}} \left(p_l(q_l, 0) - c_{i_l}\right) q_l \tag{13}$$

- When instead the two qualities are offered on the market, we define by $\Pi_{A_h,i_l}(q_h^*, q_l^*)$ the optimal industry profit (manufacturer i being the owner of the low quality

Table 1: Product assortment, industry profit, and consumer surplus

Assortment	Industry profit	Consumer surplus
$\{A_h\}$	$\frac{(h-c_{A_h})^2}{4h}$	$\frac{(h-c_{A_h})^2}{8h}$
$\{i_l\}$	$\frac{(l-c_{i_l})^2}{4l}$	$\frac{(l-c_{i_l})^2}{8l}$
$\{A_h, i_l\}$	$\frac{l\left(l(h-2c_{A_h})+(h-c_{A_h})^2\right)+c_{i_l}(hc_{i_l}-2lc_{A_h})}{4l(h-l)}$	$\frac{(c_{A_h}-c_{i_l}-h+l)(c_{A_h}(h-2l)+h(c_{i_l}-h+l))}{8(h-l)^2}+\frac{(hc_{i_l}-lc_{A_h})^2}{8l(h-l)^2}$

product), where

$$\{q_h^*, q_l^*\} \equiv \underset{q_h, q_l}{\operatorname{argmax}} \left(p_h(q_h, q_l) - c_{A_h}\right) q_h + \left(p_l(q_l, q_h) - c_{i_l}\right) q_l \tag{14}$$

Table 1 provides expressions for industry profits and consumer surplus in all product assortments.

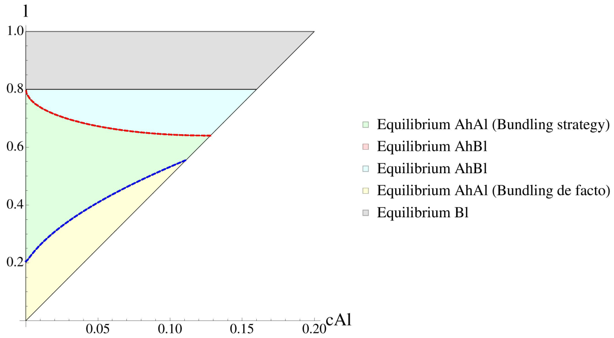
In Figure 1, we have represented the equilibria of the game under two situations: (a) when the marginal cost of A_h is low, and (b) when the marginal cost of A_h is high. The x-axis represents the marginal cost of the low quality good c_{A_l}, which varies from 0 to c_{A_h}. The y-axis denotes the quality l, which varies from 0 to $h = 1$. Both situations are solved with $\alpha = 0.5$.

To analyze full-line forcing practices, we restrict our attention to the set of parameters with a strictly positive demand for all products. First of all, the top grey areas depicted in both graphs will not be examined since they represent the case in which there is no demand for A_h when B_l is also offered on the market. Indeed, in this parameter space, the quality l is very close to h whereas the production cost c_{B_l} is by far lower than c_{A_h} which implies that there is no demand for A_h. Similarly, we will not consider the bottom-right corner area since it depicts a situation in which there would be no demand for A_l. In the other remaining areas, the inefficient assortment $\{A_h, A_l\}$ arises in equilibrium in the green and yellow regions, whereas the product assortment $\{A_h, B_l\}$ emerges in the blue and red regions. We first briefly describe each of the graphs and afterwards provide deeper insights on the economic analysis.

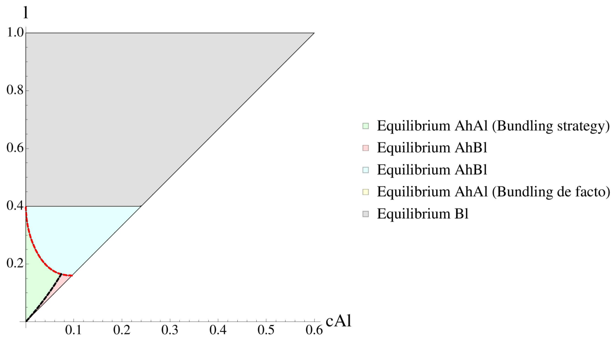
(a) When c_{A_h} is low (i.e., $c_{A_h} = 0.2$): the frontier that separates the emergence of a full-line forcing strategy in equilibrium from a pure component strategy is represented by the red dashed curve along which the equality $\Pi_{A_hA_l} = \Pi_{B_l}$ holds.[25] Below this curve, the full-line forcing strategy generates a strictly positive profit for A and it always prevails. Within this full-line forcing region, we distinguish

[25] In the previous sections we have analyzed full-line forcing with the assumption that $\Pi_{A_hA_l} > \Pi_{B_l}$. Here we can see that if this condition is not fulfilled a full-line forcing never emerges.

Figure 1: Graphic representation of the equilibria for $\alpha = 0.5$, $h = 1$, $c_{B_l} = 0$



(a) $c_{A_h} = 0.2$



(b) $c_{A_h} = 0.6$

the green area in which only A benefits from its selling strategy and the yellow area in which both A and D are better off in excluding B through the full-line forcing. Note that the frontier between these two areas (i.e. the blue dashed curve) corresponds to our threshold $\Pi_{B_l} = \text{UB}$.

(b) When c_{A_h} is high (i.e., $c_{A_h} = 0.6$): the grey area in which the high quality product is not sold increases. As previously, below the upper limit $\Pi_{A_h A_l} = \Pi_{B_l}$ (red dashed curve), the full-line forcing strategy always generates a strictly positive profit for A. However, it arises in equilibrium only in the green area since the red area corresponds to a parameter space for which A opts for a pure component strategy. Note that the frontier between these two areas (i.e. the black dashed curve) corresponds to our threshold $\Pi_{B_l} = \text{LB}$.

We now comment these different equilibria with respect to two parameters of interest, i.e. the quality and the cost parameters. In terms of quality, we can see that the ability to apply a full-line forcing strategy closely depends on the gap between goods. It is indeed easier for A to impose its product A_l on the retailer's shelves when A_h is a strong leading brand, which is the case if the difference between h and l is high

enough. In this situation, A uses its leading brand to impose its less-valued good. In terms of costs, a full-line forcing strategy arises in equilibrium when A is not too inefficient compared to B in the production cost of the low quality good. This appears clearly on each graph: because the red dashed curve is decreasing, the area in which a full-line forcing emerges in equilibrium (i.e. below the red dashed curve) shrinks as c_{A_l} increases. Again the insight is straightforward, if A is too inefficient in the production cost of A_l it would be more difficult to compete with B and impose its less-valued item to the retailer.
These comments lead us to the following corollary:

Corollary 1 *A full-line forcing emerges in equilibrium if the leading brand's quality is sufficiently high compared to the other products' quality. Moreoever, it also arises if the secondary brand of the multi-product firm is not too weak compared to that of its rival.*

An additional insight comes up with the comparison of the two graphs. When switching from (a) to (b), although the region in which the pure component and the full-line forcing strategies appear in equilibrium shrinks to the detriment of the grey area, we can see that the full-line forcing area declines relatively more. This reflects the mechanism by which, when c_{A_h} is strong, the leading brand loses its attractiveness and the full-line forcing strategy loses its strenght.

Besides quality and production costs of firms, we have seen in Section 5 that the bargaining weight of firms may also affect the emergence of a full-line forcing strategy in equilibrium. Let us fix the bargaining weight α_A. When c_{A_h} is high (Figure 1.b), an increase in α_B just shifts the black dashed curve to the left, thereby reducing the full-line forcing region (green area) in favor of the parameter space in which the pure component strategy emerges in equilibrium (red area). When c_{A_h} is low (Figure 1.a), we find that for increasing values of α_B the parameter space in which the inefficient assortment $\{A_h, A_l\}$ always emerges in equilibrium (yellow area) skrinks since UB increases. Furthermore, for higher values of α_B, we also obtain that the black dashed curve and, in turn, the red area in Figure 1.b are appearing in Figure 1.a to the detriment of the green area as stated in Proposition 4. We thus have the following ambiguous effect of the bargaining power parameter:

Corollary 2 *When the retailer has few bargaining power, the inefficient assortment $\{A_h, A_l\}$ arises more frequently in equilibrium either because of the selling strategy of A or the assortment strategy of D.*

The impact of bargaining power on the welfare effect of full-line forcing strategies is therefore ambiguous. On the one hand, without full-line forcing, the inefficient assortment arises more often in equilibrium when the bargaining power of D vis-à-vis B is low. On the other hand, in such a case, full-line forcing strategies are easier to implement in equilibrium.

7 Concluding remarks

In this article, we show that a capacity constrained retailer may not offer the best available product assortment to final consumers, which thus harms industry profit and consumer surplus, for various reasons. First, when the retailer's bargaining power is low, it may capture a greater profit in using the best secondary brand as an outside option rather than selling it in equilibrium. This first result is in line with previous findings obtained in the literature (see for instance Marx and Shaffer, 2007; Chambolle and Villas-Boas, 2015). We show that this inefficient product assortment arises in equilibrium when the quality gap between the leading and secondary brands is large enough. Second, we contribute to the literature on bundling and full-line forcing strategies and demonstrate that such practices facilitate the emergence of this inefficient product assortment in equilibrium. The multi-product supplier is able to affect threat points in the bargaining by putting the retailer in the following position: distributing the secondary brand of the single-product firm implies to give up selling the leading brand. This threat of losing the leading brand pushes the retailer to adopt the inefficient assortment. Intuitively, we show that full-line forcing strategies are easier to implement when the leading brand is strong and the inefficiency on the secondary brand is not too severe. More surprisingly, we highlight that full-line forcing strategies are facilitated by the rival's bargaining power. This result contrasts with the standard view that powerful suppliers are difficult to exclude (e.g., Pernod Ricard-Allied Domecq, 2004, p. 19; Procter and Gamble-Gillette, 2004, p. 20).

Appendix

A Pure component selling strategy

In equilibrium, when D opts for the assortment $\{A_h, B_l\}$, D's profit is given by

$$\pi_D = \Pi_{A_hB_l} - \frac{1-\alpha}{2-\alpha}\left[\left(\Pi_{A_hB_l} - \Pi_{B_l}\right) + \left(\Pi_{A_hB_l} - \Pi_{A_hA_l}\right) + (1-\alpha)\left(\Pi_{A_hA_l} + \Pi_{B_l} - \alpha\Pi_{A_l}\right)\right]$$

Now, we derive the profit of D when he chooses the assortment $\{A_h, A_l\}$.

Bargaining between D and A over A_h & A_l. As noticed in Section 3.1, firms fully internalize the externality between bilateral transactions due to the Stole and Zwiebel (1996) bargaining protocol employed in this paper. Hence, the sum of individual tariffs negotiated for each good between two players is equivalent to the lump-sum transfer negotiated for a bundle of these goods. Consequently, under this sequence, the allocation of surplus between A and D is governed by the following split-the-difference rule

$$(1-\alpha)\left[\Pi_{A_hA_l} - F'_{A_hA_l} - \left(\Pi_{B_l} - \bar{F}_{B_l}\right)\right] = \alpha F'_{A_hA_l}$$

where $\bar{F}_{B_l}$ denotes the out-of-equilibrium lump-sum transfer between B and D over the low quality good if the negotiation between A and D breaks down. We need to proceed backwards to determine this out-of-equilibrium payment.

- **Renegotiation between D and B over B_l.** The surplus division mechanism of the bilateral transaction between B and D for the low quality good is

$$(1-\alpha)\left[\Pi_{B_l} - \bar{F}_{B_l}\right] = \alpha\bar{F}_{B_l}$$

From the above allocation of surplus, the out-of-equilibrium lump-sum payment determined between A and D for the low quality good is defined as follows

$$\bar{F}_{B_l} = (1-\alpha)\Pi_{B_l}$$

Turning back to the bilateral transaction between A and D for goods A_h and A_l, the equilibrium lump-sum tariff can be written as follows

$$F'_{A_hA_l} = (1-\alpha)\left[\Pi_{A_hA_l} - \alpha\Pi_{B_l}\right] \tag{15}$$

Equilibrium profits. Equilibrium profits for the assortment $\{A_h, A_l\}$ are given by

$$\pi'_A = (1-\alpha)\left[\Pi_{A_hA_l} - \alpha\Pi_{B_l}\right]$$
$$\pi'_D = \alpha\Pi_{A_hA_l} + (1-\alpha)\alpha\Pi_{B_l}$$

which coincides with the equilibrium under A's full-line forcing strategy.

B Full-line forcing strategy

In equilibrium, when D chooses the assortment $\{A_h, A_l\}$, its profit is given by

$$\pi_D^b = \alpha \Pi_{A_h A_l} + (1-\alpha)\alpha \Pi_{B_l}$$

Now, let's derive its profit for the assortment $\{B_l\}$.

Bargaining between D and B for B_l. The division of surplus between B and D is determined by the split-the-difference rule

$$\begin{aligned} & (1-\alpha)\Big[\Pi_{B_l} - F_{B_l}^{b'} - \Big(\Pi_{A_h A_l} - \bar{F}_{A_h A_l}^{b}\Big)\Big] = \alpha F_{B_l}^{b'} \\ \Leftrightarrow \quad & F_{B_l}^{b'} = (1-\alpha)\Big[\Pi_{B_l} - \Pi_{A_h A_l} + \bar{F}_{A_h A_l}^{b}\Big] \end{aligned}$$

where $\bar{F}_{A_h A_l}^{b}$ represents the out-of-equilibrium tariff negotiated between A and D for the bundle of goods.[26] Consequently, if $\Pi_{B_l} > \alpha \Pi_{A_h A_l}$, the equilibrium lump-sum payment for B_l is given by[27]

$$F_{B_l}^{b'} = (1-\alpha)\Big[\Pi_{B_l} - \alpha \Pi_{A_h A_l}\Big] \tag{16}$$

Equilibrium profits. From equation (16) and if $\Pi_{B_l} > \alpha \Pi_{A_h A_l}$, the equilibrium profit of D from selling the product assortment $\{B_l\}$ is derived as follows

$$\pi_D^{b'} = \alpha \Pi_{B_l} + (1-\alpha)\alpha \Pi_{A_h A_l}$$

[26]Since both players have no status quo payoffs under this bargaining game, this tariff is straightfowardly derived as $\bar{F}_{A_h A_l}^{b} = (1-\alpha)\Pi_{A_h A_l}$.

[27]If $\Pi_{B_l} > \alpha \Pi_{A_h A_l}$ is not satisfied no agreement is formed between B and D and an out-of-equilibrium arises.

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Résumé substantiel en langue française

Dans de nombreuses industries, les producteurs doivent passer par des intermédiaires afin de distribuer leurs produits sur les marchés. Par exemple, dans le secteur de la grande distribution alimentaire, les producteurs vendent leurs produits à des distributeurs qui ont un accès direct aux consommateurs finaux; dans les secteurs de la santé, les fournisseurs de soins médicaux (e.g., les hôpitaux) traitent avec les assureurs afin d'avoir accès à leurs clients souffrant d'une maladie. Toutes ces industries sont souvent caractérisées par une structure oligopolistique bilatérale avec un petit nombre d'entreprises opérant sur les deux côtés du marché, impliquant des relations commerciales complexes entre les acteurs. En effet, les externalités contractuelles sont omniprésentes dans ce type d'environnement puisque la valeur générée par une transaction et partagée entre un fabricant et un détaillant dépend généralement des décisions contractuelles des autres entreprises opérant sur le marché. Un certain nombre de pratiques, communément appelées « restrictions verticales », peuvent également survenir telles que les contrats d'exclusivité, les pratiques de ventes liées, ou bien encore les fixations de prix de revente. En outre, les conditions tarifaires sont principalement déterminées par un processus de négociation entre les entreprises.

L'objet de ma recherche consiste à étudier comment les relations verticales entre producteurs et distributeurs dans un contexte aussi complexe que celui des oligopoles bilatéraux peuvent avoir un impact sur le surplus du consommateur et le bon fonctionnement de l'industrie.

Dans le premier chapitre de ma thèse, j'élabore un modèle d'économétrie structurelle afin d'analyser empiriquement les relations producteur-distributeur dans des oligopoles bilatéraux avec produits différenciés. L'approche contraste avec la plupart des méthodes empiriques antérieures et permet d'identifier la division du surplus entre les entreprises sans la nécessité d'avoir des données sur les contrats de gros et les coûts marginaux des firmes.

Le deuxième chapitre se concentre sur l'étude des effets générés par la formation d'alliances entre distributeurs pour négocier des tarifs communs et acheter des produits auprès de leurs fournisseurs. En utilisant des données d'achats sur les eaux embouteillées réalisés par un panel de consommateurs représentatif de la population Française, j'estime un modèle structurel de demande et d'offre. Je réalise ensuite des simulations pour étudier les effets de trois alliances formées par des distributeurs dans le secteur de la distribution alimentaire en France au cours de l'année 2014. Les résultats montrent que le pouvoir de négociation des distributeurs peut être affaibli, le profit total de l'industrie peut diminuer, et que les consommateurs finaux peuvent faire face à des prix plus élevés.

Le troisième chapitre de cette thèse analyse la pratique du « full-line forcing » comme mécanisme d'éviction sur les marchés verticalement liées. Je considère un modèle dans lequel un producteur multi-produit offre une marque leader et une marque secondaire sur laquelle il est en concurrence avec une entreprise plus efficace. Le modèle permet de mettre en évidence que le « full-line forcing » est une stratégie de négociation efficace car elle permet au producteur multi-produit d'influer sur les points de menace dans les négociations et d'imposer son portefeuille de marques sur les étagères du distributeur, excluant ainsi le producteur concurrent. Cette stratégie émerge à l'équilibre sous trois conditions : (i) la marque leader de l'entreprise multi-produit est suffisamment forte, (ii) son inefficacité sur la marque secondaire n'est pas trop sévère, et (iii) le fournisseur concurrent est assez puissant dans sa négociation avec le distributeur. Les résultats suggèrent que les consommateurs finaux et le bien-être total peuvent être réduit alors que, dans certains cas, le distributeur bénéficie d'une telle stratégie d'éviction.

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Titre : Etudes sur les relations verticales, le pouvoir de négociation et la politique de la concurrence.

Mots clés : Economie industrielle empirique, relations verticales, pouvoir de négociation.

Dans de nombreuses industries, les producteurs doivent passer par des intermédiaires afin de distribuer leurs produits sur les marchés. L'objet de ma recherche consiste à analyser comment les relations verticales entre entreprises dans un contexte aussi complexe que celui des oligopoles bilatéraux peuvent avoir un impact sur le surplus du consommateur et le bon fonctionnement de l'industrie. Dans le premier chapitre de ma thèse, j'élabore un modèle d'économétrie structurelle afin d'analyser empiriquement les relations producteur-distributeur dans des oligopoles bilatéraux avec produits différenciés. L'approche contraste avec la plupart des méthodes empiriques antérieures et permet d'identifier la division du surplus entre les entreprises sans la nécessité d'avoir des données sur les contrats de gros et les coûts marginaux des firmes. Le deuxième chapitre se concentre sur l'étude des effets générés par la formation d'alliances entre distributeurs pour négocier des tarifs communs et acheter des produits auprès de leurs fournisseurs. Après avoir estimé un modèle structurel de demande et d'offre, je réalise des simulations pour étudier les effets de trois alliances formées par des distributeurs dans le secteur de la distribution alimentaire en France. Les résultats montrent que le pouvoir de négociation des distributeurs est affaibli, le profit total de l'industrie diminue, et que les consommateurs finaux font face à des prix plus élevés. Le troisième chapitre de cette thèse analyse la pratique du « full-line forcing » comme mécanisme d'éviction sur les marchés verticalement liées. Le modèle permet de mettre en évidence que le « full-line forcing » est une stratégie de négociation efficace car elle permet à un producteur multi-produit d'influer sur les points de menace dans les négociations et d'imposer son portefeuille de marques sur les étagères du distributeur, excluant ainsi le producteur concurrent.

Title : Essays on vertical relationships, bargaining power, and competition policy

Keywords : Empirical industrial organization, vertical relationships, bargaining power.

Abstract : In many economic environments, producers need to deal with intermediaries to supply their products on markets. My research consists in analyzing how vertical relationships between firms impact consumer surplus and total welfare. In the first chapter of this dissertation I design a structural framework to analyze manufacturer-retailer relationships in bilateral oligopolies with differentiated products. My approach contrasts with most prior empirical models of bargaining and allows to identify the division of surplus between firms without data on wholesale contracts and marginal costs. The second chapter investigates the economic effects of alliances formed by retailers to negotiate common prices and purchase products from manufacturers. I use household-level scanner data on bottled water purchases and estimate a structural model of demand and supply. I perform simulations to study the economic effects of three buyer alliances that have been formed by competing retailers in the French food retail sector. Results show that the bargaining power of retailers is weakened, total industry profit decreases, and final consumers face higher prices. The third chapter examines the case of full-line forcing as a foreclosure device in vertically related markets. I consider a setting in which a multi-product manufacturer offers a leading brand and a secondary brand for which it competes with a more efficient single-product firm. It is shown that full-line forcing is an efficient bargaining strategy as it allows the multi-product manufacturer to affect threat points and impose its brand portfolio on the retailer's shelves therefore excluding the rival supplier.

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