An Empirical Model of Bargaining with Equilibrium of Fear: Application to Retail Mergers in the French Soft Drink Industry

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Abstract

We develop a bilateral oligopoly framework with manufacturer-retailer bargaining to analyze the impact of retail mergers on market outcomes. We show that the surplus division between manufacturers and retailers depends on three bargaining forces and can be interpreted in terms of "equilibrium of fear". We estimate our framework in the French soft drink industry and find that retailers have a higher bargaining power than manufacturers. Using counterfactual simulations, we highlight that retail mergers increase retailers' fear of disagreement which weakens their bargaining power vis-à-vis soft drink manufacturers and leads to higher wholesale and retail prices.

Keywords: Bilateral oligopoly, Bargaining, Retail mergers, Soft drink industry.

JEL classification: C78, D43, L11, L13, L14, L41, L81.

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1 Introduction

The analysis of mergers between retailers or intermediaries in vertically related markets raises thorny questions.[1] In particular, the role of buyer power and its consequences for upstream manufacturers and downstream consumers is a subject of contention in antitrust enforcement. Whereas the 2004 Horizontal Merger Guidelines of the European Commission permit a buyer power defense on the ground that it may counteract the established market power of manufacturers to the benefit of consumers (paragraph 62, Section IV), the U.S. 2010 Guidelines take a more ambiguous position.[2] Furthermore, some antitrust scholars argue that such a (potential) harm to manufacturers should instead raise anti-competitive concerns (Hemphill and Rose, 2018; Baker, 2019). The primary challenge in determining an appropriate merger policy in this context stems from the prevalence of complex multilateral relationships in numerous vertical markets, where terms of trade are often established through bilateral negotiations. Given that the mechanisms underlying buyer power are intricate and lack empirical evidence, the proper treatment of buyer power in retail merger review remains an unsettled question (Carlton and Israel, 2011).

This article provides a comprehensive framework for analyzing competition and market structure changes in bilateral oligopolies with product differentiation. Our framework includes a two-stage game in which multiple manufacturers engage in simultaneous and secret bilateral negotiations with multiple retailers to determine wholesale prices and where the latter subsequently compete in retail prices for consumers. Using the "Nash-in-Nash" bargaining solution (Horn and Wolinsky, 1988) as a surplus sharing rule, we highlight that bargaining outcomes directly relate to the concept of "equilibrium of fear" introduced by Aumann and Kurz (1977) and Svejnar (1986). In particular, our framework embeds three different sources of bargaining power. First, a firm's bargaining power increases when its gains from trade decrease (i.e., its losses from not reaching an agreement are smaller) or when the gains of its trading partner increase. Second, a firm's bargaining power is greater

[1] These types of mergers have been particularly numerous these last decades. For instance, the food retail sector has undergone profound changes with the formation of retail mergers and buyer alliances in many European countries (Colen et al., 2020). Hospital markets in the U.S. have also become increasingly concentrated over the last 25 years (Gaynor, Ho and Town, 2015).

[2] See European Commission (2004) and US Department of Justice and the Federal Trade Commission (2010). As pointed out by Kirkwood (2012), Section 12 of the U.S. Guidelines ("Mergers of Competing Buyers") confines to the notion of "monopsony power" which presumes that upstream manufacturers have no market power. Only Section 8 ("Powerful Buyers") of the Guidelines allude to the concept of countervailing buyer power as a factor that mitigates the price increase of upstream mergers. Moreover, the Federal Trade Commission and the U.S. Department of Justice have adopted conflicting views on the treatment of buyer power in recent merger reviews (Sallet, 2017; Hemphill and Rose, 2018).

the higher its cost of making price concessions (that is, agreeing to concede more favorable trading terms to its partner) relative to that of its trading partner.[3] Third, we allow for asymmetric bargaining weights in each bilateral negotiation to capture the ability of firms to get more favorable trading terms.[4]

We leverage our framework to study manufacturer-retailer relationships in the French soft drink industry. Given its particular features, this industry offers an interesting laboratory for analyzing the potential countervailing buyer power effect of retail mergers. First, the upstream market is one of the most concentrated of the French agri-food sector.[5] Second, manufacturers supply brands that are often deemed as having "must-have" status for retailers due to consumer brand loyalty.[6] Soft drink manufacturers are thus likely to exert market power despite the presence of large downstream retailers.

Using household-level scanner data on soft drink purchases, we develop a structural model of demand and supply to conduct our analysis. The demand-side consists of a random coefficient logit model which allows for unobserved heterogeneity in consumer preferences. The supply-side is directly based on our bilateral oligopoly framework. Absent data on wholesale contracts negotiated between manufacturers and retailers, our empirical strategy relies on demand estimates as well as on the set of first-order conditions characterizing the pricing behavior of retailers on the downstream market to back out retail marginal costs for each soft drink product (e.g., Villas-Boas, 2007). Using these (inferred) marginal costs, we then specify the marginal cost function of retailers in terms of: (i) production and distribution costs for soft drink products and (ii) price-cost margins of manufacturers which are determined through bilateral negotiations with retailers and derived from the "Nash-in-Nash" solution. Based on (plausibly) exogenous variation that shifts the price-cost margins of manufacturers but not marginal costs of products, we form moment conditions to estimate bargaining and cost parameters and recover the surplus division between manufacturers and retailers in the supply chain.

Our results indicate that more than 65 percent of the surplus generated by bilateral contracts is captured by retailers, suggesting that they have greater bargaining power than soft drink manufacturers. This is mainly due to the fact that retailers incur larger costs

[3]In other words, a firm's concession cost reflects how its profit decreases when it agrees to grant a better price to its trading partner.

[4]Following Grennan's (2013) terminology, we refer to this source of bargaining power as the bargaining ability of firms.

[5]See European Commission (2014, page 306).

[6]As pointed out by the European Commission (2007, page 34): "Just a small number of food products have a recognized brand value. Coca-Cola, the number 1 global brand, is a frequently mentioned and well-recognized example. The top 50 global brands include 7 food products, mainly beverages."

from making price concessions during negotiations than manufacturers. Using estimates of our structural model, we simulate (hypothetical) retail mergers that give rise to multi-store retailers. Based on the concept of "equilibrium of fear", we explore the countervailing buyer power hypothesis and find that retail mergers increase the fear of disagreement of the merging retailers relative to that of manufacturers, suggesting that wholesale prices increase post-merger. We show that this stems from the effect of retail mergers on the concession costs of manufacturers and the merging retailers, which weakens buyer power. This result is supported by counterfactual simulations in which we recalculate a new bargaining and downstream price equilibrium following a retail merger. Despite the retailers' loss of bargaining power vis-à-vis manufacturers, our simulations further show that retail mergers remain profitable due to a lessening of downstream competition. As a result, our empirical analysis does not provide any support for the buyer power defense to retail mergers which, instead, raise substantial antitrust concerns due to the increase of market power at both the upstream and the downstream level of the supply chain. We show that this finding is fairly robust to changes in demand and supply factors (e.g., heterogeneity in consumer price sensitivity, firms' relative bargaining ability).

Contribution to the literature. Our article contributes to the extensive literature on buyer power.[7] Since Galbraith (1952, 1954) who introduced the concept of countervailing buyer power, a large number of articles have analyzed circumstances under which mergers between competing retailers mitigate upstream market power and may generate pro-consumer effects.[8] Although theoretical work highlights that the emergence of countervailing buyer power is ambiguous and depends on particular market conditions, empirical works on this topic remain fairly limited.[9] Our approach relates to structural empirical models that use the "Nash-in-Nash" bargaining to study downstream market concentration.[10] In line with our findings, Grennan (2013) shows that hospital mergers may weaken their buyer power vis-à-vis coronary stent manufacturers. By considering an oligopoly model in which hospi-

[7] See Snyder (2008) and Smith (2016) for recent surveys.

[8] A strand of the literature also examines mergers between retailers operating in separate markets. Among others, it has been shown that countervailing buyer power may arise when marginal production costs are convex (Chipty and Snyder, 1999; Inderst and Wey, 2003) or when the merging retailers adopt a single-sourcing policy forcing manufacturers to compete for exclusivity (Inderst and Shaffer, 2007; Dana, 2012).

[9] E.g., it has been shown that countervailing buyer power depends on the degree of product differentiation (Dobson and Waterson, 1997), the nature of downstream competition and the observability of bargaining breakdowns (Iozzi and Valletti, 2014), or the pass-through rate of wholesale to retail prices (Gaudin, 2018).

[10] Along with the structural approach, the impact of downstream concentration on market outcomes has also been studied using a reduced-form approach (see, e.g., Chorniy, Miller and Tang, 2020; Craig, Grennan and Swanson, 2021). These articles document mixed evidence on countervailing buyer power effects.

tal buyers operate in different markets and where a merger creates a single buyer (no price discrimination between the merging hospitals), it is worth noting that the mechanisms underlying Grennan's (2013) results differ from ours in many aspects.[11] Instead, our empirical analysis is more closely related to two recent articles that examine the impact of downstream concentration in bilateral oligopolies. Ho and Lee (2017) simulate the effects of the removal of a downstream firm on market outcomes and find evidence that countervailing buyer power effects depend on the competitiveness of the firm being removed.[12] Focusing on the effects of horizontal and vertical mergers, Sheu and Taragin (2021) find that mergers between downstream firms improve their bargaining power vis-à-vis upstream firms by decreasing their relative gains from trade. We show, however, that this result hinges on their simultaneous timing assumption which precludes the concession costs of firms to play a role in the post-merger bargaining outcome.[13] By offering an empirical framework that explicitly accounts for this source of bargaining power in a tractable way, our article highlights that changes in the concession costs of firms can rule out the countervailing buyer power effect of downstream mergers identified in Sheu and Taragin (2021). This result complements prior work in showing that buyer power is very unlikely to offset the standard upward pressure on retail prices caused by a reduction of competition, an argument that is often debated in merger litigation in Europe and more recently in the United States.[14]

Our article also provides a methodological contribution to the recent empirical literature on buyer-seller bargaining in bilateral oligopolies. Since Draganska, Klapper and Villas-Boas (2010), a large number of articles have adopted the timing assumption that wholesale and retail prices are determined simultaneously to simplify the estimation and computation of the "Nash-in-Nash" bargaining model (see, e.g., Ho and Lee, 2017; Crawford et al., 2018;

[11] The economic mechanisms in Grennan (2013) directly relate to the oligopoly price discrimination literature, especially Corts (1998). As hospitals differ in their preferences for manufacturers, a merger that prevents price discrimination tends to soften competition between manufacturers (i.e., uniform pricing implies in this case that manufacturers focus on their "captive" hospitals instead of competing for other hospitals).

[12] More precisely, Ho and Lee (2017) show that countervailing buyer power effects arise only upon the removal of a weak downstream firm which generates limited upward pressure on downstream prices, implying that the gains from trade of the remaining downstream firms are less likely to increase relative to that of the upstream firms. They further show that this countervailing force decreases downstream prices only when they are determined via bilateral bargains.

[13] Note also that Sheu and Taragin (2021) use a calibration routine to estimate model parameters which requires the observation of one upstream and downstream margin. As emphasized in footnote 16, our approach only requires data on market shares and retail prices as in Berry, Levinsohn and Pakes (1995) and the ensuing literature.

[14] See, e.g., Kesko/Tuko (1996) – Case No IV/M.784; Rewe/Meinl (1999) – Case No IV/M.1221; Anthem/Cigna (2017) – United States v. Anthem, Inc., 236 F. Supp. 3d 171 (D.D.C. 2017); Tesco Plc/Booker Group Plc, Competition and Markets Authority (CMA) decision of 20 December 2017; J Sainsbury Plc/Asda Group Ltd., CMA decision of 25 April 2019.

Noton and Elberg, 2018; Sheu and Taragin, 2021). Although reasonable in the presence of retail price stickiness, this assumption does not reflect well the functioning of vertical markets in which retailers can easily change the retail prices of products.[15] Our article highlights that this simultaneous timing assumption imposes strong restrictions on the concession costs of firms in bilateral negotiations which, in turn, have important consequences for merger analysis. A notable exception is the bilateral oligopoly framework of Crawford and Yurukoglu (2012) which, like ours, includes a sequential timing where retailers are able to observe wholesale prices and optimally adjust their pricing behavior accordingly.[16] We differ from Crawford and Yurukoglu (2012) in two important aspects. First, in contrast to their approach assuming no marginal costs, we allow for the presence of marginal costs of production and distribution. Second, we derive closed-form expressions for the price-cost margins of manufacturers which considerably ease the estimation of our model as well as the computational burden of counterfactual simulations involving a new bargaining and downstream price equilibrium.

The remainder of this article is organized as follows. Section 2 introduces our bilateral oligopoly framework. Section 3 describes our empirical application to the French soft drink industry, discusses the identification and estimation of model parameters, and presents the empirical results. Section 4 is devoted to the analysis of retail mergers with a focus on the role of buyer power. Section 5 provides robustness checks to our main results and Section 6 concludes.

2 A model of bilateral oligopoly

To analyze bilateral oligopolistic markets, we develop a flexible framework involving "interlocking relationships" in which multi-product manufacturers engage in bilateral negotiations with multi-product retailers competing in retail prices for consumers. Our framework embeds three sources of bargaining power, accounts for the effects of negotiated wholesale prices on downstream competition, and allows for positive (constant) marginal costs of pro-

[15] For instance, recent empirical works provide suggestive evidence that retail prices in the supermarket industry immediately adjust to wholesale price changes (see, e.g., Nakamura and Zerom, 2010; Goldberg and Hellerstein, 2013; Anderson et al., 2017).

[16] Yang (2020) develops an empirical dynamic model of innovation that embeds a static framework of vertical relations which also considers sequential timing. We differ from his approach in many dimensions. First, we allow for upstream competition. Second, our estimation method does not involve a calibration routine requiring information on upstream price-cost margins and marginal costs. Third, we assume that bargaining breakdowns between manufacturers and retailers entail product removals.

duction and distribution. We further show that it admits a bargaining equilibrium outcome with an analytically tractable form and an intuitive interpretation.

Formally, we consider a market, indexed by t, in which F multi-product manufacturers, indexed by $f = 1, \ldots, F$, sell their brands to R multi-product retailers, indexed by $r = 1 \ldots, R$, which resell to consumers. Assuming that a product consists of a brand-retailer combination, each consumer on the market chooses among a set $\mathscr{J}_t \equiv \{0, 1, \ldots, J_t\}$ of differentiated products.[17] Let $\mathscr{J}_{ft}$ denotes the set of products owned by manufacturer f and $\mathscr{J}_{rt}$ the set of products distributed by retailer r such that $\bigcup_{f=1}^{F} \mathscr{J}_{ft} = \bigcup_{r=1}^{R} \mathscr{J}_{rt} = \mathscr{J}_t \backslash \{0\}$.

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

- Stage 1: Manufacturers and retailers engage simultaneously and secretly in bilateral bargains to determine wholesale prices of products.

- Stage 2: Retailers compete in retail prices on the downstream market.

To determine wholesale prices in stage 1, we leverage the "Nash-in-Nash" bargaining solution pioneered by Horn and Wolinsky (1988) which has been extensively used in applied work to deal with the presence of contracting externalities (see, e.g., Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran, Nevo and Town, 2015; Ho and Lee, 2017). In stage 2, we consider that retail prices are determined by retailers competing on the downstream market with "interim unobservability", implying that bargaining outcomes between manufacturers and a given retailer remain unobserved to other retailers (Rey and Vergé, 2004, 2020; Gaudin, 2019).[18] Hence, any (unexpected) change in wholesale prices paid by one retailer does not affect the pricing behavior of other retailers. However, absent retail price inertia, we consider that each retailer sets retail prices conditional on the outcomes of its negotiations with manufacturers. We assume complete information about the (constant) marginal cost of production and distribution for each product and we solve our two-stage game by working backwards.

[17] We define product 0 as the outside option to the J_t products in the choice set of consumers.

[18] Alternative information structures have been proposed in the literature such as "observable breakdowns" in which bargaining breakdowns are observed before retail price competition takes place (Iozzi and Valletti, 2014) and "interim observability" where all bargaining outcomes are revealed (Rey and Vergé, 2004). Following Iozzi and Valletti (2014), the "interim unobservability" assumption is more in line with the retail grocery industry considered in our application (Section 3) as negotiation failures will probably not be immediately observed by competing retailers.

To gain insights into our equilibrium notion, we refer to Rey and Vergé (2020) who show that the equilibrium of our game coincides with the sequential equilibrium (Kreps and Wilson, 1982) of a two-stage noncooperative game comprising a model of delegated negotiations with a random-proposer protocol in the first stage, followed by a model of retail price competition similar to our second stage. As the notion of sequential equilibrium requires firms' beliefs to be "consistent", retailers competing in stage 2 always conjecture that their rivals have negotiated the equilibrium wholesale prices and therefore set the equilibrium retail prices.[19]

Contractual form. We restrict the contractual form between manufacturers and retailers to linear wholesale prices. Even though such a simple payment scheme generates double marginalization, a body of empirical work has provided evidence of its use in numerous vertical markets.[20] We however acknowledge that extending our empirical framework to nonlinear wholesale contracts raises important identification issues that are beyond the scope of this article.[21]

Profit functions. We define respectively the (per-market) profit function of manufacturer f and retailer r as follows:

$$\pi_{ft} \equiv \sum_{j \in \mathscr{J}_{ft}} \left(w_{jt} - \mu_{jt}\right) q_{jt}(\mathbf{p}_t) \tag{1a}$$

$$\pi_{rt} \equiv \sum_{j \in \mathscr{J}_{rt}} \left(p_{jt} - w_{jt} - c_{jt}\right) q_{jt}(\mathbf{p}_t) \tag{1b}$$

[19] Following Fudenberg and Tirole (1991), retailers believe that any out-of-equilibrium event (e.g., bargaining breakdowns) is the result of a tremble.

[20] Luco and Marshall (2020) provide (indirect) evidence of the presence of linear wholesale prices in the U.S. carbonated-beverage industry. Noton and Elberg (2018) observe wholesale unit prices negotiated between manufacturers and retailers in the Chilean coffee market. Smith and Thanassoulis (2015) provide interview-based evidence of the use of linear tariffs in the UK liquid milk industry. Outside the food industry, simple linear prices have also been either observed or considered as a good approximation of the contractual form used in the U.S. healthcare sector (Grennan, 2013; Gowrisankaran, Nevo and Town, 2015; Ho and Lee, 2017), the U.S. television multichannel industry (Crawford and Yurukoglu, 2012; Crawford et al., 2018), or the U.S. video rental industry (Mortimer, 2008). Several rationales have also been advanced to justify the use of such simple contracts in bilateral oligopolies. For instance, Crawford and Yurukoglu (2012) argue that committing to linear wholesale prices can be a means to avoid the dissipation of profits when the downstream competition is fierce. In the presence of demand uncertainty and risk-averse retailers, double marginalization may also arise to reduce the sensitivity of retailers' profits to demand variations (Rey and Tirole, 1986).

[21] In particular, Rey and Vergé (2020) have shown that nonlinear tariffs are always cost-based in bilateral oligopolies with secret contracting (i.e., marginal wholesale prices reflect marginal costs of production). This implies that the distribution of bargaining power in the vertical chain never affects the marginal costs of retailers and, in turn, retail prices which are the primary source of variation that we exploit to identify parameters in our "Nash-in-Nash" bargaining model (see Section 3).

where w_{jt} is the wholesale price of product j in market t, μ_{jt} and c_{jt} are respectively the (constant) marginal cost of production and distribution for product j in market t, and q_{jt} is the corresponding demand written as a function of retail prices denoted by the J_t-dimensional vector $\mathbf{p}_t$. For expositional purpose, we take demand as a primitive of our bilateral oligopoly model and defer to Section 3.2.1 for an application to the French soft drink industry.

2.1 Stage 2: Downstream price competition

Each retailer sets the retail prices of its products to maximize profit, holding the belief that its rivals pay the equilibrium wholesale prices to manufacturers. From the maximization problem of each retailer's profit function (1b), we can derive the set of first-order conditions characterizing the equilibrium retail prices in market t as follows:

$$q_{jt}(\mathbf{p}_t) + \sum_{k \in \mathscr{J}_{r(j)t}} (p_{kt} - w_{kt} - c_{kt}) \frac{\partial q_{kt}}{\partial p_{jt}} = 0 \quad \forall j \in \mathscr{J}_t \backslash \{0\} \tag{2}$$

where *r(j)* indexes the retailer distributing product j. Following Berry and Haile (2014), price-cost margins and marginal costs of retailers can be directly recovered from (2) when demand is continuously differentiable with respect to retail prices and products are "connected substitutes".[22] Importantly, they stress that such conditions for invertibility of (2) do not place any restriction on the structure of retailers' marginal costs which are fundamental ingredients for the determination of the surplus division in our empirical framework. Hence, using matrix algebra, we invert (2) and recover the J_t-dimensional vector of price-cost margins of retailers (computational details are deferred to Appendix S1.1 of the Supplemental Material). The retail price-cost margin of product $j \in \mathscr{J}_t \backslash \{0\}$ is given by $p_{jt} - w_{jt} - c_{jt} = \gamma_{jt}(\mathbf{q_t}, \mathbf{Q_{p_t}})$ where $\mathbf{Q_{p_t}}$ denotes the $J_t \times J_t$ matrix of partial derivatives $\frac{\partial q_{kt}}{\partial p_{jt}}$ and $\mathbf{q}_t$ is the J_t-dimensional vector of demand for products in market t. We then recover the marginal cost of retailers for each product $j \in \mathscr{J}_t \backslash \{0\}$ as follows:

$$w_{jt} + c_{jt} = p_{jt} - \gamma_{jt}. \tag{3}$$

[22] The notion of "connected substitutes" implies weak substitution between all products and some strict substitution as well. These conditions are shown to hold under a wide range of demand models including the random coefficient logit considered in our application (see Section 3).

2.2 Stage 1: Manufacturer-retailer bargaining

Bargaining between manufacturer f and retailer r over w_{jt}. We determine the allocation of surplus in the supply chain according to the "Nash-in-Nash" bargaining solution. Therefore, the equilibrium wholesale price of product j owned by manufacturer f and distributed by retailer r solves the following Nash bargaining problem conditioning on all other wholesale prices:

$$w_{jt}^{*} \equiv \underset{w_{jt}}{\operatorname{argmax}} \left(\pi_{ft} - d_{ft}^{-j}\right)^{1-\lambda_{fr}} \left(\pi_{rt} - d_{rt}^{-j}\right)^{\lambda_{fr}} \tag{4}$$

where $\lambda_{fr} \in [0,1]$ denotes the bargaining weight of retailer r when negotiating with manufacturer f, π_{ft} and π_{rt} are profits of firms respectively defined in (1a) and (1b), and d_{ft}^{-j} and d_{rt}^{-j} correspond respectively to the status quo payoffs of manufacturer f and retailer r in the event of a bilateral disagreement over the wholesale price of product j. This specification thus implies that each manufacturer-retailer pair negotiates the wholesale prices of products separately.[23] Following our bargaining protocol and that retailers compete downstream with "interim unobservability", the status quo payoffs of firms are given by:

$$d_{ft}^{-j} = \sum_{k \in \mathscr{J}_{ft} \setminus \{j\}} \left(w_{kt}^{*} - \mu_{kt}\right) \tilde{q}_{kt}^{-j}(\tilde{\mathbf{p}}_{t}^{-j}) \tag{5a}$$

$$d_{rt}^{-j} = \sum_{k \in \mathscr{J}_{rt} \setminus \{j\}} \left(\tilde{p}_{k,t}^{-j} - w_{kt}^{*} - c_{kt}\right) \tilde{q}_{kt}^{-j}(\tilde{\mathbf{p}}_{t}^{-j}) \tag{5b}$$

where w_{kt}^{*} corresponds to the (anticipated) equilibrium wholesale price of product $k \neq j$, $\tilde{\mathbf{p}}_{t}^{-j}$ denotes the J_t-dimensional vector of out-of-equilibrium retail prices when product j is no longer offered on market t (see Appendix S3 of the Supplemental Material for computational details), and $\tilde{q}_{kt}^{-j}$ is the demand for each product k remaining on the market. The status quo payoffs of firms are thus determined by removing product j from market t, holding fixed wholesale prices of other products as well as retail prices chosen by retailer r's rivals. Importantly, however, we allow retailer r to adjust retail prices for its remaining products and consumers to select and purchase other products from their choice set.

Surplus division and determinants of bargaining power. From (4), we can obtain the set of first-order conditions that characterizes the division of surplus in every bilateral negotiation

[23] We have also considered an alternative specification with joint negotiations (see Appendix S7 of the Supplemental Material).

taking place in market t as follows:

$$\underbrace{\lambda_{f(j)r(j)}\left(\pi_{f(j)t}-d_{f(j)t}^{-j}\right)\frac{\partial\pi_{r(j)t}}{\partial w_{jt}}}_{\text{retailer } r(j)\text{'s bargaining power}}+\underbrace{\left(1-\lambda_{f(j)r(j)}\right)\left(\pi_{r(j)t}-d_{r(j)t}^{-j}\right)\frac{\partial\pi_{f(j)t}}{\partial w_{jt}}}_{\text{manufacturer } f(j)\text{'s bargaining power}}=0 \quad \forall j\in\mathscr{J}_t\backslash\{0\} \tag{6}$$

where $f(j)$ indexes the manufacturer of product j. For a given bilateral negotiation, the first (resp. second) term on the left-hand side of (6) embeds every factor determining the retailer's (resp. manufacturer's) bargaining power. More precisely, we can identify three sources of bargaining power.

The first source of bargaining power comes from the bargaining weight λ_{fr}, which captures asymmetries in the bargaining ability of firms.[24] The second source of bargaining power is captured by the terms $\pi_{f(j)t}-d_{f(j)t}^{-j}$ and $\pi_{r(j)t}-d_{r(j)t}^{-j}$, which represent respectively the incremental gains from trade obtained by manufacturer *f(j)* and retailer *r(j)* given that all other bilateral contracts are formed. The higher a firm's incremental gains from trade the larger its losses from not reaching an agreement, which reinforces the bargaining power of its trading partner. In our bilateral oligopoly framework, these terms are given by:

$$\pi_{f(j)t}-d_{f(j)t}^{-j}=(w_{jt}-\mu_{jt})q_{jt}(\mathbf{p}_t)-\sum_{k\in\mathscr{J}_{f(j)t}\backslash\{j\}}(w_{kt}^{*}-\mu_{kt})\left(\tilde{q}_{kt}^{-j}(\tilde{\mathbf{p}}_t^{-j})-q_{kt}(\mathbf{p}_t)\right) \tag{7a}$$

$$\begin{aligned}\pi_{r(j)t}-d_{r(j)t}^{-j}&=(p_{jt}-w_{jt}-c_{jt})q_{jt}(\mathbf{p}_t)\\&\quad-\sum_{k\in\mathscr{J}_{r(j)t}\backslash\{j\}}(\tilde{p}_{kt}^{-j}-w_{kt}^{*}-c_{kt})\tilde{q}_{kt}^{-j}(\tilde{\mathbf{p}}_t^{-j})-(p_{kt}-w_{kt}^{*}-c_{kt})q_{kt}(\mathbf{p}_t)\end{aligned} \tag{7b}$$

that is, they correspond to the difference between the profit generated by the sale of product j for each trading partner and the additional profit that each trading partner would get from removing product j.[25] The last source of bargaining power which has often been ignored in empirical work of bilateral oligopoly relates to the concession costs of firms. They are embedded in $\frac{\partial\pi_{f(j)t}}{\partial w_{jt}}$ and $\frac{\partial\pi_{r(j)t}}{\partial w_{jt}}$ which respectively refer to the cost incurred by manufac-

[24]These weights are often deemed to reflect some imprecisely defined asymmetries in the bargaining power of firms. As stated by Roth (1979), they may attempt to capture some factors "outside" the model that affect the bargaining outcome. Using strategic models of bargaining, Binmore, Rubinstein and Wolinsky (1986) provide ground for the presence of such parameters in showing that they may capture differences in bargainers' beliefs or asymmetries in the bargaining procedure.

[25]The additional profit that retailer *r(j)* would obtain upon dropping product j is strictly positive whenever products are gross substitutes. However, the additional profit that manufacturer *f(j)* would obtain is not necessarily positive (due to the change in retail prices) and can be related to the "recapture effect" in Ho and Lee (2017) which describes the ability of consumers to switch to a different retailer to purchase the same brand or another brand belonging to manufacturer *f(j)*.

turer *f(j)* and retailer *r(j)* from making a price concession to its trading partner during the course of negotiations.[26] Hence, a bargainer with a high concession cost is less willing to provide more favorable terms of trade to his trading partner which, in turn, increases his bargaining power in the bilateral negotiation. In our setting, the concession cost of manufacturer $f(j)$ when bargaining with retailer $r(j)$ over w_{jt} is given by:

$$
\begin{aligned}
\frac{\partial \pi_{f(j)t}}{\partial w_{jt}} = q_{jt}(\mathbf{p}_t) &+ \underbrace{(w_{jt}-\mu_{jt})\frac{\partial q_{jt}}{\partial p_{jt}}\frac{\partial p_{jt}}{\partial w_{jt}}}_{\substack{\text{double-marginalization effect}\\ \text{on demand}}} + \underbrace{(w_{jt}-\mu_{jt})\sum_{l\in\mathscr{J}_{r(j)t}\backslash\{j\}}\frac{\partial q_{jt}}{\partial p_{lt}}\frac{\partial p_{lt}}{\partial w_{jt}}}_{\text{direct steering effect}} \\
&+ \underbrace{\sum_{k\in\mathscr{J}_{f(j)t}\backslash\{j\}}(w_{kt}-\mu_{kt})\frac{\partial q_{kt}}{\partial p_{jt}}\frac{\partial p_{jt}}{\partial w_{jt}} + \sum_{k\in\mathscr{J}_{f(j)t}\cap\mathscr{J}_{r(j)t}\backslash\{j\}}(w_{kt}-\mu_{kt})\frac{\partial q_{kt}}{\partial p_{kt}}\frac{\partial p_{kt}}{\partial w_{jt}}}_{\text{recapture effect}} \qquad (8a) \\
&+ \underbrace{\sum_{k\in\mathscr{J}_{f(j)t}\backslash\{j\}}(w_{kt}-\mu_{kt})\sum_{l\in\mathscr{J}_{r(j)t}\backslash\{j,k\}}\frac{\partial q_{kt}}{\partial p_{lt}}\frac{\partial p_{lt}}{\partial w_{jt}}}_{\text{indirect steering effect}}
\end{aligned}
$$

In words, an increase in w_{jt} raises manufacturer $f(j)$'s price-cost margins for product j which, in turn, increases its profit proportionally to product j's demand. This wholesale price increase of product j, however, generates two negative effects on its profit. First, it increases the double-marginalization which reduces demand for product j. Second, whenever $\frac{\partial p_{lt}}{\partial w_{jt}} < 0 \ \forall l \in \mathscr{J}_{r(j)}\backslash\{j\}$, it decreases retail prices of other products sold by retailer $r(j)$ which, in turn, steers consumers of product j towards these other products ("direct steering effect").[27] Although these two negative effects reduce manufacturer $f(j)$'s profit over product j, they increase demand for other manufacturer $f(j)$'s products which, in turn, increases its profit over these products ("recapture effect"). Lastly, the retail price drop of retailer $r(j)$'s products (excluding product j) tends to mitigate the increase in demand from the "recapture effect" ("indirect steering effect"). Similarly, the concession cost of

[26]In other words, this can be defined as the marginal effect of agreeing upon a lower (resp. higher) wholesale price on manufacturer *f(j)*'s profit (resp. retailer *r(j)*'s profit).

[27]Negative cross retail pass-through rates ($\frac{\partial p_{lt}}{\partial w_{jt}} < 0 \ \forall l \in \mathscr{J}_{r(j)}\backslash\{j\}$) stem from the fact that, following an increase in w_{jt}, retailer $r(j)$ has an incentive to divert consumer demand towards its other products as product j becomes less profitable. This situation is consistent with estimates of our structural model of demand and supply described in Section 3.

retailer $r(j)$ when bargaining with manufacturer $f(j)$ over w_{jt} is derived as follows:

$$
\begin{aligned}
\frac{\partial \pi_{r(j)t}}{\partial w_{jt}} = & -q_{jt}(\mathbf{p}_t) + \underbrace{\frac{\partial p_{jt}}{\partial w_{jt}} q_{jt}(\mathbf{p}_t)}_{\text{double-marginalization effect}} + \underbrace{\sum_{k \in \mathscr{J}_{r(j)t} \setminus \{j\}} \frac{\partial p_{kt}}{\partial w_{jt}} q_{kt}(\mathbf{p}_t)}_{\text{cross double-marginalization effect}} \\
& + \underbrace{(p_{jt} - w_{jt} - c_{jt}) \frac{\partial q_{jt}}{\partial p_{jt}} \frac{\partial p_{jt}}{\partial w_{jt}}}_{\substack{\text{double-marginalization effect} \\ \text{on demand}}} + \underbrace{(p_{jt} - w_{jt} - c_{jt}) \sum_{l \in \mathscr{J}_{r(j)t} \setminus \{j\}} \frac{\partial q_{jt}}{\partial p_{lt}} \frac{\partial p_{lt}}{\partial w_{jt}}}_{\text{direct steering effect}} \\
& + \underbrace{\sum_{k \in \mathscr{J}_{r(j)t} \setminus \{j\}} (p_{kt} - w_{kt} - c_{kt}) \frac{\partial q_{kt}}{\partial p_{jt}} \frac{\partial p_{jt}}{\partial w_{jt}} + \sum_{k \in \mathscr{J}_{r(j)t} \setminus \{j\}} (p_{kt} - w_{kt} - c_{kt}) \frac{\partial q_{kt}}{\partial p_{kt}} \frac{\partial p_{kt}}{\partial w_{jt}}}_{\text{recapture effect}} \\
& + \underbrace{\sum_{k \in \mathscr{J}_{r(j)t} \setminus \{j\}} (p_{kt} - w_{kt} - c_{kt}) \sum_{l \in \mathscr{J}_{r(j)t} \setminus \{j,k\}} \frac{\partial q_{kt}}{\partial p_{lt}} \frac{\partial p_{lt}}{\partial w_{jt}}}_{\text{indirect steering effect}}
\end{aligned}
\tag{8b}
$$

In addition to the aforementioned effects, three additional effects come into play. First, an increase in w_{jt} reduces retailer $r(j)$'s price-cost margins over product j which, in turn, decreases its profit proportionally to product j's demand. Second, this wholesale price increase raises retailer $r(j)$'s price-cost margin over product j which, in turn, increases its profit ("double-marginalization effect"). Third, whenever $\frac{\partial p_{lt}}{\partial w_{jt}} < 0 \; \forall l \in \mathscr{J}_{r(j)} \setminus \{j\}$, the increase in w_{jt} reduces the retail price of other products sold by retailer $r(j)$ which, in turn, decreases its profit ("cross double-marginalization effect").

"Equilibrium of fear". To gain further insights into the bargaining outcome obtained in our framework, we can rearrange (6) as follows:

$$
\frac{1}{\lambda_{f(j)r(j)}} \frac{\pi_{r(j)t} - d_{r(j)t}^{-j}}{-\partial \pi_{r(j)t} / \partial w_{jt}} = \frac{1}{\left(1 - \lambda_{f(j)r(j)}\right)} \frac{\pi_{f(j)t} - d_{f(j)t}^{-j}}{\partial \pi_{f(j)t} / \partial w_{jt}} \quad \forall j \in \mathscr{J}_t \setminus \{0\} \tag{9}
$$

where the ratios $\frac{\pi_{r(j)t} - d_{r(j)t}^{-j}}{-\partial \pi_{r(j)t} / \partial w_{jt}}$ and $\frac{\pi_{f(j)t} - d_{f(j)t}^{-j}}{\partial \pi_{f(j)t} / \partial w_{jt}}$ relate to the concept of "fear of ruin" introduced in Aumann and Kurz (1977). More specifically, firms' gains from trade in the numerator of each ratio can be interpreted as the cost incurred by retailer *r(j)* (reps. manufacturer *f(j)*) in the event of a bargaining breakdown. Therefore, each ratio provides a measure of a firm's fear of risking a bargaining breakdown compared to accepting a concession to its trading partner. Based on this appealing concept, Svejnar (1986) develops a bargaining model in which, at any given stage, the firm with greater fear of bargaining breakdown relative to its bargaining ability must make a price concession to its trading partner (that is, retailer *r(j)* makes a price concession to manufacturer *f(j)* whenever $\frac{1}{\lambda_{f(j)r(j)}} \frac{\pi_{r(j)t} - d^{-j}_{r(j)t}}{-\partial \pi_{r(j)t}/\partial w_{jt}} > \frac{1}{(1-\lambda_{f(j)r(j)})} \frac{\pi_{f(j)t} - d^{-j}_{f(j)t}}{\partial \pi_{f(j)t}/\partial w_{jt}}$, and conversely). It is shown that the unique solution to this bargaining process is obtained when firms perceive the same fear of bargaining breakdown relative to their bargaining ability, which is precisely what the equality of ratios in (9) describes.[28] Hence, our bargaining outcome has intuitive appeal in that it can be interpreted in terms of "equilibrium of fear". In Section 4, we further show that the left- and right-hand side of (9) provide insightful measures to predict the directional wholesale price effects of changes in market conditions.

Price-cost margins of manufacturers. As for the vector of retail price-cost margins derived from (2), we show in Appendix S1.2 of the Supplemental Material that a closed-form expression for the J_t-dimensional vector of price-cost margins of manufacturers can be obtained by inverting the system (6). The price-cost margins of manufacturer *f(j)* for product j is given by:

$$w_{jt} - \mu_{jt} = \Gamma_{jt}(\mathbf{q}_t, \mathbf{Q}_{\mathbf{p}_t}, \mathbf{Q}_{\mathbf{p}_t\mathbf{p}_t}, \tilde{\mathbf{Q}}_{\Delta t}; \boldsymbol{\lambda}) \tag{10}$$

where $\boldsymbol{\lambda}$ denotes the J_t-dimensional vector of bargaining weights, $\mathbf{Q}_{\mathbf{p}_t\mathbf{p}_t}$ is an array of J_t matrices of second partial derivatives $\frac{\partial^2 q_{jt}}{\partial p_{kt} \partial p_{lt}}$ denoted by $\mathbf{Q}_{\mathbf{p}_{kt}\mathbf{p}_t}$ (each matrix $\mathbf{Q}_{\mathbf{p}_{kt}\mathbf{p}_t}$ being of $J_t \times J_t$ dimension), and $\tilde{\mathbf{Q}}_{\Delta t}$ is the $J_t \times J_t$ matrix of differences in quantities upon a bargaining breakdown (that is, $q_{kt}(\mathbf{p}_t) - \tilde{q}^{-j}_{kt}(\tilde{\mathbf{p}}^{-j}_t)$).[29] This result makes our model of bilateral oligopoly particularly attractive for empirical works. In what follows, we show how to take the model to data and estimate the surplus division between manufacturers and retailers in the French soft drink industry.

[28] It is noteworthy that the bargaining process postulated by Svejnar (1986) is similar in spirit to the behavioural approach of Zeuthen-Harsanyi (Harsanyi, 1956, 1977). In particular, it leads to the Zeuthen-Harsanyi solution when the bargaining ability of firms are equal ($\lambda_{f(j)r(j)} = 0.5 \ \forall j \in \mathcal{J}_t \backslash \{0\}$).

[29] The closed-form expression also includes every J_t-dimensional vector of out-of-equilibrium demand for products and $J_t \times J_t$ matrix of out-of-equilibrium first partial derivatives upon removing product $k \in \mathcal{J}_t$ from market t: that is, $(\tilde{\mathbf{q}}^{-1}_t, \ldots, \tilde{\mathbf{q}}^{-J_t}_t)$ and $(\tilde{\mathbf{Q}}_{\tilde{\mathbf{p}}^{-1}_t}, \ldots, \tilde{\mathbf{Q}}_{\tilde{\mathbf{p}}^{-J_t}_t})$. For the sake of conciseness, we omit to express this dependence in our notations.

3 Application to the French soft drink industry

We apply our framework to the French soft drink industry which features a classic example of bilateral oligopoly in which large firms operate at both levels of the supply chain. Six large retail groups dominate the downstream level of the French food retail sector: Groupe Carrefour, Groupe Leclerc, ITM Entreprises, Groupe Casino, Groupe Auchan, and Groupe Système U. These retailers deal with four large soft drink manufacturers operating upstream: The Coca-Cola Company, PepsiCo, Orangina-Schweppes, and Unilever. Our empirical analysis of this industry proceeds as follows. First, we present our dataset. Second, we introduce our econometric methodology including the specification of consumers' utility and firms' marginal cost functions. We also describe our strategy to identify and estimate model parameters. Third, we discuss the empirical results by paying particular attention to the determinants of bargaining power in the supply chain.

3.1 Data

We use data from a panel of households representative of the French population who scan the bar code of their grocery purchases for home consumption from April 2005 to September 2005. The data are collected by Kantar WorldPanel and include a total of 265,998 soft drink purchases. For each purchase, we observe the date of the shopping trip, the quantity bought in liters, the retail price in euros, the brand name of the purchased item (e.g., Coca-Cola) and its packaged type (e.g., can, plastic bottle). The data also provide information on the store at which each purchase was made including its name, its size area, and its type (e.g., supermarket, hypermarket).

Following Bonnet and Réquillart (2013*b*), we consider purchases of soft drinks at all retailers. Among the five largest retailers, three are characterized by large stores whereas the two others have intermediate-sized stores. We also define two aggregates: an aggregate of discounters which are stores of small to intermediate size offering basic services, and an aggregate of the remaining retailers. In addition to the purchases of private labels (store brands), we focus on the purchases of the 21 top-selling national brands according to our sample. All remaining soft drink purchases are aggregated under the label "outside good" which also includes purchases of flavored water. To analyze the interaction between manufacturers and retailers, we define a product as a brand-retailer combination.[30] Conse-

[30]Hence, a national brand (e.g., Coca-Cola) sold by two retailers corresponds to two different products.

quently, we have a total of 157 differentiated products representing 72.51% of all soft drink and flavored water purchases (the remaining 27.49% being the outside good).

Although we observe the retail price of each purchased product, our data do not provide information on the other products available to consumers during their shopping trips. To reconstitute the choice set of each consumer, we proceed as follows. First, we define each market t as all soft drink purchases for home consumption in France within a month (implying that $t = 1, \ldots, 6$). Second, we assume that each consumer has access to the seven retailers. This is a plausible assumption given that we consider soft drink purchases at national retail chains with stores located in every region in France.[31] Third, we assume that the set of brands distributed by a retailer in a particular month consists of any brand of soft drink for which we observe a purchase at this retailer during the same month. We believe this assumption to be realistic as we focus on the top-selling national brands of soft drinks. These modeling choices imply that the choice set of each consumer consists of the 157 differentiated products plus the outside good. Finally, we compute a monthly average (deflated) retail price for each product in the choice set to infer the retail prices of products available to consumers during their shopping trips.[32]

Table 1 reports summary statistics of market shares and retail prices across manufacturers and soft drink categories. There is substantial heterogeneity in the market shares of national brand manufacturers, ranging from 2.07% to 14.37%. We observe, however, that each national brand manufacturer has a market share advantage over its rivals in each soft drink category. The greatest dominance is in the cola category where the leading national brand manufacturer has a market share of 12% (representing 70% of total cola product sales). Despite the presence of large national brand manufacturers, private labels have a market share of 43.63%. Ranging from 2.32% of market share in the iced tea category to 29.83% in the fruit juice category, we find that private labels constitute a substantial part of total sales in each soft drink category. This descriptive evidence suggests that retailers

[31] To test the robustness of this assumption, we examined whether each retailer operates in each of the 95 "départements" in France (the finest geographic area available in our data). Out of the 1,140 retailer-département interactions, we found that only 12 combinations did not exist. Based on this observation, we removed retailers from the choice set of consumers if they did not have stores in their respective "département" of residence and we re-estimated our demand model outlined in Section 3.2.1. The results (available upon request) yielded similar estimates.

[32] More precisely, we construct the retail price of product j in month t as follows: $p_{j,t} = \frac{\sum_i \mathbb{1}_{i,j,t} p_{i,j,t} q_{i,j,t}}{\sum_i \mathbb{1}_{i,j,t} q_{i,j,t}}$, where $\mathbb{1}_{i,j,t}$ is an indicator equals to 1 if consumer i has purchased product j in month t, $p_{i,j,t}$ is the observed retail price paid by the consumer, and $q_{i,j,t}$ is the observed quantity purchased (in liter). As we average retail prices within a month and across stores of a retail chain, we acknowledge that this might introduce measurement error bias (see Dubois, Griffith and O'Connell, 2020, for a discussion on this issue).

Table 1: Descriptive statistics for manufacturers and product categories

	Market share					Retail price				
	colas	sodas	juices	iced tea	total	colas	sodas	juices	iced tea	total
M1	12.00	1.58	0.57	0.22	14.37	0.92	0.91	1.61	0.93	0.95
	(0.53)	(0.11)	(0.14)	(0.06)	(0.42)	(0.02)	(0.03)	(0.08)	(0.03)	(0.02)
M2	1.12	0.45	3.36	–	4.93	0.71	0.76	2.19	–	1.72
	(0.09)	(0.10)	(0.21)		(0.17)	(0.02)	(0.02)	(0.04)		(0.05)
M3	–	–	–	2.07	2.07	–	–	–	1.09	1.09
				(0.39)	(0.39)				(0.02)	(0.02)
M4	–	6.66	0.84	–	7.50	–	1.08	1.79	–	1.16
		(0.61)	(0.10)		(0.57)		(0.02)	(0.03)		(0.02)
PL	4.12	7.36	29.83	2.32	43.63	0.30	0.39	0.84	0.52	0.70
	(0.15)	(0.46)	(1.92)	(0.37)	(1.32)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

Notes: $N = 265,998$. "M1", "M2", "M3" and "M4" refer respectively to manufacturers 1, 2, 3, and 4, "PL" corresponds to private label, and "sodas" and "juices" refer respectively to other sodas and fruit juices. Market shares are in number of household purchases. Retail prices in euro per liter are calculated using quantity weights. Standard deviations in parenthesis refer to variation across months. Remark that we are not permitted to reveal names of manufacturers due to confidentiality regarding Kantar WorldPanel data.

are likely to play an important role in the soft drink industry. For a given national brand manufacturer, we find little variation in retail prices across soft drink categories, except for fruit juices which are substantially more expensive than other products. The variation in retail prices is more important across manufacturers. For instance, the average retail price of manufacturer 1's products in the cola category equals 0.92 euro per liter whereas that of manufacturer 2's products is 0.71 euro per liter. This retail price gap is even higher between national brands and private labels. For instance, the average retail price of national brands is three times higher than that of private labels in the cola category.

Table 2 displays the same summary statistics across retailers. We also find large heterogeneity in the market shares of retailers, ranging from 5.88% to 14.51%. National brands do not always constitute the largest part of retailers' market shares, especially for retailer 5 for which private labels represent more than 90% of its sales. We also observe variations in the retail prices across retailers. In particular, the retail prices of national brands and private labels distributed by retailer 5 are considerably lower than the retail prices charged by other retailers. Table 10 in Appendix A reports additional summary statistics for each brand of soft drink considered in our analysis (including also the brand ownership of each manufacturer).

3.2 Empirical framework

To analyze the supply chain of the French soft drink industry, we first specify and estimate a model of consumer demand for soft drinks. Based on our demand estimates, we then

Table 2: Descriptive statistics for retailers

	Market share			Retail price		
	national brand	private label	total	national brand	private label	total
Retailer 1	7.82	6.69	14.51	1.20	0.82	1.02
	(0.25)	(0.34)	(0.53)	(0.02)	(0.02)	(0.02)
Retailer 2	3.92	5.01	8.93	1.14	0.72	0.90
	(0.21)	(0.13)	(0.16)	(0.02)	(0.02)	(0.02)
Retailer 3	4.56	3.14	7.71	1.13	0.76	0.98
	(0.26)	(0.27)	(0.18)	(0.03)	(0.01)	(0.02)
Retailer 4	4.29	7.91	12.21	1.21	0.79	0.94
	(0.18)	(0.40)	(0.44)	(0.02)	(0.02)	(0.01)
Retailer 5	1.05	10.31	11.36	0.82	0.55	0.57
	(0.08)	(0.41)	(0.44)	(0.03)	(0.01)	(0.01)
Retailer 6	4.94	6.98	11.91	1.10	0.68	0.85
	(0.32)	(0.27)	(0.29)	(0.03)	(0.02)	(0.01)
Retailer 7	2.29	3.59	5.88	1.12	0.69	0.86
	(0.20)	(0.25)	(0.25)	(0.03)	(0.03)	(0.02)

Notes: $N = 265,998$. Market shares are in number of household purchases. Retail prices in euros per liter are calculated using quantity weights. Standard deviations in parenthesis refer to variation across months. Remark that we are not permitted to reveal names of retailers due to confidentiality regarding Kantar WorldPanel data.

discuss the identification and estimation of our bilateral oligopoly framework.

3.2.1 Consumer demand for soft drinks

Demand specification. We consider a discrete choice model of consumer behavior in which each consumer chooses one unit of the product that maximizes his utility (McFadden, 1974). Following the discrete-choice literature (e.g., Berry, Levinsohn and Pakes, 1995; Nevo, 2001; Train, 2009), the indirect utility is a function of the product characteristics for which we determine consumer preferences. More precisely, we specify the utility that consumer i derives from purchasing product j in month t as follows:

$$U_{ijt} = \delta_{b(j)} + \delta_{r(j)} - \alpha_{ij} p_{jt} + \xi_{jt} + \epsilon_{ijt} \tag{11}$$

where $\delta_{b(j)}$ and $\delta_{r(j)}$ are brand and retail fixed effects which capture respectively the mean utility in the population generated by unobserved time-invariant brand and retailer characteristics, p_{jt} denotes the retail price of product j in month t, ξ_{jt} is a scalar that represents unobserved (to the econometrician) characteristics of product j in month t, and ϵ_{ijt} is an error term capturing unobserved consumer-specific preferences. The parameter α_{ij} represents the sensitivity (or disutility) of consumer i for the retail price of product j. Allowing for heterogeneous consumer price sensitivity, 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 of the log-normal distribution. We allow for a different price sensitivity for national brand and private label products, $\alpha_{nb(j)}$ and $\alpha_{pl(j)}$ respectively, to obtain a more flexible pattern of substitution across products.[33] We normalize the utility from purchasing the outside good to $U_{i0t} = \epsilon_{i0t}$. Assuming that ϵ_{ijt} is independently and identically distributed from the standard Gumbel distribution, the individual market share of product $j \in \mathcal{J}_t \backslash \{0\}$ in month t can be written as follows:

$$s_{ijt} = \int_{0}^{+\infty} \frac{\exp(\delta_{b(j)} + \delta_{r(j)} - \alpha_{ij} p_{jt} + \xi_{jt})}{1 + \sum_{k=1}^{J_t} \exp(\delta_{b(k)} + \delta_{r(k)} - \alpha_{ik} p_{kt} + \xi_{kt})} f(\alpha_{ij}) \, \mathrm{d}\alpha_{ij} \tag{12}$$

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

Identification. We identify consumer substitution patterns from the variation in retail prices and changes in the number of products offered to consumers each month. However, the retail price variation may not be exogenous because the pricing behavior of retailers depends on all product characteristics, including ξ_{jt}.[34] As stressed by Berry (1994), the correlation between retail prices and unobserved demand factors introduces an endogeneity problem that threatens the identification of demand parameters. To address this issue and obtain consistent estimates, we use a control function approach (Petrin and Train, 2010) involving

[33] See Bonnet and Réquillart (2013*a*,*b*) for a similar specification which has also been used to allow for heterogeneous price sensitivity across box sizes in the cereal market (Kiser, 1998), movie theaters (Davis, 2002), brands of beer (Slade, 2004), and brands of food and hygiene products (Erdem, Keane and Sun, 2008).

[34] For instance, we do not observe changes in advertising expenditure for soft drink products or changes in shelf display which are likely to affect consumer behavior and are included in our model through ξ_{jt}.

two steps.[35] First, we regress the retail price variable on a set of instruments:

$$p_{jt} = \delta_{b(j)} + \delta_{r(j)} + \boldsymbol{\beta}\mathbf{Z}_{jt}^{d} + u_{jt} \tag{13}$$

where $\delta_{b(j)}$ and $\delta_{r(j)}$ are the exogenous brand and retail fixed effects (included instruments), $\mathbf{Z}_{jt}^{d}$ is a vector of excluded instruments, $\boldsymbol{\beta}$ is a vector of parameters, and u_{jt} is an error term capturing all unobserved factors explaining p_{jt}. Instrumental variables in $\mathbf{Z}_{jt}^{d}$ should affect retail prices by shifting supply (costs or markups of firms) but not consumer preferences for unobserved product attributes. In practice, we use the number of competing products in each month. Exogeneity of this BLP-type instrument rests on the common assumption that product characteristics are uncorrelated with ξ_{jt} (Berry, Levinsohn and Pakes, 1995). We also use two cost shifters consisting of the input price index of sugar interacted with the quantity of added sugar for each brand of soft drink and the input price index of aluminum interacted with the average canned rate sold for each product in other months.[36] Exogeneity of these variables relies on the assumption that the soft drink industry represents only a small share of the demand for sugar and aluminum.[37]

The second step of the control function approach uses the OLS residuals of the regression model (13), denoted by $\hat{u}_{jt}$, as a proxy for the unobserved product characteristics that affect both retail prices and consumer behavior (e.g., advertising, shelf display). More specifically, we include $\hat{u}_{jt}$ into (11) to control for the correlation between p_{jt} and ξ_{jt} as follows:

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

where ρ is a parameter capturing the mean utility generated by unobserved product attributes that are correlated with retail prices.

[35] We acknowledge that the control function approach is valid under restrictive functional form restrictions (Blundell and Matzkin, 2014). An alternative is the BLP approach (Berry, 1994; Berry, Levinsohn and Pakes, 1995, 2004) which consists in estimating each product's mean utility (product-month fixed effects). As analyzed in Berry, Linton and Pakes (2004) and discussed in Petrin and Train (2010), however, this approach is difficult to use when we have just a small number of observed purchases for some products (10% of our products have on average less than 5 observed purchases per month). Given the pros and cons of each method, we opted for the control function which is less computationally burdensome and not sensitive to products having little observed purchases (Petrin and Train, 2010). For recent use of the control function approach in demand estimation, see Hausman and Newey (2016); Crawford, Pavanini and Schivardi (2018); Dubois, Griffith and O'Connell (2018); Beck and Lein (2020) .

[36] These input price indexes are from the French National Institute for Statistics and Economic Studies.

[37] In a spirit similar to the Hausman-type instruments (Hausman, 1996), our second cost shifter also relies on the identification assumption that demand for soft drinks is independent across months.

Estimation procedure. We estimate the vector of demand parameters, denoted by $\theta^d \equiv (\alpha_{nb(j)}, \alpha_{pl(j)}, \sigma, \delta_{b(j)}, \delta_{r(j)}, \rho)^\top$, by maximizing the following simulated log-likelihood function:[38]

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

where $\check{s}_{ijt}(\theta^d)$ represents the simulated counterpart of (12). In practice, we compute this simulated market share using Monte Carlo integration as follows:

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

where ns denotes the total number of random draws for each consumer i. The use of simulated market shares in the log-likelihood function may generate both noise and bias (Train, 2009, Chap. 10). With a large sample size, the simulation noise has the desirable property to vanish without even increasing the number of simulation draws. However, the simulation bias may be magnified which renders the maximum simulated likelihood estimator inconsistent. Fortunately, this bias decreases with the number of draws used in the simulation.[39] In our application, we use 100 Halton draws.[40]

3.2.2 Identification and estimation of bargaining stage

Econometric model. As shown in (3), we can recover the marginal cost of retailers for each soft drink product $j \in \mathscr{J}_t \backslash \{0\}$ from demand estimates and by inverting (2). We have further shown in (10) that one can recover the price-cost margins of manufacturers up to an unknown vector of bargaining weights $\boldsymbol{\lambda}$ to be estimated. To this end, we rely on the variation in marginal costs of retailers across products and markets which can be explained by (i) asymmetries in the bargaining power of firms in the supply chain, and (ii) differences in marginal costs of production and distribution. We thus proceed by partitioning the marginal

[38] The mathematical symbol "$\top$" denotes the transpose operator.

[39] In particular, Lee (1995) has shown that the maximum simulated likelihood estimator is equivalent to its nonsimulated counterpart when the number of draws rises faster than the square root of the number of observations.

[40] For one-dimensional integration, Bhat (2001) has shown that the simulation error is smaller with 75 Halton draws than with 2000 pseudo-random draws (see also Train, 2000).

cost of retailers for each product $j \in \mathscr{J}_t \backslash \{0\}$ as follows:

$$w_{jt} + c_{jt} \quad = \quad \underbrace{(w_{jt} - \mu_{jt})}_{\text{price-cost margins of manufacturers}} \quad + \quad \underbrace{(c_{jt} + \mu_{jt})}_{\text{operational costs}} \tag{14}$$

Then, we leverage our bilateral oligopoly model and make use of the closed-form expression in (10) for the price-cost margins of manufacturers in (14). This markup term is derived from consumer demand for each product $j \in \mathscr{J}_t \backslash \{0\}$ which is given by $q_{jt} = M_t s_{jt}$, where M_t denotes the market size and s_{jt} is the aggregate market share of product j in market t.[41] As further detailed in Appendix S1.2 of the Supplemental Material, this markup term also depends on the out-of-equilibrium demand of each product $k \in \mathscr{J}_t \backslash \{0, j\}$ following the removal of product $j \in \mathscr{J}_t \backslash \{0\}$, which is given by $\tilde{q}_{kt}^{-j} = M_t \tilde{s}_{kt}^{-j}$. We derive the out-of-equilibrium market share $\tilde{s}_{kt}^{-j}$ as follows:

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

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

Absent additional information, we impose further structure on the "operational costs" term in (14). Following Gowrisankaran, Nevo and Town (2015), we assume that the constant marginal cost of product $j \in \mathscr{J}_t \backslash \{0\}$ is given by: $c_{jt} + \mu_{jt} = \mathbf{v}_{jt} \boldsymbol{\kappa} + \omega_{jt}$, 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).[42] In our application, $\mathbf{v}_{jt}$ includes category and retailer fixed effects, the (monthly) input price of sugar interacted with the sugar content of each brand of soft drink, and the (monthly) input price of aluminum interacted with the average percentage of cans sold for each product. To sum up, we specify the marginal cost function of retailers in the soft drink

[41] The aggregate market share of product $j \in \mathscr{J}_t \backslash \{0\}$ predicted by our demand model is given by: $s_{jt} = \int_0^{+\infty} \frac{\exp(\delta_{b(j)} + \delta_{r(j)} - \alpha_{ij} p_{jt} + \xi_{jt})}{\sum_{k \in \mathscr{J}_t} \exp(\delta_{b(k)} + \delta_{r(k)} - \alpha_{ik} p_{kt} + \xi_{kt})} f(\alpha_{ij}) \, \mathrm{d}\alpha_{ij}$ (see, e.g., Nevo, 2001).

[42] Other approaches have been considered in the literature. For instance, Crawford and Yurukoglu (2012) make the assumption that there is no marginal cost of production in the multichannel television industry. Grennan (2013) adopts an alternative specification in which costs are represented only in terms of data and parameters (i.e., without unobservables) which enables estimating the full distribution of bargaining weights. Our marginal cost specification is instead in line with empirical studies on food industries (e.g., Villas-Boas, 2007; Miller and Weinberg, 2017).

industry as follows:

$$w_{jt} + c_{jt} = \Gamma_{jt}(\mathbf{q}_t, \mathbf{Q}_{\mathbf{p}_t}, \mathbf{Q}_{\mathbf{p}_t\mathbf{p}_t}, \tilde{\mathbf{Q}}_{\Delta t}; \boldsymbol{\lambda}) + \mathbf{v}_{jt}\boldsymbol{\kappa} + \omega_{jt} \tag{15}$$

where the vector of supply parameters to be estimated is $\theta^s \equiv (\boldsymbol{\lambda}^\top, \boldsymbol{\kappa}^\top)^\top$.

Identification. Intuitively, identification of the bargaining weights amounts to identifying the slope of the marginal cost function of retailers. For instance, when $\lambda_{fr} = 0\ \forall f, r$ (retailers make take-it-or-leave-it offers to manufacturers), the price-cost margins of manufacturers equal zero and (15) is flat with respect to quantity as in Berry, Levinsohn and Pakes (1995). In contrast, when manufacturers exert market power, (15) also depends on the price-cost margins of manufacturers Γ_{jt} and, in turn, on quantity. In this case, the pricing behavior of retailers differs from the standard oligopoly setting due to the double marginalization, thereby revealing the presence of manufacturers' bargaining power.

However, identification of θ^s can be jeopardized by the fact that the quantity vector $\mathbf{q}_t$, which enters non-linearly into (15) through the markup term Γ_{jt}, is likely to be correlated with unobserved cost factors ω_{jt}. Indeed, under complete information about marginal costs, firms observe the realization of ω_{jt} before setting wholesale and retail prices which, in turn, affects $\mathbf{q}_t$. Moreover, the variation in quantities depends on the unobserved product characteristics ξ_{jt} which is likely to be correlated with ω_{jt}. To address this endogeneity issue, one needs instrumental variables that shift either demand or the price-cost margins of manufacturers but not the marginal costs of products. In our application, we rely on the amount of competition that each product faces in characteristics space.[43] Intuitively, after controlling for differences in marginal costs, products with distant substitutes in characteristics space should systematically have higher wholesale prices (and thus greater retail marginal costs) than products with close substitutes if manufacturers are able to exert market power (bargaining weights are close to 0). If, however, the location of products in characteristics space does not explain differences in retail marginal costs across products, this may reveal that retailers are able to mitigate the market power of manufacturers such that wholesale prices only reflect production costs (bargaining weights are close to 1).

In practice, we use two sets of instrumental variables: (i) the number of rival products in the same soft drink category, and (ii) the number of rival products sold by the same

[43] This markup shifter relates to the so-called BLP instruments and directly builds on the "Differentiation IVs" suggested by Gandhi and Houde (2023, 2020) to identify consumer substitution patterns as well as firms' conduct in oligopoly markets (see also Michel, Paz y Miño and Weiergraeber, forthcoming).

retailer interacted with manufacturer-category fixed effects. The validity of these instruments hinges on the conditions that they are correlated with quantities and exogenous to the structural error term ω_{jt}. For the first condition, our instruments aim at measuring the competitive pressure exerted on each product which is very likely to explain differences in quantity sold across products and markets. For the exogeneity condition, we rely on the common assumption that observed product characteristics are exogenous.

As the order condition requires at least one instrument for each bargaining weight that interacts with quantities (which grows with the number of manufacturer-retailer pairs), we consider only manufacturer-specific bargaining weights in estimation ($\lambda_{fr} = \lambda_f$).[44] For manufacturers 1 and 2 which have the most diverse brand portfolio (see Table 10 in Appendix A), we allow bargaining weights to differ between cola/other soda products and fruit juice/iced tea products. Hence, there are six bargaining weights to be estimated.

Estimation procedure. We estimate the vector of supply parameters $\boldsymbol{\theta}^s$ by continuous-updating GMM (Hansen, Heaton and Yaron, 1996). Note that we concentrate the cost parameters $\boldsymbol{\kappa}$ out of the GMM objective function and search nonlinearly over the vector of bargaining weights $\boldsymbol{\lambda}$. Formally, our GMM estimator is defined as follows:

$$\hat{\boldsymbol{\lambda}} \equiv \underset{\boldsymbol{\lambda}}{\operatorname{argmin}} \, (\mathbf{Z}^s \boldsymbol{\omega}(\boldsymbol{\lambda}, \boldsymbol{\kappa}(\boldsymbol{\lambda})))^\top \mathbf{A}^{-1} \mathbf{Z}^s \boldsymbol{\omega}(\boldsymbol{\lambda}, \boldsymbol{\kappa}(\boldsymbol{\lambda})) \tag{16}$$

where $\boldsymbol{\omega}(\boldsymbol{\lambda}, \boldsymbol{\kappa}(\boldsymbol{\lambda}))$ is the $\sum_t J_t$-dimensional vector of unobserved cost factors, $\mathbf{Z}^s$ is a $L \times \sum_t J_t$ matrix of instrumental variables (including the K exogenous cost shifters), and $\mathbf{A}$ is a $L \times L$ weighting matrix (see Appendix S5 of the Supplemental Material for further details on our estimation procedure).

3.3 Estimation results

We first estimate the random coefficient logit model using our household-level data on soft drink purchases presented in Section 3.1. Given demand estimates, we compute the price-cost margins and marginal costs of retailers by inverting the system of first-order conditions

[44] There are 28 manufacturer-retailer pairs in our application, which necessitates the use of at least 28 instruments. We thus employ parameter restrictions for tractability motives as commonly applied in the literature (see e.g. Gowrisankaran, Nevo and Town, 2015; Ho and Lee, 2017; Crawford et al., 2018). Moreover, we make the simplifying assumption that private label manufacturers are vertically integrated with retailers, implying that wholesale prices of private labels are set to their marginal costs of production ($\lambda = 1$). We consider this assumption to be reasonable as, to the best of our knowledge, national brand manufacturers do not produce private labels in the French soft drink industry.

Table 3: Results of the random coefficient logit model

Variable	Coefficient	Variable	Coefficient
Retail price × Private label	2.24* (0.65)		
Retail price × National brand	1.05* (0.21)		
Retail price × ν_i	0.81* (0.28)		
Control function	3.77* (0.96)		
Retailer fixed effects:			
Retailer 1	0.99 (0.58)	Retailer 5	0.25 (0.59)
Retailer 2	0.49 (0.58)	Retailer 6	0.65 (0.58)
Retailer 3	0.32 (0.58)	Retailer 7	ref.
Retailer 4	0.87 (0.58)		
Brand fixed effects:			
Colas			
Brand 23 *(PL)*	0.49 (0.92)	Brand 9	−1.89 (1.57)
Brand 5	1.13 (1.86)	Brand 4	−2.83 (1.99)
Other sodas			
Brand 25 *(PL)*	1.94* (0.95)	Brand 14	−0.95 (1.79)
Brand 3	−2.71 (1.64)	Brand 15	−0.46 (1.98)
Brand 6	−0.93 (1.92)	Brand 17	0.15 (2.09)
Brand 7	−0.60 (2.45)	Brand 19	−3.36 (1.96)
Brand 8	−4.13* (1.68)	Brand 20	1.82 (3.31)
Brand 10	−2.96 (1.60)	Brand 21	−4.84* (1.57)
Fruit juices			
Brand 22 *(PL)*	6.25* (1.05)	Brand 1	−0.08 (2.63)
Brand 11	2.90 (2.86)	Brand 18	−0.82 (2.12)
Brand 16	0.95 (2.67)		
Iced tea			
Brand 24 *(PL)*	1.70 (0.97)	Brand 12	−0.21 (2.03)
Brand 2	−2.59 (1.84)	Brand 13	−2.13 (2.27)
Simulated Log-likelihood	−922,237		
Number of observations	265,998		

Notes: Maximum simulated likelihood estimates. Standard errors in parenthesis are computed using the asymptotic formula of Karaca-Mandic and Train (2003) which takes into account the sampling variance in the first-step estimates of the control function approach. * indicates significance at the 5% level. "*PL*" stands for private label.

described in (2). Finally, using demand and retailers' marginal cost estimates, we estimate the marginal cost function of retailers described in (15). In what follows, we present our estimation results.

3.3.1 Demand estimates

Table 3 reports parameter estimates of our random coefficient logit model. The estimated coefficient of the first-step residuals of the control function approach is positive and significant at the 5% level. This suggests that unobserved product attributes are positively correlated with the retail price variable, justifying the need to account for the retail price endogeneity issue.[45] The retail price has a significant and negative impact on consumer utility. On average, we find that consumers are more sensitive to price variation of private labels than national brands. This result may stem from greater consumer brand loyalty with respect to national brands than private labels. Our estimates also reveal heterogeneity in price sensitivity across consumers (see Figure 2 in Appendix B).

We use demand estimates to compute the own and cross-price elasticity of demand for each product. Our results are in line with recent empirical work on the soft drink industry. For instance, we find an aggregate own-price elasticity of -1.49 for soft drinks (excluding fruit juices) as in Dubois, Griffith and O'Connell (2020).[46] In line with Dubé (2004) and Ershov et al. (2021), we also obtain that the own-price elasticities for brands in the cola category range from -2.76 to -3.28 on average. To gain additional insights into our estimates of substitution patterns among products, we have also computed the average recapture ratios (also known as the aggregate diversion ratios) for each soft drink category. This provides a measure of the average fraction of sales lost by a product due to a retail price increase that is recaptured by all products belonging to another category. Results reported inTable 4 reveal intuitive patterns. For instance, 25.00% of the demand lost by a product in the cola category due to a retail price increase diverts to other sodas. This demand diversion is lower for other soft drink categories (21.85% for fruit juices and 6.42% for iced tea). It is worth noting that diagonal elements in the table are not equal to -100% due to intra-category substitution.

3.3.2 Supply estimates

Table 5 reports estimates of the retail marginal cost function described in (15). The value of the GMM objective function at estimated parameters is 1.90 and the overidentification test of Hansen (1982) cannot reject our model at the 95% confidence level. Cost parameters are precisely estimated and have the expected signs. For instance, fruit juice fixed effects contribute positively to the marginal costs of products due to their fruit content. In contrast, the marginal cost of private labels is on average lower than that of national brands. Although bargaining weight parameters should theoretically lie in the interval $[0, 1]$, we do not impose any parameter constraints in our estimation. Results indicate that there is sub-

[45] Table 11 in Appendix B displays estimates of the first step of the control function approach. We find an F-stat equal to 22.62, indicating that our excluded instruments are not weakly correlated with the endogenous retail price variable.

[46] Consistent with Bonnet and Réquillart (2013*a*), we also obtain an average own-price elasticity of -3.27 for soft drinks (excluding fruit juices).

Table 4: Recapture ratios at the soft drink category level

Category	Recapture ratios				
	Colas	Other sodas	Fruit juices	Iced tea	Outside good
Colas	−76.86	25.00	21.85	6.42	3.98
	(8.11)	(3.13)	(9.31)	(0.90)	(1.63)
Other sodas	25.44	−77.68	27.97	6.58	3.03
	(7.96)	(2.68)	(9.55)	(0.73)	(1.29)
Fruit juices	17.36	20.10	−46.91	6.24	0.53
	(7.98)	(3.27)	(11.29)	(0.68)	(0.35)
Iced tea	24.56	24.19	32.19	−94.32	2.27
	(9.16)	(2.71)	(11.17)	(0.67)	(0.95)

Notes: The (quantity-weighted) average recapture ratios (also known as "aggregate diversion ratios") measure the average fraction of sales lost by a product in the category of row j following a small retail price increase that is recaptured by all products in the category of column k. Standard errors in parenthesis are computed using a parametric bootstrap where 500 draws are taken from the estimated asymptotic normal distribution of our demand parameters.

stantial heterogeneity in the bargaining weights of retailers across manufacturers and soft drink categories. Whereas retailers have a lower bargaining ability than manufacturers 3 and 4, results vis-à-vis manufacturer 1 are more balanced. We do not report standard errors for the bargaining weights of retailers vis-à-vis manufacturer 2 because they lie on the boundary of the parameter space. Instead, we use a grid search method and select values of the bargaining weights of retailers vis-à-vis manufacturer 2 that minimize our GMM objective function (we refer to Appendix S5 of the Supplemental Material for further details). We find that retailers make take-it-or-leave-it offers to manufacturer 2 for products belonging to the cola and other soda categories. This result is particularly consistent with anecdotal evidence suggesting that the market penetration of manufacturer 2 over these soft drink categories in France is very limited.[47] In contrast, when negotiating wholesale prices of fruit juice products, we find that retailers receive take-it-or-leave-it offers from manufacturer 2 which owns the leading brand in this category.

Using bargaining weight and cost parameter estimates, we compute the price-cost margins of manufacturers, the marginal cost of production and distribution of products, and the surplus division in the supply chain of the French soft drink industry. Table 6 displays the results. Consistent with our cost parameter estimates, we find that the marginal cost of fruit juice products is twice higher than that of cola, other soda, and iced tea products. For each

[47] At the end of the 1990s, the European Commission (EC) received several complaints from manufacturer 2 alleging abuse of a dominant position of manufacturer 1 which raise entry barriers in the cola and other soda product categories. In 2005, the EC adopted a commitment decision (Case COMP/A.39.116/B2) requiring manufacturer 1 to stop its anti-competitive business practices including exclusive dealing and bundling. In addition to this anecdotal evidence, Table 1 provides descriptive evidence of the low market shares of manufacturer 2's cola and other soda products.

Table 5: Bargaining and marginal cost parameter estimates

Variable	Coefficient	S.E.
Cost parameters:		
Sugar content × Sugar price	0.01	0.03
Canned rate × Aluminium price	0.31^{*}	0.04
Cola	0.43^{*}	0.03
Sola	0.45^{*}	0.03
Fruit juice	0.88^{*}	0.03
Pure fruit juice	1.11^{*}	0.01
Iced tea	0.53^{*}	0.02
Private label	-0.21^{*}	0.01
Brand 20	1.73^{*}	0.02
Retailer fixed effects (not shown)		
Bargaining weights:		
Manufacturer 1 (colas, other sodas)	$0.68^{\star}$	0.03
Manufacturer 1 (fruit juices, iced tea)	0.57	0.06
Manufacturer 3	$0.26^{\star}$	0.07
Manufacturer 4	$0.39^{\star}$	0.03
Manufacturer 2 (colas, other sodas)	1.00	–
Manufacturer 2 (fruit juices)	0.00	–
GMM objective function value (J-statistic)	1.92	
χ^2 critical values (5%)	5.99	
Number of observations	920	

Notes: Continuously-updating GMM estimates (see Appendix S5 for technical details). Heteroskedasticity-robust standard errors. * indicates significance at the 5% level. * indicates bargaining weight estimates that differ significantly from 0.5 at the 5% level.

soft drink category, we also find that private labels have much smaller marginal costs than national brands. These results explain part of the (observed) retail price variation which is also driven by differences in price-cost margins. In each category, we find greater total price-cost margins for national brands than for private labels, which is mainly due to the double-marginalization effects. These margins, however, are not evenly split between manufacturers and retailers. In particular, we find that the price-cost margins of manufacturers are systematically lower than the price-cost margins of retailers. This suggests that the estimated bargaining weights partially explain the surplus division in the soft drink industry, especially for manufacturers 3 and 4 which have a higher bargaining ability than retailers.

In addition to the relative bargaining ability of firms, Section 2.2 highlights that two other sources of bargaining power influence the determination of trading terms between manufacturers and retailers. Table 7 displays estimates of these two bargaining forces as well as the share of the surplus generated by bilateral agreements captured by each retailer. We find that the ratio of the gains from trade of manufacturers to retailers ranges from 0.43 to 0.50, suggesting that the losses from not reaching an agreement are twice higher for retailers than for manufacturers. Although this bargaining force tends to tilt the distribution of

Table 6: **Price-cost margins and marginal costs estimates**

Categories	Retail price	Own-price elasticities	Marginal Cost	Price-cost margins: Manufacturers	Retailers	Total
Manufacturer 1:						
Colas	0.92	−3.05	0.49	12.09	35.13	47.22
	(0.02)	(0.02)	(0.01)	(0.08)	(0.19)	(0.25)
Other sodas	0.94	−3.13	0.50	12.32	35.30	47.62
	(0.03)	(0.04)	(0.03)	(0.19)	(0.40)	(0.57)
Fruit juices	1.61	−3.86	0.99	11.41	28.35	39.76
	(0.08)	(0.06)	(0.07)	(0.26)	(0.45)	(0.70)
Iced tea	0.93	−3.17	0.47	15.06	35.01	50.07
	(0.03)	(0.04)	(0.02)	(0.17)	(0.41)	(0.57)
Manufacturer 2:						
Colas	0.71	−2.76	0.43	1.29	39.89	41.18
	(0.02)	(0.05)	(0.02)	(0.06)	(0.59)	(0.60)
Other sodas	0.76	−2.82	0.45	1.32	39.21	40.53
	(0.02)	(0.05)	(0.02)	(0.06)	(0.89)	(0.86)
Fruit juices	2.19	−4.07	1.15	20.52	26.28	46.80
	(0.04)	(0.01)	(0.02)	(0.05)	(0.07)	(0.08)
Manufacturer 3:						
Iced tea	1.09	−3.35	0.52	19.45	32.81	52.26
	(0.02)	(0.02)	(0.01)	(0.10)	(0.19)	(0.29)
Manufacturer 4:						
Other sodas	1.08	−3.29	0.53	18.49	33.41	51.90
	(0.02)	(0.01)	(0.01)	(0.09)	(0.14)	(0.20)
Fruit juices	1.79	−3.96	1.04	14.57	27.38	41.95
	(0.03)	(0.02)	(0.01)	(0.11)	(0.12)	(0.23)
Private labels:						
Colas	0.30	−3.20	0.18	–	41.89	41.89
	(0.01)	(0.08)	(0.01)		(1.12)	(1.12)
Other sodas	0.39	−3.53	0.25	–	36.53	36.53
	(0.01)	(0.04)	(0.01)		(0.36)	(0.36)
Fruit juices	0.84	−3.83	0.60	–	28.83	28.83
	(0.01)	(0.01)	(0.01)		(0.12)	(0.12)
Iced tea	0.52	−3.83	0.33	–	33.64	33.64
	(0.01)	(0.04)	(0.01)		(0.38)	(0.38)

Notes: Retail prices and total marginal costs are in euros per liter. Price-cost margins are in percentage of the retail prices. All values are calculated using quantity weights and standard deviations in parenthesis refer to variation across months.

bargaining power towards manufacturers, we also find that the ratio of the concession costs of manufacturers to retailers is close to half. This highlights that the costs of making price concessions in negotiations decrease substantially more retailers' profits than manufacturers' profits, implying that the former are less willing to grant wholesale price concessions which reinforces their bargaining power. Overall, we obtain that each retailer captures more than 65% of the surplus generated by its bilateral agreements with manufacturers, indicating that retailers have a higher bargaining power than soft drink manufacturers. This result shows that firms' relative concession costs play a critical role in the distribution of bargaining power in bilateral oligopolies.

Table 7: Surplus division estimates

	Ratio of gains from trade	Ratio of concession costs	Share of retailers
Retailer 1	0.49	−0.48	67.60
	(0.01)	(0.00)	(0.18)
Retailer 2	0.48	−0.49	67.01
	(0.01)	(0.01)	(0.51)
Retailer 3	0.48	−0.48	66.48
	(0.01)	(0.01)	(0.25)
Retailer 4	0.50	−0.48	67.11
	(0.01)	(0.01)	(0.26)
Retailer 5	0.43	−0.55	69.51
	(0.01)	(0.02)	(0.67)
Retailer 6	0.48	−0.49	67.61
	(0.01)	(0.01)	(0.50)
Retailer 7	0.47	−0.49	66.60
	(0.01)	(0.00)	(0.23)

Notes: The first column displays the average ratio of gains from trade of manufacturers to retailers: $(\pi_{ft} - d_{ft}^{-j})/(\pi_{rt} - d_{rt}^{-j})$. The second column shows the quantity weighted average ratio of concession costs of manufacturers to retailers: $\frac{\partial \pi_{ft}}{\partial w_{jt}} / \frac{\partial \pi_{rt}}{\partial w_{jt}}$. The third column shows the average share of the surplus from bilateral agreements captured by each retailer. Standard deviations in parenthesis refer to variation across months.

4 The equilibrium effects of retail mergers

By affecting both downstream consumers and upstream manufacturers, the analysis of retail mergers raises thorny questions for competition authorities. In particular, the effect on buyer power and its appropriate treatment remains a challenging issue in merger enforcement. As stated by Carlton and Israel (2011): “The difficulties arise from the fact that answers to these questions turn on specific details of underlying bargaining games, which are hard to observe in practice. Hence, answers to these questions will depend on empirical tests that have been applied to the specific industries and firms in question”. Leveraging estimates of our structural model of bilateral oligopoly, we aim at shedding new light on the effect of retail mergers on the buyer power of retailers vis-à-vis manufacturers and retail prices paid by consumers.

Theoretical insights. Consider a hypothetical merger between two retailers, indexed by r and r', which gives rise to a multi-store retailer, indexed by rr', distributing the set of products $\mathscr{J}_{rt} \cup \mathscr{J}_{r't}$ (e.g., Rey and Vergé, 2020; Sheu and Taragin, 2021).[48] Based on (1b),

[48] In other words, the merger can be seen as a collusive behavior between retailers r and r' which seek to maximize their joint profits $(\pi_{rt} + \pi_{r't})$. This differs from the case where a merger reduces product variety (e.g., Iozzi and Valletti, 2014; Ho and Lee, 2017; Gaudin, 2018) or induces uniform pricing (Grennan, 2013).

we define the (per-market) profit function of the merged entity by:

$$\pi^{post}_{rr't} \equiv \sum_{j \in \mathscr{J}_{rt} \cup \mathscr{J}_{r't}} \left(p_{jt} - w_{jt} - c_{jt}\right) q_{jt}(\mathbf{p}_t) \tag{17}$$

In what follows, we examine the (pure) bargaining effect of the merger using insights drawn from Section 2. More specifically, we compare the pre-merger bilateral negotiation between manufacturer *f(j)* and retailer r over the wholesale price of product $j \in \mathscr{J}_{rt}$ with the post-merger bilateral negotiation between manufacturer *f(j)* and the merged retailer rr' over the same wholesale price.

As (17) shows, the merged retailer rr' distributes both sets of products $\mathscr{J}_{rt}$ and $\mathscr{J}_{r't}$. When these products are substitutes, the gains from trade of the merged retailer rr' in its negotiation for product $j \in \mathscr{J}_{rt}$ are lower than what retailer r obtains in the pre-merger situation. The intuition is that the marginal contribution of product j to retailer r's profit reduces when it distributes a larger number of substitute products. Based on (6), we obtain that a decrease in the gains from trade of the merged retailer strengthens its bargaining power vis-à-vis manufacturer *f(j)*. This mechanism is in line with the conventional wisdom suggesting that larger retailers are able to secure better trading terms. However, the effects generated by the merger on the relative concession costs of firms may nuance this view.

Using estimates of our structural model, Table 8 shows how firms' concession costs and their determinants described in (8a) and (8b) are affected by retail mergers in the French soft drink industry when holding retail prices fixed at the pre-merger level. The first row of the table shows that retail mergers increase on average the concession costs of manufacturers by 16.24% and decrease those of the merging retailers by −8.49%. As described in (6), these effects weaken the bargaining power of the merging retailers vis-à-vis soft drink manufacturers. Subsequent rows of the table provide further insights into the mechanisms at play by reporting the impact of retail mergers on firms' concession costs when holding one of their determinants fixed at the pre-merger level. The results show that, on average, the concession costs of manufacturers (resp. the merging retailers) would have decreased (resp. increased) by −1.06% (resp. 4.51%) if retail mergers had not impacted the effect of double-marginalization (DM) on demand. This suggests that the change in the effect of DM on demand is a key driver of the increase (resp. decrease) in manufacturers' (resp. retailers') concession costs caused by retail mergers. The intuition underlying this result is as follows. By decreasing the own retail pass-through (−9.68%), retail mergers reduce the negative effect of DM on demand which, in turn, raises the profitability of a wholesale

Table 8: Changes in firms' concession costs following retail mergers

	$\Delta \partial \pi_{f(j)}/\partial w_j$	$\Delta(-\partial \pi_{r(j)}/\partial w_j)$
Changes in firms' concession costs	16.24	−8.49
Decomposition:		
No change in the DM effect on demand	−1.06	4.51
No change in the direct steering effect	16.27	−8.51
No change in the recapture effect	16.52	5.15
No change in the indirect steering effect	17.00	−10.13
No change in the DM effect	–	−20.46
No change in the cross DM effect	–	−12.99

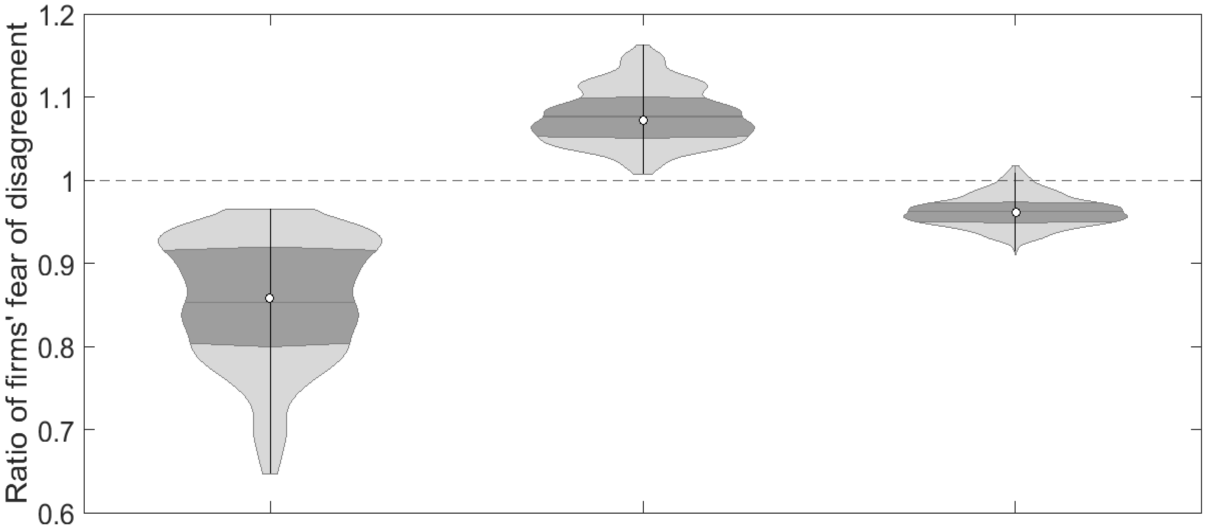
Notes: Average percentage changes in firms' concession costs following a retail merger (holding retail prices fixed at the pre-merger level) are reported across the 21 mergers involving two retailers. The first row labeled "changes in all concession costs' effects" reports the average percentage change in firms' concession costs when accounting for the impact of retail mergers on all concession costs' effects described in (8a) and (8b). Subsequent rows show the average percentage changes in firms' concession costs when holding one of their determinants fixed at the pre-merger level. DM stands for "double-marginalization".

price increase for manufacturers ($\partial \pi_{f(j)t}/\partial w_{jt}$ goes up). In contrast, this effect reduces the merging retailers' losses from a wholesale price increase, which decreases their concession costs ($-\partial \pi_{r(j)}/\partial w_j$ goes down). Although the table shows that the impact of retail mergers on the "recapture effect" also explains the decrease in retailers' concession costs, we find that changes in other determinants of firms' concession costs play a less important role in our results (especially for the increase in manufacturers' concession costs).

To summarize, we find that the ultimate impact of downstream mergers on the bargaining power of retailers vis-à-vis manufacturers depends on two opposite bargaining forces. Based on this theoretical insight, we analyze the bargaining effect of retail mergers using the notion of "equilibrium of fear" before conducting merger simulations.

Retail mergers and "equilibrium of fear". As described in (9), the outcome of the bargaining game developed in Section 2 can be interpreted in terms of "equilibrium of fear". Hence, the directional impact of retail mergers on wholesale prices can be understood by analyzing the effects on firms' fear of disagreement. Using estimates of our structural model, we compute the ratio of firms' fear of disagreement for any (hypothetical) merger of two retailers. Figure 1 displays the results. The first violin plot shows the distribution of the ratios of firms' fear of disagreement following retail mergers given that retail prices are held fixed at the pre-merger level. For any merger of two retailers, we find that the fear of disagreement of the merging retailers is systematically higher than that of manufacturers in every bilateral negotiation (that is, $\frac{1}{\lambda}\frac{\pi_{rr'(j)t}-d^{-j}_{rr'(j)t}}{-\partial \pi_{rr'(j)t}/\partial w_{jt}} > \frac{1}{(1-\lambda)}\frac{\pi_{f(j)t}-d^{-j}_{f(j)t}}{\partial \pi_{f(j)t}/\partial w_{jt}}$). Following Svejnar (1986), this suggests

Figure 1: The effects of retail mergers on the ratio of firms' fear of disagreement



Notes: Violin plots (combination of box plots with kernel density plots) depict the distribution of the effect of mergers between two retailers on the ratio of firms' fear of disagreement: $\frac{1}{1-\lambda}\frac{\pi_{ft}-d_{ft}^{-j}}{\partial\pi_{ft}/\partial w_{jt}} \times \left(\frac{1}{\lambda}\frac{\pi_{rr't}-d_{rr't}^{-j}}{-\partial\pi_{rr't}/\partial w_{jt}}\right)^{-1}$. The first violin plot shows the distribution of ratios when the retail prices are held fixed at the pre-merger level. The second violin plot shows the distribution of ratios when both the retail prices and firms' concession costs are held fixed at the pre-merger level. The third violin plot shows the distribution of ratios when retail prices are adjusted following retail mergers but wholesale prices are held fixed at the pre-merger level. In each violin plot, the dark grey area represents the interval between the 25th and the 75th percentile, the white circle shows the median, and the horizontal grey line represents the average ratio of firms' fear of disagreement.

that the merging retailers have to make price concessions to manufacturers, implying that retail mergers in the French soft drink industry tend to weaken buyer power.

To shed light on the bargaining forces at play, the second violin plot in the figure displays the distribution of the ratios of firms' fear of disagreement following retail mergers when both retail prices and firms' concession costs are held fixed at the pre-merger level. The results indicate that the fear of disagreement of the merging retailers is systematically lower than that of manufacturers, suggesting in this case that retail mergers strengthen buyer power. Combined with the first violin plot, this demonstrates that the negative effect of retail mergers on buyer power stems from their impact on firms' concession costs. By holding retail prices fixed at the pre-merger level, it is worth noting that our analysis omits the effect of retail mergers on the downstream market. To evaluate the robustness of our results to changes in downstream market concentration, we simulate post-merger retail prices (holding wholesale prices fixed at the pre-merger level) and recompute the ratios of firms' fear of disagreement. The third violin plot in the figure displays the results.[49] For most

[49]By accounting for the effect on the downstream market, these ratios provide a more accurate measure of

bilateral bargains, we find that the fear of disagreement of the merging retailers remains higher than that of manufacturers, suggesting that our results are fairly robust to changes in retail prices due to greater downstream concentration. Interestingly, however, we find that some ratios of firms' fear of disagreement are above 1. This indicates that the negative effect of retail mergers on buyer power applies to most but not all bilateral negotiations.

These results offer preliminary evidence that the impact of retail mergers on firms' concession costs dominates that on firms' gains from trade, which weakens the bargaining power of the merging retailers vis-à-vis soft drink manufacturers. To further examine the equilibrium effect of retail mergers in bilateral oligopolies, we simulate three different mergers: (i) a merger involving two large retailers (retailers 1 and 4), (ii) a merger involving a small and a large retailer (retailers 2 and 6), and (iii) a merger involving two small retailers (retailers 3 and 7).

Merger simulations. Using estimates of our bilateral oligopoly model, we simulate the impact of retail mergers on equilibrium outcomes. Based on our algorithm described in Appendix S4 of the Supplemental Material, we recompute a new bargaining and downstream price equilibrium. In particular, we perform our merger simulations holding fixed: (i) consumer preferences, (ii) the marginal cost of production and distribution of each product, (iii) the buyer-seller network structure, and (iv) the Nash bargaining weights of firms.[50]

Simulation results are reported in Table 9. For each merger, we find that the (quantity-weighted) average price-cost margins of manufacturers for products distributed by the merging retailers increase. Retail mergers thus weaken the bargaining power of the merging retailers vis-à-vis manufacturers which is consistent with the insight drawn from our preliminary analysis (Figure 1). More specifically, the change in concession costs of firms which undermines the clout of the merging retailers in negotiations with manufacturers dominates the benefit obtained from the reduction in their gains from trade. Interestingly, this wholesale price increase is higher (resp. smaller) when the merger involves two large (resp. small) retailers. Despite the retailers' loss of bargaining power vis-à-vis manufacturers, our simulation results highlight that each merger remains profitable due to a substantial increase

the directional impact of retail mergers on wholesale prices.

[50]The fact that marginal costs are held fixed is a reasonable short-run assumption that allows us to exclusively focus on the role of buyer power in merger analysis. Following prior empirical work, we also assume that the Nash bargaining weights remain unaffected by mergers (e.g., Gowrisankaran, Nevo and Town, 2015; Sheu and Taragin, 2021). An extension would be to use the approach developed by Molina (2021) which, however, requires post-merger data. Section 5 examines the robustness of our results to these assumptions.

Table 9: Results of the merger simulations

	Δ Retail price	Δ Price-cost margins		Δ Profit		Δ CS
		Manufacturer	Retailers	Manufacturer	Retailers	
Merger between retailers 1 and 4:						
Retailer 1	8.08	4.65	22.49	−2.08	2.64	–
	(0.26)	(0.12)	(0.48)	(0.21)	(0.12)	
Retailer 4	9.28	4.66	27.06	−4.37	2.03	–
	(0.17)	(0.10)	(0.44)	(0.23)	(0.08)	
Other retailers	0.66	1.42	1.76	9.75	9.95	–
	(0.01)	(0.05)	(0.02)	(0.22)	(0.16)	
Total	3.60	2.71	10.17	4.30	6.86	−1.84
	(0.08)	(0.06)	(0.16)	(0.14)	(0.07)	(0.03)
Merger between retailers 2 and 6:						
Retailer 2	6.54	2.73	12.40	−5.18	1.17	–
	(0.20)	(0.07)	(0.36)	(0.29)	(0.09)	
Retailer 6	5.36	3.29	9.34	−2.46	1.50	–
	(0.08)	(0.15)	(0.11)	(0.22)	(0.07)	
Other retailers	0.42	0.99	1.06	5.69	5.60	–
	(0.01)	(0.03)	(0.01)	(0.17)	(0.13)	
Total	1.99	1.60	5.95	2.94	4.38	−1.02
	(0.05)	(0.05)	(0.13)	(0.10)	(0.08)	(0.02)
Merger between retailers 3 and 7:						
Retailer 3	2.99	1.40	9.66	−2.56	0.69	–
	(0.01)	(0.06)	(0.18)	(0.06)	(0.02)	
Retailer 7	4.34	2.00	14.59	−4.48	0.13	–
	(0.05)	(0.12)	(0.20)	(0.09)	(0.03)	
Other retailers	0.19	0.41	0.48	2.38	2.37	–
	(0.01)	(0.01)	(0.02)	(0.05)	(0.05)	
Total	0.82	0.66	2.61	1.24	2.02	−0.44
	(0.02)	(0.02)	(0.05)	(0.04)	(0.04)	(0.01)

Notes: Percentage changes in retail prices and price-cost margins are calculated using quantity weights. "Δ CS" stands for variation in consumer surplus. Standard deviations in parenthesis refer to variation across markets.

in retail prices.[51] This upward pricing pressure causes a fall in consumer surplus which is greater for retail mergers generating higher retail price increases.

This analysis illustrates well the different bargaining forces at work in our model of bilateral oligopoly. In particular, we highlight that the concession costs of firms during negotiations may have important implications for retail merger reviews. Interestingly, our results regarding the effect of retail mergers on buyer power stand in contrast with Sheu and Taragin (2021) who consider a framework of bilateral oligopoly with a simultaneous timing assumption that rules out the role of firms' concession costs in the bargaining outcome. By accounting for this additional bargaining force, we find no support for the emergence of

[51] Note that this increase in profits is higher for the non-merging retailers than the merging retailers, which is consistent with the free-riding effect highlighted in Deneckere and Davidson (1985).

a countervailing buyer power effect as envisioned by Galbraith (1952) and outlined in the European Commission's guidelines. Instead, we obtain that the main motive for retail mergers is to increase market power, implying that antitrust practitioners should be particularly concerned about these operations. We thus believe that our findings may offer guidance on the appropriate treatment of buyer power in merger reviews.

5 Sensitivity analysis

To further analyze the economic forces underlying our results and their robustness to alternative market conditions, we conduct a sensitivity analysis. First, we examine the sensitivity of our results to changes in demand and supply-side factors, including demand curvature, the secrecy of wholesale contracts, and the pre-merger bargaining ability of retailers vis-à-vis manufacturers. Second, we analyze the robustness of our simulation results to two types of merger-specific efficiency gains: (i) greater post-merger bargaining ability and (ii) marginal cost savings.

5.1 Demand and supply-side factors

Demand curvature. Our analysis in Section 4 provides suggestive evidence that the reduction in buyer power of the merging retailers is caused by the decrease (resp. increase) in retailers' (resp. manufacturers') concession costs, which mainly depend on the pass-through rate of wholesale prices to retail prices. Following the literature on pass-through in imperfectly competitive markets (e.g., Weyl and Fabinger, 2013; Miller, Osborne and Sheu, 2017), we analyze how the buyer power effect of retail mergers depends on the curvature of demand. As pointed out by Nakamura and Zerom (2010), a key parameter of demand curvature in the random coefficient logit model is the degree of consumer heterogeneity in price sensitivity.[52] We thus perform a first counterfactual exercise by recomputing a new bargaining and downstream price equilibrium absent consumer heterogeneity in price sensitivity as in the simple logit model. We obtain that the average own-price elasticity decreases by 31.88% (from -3.39 to -4.60) and the super-elasticity of demand increases by 130.26% (from 0.40 to 1.02). This result indicates that demand becomes increasingly more elastic

[52] As stated by Nakamura and Zerom (2010): "The more heterogeneous are consumers in their degree of price sensitivity, the more a firm has an incentive to raise its markup as costs rise, because the firm's consumer base is increasingly dominated by less price sensitive consumers." (see also Goldberg and Hellerstein, 2013; Miller, Osborne and Sheu, 2017, among others).

when retail prices go up implying that retailers have more incentives to adjust their price-cost margins downward in response to an increase in wholesale prices.

Absent heterogeneity in consumer price sensitivity, we re-simulate each retail merger considered in Section 4. Results reported in Table 12 of Appendix C indicate that removing consumer heterogeneity in price sensitivity largely reduces the negative effect of retail mergers on buyer power. The intuition underlying these results is as follows. The removal of consumer heterogeneity in price sensitivity induces demand to be more price elastic as retail prices increase (the super-elasticity of demand is higher). In this case, the effect of double-marginalization on demand becomes more negative which implies that any increase in wholesale prices turns out to be less profitable for manufacturers and more detrimental for the merging retailers. Consequently, the increase (resp. decrease) in the concession costs of manufacturers (resp. the merging retailers) caused by retail mergers is smaller, which reduces its negative effect on buyer power. We obtain the same findings in another counterfactual exercise in which we increase consumer heterogeneity in price sensitivity by 100% compared to our baseline estimates (this reduces the average super-elasticity of demand by 23.77%). The simulation results are also reported in Table 12 and, for reasons similar to the scenario without consumer heterogeneity, we find that the decrease in buyer power caused by retail mergers is exacerbated compared to our baseline results.

To gain additional insights on the role of demand curvature in our results, Appendix S6 of the Supplemental Material considers a calibration exercise to examine the predictions of a retail merger under a logit demand and a linear demand system (zero curvature) in a simple model of vertical relations. Whereas the predictions under a logit demand indicate that retail mergers may either decrease or increase buyer power, we find that post-merger buyer power always increases under a linear demand. Consistent with our counterfactual simulations, this result contributes to the strand of literature studying the role of demand curvature in merger simulations (e.g., Crooke et al., 1999; Miller et al., 2016) by showing that it plays a critical role in the buyer power effect of retail mergers.

Contract observability. As stated in Section 4, we consider retail mergers that give rise to multi-store retailers. This generates two effects in our bilateral oligopoly setting with secret contracting. First, we have a more concentrated ownership structure in the downstream market. Second, there is no longer contract secrecy between the merging retailers. To disentangle the role of each effect on buyer power, we consider a counterfactual scenario in which, instead of merging, retailers are allowed to share information about their wholesale contracts (i.e., we rule out the ownership consolidation effect). More specifically, we recompute a new bargaining and downstream price equilibrium given that two retailers share information about the wholesale prices of their products before competing on the downstream market. The results depicted in Table 13 of Appendix C show that sharing information about wholesale contracts weakens the bargaining power of retailers vis-à-vis manufacturers. For instance, we find that wholesale prices paid by retailers 1 and 4 increase on average by 1.08% and 1.30% respectively. This corresponds to roughly 30% of the wholesale price increase incurred by retailers 1 and 4 when they merge. Hence, this result suggests that contract observability is an important factor in the negative effect of retail mergers on buyer power.

Pre-merger bargaining ability. To gauge the sensitivity of our result to changing the estimated vector of bargaining weights of retailers vis-à-vis manufacturers displayed in Table 5, we proceed as follows. First, holding the marginal cost of each product fixed to its estimated value, we set each element of the vector of bargaining weights to 0.5 and recompute a new bargaining and downstream price equilibrium accordingly. Given this new equilibrium, we re-simulate each retail merger considered in Section 4. We repeat the exercise by setting each element of the vector of bargaining weights to 0.01 and 0.99 respectively. Table 14 in Appendix C reports our simulation results. For each value of pre-merger bargaining weights that we consider, we find that retail mergers always increase the (quantity-weighted) average wholesale price paid by the merging retailers. This suggests that changes in firms' concession costs play a key role in the buyer power effect of retailer mergers at any level of the pre-merger bargaining weights. Note, however, that the magnitude of the wholesale price increase caused by retail mergers is smaller when the bargaining weights of retailers vis-à-vis manufacturers are low. Intuitively, this stems from the high degree of double-marginalization which, in this case, reduces the profitability of increasing wholesale prices for manufacturers.

5.2 Efficiency gains

Bargaining weight efficiencies. In addition to affecting firms' gains from trade and concession costs, we examine retail mergers that also affect the bargaining ability of the merging retailers. Assuming that the marginal cost of production and distribution of each product remains fixed, we re-simulate each retail merger of Section 4 by considering that the bargaining weights of the merging retailers vis-à-vis manufacturers increase respectively by 2.5%, 5%, 10%, and 45%. Table 15 in Appendix C reports the simulation results. We find that a 2.5% increase in the bargaining weights of the merging retailers annihilates the negative effect on buyer power of the merger between retailers 3 and 7 (two small retailers). We also find that this increase in buyer power caused by the merger is greater when considering larger efficiencies in bargaining weights. Furthermore, these efficiency gains mitigate the anti-competitive effect of the merger by lowering the retail price increase due to greater downstream concentration. Interestingly, however, we find no evidence of a countervailing buyer power effect whereby the gain in buyer power of the merging retailers generates a decrease in retail prices to the benefit of consumers. Simulation results for the two other retail mergers are more nuanced. Whereas efficiencies in the bargaining weights reduce the wholesale price increase caused by retail mergers, we find that the negative effect on buyer power still holds even with a 45% increase in the bargaining weights of the merging retailers. This suggests that mergers involving at least one large retailer are unlikely to strengthen buyer power through efficiency gains in bargaining abilities.

Marginal cost efficiencies We now investigate the case in which mergers reduce the marginal costs of distribution of the merging retailers. Assuming that retailers' bargaining weights remain fixed, we re-simulate the retail mergers by considering that the marginal cost of each product distributed by the merging retailers decreases respectively by 2.5%, 5%, and 10%.[53] Table 16 in Appendix C displays the results. As for the efficiencies in bargaining weights, we find that a 2.5% decrease in the marginal costs of products distributed by the merging retailers (almost) annihilates the negative effect of the merger between retailers 3 and 7 (two small retailers) on buyer power. We also find that these efficiency gains not only reduce but may offset the anti-competitive effect of the merger. For instance, a 10% marginal cost decrease reduces the retail prices of products sold by retailers 3 and 7 by 3.94% and 2.64% respectively. Simulation results for the two other retail mergers are more mixed. For each merger, we find that a 2.5% decrease in the marginal costs mitigates but does not neutralize the loss of buyer power of the merging retailers. As a result, this suggests that mergers involving at least one large retailer require substantial marginal cost savings to strengthen the buyer power of the merging retailers.

[53]As we are not able to separately identify the marginal costs of distribution from that of production, it is worth noting that similar results would obtain for a post-merger decrease in the marginal costs of production.

6 Concluding remarks

The concept of buyer power and its implications for market outcomes have become increasingly topical in political and antitrust debates. In this article, we offer a framework for analyzing bilateral oligopolies with upstream and downstream competition. Using the "Nash-in-Nash" solution to determine the surplus division between manufacturers and retailers, we show that bargaining outcomes can be interpreted in terms of "equilibrium of fear" and depend on three different sources of bargaining power. We also show that our framework admits analytical solutions and can be estimated in a tractable way using data on soft drink purchases in France.

Our results suggest that retailers have a higher bargaining power than soft drink manufacturers. Exploring determinants of buyer power, we find evidence that retailers' costs of making price concessions during negotiations play an important role in their bargaining power vis-à-vis manufacturers. Using estimates of our bilateral oligopoly framework, we analyze the effects of retail mergers on buyer power and retail prices paid by consumers. In contrast to the conventional wisdom, we find that the merging retailers pay higher wholesale prices following the merger. The mechanism underlying this result stems from the impact of retail mergers on the concession costs of firms in bilateral bargains. Our findings thus suggest that such bargaining effects, which have largely been ignored in previous work, have critical implications for merger analysis in bilateral oligopolies. The sensitivity analysis reveals that this negative effect on buyer power is fairly robust to the degree of heterogeneity in consumer price sensitivity, the observability of wholesale contracts, and the exogenous bargaining ability of retailers vis-à-vis manufacturers. We find, however, that merger-specific efficiencies may nuance these findings, particularly for mergers between small retailers.

Although we focus on retail mergers in the French soft drink industry, our bilateral oligopoly framework can be used to analyze a number of other industries or policy questions such as buyer alliances (Molina, 2021) or upstream horizontal mergers. In addition to its flexibility, our framework can be estimated without data on wholesale contracts or marginal costs of firms, which are rarely available in practice.

As retailers often distribute multiple product categories, a fruitful area for future research would be to extend our model to multi-category pricing. This would involve a multi-category demand model allowing for possible substitution and complementarity between product categories (see, e.g., Thomassen et al., 2017). The presence of complementary products in the "Nash-in-Nash" bargaining model would also raise a number of interesting theoretical and empirical issues that remain unexplored in the literature (see Collard-Wexler, Gowrisankaran and Lee, 2019; Easterbrook et al., 2019).

Appendix

A Descriptive statistics

Table 10: Descriptive statistics for brands

	Brand ownership					Market share		Retail price	
	M1	M2	M3	M4	PL	mean	s.d.	mean	s.d.
Colas									
Brand 4	•	◦	◦	◦	◦	0.14	0.03	1.02	0.11
Brand 5	•	◦	◦	◦	◦	11.86	0.55	0.92	0.02
Brand 9	◦	•	◦	◦	◦	1.12	0.09	0.72	0.02
PL	◦	◦	◦	◦	•	4.12	0.15	0.30	0.01
Total						17.25	0.64	0.76	0.01
Other sodas									
Brand 3	•	◦	◦	◦	◦	0.39	0.02	0.78	0.01
Brand 6	•	◦	◦	◦	◦	1.20	0.10	0.95	0.05
Brand 8	◦	•	◦	◦	◦	0.08	0.03	0.80	0.03
Brand 10	◦	•	◦	◦	◦	0.37	0.08	0.75	0.02
Brand 14	◦	◦	◦	•	◦	1.71	0.11	0.89	0.05
Brand 15	◦	◦	◦	•	◦	1.75	0.20	1.03	0.02
Brand 17	◦	◦	◦	•	◦	2.21	0.41	1.11	0.02
Brand 18	◦	◦	◦	•	◦	0.77	0.07	1.14	0.02
Brand 19	◦	◦	◦	•	◦	0.09	0.01	1.00	0.02
Brand 20	◦	◦	◦	•	◦	0.13	0.02	3.50	0.03
Brand 21	◦	◦	◦	•	◦	0.02	0.01	0.75	0.01
PL	◦	◦	◦	◦	•	7.36	0.46	0.39	0.01
Total						16.05	1.17	0.74	0.01
Fruit juices									
Brand 1	•	◦	◦	◦	◦	0.26	0.07	1.78	0.11
Brand 7	•	◦	◦	◦	◦	0.31	0.16	1.48	0.07
Brand 11	◦	•	◦	◦	◦	3.36	0.21	2.19	0.04
Brand 16	◦	◦	◦	•	◦	0.84	0.10	1.79	0.03
PL	◦	◦	◦	◦	•	29.83	1.92	0.84	0.01
Total						34.60	2.10	1.01	0.02
Iced tea									
Brand 2	•	◦	◦	◦	◦	0.22	0.06	0.93	0.03
Brand 12	◦	◦	•	◦	◦	1.95	0.35	1.08	0.02
Brand 13	◦	◦	•	◦	◦	0.12	0.05	1.32	0.08
PL	◦	◦	◦	◦	•	2.32	0.37	0.52	0.01
Total						4.61	0.79	0.79	0.02
Outside good						27.49	0.81		

Notes: $N = 265,998$. "M1", "M2", "M3" and "M4" refer respectively to manufacturers 1, 2, 3, and 4 and "PL" stands for private label. Filled circles represent the brand ownership of each manufacturer. Market shares are in number of household purchases and standard deviations refer to variation across months. Retail prices in euro per liter are calculated using quantity weights and standard deviations refer to variation across months. Remark that we are not permitted to reveal names of the brands, manufacturers and retailers due to confidentiality regarding Kantar WorldPanel data.

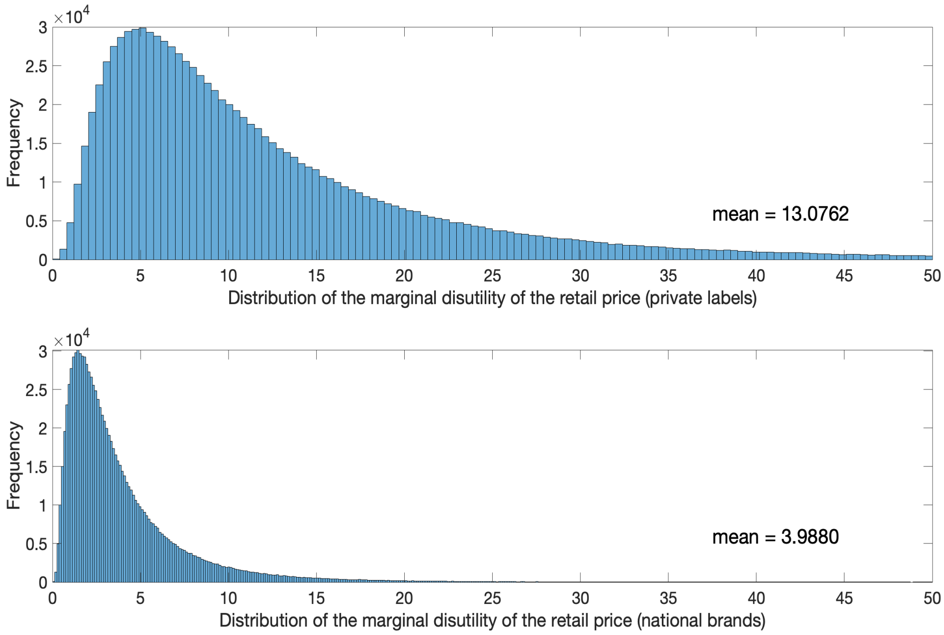
B Demand results

Table 11: First-stage of the control function approach

Variable	Coefficient	SE
Sugar content × Sugar price	0.0005	0.0012
Canned rate × Aluminium price	0.0037*	0.0004
Number of competing products	−0.0034*	0.0016
Retailer fixed effects (not shown)		
Brand fixed effects (not shown)		
F-statistic		
Excluded instruments	22.62	
R^2 adjusted	0.99	
Number of observations	919	

* indicates significance at the 5% level. Heteroskedasticity-robust standard errors.

Figure 2: Distribution of the retail price sensitivity across consumers



C Sensitivity Analysis

Table 12: Post-merger manufacturers' price-cost margins under different degrees of consumer heterogeneity in price sensitivity

	Estimated heterogeneity	No heterogeneity	Larger heterogeneity
Merger between retailers 1 and 4:			
Retailer 1	3.97	1.44	5.03
	(0.12)	(0.07)	(0.16)
Retailer 4	3.59	0.80	4.67
	(0.18)	(0.15)	(0.17)
Other retailers	1.31	0.28	1.60
	(0.05)	(0.02)	(0.05)
Total	2.30	0.63	2.91
	(0.07)	(0.02)	(0.07)
Merger between retailers 2 and 6:			
Retailer 2	1.84	−0.21	2.50
	(0.07)	(0.17)	(0.07)
Retailer 6	2.84	0.93	3.60
	(0.20)	(0.15)	(0.27)
Other retailers	0.91	0.21	1.09
	(0.03)	(0.02)	(0.03)
Total	1.35	0.27	1.69
	(0.04)	(0.01)	(0.06)
Merger between retailers 3 and 7:			
Retailer 3	1.00	0.03	1.34
	(0.08)	(0.09)	(0.08)
Retailer 7	1.50	0.28	1.95
	(0.13)	(0.09)	(0.16)
Other retailers	0.38	0.07	0.48
	(0.01)	(0.01)	(0.01)
Total	0.55	0.08	0.70
	(0.02)	(0.00)	(0.03)

Notes: Percentage changes in price-cost margins are calculated using pre-merger quantity weights. Standard deviations in parenthesis refer to variation across markets. The first column labeled "Estimated heterogeneity" shows the results of merger simulations using parameter estimates of our baseline model. The second column labeled "No heterogeneity" shows the results of merger simulations when consumer heterogeneity in price sensitivity is zero. The last column labeled "Larger heterogeneity" shows the results of merger simulations when consumer heterogeneity in price sensitivity is 100% larger than our baseline estimates.

Table 13: Results of the information sharing on manufacturers' price-cost margins

Information sharing between retailers 1 and 4:	
Retailer 1	1.08
	(0.06)
Retailer 4	1.30
	(0.04)
Other retailers	0.02
	(0.00)
Total	0.49
	(0.02)
Information sharing between retailers 2 and 6:	
Retailer 2	1.08
	(0.08)
Retailer 6	0.62
	(0.10)
Other retailers	0.01
	(0.00)
Total	0.26
	(0.02)
Information sharing between retailers 3 and 7:	
Retailer 3	0.42
	(0.03)
Retailer 7	0.54
	(0.03)
Other retailers	0.01
	(0.00)
Total	0.10
	(0.00)

Notes: Percentage changes in price-cost margins are calculated using quantity weights. Standard deviations in parenthesis refer to variation across markets.

Table 14: Sensitivity to changes in retailers' bargaining weights

	Δ manufacturers' price-cost margins
Pre-merger bargaining weights equal 0.01:	
Retailers 1 and 4 (merging retailers)	2.58
	(0.06)
Retailers 2 and 6 (merging retailers)	1.95
	(0.02)
Retailers 3 and 7 (merging retailers)	1.20
	(0.02)
Pre-merger bargaining weights equal 0.50:	
Retailers 1 and 4 (merging retailers)	3.01
	(0.07)
Retailers 2 and 6 (merging retailers)	2.11
	(0.03)
Retailers 3 and 7 (merging retailers)	1.18
	(0.02)
Pre-merger bargaining weights equal 0.99:	
Retailers 1 and 4 (merging retailers)	4.02
	(0.04)
Retailers 2 and 6 (merging retailers)	2.56
	(0.04)
Retailers 3 and 7 (merging retailers)	1.32
	(0.03)

Notes: Percentage changes in manufacturers' price-cost margins are calculated using quantity weights. Standard deviations in parenthesis refer to variation across markets.

Table 15: Results of the merger simulations with bargaining weight efficiencies

	Merger between retailers 3 and 7		Merger between retailers 2 and 6		Merger between retailers 1 and 4	
	△ Retail price	△ Manufacturers' margins	△ Retail price	△ Manufacturers' margins	△ Retail price	△ Manufacturers' margins
Efficiency in bargaining weights: 2.5%						
Retailer A	2.83	−1.60	6.49	1.78	8.07	3.91
	(0.07)	(0.09)	(0.20)	(0.07)	(0.26)	(0.12)
Retailer B	4.18	−1.11	5.35	2.78	9.23	3.53
	(0.05)	(0.14)	(0.08)	(0.20)	(0.17)	(0.17)
Other retailers	0.19	0.32	0.38	0.14	0.61	0.41
	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.06)
Total	0.79	−0.02	1.95	0.79	3.55	1.74
	(0.02)	(0.02)	(0.05)	(0.05)	(0.08)	(0.07)
Efficiency in bargaining weights: 5%						
Retailer A	2.69	−4.20	6.48	1.72	8.06	3.85
	(0.07)	(0.11)	(0.20)	(0.07)	(0.26)	(0.12)
Retailer B	4.06	−3.73	5.35	2.71	9.23	3.47
	(0.06)	(0.17)	(0.08)	(0.20)	(0.17)	(0.17)
Other retailers	0.19	0.27	0.34	−0.63	0.56	−0.50
	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.07)
Total	0.77	−0.58	1.92	0.23	3.52	1.17
	(0.02)	(0.02)	(0.05)	(0.05)	(0.08)	(0.08)
Efficiency in bargaining weights: 10%						
Retailer A	2.41	−9.41	6.47	1.59	8.05	3.72
	(0.07)	(0.18)	(0.20)	(0.07)	(0.26)	(0.12)
Retailer B	3.81	−8.98	5.34	2.57	9.21	3.35
	(0.06)	(0.23)	(0.08)	(0.20)	(0.17)	(0.17)
Other retailers	0.18	0.14	0.26	−2.19	0.47	−2.32
	(0.01)	(0.01)	(0.01)	(0.04)	(0.01)	(0.09)
Total	0.71	−1.72	1.86	−0.91	3.46	0.03
	(0.02)	(0.02)	(0.05)	(0.06)	(0.08)	(0.08)
Efficiency in bargaining weights: 45%						
Retailer A	0.47	−46.60	6.41	0.26	7.95	2.47
	(0.10)	(0.64)	(0.20)	(0.09)	(0.25)	(0.10)
Retailer B	2.09	−46.45	5.28	1.16	9.12	2.12
	(0.12)	(0.66)	(0.08)	(0.23)	(0.16)	(0.14)
Other retailers	0.15	−1.15	0.31	−13.50	-0.16	−15.53
	(0.01)	(0.04)	(0.02)	(0.13)	(0.02)	(0.28)
Total	0.34	−10.14	1.43	−9.26	3.03	−8.39
	(0.02)	(0.10)	(0.06)	(0.14)	(0.08)	(0.15)

Notes: Percentage changes in retail prices and price-cost margins are calculated using quantity weights. Standard deviations in parenthesis refer to variation across markets. Retailers A and B refer to the merging retailers, where retailer A refers to either retailer 3, or 2, or 1, and retailer B refers to either retailer 7, or 6, or 4.

Table 16: Results of the merger simulations with cost efficiencies

	Merger between retailers 3 and 7		Merger between retailers 2 and 6		Merger between retailers 1 and 4	
	Δ Retail price	**Δ Manufacturers' margins**	**Δ Retail price**	**Δ Manufacturers' margins**	**Δ Retail price**	**Δ Manufacturers' margins**
Efficiency in marginal costs: 2.5%						
Retailer A	1.21	−0.07	4.87	0.76	6.68	3.07
	(0.07)	(0.08)	(0.22)	(0.07)	(0.29)	(0.13)
Retailer B	2.54	0.41	3.81	1.78	7.78	2.66
	(0.06)	(0.14)	(0.09)	(0.20)	(0.19)	(0.18)
Other retailers	0.09	0.28	0.31	0.79	0.53	1.30
	(0.01)	(0.01)	(0.01)	(0.03)	(0.01)	(0.05)
Total	0.41	0.25	1.44	0.94	2.98	1.93
	(0.02)	(0.02)	(0.06)	(0.04)	(0.09)	(0.07)
Efficiency in marginal costs: 5%						
Retailer A	−0.53	−4.20	3.28	−0.33	5.32	2.17
	(0.08)	(0.11)	(0.23)	(0.06)	(0.33)	(0.13)
Retailer B	0.79	−3.73	2.19	0.72	6.35	1.74
	(0.07)	(0.17)	(0.11)	(0.21)	(0.20)	(0.19)
Other retailers	0.00	0.27	0.19	0.67	0.40	1.29
	(0.00)	(0.01)	(0.01)	(0.04)	(0.01)	(0.05)
Total	0.00	−0.58	0.92	0.54	2.39	1.56
	(0.02)	(0.02)	(0.06)	(0.05)	(0.09)	(0.08)
Efficiency in marginal costs: 10%						
Retailer A	−3.94	−3.35	0.16	−2.53	2.68	0.41
	(0.10)	(0.10)	(0.27)	(0.07)	(0.40)	(0.15)
Retailer B	−2.64	−2.92	−0.67	−1.42	3.58	−0.08
	(0.09)	(0.20)	(0.14)	(0.22)	(0.24)	(0.20)
Other retailers	−0.21	−0.05	−0.04	0.41	0.15	1.29
	(0.01)	(0.03)	(0.01)	(0.06)	(0.02)	(0.06)
Total	−0.80	−0.67	−0.12	−0.28	1.24	0.85
	(0.01)	(0.04)	(0.06)	(0.05)	(0.10)	(0.09)

Notes: Percentage changes in retail prices and price-cost margins are calculated using quantity weights. Standard deviations in parenthesis refer to variation across markets. Retailers A and B refer to the merging retailers, where retailer A refers to either retailer 3, or 2, or 1, and retailer B refers to either retailer 7, or 6, or 4.

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