Direct-to-Consumer Sales by Manufacturers and Bargaining

Donna, Javier D. and Pereira, Pedro and Trindade, Andre and Yoshida, Renan C.

University of Florida, Autoridade da Concorrencia, FGV EPGE, Stanford University

5 February 2020

Direct-to-Consumer Sales by Manufacturers and Bargaining

Javier D. Donna Pedro Pereira Andre Trindade Renan C. Yoshida*

February 5, 2021.

Abstract

Cutting out the intermediary and selling directly to consumers is an increasingly common strategy by manufacturers in many industries. We develop a structural model of vertical relations where manufacturers both bargain with retailers over wholesale prices and sell their products directly to consumers. We show that direct sales by manufacturers generate two effects that have opposing impact on welfare. First, direct sales generate potential welfare gains to consumers downstream due to additional competition and product variety. Second, in the upstream, there is an increase in the bargaining leverage of the manufacturers selling directly to consumers. Negotiated wholesale prices increase, thus increasing final prices to consumers and decreasing consumer welfare. We show how our model can be used to quantify the bargaining leverage and welfare effects of direct sales. We estimate our model using data from the outdoor advertising industry and use the estimated model to simulate counterfactual scenarios to isolate these effects. We conclude by discussing the relevance of the bargaining leverage effect for vertical merger evaluation.

JEL Codes: D43, L13, L42, L51, L81, M37.

Keywords: Direct-to-consumer sales, bargaining, vertical mergers, advertising.

*Donna: Department of Economics, University of Florida; and Rimini Center for Economic Analysis; jdonna@ufl.edu. Pereira: Autoridade da Concorrência; pedro.br.pereira@gmail.com. Trindade: FGV EPGE; andre.trindade@fgv.br. Yoshida: Stanford University; yoshida2@stanford.edu. We especially thank David Sappington for his many and helpful suggestions. We also thank Lucas de Lara, Fábio Miessi, and Marcelo Sant'Anna for insightful comments. The opinions expressed in this manuscript reflect only the authors' views and in no way bind the institutions to which they are affiliated. P. Pereira is pleased to acknowledge financial support from Fundação para a Ciência e Tecnologia and FEDER/COMPETE (grant UID/ECO/04007/2013). First version: June, 2018.

1 Introduction

When analyzing the negotiation of wholesale prices, most of the literature assumes that manufacturers cannot sell directly to consumers. In recent years there has been an increase in these type of direct sales to consumers as discussed below. Such increase has motivated a number of recent studies, described in the related literature, investigating the competitive effects of direct-to-consumer sales by manufacturers. Most of these papers are theoretical. At the same time, competition authorities have emphasized the importance of allowing consumers to choose between manufacturers and retailers, and the anticompetitive impact of prohibiting direct-to-consumer sales by manufacturers. Yet there are remarkably few empirical studies investigating the impact of direct-to-consumer sales on welfare, and its implications for market power and merger evaluation. This paper develops a structural model where manufacturers bargain with retailers over wholesale prices and can sell directly to consumers, estimates the model using a rich dataset from the outdoor advertising industry and uses the estimated model to quantify both the effects of direct-to-consumer sales by manufacturers on welfare and bargaining outcomes, and to evaluate policy interventions in the industry.

Direct sales to consumers by manufacturers have increased across a wide range of industries. Examples include Apple and Microsoft, selling their products directly in their stores in addition to using retailers such as Best Buy and Walmart; Nike and Adidas, selling their products directly online in addition to using retailers such as Foot Locker and Macy's; and television networks, like HBO and ESPN, selling their content directly through their online platforms, HBO Now and ESPN+, in addition of selling their content to cable companies such as Comcast and Time Warner Cable. The increase in direct sales to consumers has been facilitated by the internet through own-developed online platforms; trading platforms like Amazon, eBay, or Taobao; social media like Facebook, Twitter, and Instagram; and the internet search advertising market, where online publishers sell their inventory to advertisers either directly or through advertising marketplaces, and where large companies like Google have recently been subject of antitrust lawsuits.[1]

Concurrently, competition authorities at the Federal Trade Commission (FTC) and the Department of Justice (DOJ) have urged legislators against prohibitions of direct-to-consumer sales by manufacturers. For example, regarding the prohibitions in the U.S. on direct sales to consumers by auto manufacturers—and Tesla Motors in particular—, the FTC's Office of Policy Planning argued: "FTC staff offer no opinion on whether automobile distribution through independent dealerships is superior or inferior to direct distribution by manufacturers. [...] [C]onsumers are the ones best situated to choose for themselves both the cars they want to buy and how they want to buy them." (Federal Trade Commission, Press Release 2014). On the same subject the following quotation from the DOJ website reads: "Just as Dell has altered its distribution model in the personal computer industry to better meet evolving consumer preferences, car customers would benefit from elimination of state bans on auto manufacturers'

[1] See, *e.g.*, United States of America et al. v. Google LLC (2020) and Texas et al. v. Google LLC (2020).

making direct sales to consumers." (Bodisch 2009, p. 11).[2] The fundamental principle that consumers should be allowed to choose between manufacturers and retailers has been used beyond Tesla's case.[3]

Allowing direct-to-consumer sales by manufacturers (direct sales, henceforth) juxtaposes potential gains to consumers related to additional competition/variety downstream and potential increases in the costs of retailers arising from the additional *bargaining leverage* of manufacturers.[4] These two channels affect prices paid by consumers in opposite directions. First, direct sales by the manufacturer increase competition in the market for final products, thereby exerting downward pressure on the prices paid by consumers. Direct sales also generate additional product variety for consumers.[5] When products are differentiated, additional variety potentially increases consumer welfare through better segmentation as has been documented in the related literature described below. Second, direct sales increase the bargaining leverage of manufacturers when negotiating with retailers. This effect increases retailers' costs by increasing negotiated wholesale prices and exerts upward pressure on the prices paid by consumers. The net effect on the prices paid by consumers is ambiguous as we show in section 2. To quantify the magnitude of these effects, estimating a structural model is essential.

We develop a structural equilibrium model of a vertical industry, where manufacturers have a dual channel to the consumer. The supply side features bargaining between manufacturers and retailers, and direct sales. Manufacturers and retailers bargain over wholesale prices through Nash bargaining. We incorporate direct sales to the workhorse bargaining model used for applied work (*e.g.*, Collard-Wexler *et al.* 2019). The outside option of a manufacturer improves with direct sales: if negotiations fail a manufacturer is better off with direct sales than without them. This feature is the main difference between our model and others in the applied literature on bargaining.[6] Final prices to consumers are determined through Bertrand competition. The demand side is a standard discrete choice model of differentiated products. Consumers have idiosyncratic preferences for prices; that is, we allow for unobserved heterogeneity in the form of random coefficients for the price paid by consumers.

To illustrate our approach to investigating the welfare effects of direct sales, we estimate our model using a unique dataset from the Portuguese outdoor advertising industry. We exploit three features of the industry/data for the estimation. First, direct sales have been a steady

[2] Lafontaine and Scott Morton (2010) discuss state franchise laws in the context of automobile distribution and their implications for the profits of car manufacturers and dealers. They conclude that (p. 248): "consumers would benefit if manufacturers could have much more leeway in experimenting with alternative distribution models than the web of franchise laws currently in place allow them to do." A direct-sales channel is one of such alternative distribution models.

[3] See, *e.g.*, Bodisch (2009), Lafontaine and Scott Morton (2010), and Lao *et al.* (2015).

[4] In the context of direct sales of this paper, the bargaining leverage of a manufacturer is defined as the increase in the bargaining power of the manufacturer negotiating with a retailer due to the presence of direct sales. See subsection 4.1 for details.

[5] We define variety as the number of products available to consumers in the market. See subsection 3.1 for details.

[6] *E.g.*, see Crawford and Yurukoglu (2012), Grennan (2013), Crawford *et al.* (2018), and the references therein.

feature of this industry over the last decade. Second, we collected market level data directly from all the meaningful manufactures and retailers in the industry. The data encompass more than 95 percent of the volume of transactions in the industry. Finally, we observe both final prices paid by consumers and wholesale prices negotiated between manufacturers and retailers.

We separately estimate the demand- and supply-side parameters by GMM. The demand estimation is standard and relies on a set of moment conditions and an adequate set of instruments. We estimate the supply-side parameters conditional on the demand estimates. For the supply estimation we follow the literature on vertical relationships described below and use the optimality of the pricing decisions upstream and downstream. Specifically, the first-order conditions from the bargaining game between manufacturers and retailers determine the bargaining parameters and marginal costs, conditional on prices and demand estimates. The first-order conditions from the Bertrand-competition game for the final products determine the marginal costs, conditional on prices and demand estimates. Identification of supply relies on a set of instruments and the restrictions that marginal costs for a given manufacturer do not vary across retailers and bargaining weights for a given retailer do not vary across manufacturers, as discussed in section 3.

We use the estimated model to simulate counterfactual scenarios assessing the role of direct sales on prices and welfare in the industry. We consider a counterfactual scenario where direct sales are present but manufacturers cannot use them to increase their bargaining leverage. We also consider a counterfactual scenario where direct sales are prohibited. We show how the simulated counterfactual scenarios can be used to isolate the bargaining leverage of manufacturers due to direct sales and to quantify the welfare effects of direct sales.

Our empirical analysis quantifies the two main effects discussed: the extent to which direct sales increase wholesale prices due to the additional leverage of manufacturers, and its welfare effects. First, direct sales increase manufacturers' bargaining leverage allowing them to charge wholesale prices that are 4 percent higher in our application. The additional bargaining leverage decreases the profits of the retailers substantially, by 20 percent. Consumer welfare is reduced due to the resulting increase in consumer retail prices. Second, prohibiting direct sales generates a large decrease in both consumer welfare and manufacturers' profits in our application, 59 percent and 43 percent, respectively. Retail prices increase substantially by 26 percent as a consequence of the prohibition. There is yet an increase in retail market shares reflecting that consumers divert from direct to retail products. Retailers are the conspicuous winners from the direct-sales prohibition. Their profits increase substantially. We conclude by discussing the relevance of the bargaining leverage effect for vertical merger evaluation.

In summary, this paper makes two main contributions. First, it develops a supply model featuring bargaining and direct sales to show that direct sales increase the bargaining power of manufacturers and have ambiguous effects on final prices paid by consumers and welfare. Second, we apply our model to the outdoor advertising industry to illustrate how the estimated model can be used to quantify these effects and discuss the implications for merger evaluation.

Related Literature

Since the work by McGuire and Staelin (1983), Lee and Staelin (1997), and Choi (1991), the theoretical implic*i.e.*, ations of direct-to-consumer sales by manufacturers have been studied extensively in the marketing literature.[7] In an influential paper, McGuire and Staelin (1983) develop a model of retail choice in a duopoly setting where each manufacturer distributes its products through a single exclusive retailer. They find that vertical integration is more profitable than non-integration when consumers' preferences for the manufacturer's products are sufficiently differentiated. Chiang, Chhajed, and Hess (2003) study the strategic effects arising when a manufacturer decides to use direct marketing (*i.e.*, a direct channel to the consumers). They study a Stackelberg game, where a manufacturer distributes its product through a retailer and considers opening a direct channel. The direct channel makes the manufacturer more profitable even if no sales occur by reducing inefficiencies due to double marginalization, similar to our case. Different to our case where wholesale prices are negotiated, opening a direct channel in their game results in a reduction in wholesale prices which may also benefit the retailers. Also in a setting where wholesale prices are not negotiated, Arya, Mittendorf, and Sappington (2007) show that retailers may benefit from direct sales from an encroaching supplier when the latter does not facilitate product differentiation. Cai (2010) also uses a Stackelberg game to study the impact of channel selection on the supply chain with dual-channels (*i.e.*, with direct sales) with and without coordination; the paper shows that the profitability of different supply chain structures depends on consumers' preferences/substitutability for the distribution channels and their operational costs, similar to our paper.

Our paper is also related to the raising rivals' costs (RRC) theory by Salop and Scheffman (1983).[8] The RRC theory proposes a model to explain why vertical integration raises input prices to downstream rivals and may foreclose product-market competition, thus decreasing consumer welfare.[9] The original RRC theory assumes that manufacturers upstream have all the bargaining power.[10] Recent studies by Rogerson (2020, 2021) incorporate bargaining between upstream and downstream firms to investigate the competitive effect of vertical mergers. Closest to our paper, Rogerson (2020) shows that a vertical merger allows the merged firm to increase the price that it charges rival downstream firms for inputs by increasing its bargaining leverage over these downstream rivals. He calls it the bargaining leverage over rivals (BLR)

[7] There is also a large literature on the theoretical effects of supply chain competition. See Cachon (2002) and Ingene and Parry (2004) for surveys of the models used by the literature. See Tsay, Nahmias, and Agrawal (1999) for a review of the literature on supply chain contracts. See Cattani, Gilland, and Swaminathan (2004) for a survey of models used in internet supply chains.

[8] See also Krattenmaker and Salop (1986) and Salop and Scheffman (1987).

[9] See Riordan (2008) for a survey about the economics literature on the competitive effects of vertical integration. See also the discussions by Salop and Culley (2016) and Salop (2018). Below we discuss the empirical studies investigating vertical integration.

[10] In early studies, the submissions by Rogerson (2003a,b) to the Federal Communications Commission for the merger evaluation by News Corp./DirecTV introduce bargaining theory to the analysis of the vertical merger. See Rogerson (2021) for a recent discussion about the generalized RRC theory for vertical merger evaluation.

effect. The BLR effect has a similar economic interpretation to the bargaining leverage effect analyzed in our paper. There are two main differences between the paper by Rogerson and ours. First, the main focus of Rogerson (2020) is the evaluation of vertical mergers. Our main focus in this paper is the evaluation of direct sales. A vertical merger and the creation of a direct-to-consumer channel give rise to similar economic principles. They are, however, different strategies. The magnitude of the bargaining leverage and double marginalization effects may differ across these two strategies, as discussed in subsection 4.3. Furthermore, the creation of a direct-to-consumer channel involves an additional effect: the creation of a new downstream brand, thus increasing competition and product variety downstream and benefiting consumers. Second, the models developed are different. Rogerson (2020) develops a theory that can be used to derive an intuitive formula to measure the upward pricing pressure caused by a vertical merger due to changes in bargaining leverage. We develop a structural model injecting bargaining theory into the evaluation of direct sales that can be used to quantify the bargaining leverage and welfare effects of direct sales. Rogerson (2021) investigates the extent to which vertical integration raises input prices to downstream rivals when input prices are determined by Nash bargaining, both for the case where upstream and downstream prices are set sequentially and for the case where they are set simultaneously. To summarize, our contributions to the strands of literatures mentioned in this and the previous paragraphs are twofold. First, to provide an empirical framework to study direct sales when manufacturers and retailers bargain over wholesale prices. Second, to quantify the impact of direct sales on (wholesale and final) prices and welfare to consumers in a real-world setting.

There has also been a number of empirical studies investigating direct and online sales (*e.g.*, Anderson and Coughlan 1987; Pozzi 2013; Duch-Brown, Grzybowski, Romahn, and Verboven 2017; Quan and Williams 2018; Cazaubiel, Cure, Johansen, and Vergé 2018), channel interactions (*e.g.*, Kadiyali, Chintagunta, and Vilcassim 2000; Sudhir 2001; Cotterill and Putsis 2001; Villas-Boas and Zhao 2005), bargaining (*e.g.*, Draganska, Klapper, and Villas-Boas 2010; Crawford and Yurukoglu 2012; Grennan 2013), intermediaries (*e.g.*, Quan and Williams 2018; Donna, Pereira, Pires, and Trindade 2019), and vertical relations and vertical integration (*e.g.*, Brenkers and Verboven 2006; Villas-Boas 2007; Crawford, Lee, Whinston, and Yurukoglu 2018; Cuesta, Noton, and Vatter 2019; Luco and Marshall 2020a). We discuss the relation to each of these branches in turn.

As regards online sales, Anderson and Coughlan (1987) empirically investigate the choice of the distribution channel in foreign markets by U.S. semiconductor firms using a logistic regression analysis. They show that a product is more likely to be sold through the channel in place and that U.S. firms are more likely to integrate the distribution channel in Western Europe. They are interested in the factors leading to the distribution choice; instead, we are interested in the effect of the direct channel on market outcomes. Duch-Brown, Grzybowski, Romahn, and Verboven (2017) investigate the impact of e-commerce in the consumer electronics industry in Europe. They find that an online distribution channel increases total sales but also diverts sales from the traditional channel. They conclude that consumers and firms

benefit but the increase in consumer surplus is larger due to the positive valuation from the additional channel. Pozzi (2013) studies the introduction of online shopping by a supermarket chain. He finds an increase in overall revenues and limited cannibalization of sales from brick-and-mortar stores. Quan and Williams (2018) investigate the impact of online retail. They focus on the gains from increased product variety. In our model, direct sales increase product variety, thus improving consumer welfare through better segmentation similar to, *e.g.*, Trindade (2015). Cazaubiel, Cure, Johansen, and Vergé (2018) investigate the degree of substitution between booking a hotel room directly and using online platforms. They find that consumers are more likely to substitute to other hotels in that platform rather than staying loyal to the chain. They also find that most of the consumers who switch channels prefer to book directly with the hotel rather than through a competing platform. These papers study how the introduction of online sales affects offline sales from the same firm. Our contribution to this literature is to investigate the effect of direct sales on the sales of retailers. The direct channel in our context affects how firms (manufacturers and retailers) interact. For example, it can increase a manufacturer's bargaining leverage when negotiating wholesale prices with retailers.

The empirical literature on channel interactions uses methods from the game-theoretical literature on channel interactions in marketing to build empirical models and to investigate issues related to market power in different industries. They typically focus the analysis on pricing power in channels and within a product category. Kadiyali, Chintagunta, and Vilcassim (2000) estimate a structural model of channel interactions to measure the degree of market power of manufacturers and a retailer in the refrigerated juice market. Sudhir (2001) structurally estimate alternative models of vertical interactions between manufacturers and a retailer for the yogurt and peanut butter markets. Villas-Boas and Zhao (2005) estimate a structural model for the ketchup market to investigate the role manufacturers' competition and the impact of category pricing of the multiproduct retailer. The structural approach and the interest of this literature on the channel interactions are similar to our paper. However, these papers do not feature bargaining on the supply side.

Closest to our paper, Draganska, Klapper, and Villas-Boas (2010) develop a bargaining model to investigate the determinants of bargaining in the channel. Their model contains bargaining, multiple retailers, multiple manufacturers, and heterogeneous consumers, similar to ours. Our bargaining model is also similar to, *e.g.*, Crawford and Yurukoglu (2012) and Grennan (2013), and the empirical literature that followed. Crawford and Yurukoglu (2012) investigate the welfare effect of bundling in multichannel television markets; they develop a channel-distributor bargaining on the supply side. Grennan (2013) studies the welfare effects of price discrimination in a medical device market; he develops a model that allows for bargaining and price discrimination in this industry. In our model manufacturers also sell directly to consumers, which is not modeled by any of these papers. Similar to our paper, manufacturers also sell directly to the consumers in Donna, Pereira, Pires, and Trindade (2019) (DPPT henceforth). This is, to the best of our knowledge, the only empirical paper where manufac-

turers sell directly to consumers and manufacturers bargain with retailers. The main focus of DPPT is, however, the demand side. DPPT investigate the welfare effects to consumers of the services provided by the intermediaries. They use their supply model only to compute counterfactual prices. DPPT do not account for the central feature in our model, which is that a direct-to-consumer channel enhances manufacturer bargaining power, which can harm retail consumers. In contrast, our main focus here is the supply side. We do this to investigate the impact of direct sales on manufacturers' bargaining power which is not studied by DPPT. Ellickson, Kong, and Lovett (2018) study how private labels improve the retailer's bargaining position. They find that direct sales by the retailer generate a bargaining benefit through more favorable margins on the competing branded products, analogue to the increase in bargaining power to manufacturers in our case. While they study the effect of direct sales by a retailer (private labels), we study the effect of direct sales by a manufacturer. In addition, the supply side models are different. While they assume that retailers are monopolists (supermarkets), we allow for Bertrand competition among multiple retailers in the final product market. They use the monopoly assumption to infer wholesale prices which are unobserved in their data. In contrast, we do observe wholesale prices in our data. We use the observed wholesale prices and the restrictions from the Bertrand equilibrium to estimate retailers' marginal costs. For these reasons, the supply side identifying assumptions are different.

Our paper is also related to the literature that studies the vertical relationships between manufacturers and retailers, and vertical integration. In our paper, the two layers of activity are related vertically as in, *e.g.*, Brenkers and Verboven (2006), Mortimer (2008), Bonnet and Dubois (2010), Villas-Boas (2007), Dubois and Sæthre (2016). The main difference between these papers and ours is that in our model manufacturers and retailers bargain over wholesale prices. Bargaining models similar to the one in our paper have been recently used in a number of empirical papers investigating vertical integration. Crawford, Lee, Whinston, and Yurukoglu (2018) study vertical integration in multichannel television markets. In their paper vertical integration creates potential losses arising from incentives to foreclose rivals and raise their costs. In our case, direct sales create potential increases in the costs of retailers arising from the additional bargaining power of manufacturers. Thus the counterfactual benchmarks are different. That is, while they study how a vertically integrated manufacturer affects wholesale/final prices and welfare (relative to a situation where the manufacturer sells through a downstream distributor), we study how the presence of a direct sales channel affects those outcomes (relative to a situation without direct channel).[11] Vertical integration generates efficiency gains due to the elimination of the double marginalization and the mentioned foreclosure effects; direct sales generates additional competition/variety downstream and the mentioned increased in the costs of retailers. Cuesta, Noton, and Vatter (2019) study vertical integration between insurers and hospitals using administrative data from Chile and find that vertical integration decreases welfare. Luco and Marshall (2020a) investigate the incentives of

[11] *E.g.*, see example 7 and the discussion in section 2.

a multiproduct firm to divert demand towards the products with eliminated double margins in vertically integrated markets. Luco and Marshall (2020b) present a model of a vertical supply chain to analyze equilibrium effects of vertical integration and show that the elimination of double marginalization may fail to be procompetitive in multiproduct industries.

Finally, our paper is related to the literature studying outdoor advertising. This literature is quite small due to data limitations. We are only aware of two papers. Pereira and Ribeiro (2018) study capacity divestitures and DPPT study intermediation in this industry. These papers do not study how direct sales affect bargaining.

The rest of this paper is organized as follows. Section 2 presents the model. Section 3 discusses the data, identification, and estimation. Section 4 quantifies the effects from direct sales on outcomes. Section 5 concludes.

2 Model

In this section we present the model, discuss the economic forces at play, and show the effects of direct sales on wholesale and final prices to consumers.

2.1 Demand Model

We use a standard random coefficients logit model for individual demand similar to Berry (1994), Berry, Levinsohn, and Pakes (1995), and Nevo (2001). Assume there are $t = 1, \ldots, T$ markets, each with a continuum of rational, utility-maximizing consumers indexed by i. In each market t there are J_t horizontally differentiated inside products indexed by $j = 1, 2, ..., J_t$. We index by $j = 0$ the outside product. The indirect utility of consumer i from buying product j in market t is:

$$u_{ijt} = -\alpha_i p_{jt} + x_{jt}\beta + \tau_f + \tau_m + \tau_r + \tau_t + \xi_{jt} + \epsilon_{ijt},$$

where p_{jt} denotes the price of product j in market t; x_{jt} is a S-dimensional (row) vector of observable characteristics of product j in market t; τ_f, τ_m, τ_r, and τ_t capture the preferences for type of good f,[12] manufacturer m, retailer r, and monthly seasonal effects in market t, using fixed dummy variables for type of good, manufacturer, retailer, and monthly seasonal effects, respectively; ξ_{jt} is the valuation of unobserved (by the econometrician) characteristics of product j in market t; ϵ_{ijt} are stochastic terms assumed to be distributed according to a Type I extreme-value distribution; α_i are individual-specific parameters that capture consumers' preferences for price as described below; and β is a S-dimensional vector of parameters. In each market t we normalize the characteristics of the outside product, $j = 0$, such that $u_{i0t} = \epsilon_{i0t}$ for all t.

We model the distribution of consumers' preferences for price as $\alpha_i = \alpha + \sigma\nu_i$, where α and σ are parameters, ν_i captures unobserved (by the econometrician) individual characteristics, and $P_\nu(\nu_i)$ is a parametric distribution assumed to be a standardized Normal, $\mathcal{N}(0, 1)$, for the

[12] Display format in the application studied in section 3.

estimation. Denote by $\delta_{jt} \equiv -\alpha p_{jt} + x_{jt}\beta + \tau_f + \tau_m + \tau_r + \tau_t + \xi_{jt}$ the mean utility for product j in market t (*i.e.*, the portion of the utility that is constant across types of consumers). Then $u_{ijt} = \delta_{jt} - \sigma v_i p_{jt} + \epsilon_{ijt}$. The probability that consumer i purchases product j in market t, denoted by $\mathbb{P}_{ijt}$, is given by:

$$\mathbb{P}_{ijt} = \frac{exp(\delta_{jt} - \sigma v_i p_{jt})}{1 + \sum_{k=1}^{J} exp(\delta_{kt} - \sigma v_i p_{kt})},$$

where the equality follows from the well known logit choice probability.

Let $A_{jt}(\cdot)$ be the set of individuals who choose product j in market t. Then $A_{jt}(x_{.t}, p_{.t}, \delta_{.t}, \sigma) = \{(v_i, \epsilon_{i0t}, ..., \epsilon_{iJt}) | u_{ijt} \geq u_{ilt}, \forall l = 0, 1, ..., J\}$, where $x_{.t} = (x_{1t}, ..., x_{Jt})'$, $p_{.t} = (p_{1t}, ..., p_{Jt})'$, and $\delta_{.t} = (\delta_{1t}, ..., \delta_{Jt})'$ are observed characteristics, prices, and mean utilities for all products, respectively. Then, the market share function for each product j is:

$$s_{j,t}(x_{.t}, p_{.t}, \delta_{.t}; \sigma) = \int_{A_{jt}} \mathbb{P}_{ijt} \, \mathrm{d}P_\nu(\nu_i). \tag{1}$$

Given our focus on the supply side in this paper we purposely posit a simple specification of the demand system. This allows to keep the notation compact and highlight the main economic forces at play on the supply side. As we explain below, the demand- and supply-side parameters are estimated separately. It is thus straightforward to apply the supply-side analysis to a different specification of the demand system. In particular, we can allow for correlation in the unobserved shocks between channels by, *e.g.*, assuming that the epsilons are distributed according to the distribution assumptions of the nested logit. We can also allow for consumers to engage in costly search. To keep the demand side simple, we present the case where the epsilons are independently and identically distributed across channels and consumers do not engage in search. See DPPT for a more general specification of the demand side.[13]

2.2 Supply Model

There are two types of multi-product firms, manufacturers and retailers. Manufacturers produce basic production factors, called display formats, that they sell either to the retailers or to the consumers directly. A production factor (display format) from a given manufacturer sold to different retailers generates different products. Retailers combine manufacturer products with their own retail production factors to produce retail products, also called display formats, that they sell to consumers. There are $m = 1, \ldots, M$ manufacturers and $r = 1, \ldots, R$ retailers. Let $\mathcal{J}$ be the set of differentiated products. Denote by Ω_m^R the set of products that manufacturer m sells to retailers, Ω_m^D the set of products that manufacturer m sells directly to the consumers, and Ω_r the set of products that retailer r sells to the consumers. The timing is as follows:

[13]The results discussed in section 3 are robust to demand specifications using unobserved preferences for the distribution channels and costly search. Results are available upon request.

(1a) Manufacturers and retailers bargain over wholesale prices, $w \equiv \{w_j\}_{j\in\mathcal{J}}$, where w_j represents the wholesale price paid by a retailer to the manufacturer of product j.

(1b) Simultaneously with the bargaining over wholesale prices, retailers and manufacturers set retail prices, $p \equiv \{p_j\}_{j\in\mathcal{J}}$ to the consumers through a Nash Bertrand game. The vector p includes products from retailers and direct sales.

(2) Consumers observe all prices, p, and choose the product that maximizes their utility, thus determining the market shares, $\{s_j(p)\}_{j\in\mathcal{J}}$. Profits are realized.

Firms maximize profits when bargaining over wholesale prices and setting retail prices. The profit of retailer r is:[14]

$$\Pi_r = \sum_{j\in\Omega_r} (p_j^R - w_j) M s_j^R(p), \tag{2}$$

where M denotes market size; p_j^R denotes the price of product j sold to consumers by the retailer; and $s_j^R(p)$ denotes the market share of product j sold to consumers by the retailer.

The profit of manufacturer m is:

$$\Pi_m = \sum_{j\in\Omega_m^R} (w_j - c_j^m) M s_j^R(p) + \sum_{j\in\Omega_m^D} (p_j^D - c_j^m) M s_j^D(p), \tag{3}$$

where c_j^m denotes the manufacturer's marginal cost of product j; p_j^D denotes the price of product j sold to consumers directly by the manufacturer; and $s_j^D(p)$ denotes the market share of product j sold to consumers by the manufacturer directly.

Three comments are in order. First, we have explicitly distinguished with superscripts the market share of product j sold to retailers, denoted by $s_j^R(p)$, and the market share of product j sold directly to consumers, denoted by $s_j^D(p)$. Similarly for the prices of products sold to consumers by retailers, p_j^R, and by manufacturers directly, p_j^D. This notation eases the discussion of the examples in subsection 2.3. Second, we assume retailers' only marginal cost is the wholesale price. We make this assumption because the observed retail margins in our data are positive but very small. Thus retailers' marginal costs would have to be very small.[15] Finally, note that the profit function of manufacturers contains two terms: the profits from selling the products to the retailers and directly to the consumers. In the subsequent analysis of this section, we take the demand system as a primitive and analyze each of the following in turn: equilibrium determination of retail prices, bargaining over wholesale prices, and the leverage effect obtained by a manufacturer with direct sales.

Retail price setting. Retail prices are given by the Nash-Bertrand equilibrium. The necessary first-order conditions for the retailers are:

[14] We omit the market subscript, t, for the variables in this subsection to simplify the notation.

[15] We obtain similar results using additional retailers' marginal costs. Results are available upon request.

$$s_j^R + \sum_{k \in \Omega_r} (p_k^R - w_k) \frac{\partial s_k^R(p)}{\partial p_j^R} = 0, \qquad \forall j \in \Omega_r, \quad r = 1, \ldots, R. \tag{4}$$

The necessary first-order conditions for manufacturers from their direct sales are:

$$s_j^D + \sum_{k \in \Omega_m^R} (w_k - c_k^m) \frac{\partial s_k^R(p)}{\partial p_j^D} + \sum_{k \in \Omega_m^D} (p_k^D - c_k^m) \frac{\partial s_k^D(p)}{\partial p_j^D} = 0, \quad \forall j \in \Omega_m^f, \;\; f \in \{\mathrm{R}, \mathrm{D}\}, \;\; m = 1, \ldots, M. \tag{5}$$

The system of equations in (4) and (5) defines the vector of prices to consumers set by the retailers and by the manufacturers directly, p^R and p^D.

Wholesale price setting. The equilibrium concept for the determination of negotiated wholesale prices is Nash equilibrium in Nash bargains (Nash-in-Nash, henceforth), first proposed by Horn and Wolinsky (1988). Each negotiated wholesale price is the solution of a Nash bargain. All negotiated wholesale prices form a Nash equilibrium, *i.e.*, no manufacturer-retailer pair would like to change their negotiated wholesale price given all other agreements. We assume that firms have "passive beliefs," in that while bargaining they do not expect the other contracts to be renegotiated in case negotiation fails. This assumption is standard and has been used in applied work by Draganska, Klapper, and Villas-Boas (2010) and Crawford, Lee, Whinston, and Yurukoglu (2018), among others.

In the Nash-in-Nash framework, the disagreement payoff of a firm in the negotiation of the wholesale price of a given product is defined as the profit this firm would earn if that product was not offered keeping the other wholesale prices fixed. The disagreement payoffs for each retailer r and each manufacturer m are, respectively:

$$\Pi_{r,-j} \equiv \sum_{k \in \Omega_r | \{j\}} (p_k^R - w_k) M s_{k,-j}^R(p_{-j}),$$

and

$$\Pi_{m,-j} \equiv \sum_{k \in \Omega_m^R | \{j\}} (w_k - c_k^m) M s_{k,-j}^R(p_{-j}) + \sum_{k \in \Omega_m^D} (p_k^D - c_k^m) M s_{k,-j}^D(p_{-j}),$$

where the terms $s_{k,-j}^R(p_{-j})$ and $s_{k,-j}^D(p_{-j})$ represent the market shares of product k if product j is not offered.

The wholesale price for product j sold by retailer r solves:

$$\max_w \left(\underbrace{\Pi_r(w, w_{-j}) - \Pi_{r,-j}(w_{-j})}_{GFT_r^j} \right)^{\lambda_j} \left(\underbrace{\Pi_m(w, w_{-j}) - \Pi_{m,-j}(w_{-j})}_{GFT_m^j} \right)^{1-\lambda_j}, \quad \forall j \in \Omega_r, \quad r = 1, \ldots, R.$$

where $\lambda_j \in (0, 1)$ for all j is the retailer's bargaining weight *vis-à-vis* manufacturers; and the terms GFT_r^j and GFT_m^j stand for gains-from-trade from product j for retailer r and

manufacturer m, respectively.

The necessary first-order conditions are given by:

$$\frac{\Pi_r(w, w_{-j}) - \Pi_{r,-j}(w_{-j})}{\Pi_m(w, w_{-j}) - \Pi_{m,-j}(w_{-j})} = \frac{\lambda_j}{1-\lambda_j}, \qquad \forall j \in \Omega_r, \quad r = 1, \ldots, R. \tag{6}$$

In words, equation (6) says that the ratio of gains over the corresponding disagreement profits is equal to the ratio of bargaining weights. Rewrite equation (6) as:[16]

$$\begin{aligned} w_j s_j^R(p) = (1-\lambda_j)\left[p_j^R s_j^R(p) - \sum_{k \in \Omega_r | \{j\}} (p_k^R - w_k)\Delta s_{k,-j}^R(p)\right] + \\ + \lambda_j \Bigg[c_j^m s_j^R(p) + \underbrace{\sum_{k \in \Omega_m^R | \{j\}} (w_k - c_k^m)\Delta s_{k,-j}^R(p)}_{\equiv d_j^R} + \underbrace{\sum_{k \in \Omega_m^D} (p_k^D - c_k^m)\Delta s_{k,-j}^D(p)}_{\equiv d_j^D}\Bigg], \quad \forall j \in \Omega_r, \quad r = 1, \ldots, R. \end{aligned} \tag{7}$$

where $\Delta s_{k,-j}^f(p) \equiv s_{k,-j}^f(p_{-j}) - s_k^f(p)$, with $f \in \{\mathrm{R}, \mathrm{D}\}$.

In the last equation we expressed the manufacturer's gains-from-trade as $GFT_m^j = (w_j - c_j^m)s_j^R - d_j^R - d_j^D$, where d_j^R and d_j^D are non-negative terms representing the additional profits the firm obtains from its other products (from the retail and direct channel, respectively) when product j stops being offered. The term $d_j^R + d_j^D$ represents manufacturer m's opportunity cost or shadow price from dealing with retailer r. The presence of direct sales increases this opportunity cost.

The system of equations in (7) defines wholesale prices as a function of demand primitives and the vector of prices to consumers set by the retailers and by the manufacturers directly, p^R and p^D. Finally, note that for manufacturers that do not sell directly to consumers the problem and optimality conditions are analogous with the only difference being that d_j^D is zero.

Equilibrium. Using the notation for the firms in this subsection rewrite the market share function for product j sold by firm $f \in \{\mathrm{R}, \mathrm{D}\}$ in equation (1) as:

$$s_j^f(\cdot) = \int_{A_j} \mathbb{P}_{ij} \, \mathrm{d}P_\nu(\nu_i), \qquad \forall j \in \mathcal{J}. \tag{8}$$

The market share function in (8), and the equilibrium prices of the industry in (4), (5), and (7) characterize the equilibrium behavior in the industry.

2.3 Economic Intuition

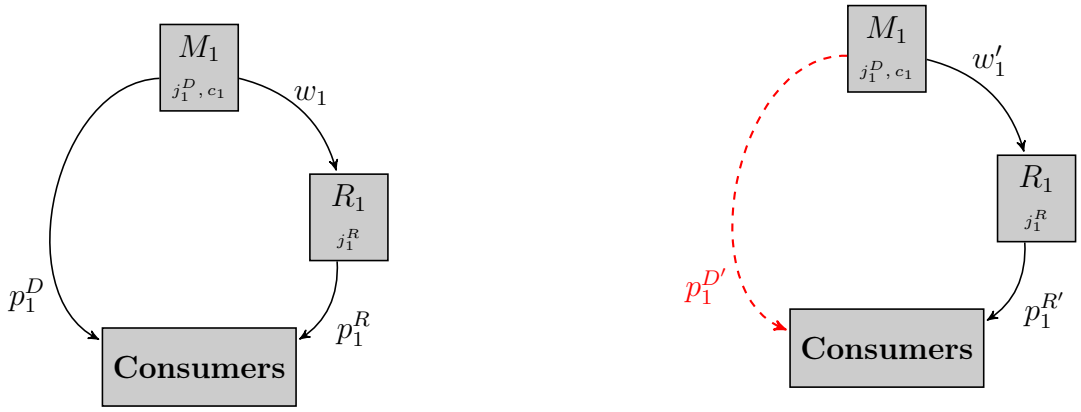
In this subsection we present three examples to discuss the main economic forces at play and how the existence of a direct channel may affect the negotiated wholesale prices and the prices paid by consumers. In the first example there is a single manufacturer interacting with a single retailer. It shows that the negotiated wholesale price and the final price to

[16] See appendix A for details about the derivations of equations (6) and (7).

consumers decrease unambiguously when the manufacturer does not leverage its direct sales in the negotiation. In the second example there are two manufacturers interacting with a single retailer. It shows the same results from example 1 when both manufacturers do not use leverage of direct sales. In the third example we show that there are ambiguous effects on prices upstream and downstream when only one manufacturer does not leverage its direct sales in the negotiation. Throughout the rest of this subsection we assume that downstream products are substitutes.[17]

Example 1. No leverage with one manufacturer and one retailer.

Figure 1: No leverage with one manufacturer and one retailer.



(a) M_1 uses leverage from direct sales.

(b) M_1 does not use leverage from direct sales.

Notes: The figure illustrates the leverage effect with one manufacturer and one retailer from example 1. Panel a. In the upstream manufacturer M_1 produces input 1 at marginal cost c_1. This input is sold to retailer R_1 at the negotiated wholesale price w_1, and used to manufacture product j_1^D. In the downstream there are two competing firms, M_1 and R_1. Manufacturer M_1 sells product j_1^D directly to consumers at price p_1^D. Retailer R_1 sells product j_1^R at price p_1^R. Panel b. The dotted red line denotes that the manufacturer M_1 does not use the leverage from direct sales when negotiating with retailer R_1. Not using the leverage results in a lower (relative to panel a) negotiated wholesale price, $w_1' < w_1$. Holding constant product competition and product variety downstream, the decrease in the wholesale price to w_1' creates a downward pressure on downstream prices, $p_1^{D'}$ and $p_1^{R'}$.

There is one manufacturer, M_1 and one retailer, R_1. In the upstream manufacturer M_1 produces input 1 at marginal cost c_1. This input is sold to retailer R_1 at the negotiated wholesale price w_1, and used to manufacture product j_1^D. In the downstream there are two competing firms, M_1 and R_1. Manufacturer M_1 sells product j_1^D directly to consumers at price p_1^D. Retailer R_1 sells product j_1^R at price p_1^R. There are three prices, w_1, p_1^D, and p_1^R, characterized by the system in equations (4), (5), and (6). Figure 1a depicts the situation. The downstream first-order conditions (4) and (5) become:

$$(p_1^R): \qquad s_1^R(p) + (p_1^R - w_1)\frac{\partial s_1^R}{\partial p_1^R}(p) = 0,$$

[17]The discussion about the opening of a direct-to-consumer channel also involves the elimination of double marginalization. We omit the double-marginalization effect in this subsection because it is not relevant for the trade-off emphasized in these examples. See subsection 4.3 for a discussion about the elimination of double marginalization in the context of direct sales.

$$(p_1^D): \qquad s_1^D + (w_1 - c_1)\frac{\partial s_1^R}{\partial p_1^D}(p) + (p_1^D - c_1)\frac{\partial s_1^D}{\partial p_1^D}(p) = 0.$$

Similarly, the upstream first-order condition (6) can be written as:

$$(w_1): \quad \left[w_1 - (\lambda_1 c_1 + (1-\lambda_1)p_1^R)\right] s_1^R(p) = \underbrace{\lambda_1(p_1^D - c_1)\underbrace{\left(s_{1,-j}^D(p) - s_1^D(p)\right)}_{>0}}_{\equiv \text{DSE}>0},$$

where the term on the right-hand side represents the direct sales effect denoted by DSE.

Now consider the same setting without leverage of the manufacturer from direct sales. Figure 1b depicts the situation. The dotted red line denotes that the manufacturer M_1 does not use the leverage from direct sales when negotiating with retailer R_1. To keep product variety and downstream competition constant we maintain that direct sales are still an option for consumers. This allows us to isolate the leverage effect due to direct sales.[18] Without leverage of the manufacturer the term DSE in the last equation is zero. Then:

$$\underbrace{w_1 = \lambda c_1 + (1-\lambda)p_1^R + {}^{\text{DSE}}/_{s_1^R(p)}}_{\text{with direct sales}} > \underbrace{w_1' = \lambda c_1 + (1-\lambda)p_1^{R'}}_{\text{without direct sales}},$$

where the inequality follows because a change in $\Delta_{w_1} > 0$ in w_1 generates a change in the same direction but lower in magnitude in p_1^R, because the pass-through from w_1 to p_1^R cannot exceed one and because $0 < \lambda < 1$.[19]

Thus, $w_1 > w_1'$. The decrease in wholesale prices without leverage creates a downward pressure on downstream prices, $p_1^{D'}$ and $p_1^{R'}$.

In sum, when the manufacturer starts using the leverage from direct sales: (i) wholesale prices increase upstream allowing it to extract a higher fraction of the vertical channel surplus; and (ii) prices to consumers increase downstream.

Example 2. No leverage effect from two manufacturers.

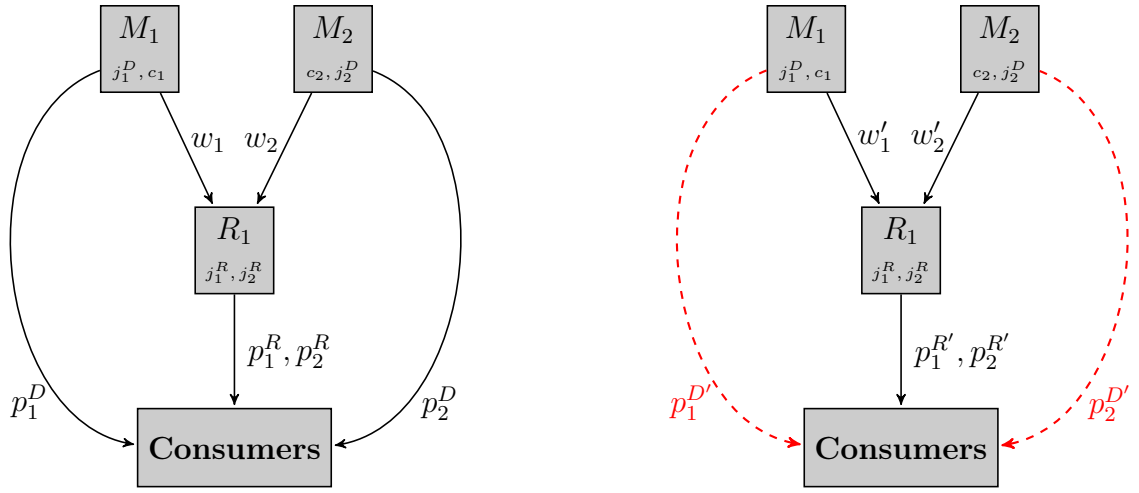
Now there are two manufactures and one retailer. In the upstream manufacturers M_1 and M_2 produce, respectively, inputs 1 and 2 at costs c_1 and c_2. These inputs are sold to retailer R_1 at, respectively, the negotiated wholesale prices w_1 and w_2, and used to manufacture products j_1^D and j_2^D. In the downstream there are three competing firms, M_1, M_2, and R_1. Manufacturers M_1 and M_2 sell, respectively, products j_1^D and j_2^D directly to consumers at prices p_1^D and p_2^D. Retailer R_1 sells products j_1^R and j_2^R at prices p_1^R and p_2^R, respectively. Now there are 6 prices, w_1, w_2, p_1^D, p_2^D, p_1^R, and p_2^R. Figure 3a depicts the situation. The downstream first-order conditions in equations (4) and (5) become:

$$(p_1^R): \qquad s_1^R(p) + (p_1^R - w_1)\frac{\partial s_1^R}{\partial p_1^R}(p) + (p_2^R - w_2)\frac{\partial s_2^R}{\partial p_1^R}(p) = 0, \tag{9}$$

[18] Alternatively, one can think about a manufacturer with two separate divisions/managers, one for direct sales to consumers and other for wholesales to retailers. These managers/divisions do not internalize the profits from the other division.

[19] That is, let $\Delta_{w_1} \equiv |w_1' - w_1|$ and $\Delta_{p_1^R} \equiv |p_1^{R'} - p_1^R|$, where the prime superscripts refer to the situation without leverage of the manufacturer from direct sales as depicted in Figure 1b. Then: $\Delta_{w_1} > \Delta_{p_1^R}$.

Figure 2: No leverage effect from two manufacturers.



(a) M_1 and M_2 use leverage from direct sales.

(b) Neither M_1 nor M_2 use leverage from direct sales.

Notes: The figure illustrates the leverage effect of one manufacturer with two manufacturers and one retailer from example 2. Panel a. In the upstream manufacturers M_1 and M_2 produce, respectively, inputs 1 and 2 at costs c_1 and c_2. These inputs are sold to retailer R_1 at, respectively, the negotiated wholesale prices w_1 and w_2, and used to manufacture products j_1^D and j_2^D. In the downstream there are three competing firms, M_1, M_2, and R_1. Manufacturers M_1 and M_2 sell, respectively, products j_1^D and j_2^D directly to consumers at prices p_1^D and p_2^D. Retailer R_1 sells products j_1^R and j_2^R at prices p_1^R and p_2^R, respectively. Panel b. The dotted red lines denote that the manufacturers M_1 and M_2 do not use the leverage from direct sales when negotiating with retailer R_1. Not using the leverage results in a lower (relative to panel a) negotiated wholesale prices: $w_1' < w_1$ and $w_2' < w_2$. Holding constant product competition and product variety downstream, the decrease in the wholesale prices create an imbalance in the first-order conditions of the retailer. The change of w_1' relative to w_2' will determine how retailer R_1 will adjust its prices. For example, if w_2' decreases more than w_1', it is relatively more profitable for R_1 to sell product j_2^R, thus creating an incentive to increase $p_1^{R'}$ and decrease $p_2^{R'}$ to divert demand to product j_2^R.

$$(p_2^R): \qquad s_2^R(p) + (p_2^R - w_2)\frac{\partial s_2^R}{\partial p_2^R}(p) + (p_1^R - w_1)\frac{\partial s_1^R}{\partial p_2^R}(p) = 0, \tag{10}$$

$$(p_1^D): \qquad (w_1 - c_1)\frac{\partial s_1^R}{\partial p_1^D}(p) + s_1^D + (p_1^D - c_1)\frac{\partial s_1^D}{\partial p_1^D}(p) = 0, \tag{11}$$

$$(p_2^D): \qquad (w_2 - c_2)\frac{\partial s_2^R}{\partial p_2^D}(p) + s_2^D + (p_2^D - c_2)\frac{\partial s_2^D}{\partial p_2^D}(p) = 0. \tag{12}$$

Upstream, first-order condition (6) for manufacturer M_1 becomes:

$$(w_1): \qquad \lambda_1 \left[(w_1 - c_1)s_1^R(p) + (p_1^D - c_1)\underbrace{\left(s_1^D(p) - s_{1,-j}^D(p)\right)}_{<0} \right]$$
$$= (1 - \lambda_1)\left[(p_1^R - w_1)s_1^R(p) + (p_2^R - w_2)\underbrace{\left(s_2^R(p) - s_{2,-j}^R(p)\right)}_{<0} \right].$$

The main difference relative to example 1 is on the right-hand side: in the downstream firms now have to take into account the profits from product 2. The above condition

can be rewritten as:

$$(w_1): \quad \left[w_1 - (\lambda_1 c_1 + (1-\lambda_1)p_1^R)\right] s_1^R(p) = \underbrace{\lambda_1(p_1^D - c_1)\underbrace{\left(s_{1,-j}^D(p) - s_1^D(p)\right)}_{>0} + (1-\lambda_1)(p_2^R - w_2)\underbrace{\left(s_2^R(p) - s_{2,-j}^R(p)\right)}_{<0}}_{\text{Direct sales term}}. \quad (13)$$

Similarly, for manufacturer M_2:

$$(w_2): \quad \left[w_2 - (\lambda_2 c_2 + (1-\lambda_2)p_2^R)\right] s_2^R(p) = \underbrace{\lambda_2(p_2^D - c_2)\underbrace{\left(s_{2,-j}^D(p) - s_2^D(p)\right)}_{>0} + (1-\lambda_2)(p_1^R - w_1)\underbrace{\left(s_1^R(p) - s_{1,-j}^R(p)\right)}_{<0}}_{\text{Direct sales term}}. \quad (14)$$

Now consider the situation in Figure 2b where neither M_1 nor M_2 use leverage from direct sales. Using the last equations one can see that both wholesale prices decrease to w_1' and w_2'. This generates an imbalance in the first-order conditions (9) to (12). Prices from the retailer downstream, p_1^R and p_2^R, may increase or decrease depending on the relative change of wholesale prices and the demand system. To see this consider the first-order conditions of the multi-product retailer, (9) and (10). For example, if w_1 decreases substantially more than w_2, R_1 may have an incentive to decrease p_1^R and to increase p_2^R to divert demand towards the cheaper product upstream. Alternatively, (9) and (10) may generate an incentive to decrease both prices, p_1^R and p_2^R. The manufacturers' first-order conditions, (11) and (12), reflect an incentive to decrease prices of direct sales downstream to $p_1^{D'} < p_1^D$ and $p_2^{D'} < p_2^D$, respectively.

In sum, when both manufacturers start using leverage from direct sales: (i) wholesale prices increase upstream; and (ii) some prices to consumers increase, while others may decline.

Example 3. Two manufacturers, no leverage from one of them.

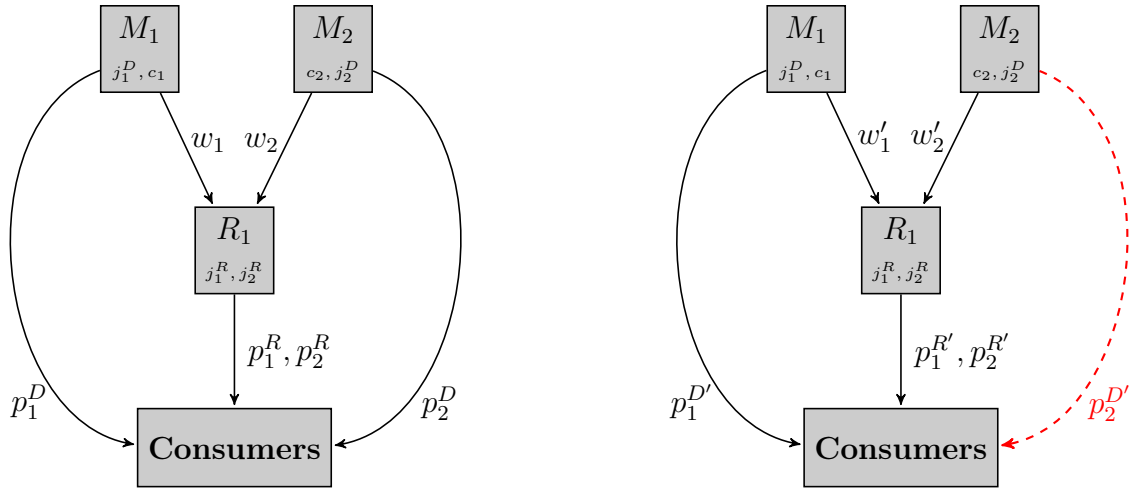
Consider now the same situation as in example 2 where equilibrium prices are characterized by first-order conditions (9) to (14). Now, however, consider a situation where only M_1 uses leverage from direct sales as depicted in figure 3b. As before when M_2 does not use the leverage of direct sales the negotiated wholesale price decreases, $w_2' < w_2$ relative to Figure 3a. The effect upon w_1 is less clear because the final prices to consumers move in different directions. To see this, consider retailer first-order conditions. The decrease in the wholesale price to w_2' creates an imbalance:

$$(p_1^R): \quad s_1^R + (p_1^R - w_1)\frac{\partial s_1^R}{\partial p_1^R}(p) + (p_2^R - w_2')\frac{\partial s_2^R}{\partial p_1^R}(p) > 0,$$

$$(p_2^R): \quad s_2^R + (p_2^R - w_2')\frac{\partial s_2^R}{\partial p_2^R}(p) + (p_1^R - w_1)\frac{\partial s_1^R}{\partial p_2^R}(p) < 0.$$

Now it is relatively more profitable for retailer R_1 to sell product j_2^R. There is an incentive to increase p_1^R relative to p_2^R to divert demand to product j_2^R. This effect

Figure 3: No leverage from one manufacturer.



(a) M_1 and M_2 use leverage from direct sales.

(b) M_2 does not use leverage from direct sales.

Notes: The figure illustrates the leverage effect of one manufacturer with two manufacturers and one retailer from example 3. Panel a. In the upstream, manufacturers M_1 and M_2 produce, respectively, inputs 1 and 2 at costs c_1 and c_2. These inputs are sold to retailer R_1 at, respectively, the negotiated wholesale prices w_1 and w_2, and used to manufacture products j_1^D and j_2^D. In the downstream, there are three competing firms, M_1, M_2, and R_1. Manufacturers M_1 and M_2 sell, respectively, products j_1^D and j_2^D directly to consumers at prices p_1^D and p_2^D. Retailer R_1 sells products j_1^R and j_2^R at prices p_1^R and p_2^R, respectively. Panel b. The dotted red line denotes that the manufacturer M_2 does not use the leverage from direct sales when negotiating with retailer R_1. Not using the leverage results in a lower (relative to panel a) negotiated wholesale price for M_2, $w_2' < w_2$. Holding constant product competition and product variety downstream, the decrease in the wholesale price to w_2' creates an imbalance in the first-order conditions of the retailer. Now is relatively more profitable for retailer R_1 to sell product j_2^R, thus creating an incentive to increase $p_1^{R'}$ and decrease $p_2^{R'}$ to divert demand to product j_2^R.

is documented by Luco and Marshall (2020a) for the carbonated beverage industry.[20] Thus, in the upstream the net effect upon w_1 is ambiguous. In the downstream prices move in different directions: p_2^D and p_2^R decrease, the effects on p_1^R and p_1^D are ambiguous.

In sum, example 3 shows that when one manufacturer starts using the leverage from direct sales it is relatively more profitable for the retailer to sell the product of the manufacturer without direct sales. This creates an incentive for the retailer to increase the price of the product from the manufacturer with direct sales. In turn this creates an ambiguous effect on final prices to consumers. There is also an ambiguous effect on the negotiated price of the other manufacturer.

In appendix C we provide three examples with the graphic representation of the industry for the following cases: (i) no direct sales from one manufacturer; (ii) no direct sales from both manufacturers; and (iii) direct sales *vs.* vertical integration. In section 4 we investigate counterfactual outcomes similar to the ones in the examples above, but using a more general setting with multiple manufacturers, multiple retailers, and multiple display formats applied to the outdoor advertising industry.

[20] They call it the Edgeworth-Salinger effect.

3 Data, Identification, and Estimation

3.1 Data

In this subsection we provide an overview of the industry and the data.[21]

Industry. For the empirical analysis we focus on the outdoor advertising industry in Portugal. There are three main economic agents in this industry: manufacturers, retailers, and consumers. A manufacturer is a firm that installs and commercially exploits equipment for the display of outdoor advertising. A retailer is an intermediary that buys advertising from the manufacturer on behalf of the consumer. Finally, a consumer is a firm that demands advertising to promote its products. For inside products, consumers make 85 percent of their purchases from the retailers and the remaining 15 percent directly from the manufacturers (table 1). In this industry there are two active distribution channels: direct sales and retailing.

There are three main display formats: 2 m^2 panels,[22] Seniors, and Others. Panels of 2 m^2 are relatively small panels that appear on city information panels, bus shelters, kiosks, *etc.* A Senior is an advertising panel with an area between 8 and 24 m^2. The last category, "Others," encompasses Transports and Special Formats. A Transport includes panels on moving vehicles (*e.g.*, buses, trains, taxis, *etc.*) or transport hubs (*e.g.*, airports, railway's stations, subways' stations, *etc.*). A Special Format is large panel typically made by special request to be displayed, *e.g.*, on buildings' gables.

Dataset, products, and market. The dataset was obtained from DPPT. It is administrative data with all the meaningful manufacturers and retailers in the industry for the year 2013 aggregated at the monthly market level. The data encompass more than 95 percent of the volume of transactions in the industry. Following DPPT, we consider 3 display formats: 2 m^2 panel, senior, and an additional category aggregating the remaining formats that have very small market shares individually. We consider 4 manufacturers: the 3 main manufacturers in the industry (J.C. Decaux Group, Cemusa, and Mop) and an additional manufacturer that aggregates the smaller manufacturers. Finally, we consider 9 retailers: the 5 main retailers in the industry (Omnicom Media Group, WPP Plc., Power Media Group Inc., Havas Media Group, and Interpublic Group of Companies), 1 additional retailer that aggregates the smaller retailers, and the 3 manufacturers selling directly to consumers (J.C. Decaux Group, Cemusa, and Mop). The smaller manufacturers do not sell directly to consumers. We refer to the 3 main manufacturers as m_1, m_2, and m_3, not necessarily in the order above, to the additional manufacturer as m_4, to the retailers that sell directly to the consumers as r_1^d, r_2^d, r_3^d, by the same order as the 3 main manufacturers, to the 5 main retailers as $r_4^v, \ldots, r_8^v$, not necessarily in the order above, and to the additional retailer as r_9^v. Characteristics of the manufacturers

[21] DPPT, Section 2 provide a thorough description.
[22] In the setting studied m^2 refers to square meters.

and retailers were collected by inspecting the websites of the retailers and manufacturers. The appendix in DPPT describes the procedure to clean the data.

In each month and for each triplet of display format, manufacturer, and retailer we observe: the total sales, measured in Euros; the total quantity of advertising sold, measured in advertising faces and square meters; the wholesale prices charged from the manufacturers to the retailers, measured in Euros; the commissions, fees, and quantity discounts paid to the manufacturers, measured in Euros; and the installed capacity, measured in advertising faces. We also observe characteristics for each manufacturer and retailer, such as the number of offices.

We define a product as a combination of display format, manufacturer, and retailer (including direct sales and retailers). Geographically, all manufacturers and retailers operate in the same market. This follows from Portugal being a small country, where the population is concentrated along the coast. For the definition of the geographic market we follow the Portuguese Competition Authority which considered that the geographic market for this industry is Portugal.[23]

Following DPPT, we use the data described above to build a data set of products sold for each month of the year 2013 and their characteristics. Market shares are defined by dividing volume sales by the total potential sales in a given month (*i.e.*, market size). This potential sales (or market size) was assumed to be twenty percent greater than the maximum observed total monthly sales of the year 2013. The market share of the outside good was defined as the difference between one, and the sum of the market shares of the inside goods in each month. The outside good can be conceptualized as including products outside the sample (*e.g.*, special request panels), outdoor advertising sold by other manufacturers and retailers (*e.g.*, small manufacturers and retailers that operate locally), and not buying outdoor advertising. An observation in this data set represents a market share of a product as defined above in a given month. We consider 12 markets, one for each month of the year, and a continuum of heterogeneous consumers in each market.

Summary statistics. We provide summary statistics of the market shares and prices in tables 1 and 2, respectively. Table 1 shows the market shares of each of the products in the sample. All of the retailers contract with the three largest manufacturers. Table 2 reports summary statistics on wholesale and retail prices for each display format. Mean retail prices are only slightly higher than the corresponding wholesale prices. That is, retailers have a low margins indicating they have low bargaining power. Table 2 shows large differences in prices across both manufacturers and retailers holding constant the display format. These price differences and the differences in the observed market shares suggest that differentiation is important in this industry.

[23] See the merger review case on the outdoor advertising industry, case Ccent. 15/2014 JCDecaux/Cemusa.

3.2 Identification and Estimation

Below, we discuss identification and estimation of the demand- and supply-side parameters using aggregate-level data. We devote more space to supply side, which is the focus of the paper.

Demand

Identification of demand. Identification of the price coefficient, α, and the heterogeneity parameter, σ, requires at least one instrument for each of these parameters. We rely on instruments with exclusion restrictions. As regards the price coefficient, we assume that firms observe ξ_{jt} in the supply model. It enters thus in the markup term of the pricing equation and introduces a bias to the estimate of α. We use prices of the same product in other markets as instruments for the price of the product in the current market, as in Hausman (1996) and Nevo (2001). As regards the heterogeneity parameter, there is an endogeneity problem due to the parameter σ interacting with the endogenous variables, (s_{jp}, p_{jt}). We use a variation of the differentiation instruments proposed by Gandhi and Houde (2019). We construct instruments defined by a proximity measure counting the number of competitors located within one standard deviation of product j. Specifically, we use the count of other products whose predicted prices lie within five Euros of the own price, and the interaction of this variable with product and manufacturer dummy variables.[24,25]

Estimation of demand. We estimate the parameters that characterize demand without using the supply-side model. We estimate the model by GMM by relying on the moment condition $\mathbb{E}[Z'\omega(\theta^*)] = 0$, where Z is the matrix of instruments obtained by stacking the instruments described in the previous paragraph, $\omega(\cdot)$ is a vector with the structural error term defined below, and $\theta^* = (\alpha, \beta, \sigma)$ is the true value of the parameters. The GMM estimate is:

$$\hat{\theta} = \arg\min_{\theta} \left[\omega(\theta)' Z A^{-1} Z' \omega(\theta)\right],$$

where A is a consistent estimate of $\mathbb{E}(Z'\omega\omega'Z)$; for the estimation we use the inverse of the sample variance of the empirical moments as the weighting matrix.

For each candidate parameter vector, we use equation (1) to compute the market share function, $s_{jt}(p_{jt}, x_{jt}, \delta_{jt}; \sigma)$. Then, we find the mean utility level, δ_{jt}, that equates:

$$s_{jt}(p_{jt}, x_{jt}, \delta_{jt}; \sigma) = S_{jt}, \tag{15}$$

[24]Following DPPT we use predicted prices instead of the potentially endogenous prices. To that end, to construct the differentiation instruments, we run a preliminary regression of prices on characteristics, predict prices from this regression, and use the predicted prices to count the number of products within the 5-Euro band. Using such predicted prices generates a valid instrument (even if prices are endogenous) because the characteristics used in the preliminary regression are exogenous. Such regression generates an unbiased estimate of prices in which structural shocks are removed. The characteristics included in the preliminary regression explain over 90 percent of the price variation in the data.

[25]We have also experimented with a band of ten Euros and obtained similar results.

where S_{jt} are the observed market shares obtained from the data. We use the contraction mapping by Berry, Levinsohn, and Pakes (1995) to solve for the system of equations in (15). Then, we define the structural error term as $\omega_{jt} \equiv \delta_{jt}(p, x, S; \sigma) + \alpha p_{jt}$.

Supply

We discuss next identification of the model in subsection 2.2. We then present the estimation procedure. For general supply identification and estimation arguments see DPPT (pp. 28-30 and appendix E).

Identification of supply. The supply is characterized by the equations in (4), (5), and (7). A necessary and sufficient condition for identification of the supply-side parameters is that the marginal cost of a given display format in a given month is the same whether the display format is sold directly to the consumer or to a retailer (DPPT). Under that assumption, equations in (4), (5), and (7) jointly identify the vectors of retail marginal costs, manufacturer marginal costs, and bargaining weights.

The following assumptions, discussed below, simplify the supply model. They provide sufficient conditions for identification. We later used them in the estimation routine.

Assumption 1. *For each retailer, the retail marginal cost is zero. That is, let c_j^r be the retailer marginal cost of product j. Then, $c_j^r = 0$ for all $j \in \Omega_r$ and for all $r = 1, \ldots, R$.*[26]

Assumption 2. *For a given manufacturer, marginal costs of a display format do not vary across retailers or direct sales. That is, call c_{dj}^m the marginal cost of of display format d sold by manufacturer m to retailer j and c_{dm}^m the marginal cost of of display format d sold directly by manufacturer m; then, $c_{dj}^m = c_{dk}^m = c_{dm}^m$ for all $(j,k) \in \Omega_m^R$ and $m \in \Omega_m^D$.*

Assumption 3. *For a given retailer, bargaining weights do not vary across manufacturers. That is, $\lambda_j = \lambda_k$ for all $(j,k) \in \Omega_r$.*

These assumptions merit further discussion. The first assumption is reasonable in our setting given the small retail margins observed in the data (see table 2).[27] The assumption allows us to omit the vector of retailer marginal costs in the supply-side analysis (estimation and counterfactual analysis). Regarding assumption 2, for a manufacturer, the physical display formats and services offered in both channels are the same. Any potential cost difference is due to fixed costs. Assumption 3 is related to the nature of the data in the empirical setting studied, as explained below. Assumptions 2 and 3 reduce respectively the dimension of the vectors of manufacturer marginal costs and bargaining weights. Assumptions 1 to 3 have implications for identification (discussed next) and for estimation (discussed in the next subsection). For identification, they allow to identify the supply-side parameters using

[26] This assumption is implicit in the formulation of the profit of the retailers, as noted in footnote 15.

[27] We have performed the estimation without this assumption and obtained retailers' marginal costs that were very close to zero.

equation (7) alone (instead of using equations 4, 5, and 7 as in DPPT). First, one can omit equation (4) to compute the structural error term (equation 16 below; equation 18 in DPPT). Intuitively, assumption 1 (zero retail costs) allows to omit equation (4), defining the necessary first-order conditions of the retailers. Alternatively, equation (4) can be used jointly with equation (7) to recover the retailer marginal costs (see footnote 27). Second, assumptions 2 and 3 allow us to omit equation (5) defining the necessary first-order conditions of the manufacturers for their direct sales. The reason is twofold. On the one hand, the manufacturer marginal costs in the second and third terms in equation (5) are, respectively, the ones in the last two terms in equation (7) due to assumption 2. On the other, the system in (7) defines a system of $M \times R$ equations for each market t and display format. This system "just identifies" the vectors of manufacturer marginal costs and bargaining weights. The vector of manufacturer marginal costs have dimension $1 \times M$ (assumption 2), while the vector of bargaining parameters have dimension $1 \times R$ (assumption 3). Example 4 illustrates the identification argument in one market with two manufacturers, two retailers, and one display format.

Example 4. Identification of supply-side parameters in one market with two manufacturers, two retailers, and one display format.
There are two manufacturers, two retailers, one display format, and one market. Both manufacturers also sell their products directly to consumers. Both retailers bargain with both manufacturers. Denote the manufacturers by M_1 and M_2, the direct sales from those manufacturers by R_1 and R_2, and the retailers by R_3 and R_4. There are 6 products in this example. The set of differentiated products is: $\mathcal{J} = \{j^D_{11}, j^R_{13}, j^R_{14}, j^D_{22}, j^R_{23}, j^R_{24}\}$, where j^D_{11} is the product sold directly by manufacturer M_1, j^R_{13} is the product manufactured by M_1 and sold by retailer R_3, *etc.* That is, $\Omega^R_{M_1} = \{j^R_{13}, j^R_{14}\}$, $\Omega^D_{M_1} = \{j^D_{11}\}$, $\Omega^R_{M_2} = \{j^R_{23}, j^R_{24}\}$, $\Omega^D_{M_2} = \{j^D_{22}\}$, $\Omega_{R_3} = \{j^R_{13}, j^R_{23}\}$, and $\Omega_{R_4} = \{j^R_{14}, j^R_{24}\}$. Index final prices in a similar form, being p^f_{kl} the final price for product $j^f_{kl} \in \mathcal{J}$ with $f \in \{\mathrm{R}, \mathrm{D}\}$. Next, index accordingly wholesale prices, w_{kl}; market shares, $s^f_{kl}(p)$; marginal costs c_{kl}, bargaining weights λ_{kl}, and change in shares, $\Delta s^f_{i,-j}(p)$. Recall that the change in shares is defined as: $\Delta s^f_{i,-j}(p) \equiv s^f_{i,-j}(p_{-j}) - s^f_i(p)$ according to equation (7) and $f \in \{\mathrm{R}, \mathrm{D}\}$. Then, equation (7) becomes:

$$(w_{13}): \quad \frac{\lambda_{13}}{1-\lambda_{13}} = \frac{(p^R_{13} - w_{13})s^R_{13}(p) - (p^R_{23} - w_{23})\Delta s^R_{23,-13}(p)}{(w_{13} - c_{13})s^R_{13}(p) - (w_{14} - c_{14})\Delta s^R_{14,-13}(p) - (p^D_{11} - c_{11})\Delta s^D_{11,-13}(p)},$$

$$(w_{14}): \quad \frac{\lambda_{14}}{1-\lambda_{14}} = \frac{(p^R_{14} - w_{14})s^R_{14}(p) - (p^R_{24} - w_{24})\Delta s^R_{24,-14}(p)}{(w_{14} - c_{14})s^R_{14}(p) - (w_{13} - c_{13})\Delta s^R_{13,-14}(p) - (p^D_{11} - c_{11})\Delta s^D_{11,-14}(p)},$$

$$(w_{23}): \quad \frac{\lambda_{23}}{1-\lambda_{23}} = \frac{(p^R_{23} - w_{23})s^R_{23}(p) - (p^R_{13} - w_{13})\Delta s^R_{13,-23}(p)}{(w_{23} - c_{23})s^R_{23}(p) - (w_{24} - c_{24})\Delta s^R_{24,-23}(p) - (p^D_{22} - c_{22})\Delta s^D_{22,-23}(p)},$$

$$(w_{24}): \quad \frac{\lambda_{24}}{1-\lambda_{24}} = \frac{(p^R_{24} - w_{24})s^R_{24}(p) - (p^R_{14} - w_{14})\Delta s^R_{14,-24}(p)}{(w_{24} - c_{24})s^R_{24}(p) - (w_{23} - c_{23})\Delta s^R_{23,-24}(p) - (p^D_{22} - c_{22})\Delta s^D_{22,-24}(p)}.$$

Using assumption 1, $c_{13} = c_{14} = c_{11} \equiv c_1$ because $(j_{13}, j_{14}) \in \Omega^R_{M_1}$ and $c_{11} \in \Omega^D_{M_1}$, and $c_{22} = c_{23} = c_{24} \equiv c_2$ because $(j_{23}, j_{24}) \in \Omega^R_{M_2}$ and $c_{22} \in \Omega^D_{M_2}$. Using assumption 2, $\lambda_{13} = \lambda_{23} \equiv \lambda_3$ because $(j_{13}, j_{23}) \in \Omega_{R_3}$, $\lambda_{14} = \lambda_{24} \equiv \lambda_4$ because $(j_{14}, j_{24}) \in \Omega_{R_4}$. The

system of equations in (6) simplifies to a system of 4 equations in 4 unknowns, c_1, c_2, λ_3, and λ_4.[28]

A similar argument to the one in example 4 can be used for multiple manufacturers and retailers. Consider the necessary first-order condition of the bargaining between a given manufacturer with two retailers. Using assumption 2, the only difference in parameters are the bargaining weights, as can be seen in equation (7). Then, the variation between these two equations identifies the bargaining weights of the retailers *vis-à-vis* this manufacturer. Next, consider the necessary first-order condition of the bargaining between a given retailer with two different manufacturers. Using assumption 3, the variation in these equations allows us to identify the different marginal costs for these manufacturers. Also due to assumption 3, the marginal costs of the products sold to consumers directly are the same as the manufacturer marginal costs of selling those products to the retailers. All manufacturer marginal costs and bargaining weights are thus identified.

Estimation of supply. We estimate the supply-side parameters conditional on the demand estimates. Assumptions 1 to 3 simplify the computational burden of the supply side for the estimation and counterfactual analysis. They reduce the dimensionality of the supply parameters. The total number of final products in a given market is given $J_t = D_t \times M_t \times (R_t)$. Under the maintained assumption of constant parameters across markets, the vectors of stacked retail marginal costs (c^r), manufacturer marginal costs (c^m), and bargaining weights (λ) have each dimension J-by-1, for a total of $3 \times J$ supply-side parameters. Under assumptions 1 to 3, the number of total parameters is reduced to $0+M+R \ll 3 \times J$, where the summands on the left-hand side represent respectively the numbers of parameters for the vectors of stacked retail marginal costs, manufacturer marginal costs, and bargaining weights.[29]

The system of equations in (7) defines marginal costs implicitly as a function of the bargaining parameters, $c^m = \mathcal{M}(\lambda)$ by applying the implicit function theorem to (7). Instead of numerically solving for the marginal costs in (7), we stack equations (5) and (7) which allows us to use matrix inversion to obtain closed-form solutions of the marginal costs as a function

[28] An important question that arises is whether this system of equations has a unique solution that is sensible economically. (Being sensible economically in our setting means that marginal costs are nonnegative and bargaining weights lie between 0 and 1.) Such uniqueness is necessary to guarantee identification of the supply model. We have used a variety of methods, solvers, and starting values and have always obtained convergence to the same solution. However, we have not proved uniqueness (of economically sensible solution) of the system.

[29] As discussed above, assumptions 1 to 3 are not necessary for identification. They simplify the supply-side computational burden. On the one hand, they reduce the number of parameters to estimate. The estimation routine is simpler and the parameters are more precisely estimated. The latter is important in the empirical setting studied given the nature of the data aggregated at the market level. On the other hand, the assumptions ease the computation of the counterfactual analysis. Solving for the equilibrium prices downstream is a difficult problem. It entails solving an implicit nonlinear system of $J = 57$ equations in J unknowns, the downstream vector prices p^D and p^R. We performed several robustness tests of our model. We also tested different specifications of the supply model. The implications discussed in section 4 are robust. Results are available upon request.

of bargaining weights, $c^m = \mathcal{M}(\lambda)$.[30] We then make the standard parametrization of marginal costs: $c_{jt} = x^S_{jt}\gamma + \hat{\epsilon}_{jt}$, where x^S_{jt} includes manufacturer and months/markets fixed effects, γ is the corresponding vector of parameters, and $\hat{\epsilon}_{jt}$ is an unobservable error term. Rearranging terms write the supply unobservable error term as:

$$\hat{\epsilon}(\lambda, \gamma) = \mathcal{M}(\lambda) - x^S\gamma, \tag{16}$$

where variables without subscripts denote the corresponding stacked vectors of parameters.

We estimate the supply parameters by GMM using the moment condition $\mathbb{E}[Z^{s\prime} \cdot \hat{\epsilon}(\lambda^*, \gamma^*)] = 0$, where Z^s is a matrix of supply-side instruments described next, $\hat{\epsilon}(\cdot)$ is the error term defined in equation (16), and (λ^*, γ^*) is the true value of the supply parameters. For the supply instruments, Z^s, we use the average price of a product in other markets as an instrument for that price of the same product in a given market. We also include in Z^s manufacturer, month, and retailer fixed effects. The identifying assumption is that the prices of a product in other markets are uncorrelated with the marginal cost shock after accounting for the manufacturer, month, and retailer fixed effects. The power of the instrument comes from the prices of a product in other markets being correlated with the price of the product in the given market through the bargaining equations in (7).

3.3 Results

Demand Estimates. The estimated demand parameters are presented in table 3 using the following specifications of the model: (1) a simple logit model (without instruments for price, without random coefficients for price); (2) a simple logit model with instruments for price (without random coefficients for price); and (3) the full model, corresponding to the mixed logit model described in subsection 2.1. All the specifications include a set of dummy variables for manufacturers, retailers, display formats, and months fixed effects. The instruments are described in subsection 3.2. The estimation algorithm from subsection 3.2 is applied to each model with the obvious modifications. For example, for the simple logit without instruments, model 1, the structural error in the system of equations in (15) has a closed-form expression and the model is estimated by OLS. The demand estimates do not impose the equilibrium conditions from the supply side.

The demand estimates are sensible in magnitude and sign, and are precisely estimated. By comparing models 1 and 2, one can see the role of price endogeneity on the demand estimates. The price coefficient doubles in absolute terms when we instrument for price. By comparing models 2 and 3, one can see the importance of consumer heterogeneity for price. The dispersion of the price sensitivity across consumers is statistically different from zero and relatively large in magnitude. The mean price coefficient in model 3 is 0.42 and is statistically different from zero. This result indicates that demand is relatively elastic. The average own-price elasticity

[30] See appendix B for details.

is -1.66. We use the results from model 3 for the remainder of the paper.

Supply Estimates. Table 4 displays the results. The estimated parameters are sensible. They are consistent with the ones in DPPT. Panel A shows the distribution of estimated manufacturer marginal costs. Manufacturers' marginal cost are relatively low in the industry studied. The mean marginal cost, 4.8 Euros, is about half the mean wholesale price obtained from the data, which is 8.2 Euros in table 2. There is a relatively large variation in marginal costs across manufacturers conditional on display formats and markets. The coefficient of variation is 0.8 ($^{3.72}/_{4.78}$). This result indicates that heterogeneities across manufacturers are important and reflects the heterogeneities in manufacturers' margins.

Panel B displays the estimates from the bargaining weights. Retailers have low bargaining power, 0.1 on average, relative to a bargaining power of 0.9 on average for manufacturers. Retailers r_8^v and r_5^v have the largest bargaining weights, 0.2 and 0.1, respectively.

Two observations suggest these numbers are consistent with the large concentration at the manufacturer level, the low retail margins, and the large heterogeneities at the retail level in the empirical setting. First, the largest manufacturer has nearly 50 percent of the sales; retailers have little bargaining power when negotiating with it.

Second, retail margins are low; the median (mean) margin of the retailers is 0.57 (1.72) Euros per square meter. To gain intuition regarding the relationship between bargaining weights and retail margins, consider the following expression for product j:

$$\frac{\lambda_j}{1-\lambda_j} \approx \frac{p_j^R - w_j}{w_j - c_j^m}, \tag{17}$$

where the approximation in (17) is due to firms selling multiple products.[31] In words, the ratio of bargaining weights is approximately equal to the ratio of retailer margins relative to manufacturer margins. In our setting, the ratio $^{\lambda_j}/_{(1-\lambda_j)}$ has median (mean) of 7.5 (7.6) percent, while the the ratio of retailer margins relative to manufacturer margins has median (mean) of 7.7 (10.5) percent.

4 The Welfare Effects of Direct-to-Consumer Sales

Next we use the estimated model to examine the effect of direct sales on negotiated prices and consumer welfare.

4.1 Welfare Scenarios and Measures

We simulate the counterfactual scenarios described below. We compare these scenarios to the baseline where we use the estimated model with direct sales.

[31] It holds with equality for single-product firms. See equation (7) and Draganska, Klapper, and Villas-Boas (2010, equation 13).

1. **No bargaining leverage from direct sales:** In this scenario, the direct-sales channel continues to operate as in the baseline but we remove the manufactures' bargaining leverage due to the direct sales. We implement this scenario by setting $d_j^D = 0$ in equation (7). In words, the manufacturers compete with retailers downstream but do not internalize the profits from direct sales when negotiating wholesale prices with the retailers.

2. **No direct sales:** In this scenario, we remove direct sales altogether. This scenario can be conceptualized as a direct-sales prohibition, whereby manufacturers are not allowed to sell directly to consumers.[32] We implement this scenario by removing from the market the products sold directly by the manufacturers in the baseline. Retailers in the vertical sales channel continue offering the same set of products as in the baseline.

We implement the counterfactual analysis as follows. For each scenario above, we use the equilibrium conditions given by the equations in (4), (5), and (7) to solve respectively for the counterfactual consumer prices, market shares, and negotiated wholesale prices.

We report the following statistics: market shares disaggregated by direct and retail sales, consumer prices disaggregated by direct sales and retail sales, negotiated wholesale prices, profits of the retailers (Π_r), and profits of the manufacturers (Π_r) disaggregated by the part coming from the direct sales channel (Π_m^D) and vertical sales channel (Π_m^V). For the computation of the profits of the retailers and manufacturers we use the formulas given by the equations in (2) and (3), respectively. We report the compensating variation as a measure of consumer welfare. The expected consumer surplus in Euros for consumer type i is:

$$\mathbb{E}(CS_i) = \frac{1}{\alpha_i} \log\left[1 + \sum_{k=1}^{J_t} \exp(\delta_{kt} - \sigma v_i p_{kt})\right] + C, \tag{18}$$

where $\mathbb{E}(\cdot)$ denotes the expectation operator taken over the random shocks ϵ_{ijt} and C is a constant.

Consumer welfare for type i is the change in consumer surplus (or compensating variation, CV) that results in the scenario performed. We compute the difference between the consumer surplus for consumer i in the baseline and in the counterfactual scenarios described above. We compute the total consumer surplus as the weighted sum of $\mathbb{E}(CS_i)$ using the weights reflecting the number of consumers who face the same representative utilities as the sampled consumer:

$$\mathbb{E}(CV) = \int_{\nu_i} \left[\mathbb{E}(CS_i^j) - \mathbb{E}(CS_i^0)\right] \mathrm{d}P_\nu(\nu_i), \qquad j = 1, 2, \tag{19}$$

where $\mathbb{E}(CV)$ denotes the weighted sum across types of consumers of the compensating variation, the superscript 0 refers to the baseline, the superscripts j refer to the counterfactuals

[32] This counterfactual may have important policy consequences. For example, see our discussion in the introduction about the Tesla's case and the responses by the FTC and the DOJ.

scenarios described above, and $\mathbb{E}(CS_i^k)$ is given by equation (18) for $k = 0, 1, 2$.

4.2 Results

Table 5 displays the estimates from the counterfactual analysis. The table shows the percentage change in the counterfactual scenarios relative to the baseline.

In counterfactual scenario 1, we remove the bargaining leverage of manufacturers from the direct sales. When direct sales are present, manufacturers internalize in the negotiated wholesale prices the increase in profits due to direct sales in case that the negotiation fails. This effect is captured by the term d_j^D in equation (7). It generates upward pressure on wholesale prices. In equilibrium, however, wholesale prices are also affected by changes in downstream prices because the latter affect both manufacturer and retailer gains-from-trade as can be seen in equation (7). In scenario 1, we held constant competition and product variety at the retail level. This feature allows us to isolate the leverage effect of manufacturers due to direct sales. Negotiated wholesale prices should decrease unambiguously. Scenario 1 shows that they decrease by 4 percent in the application studied; that is, direct sales increase manufacturers' bargaining leverage allowing them to charge wholesale prices that are 4 percent higher. In the downstream, the decrease in wholesale prices generate two effects. First, it reduces retailers' cost, thus decreasing retail sales prices. Second, it induces manufacturers to reduce direct-sales prices as indicated by the first-order condition (5). The reduction in consumer retail prices is larger than the reduction in prices of the direct sales. Retail market shares increase substantially, 12 percent, while direct-sales shares decline. The decrease in manufacturers' profits by approximately 1 percent reflects the culmination of two countervailing effects. Although the direct channel profits decrease substantially by 3 percent (last term in equation 3), consumers divert towards retail sales, thus increasing manufacturers vertical channel profits by 9 percent (first term in equation 3). Direct channel profits represent 81 percent of the total profits of the manufacturers in the baseline. Retailers profits increase substantially, 20 percent. Consumer surplus increases by a relative small magnitude, 2 percent. Total welfare also increases. The results are consistent with the economic intuition presented in examples 1 to 3.

In counterfactual scenario 2, we remove the direct-sales channel completely. In the downstream, there is a decrease in the number of products and competition. Retail prices increase substantially by 26 percent. There is a net increase in wholesale prices by 2 percent. This increase reflects two effects. First, there is a decrease in the manufacturers' bargaining leverage because they no longer have direct sales. This effect generates downward pressure on wholesale prices as discussed in counterfactual scenario 1. Second, without direct sales, there are fewer products available to the consumer, thus reducing retail competition and increasing all prices (including wholesale prices). This effect generates upward pressure on wholesale prices (see equation 7). Table 5 shows that the latter effects dominates. The increase in retail market shares arises because consumers divert from direct to retail products. Retailers are the conspicuous winners from the direct-sales prohibition. Their profits increase substantially

by 537 percent. It is a consequence of the large share of direct sales in the counterfactual considered. Although manufacturers' vertical sales profits increase substantially, such increase is insufficient to offset the reduction in profits due to direct sales. Overall, manufacturers' profits decrease substantially by 54 percent. Consumer surplus and total welfare also decrease substantially.

In sum, the counterfactual analysis sheds light on two fundamental economic issues. First, it quantifies the magnitude of the leverage effect; that is, it measures the extent to which direct sales increase manufacturers' bargaining power when negotiating wholesale prices with the retailers. Second, it quantifies the welfare effects of direct sales. We now examine the relevance of the effects for the evaluation of vertical mergers.

4.3 Implications for Vertical Mergers

So far we conducted the analysis in terms of an oligopolistic producer's decision of whether to create a direct-to-consumer channel. The same economic principles apply to an oligopolistic producer's decision of whether to merge vertically; that is, to merge with a retailer.[33] Next, we discuss two effects that may emerge from a vertical merger, similar to those analyzed for the creation of a direct-to-consumer channel.[34] We finish with a discussion about the differences between these two strategies.

Consider an industry where a few manufacturers supply a few retailers. Manufacturers sell production factors to retailers. Retailers sell retail products to final consumers. Manufacturers bargain first with retailers over wholesale prices; afterwards retailers set retail prices. Suppose that a manufacturer merges with a retailer. First, we argue that a vertical merger increases the bargaining leverage of the merged firm upstream; that is, the vertical merger increases the bargaining power of the merged firm when negotiating with the retailers. Let us call this the *bargaining leverage* effect.[35]

Suppose that the merged firm sells production factors to a rival retailer; that is, to a retailer that competes with its own retailer. Before the merger, if the manufacturer of the merging firm does not reach an agreement with the rival retailer, or if it refuses to supply the retailer, the manufacturer loses the profit it would earn if it supplied the rival retailer. If the rival retailer has no alternative equally competitive suppliers, it loses sales.[36] Part of the lost sales diverge to the retailer of the merged firm. After the merger, if the merged firm

[33] A vertical merger involves firms that operate at different levels of production and distribution. On June 30, 2020, the U.S. Department of Justice and The Federal Trade Commission updated their Vertical Merger Guidelines. The new version states that with respect to these transactions, there should not be a pro-competitive or anti-competitive presumption. Vertical mergers should be evaluated case by case, on the basis of the facts of the transaction. This perspective contrasts with that of the previous version of the guidelines, dated from 1968, which assumed that vertical mergers were mostly neutral or pro-competitive. Vertical mergers are important, *e.g.*, in digital industries. See our discussion in the introduction.

[34] A vertical merger may involve additional effects; see, *e.g.*, Riordan and Salop (1995).

[35] The economic principles of the bargaining leverage effect discussed in this section are similar to the bargaining leverage over rivals (BLR) effect by Rogerson (2020). See our discussion in the related literature.

[36] If a retail rival does not find an alternative supplier, it loses the sales related to the reduction of supply of the merged firm. If it finds a more expensive alternative supplier, it has to raise his price, thus losing sales.

does not reach an agreement with the rival retailer, it still loses the profit it would earn if supplied that firm. However, now it also earns the profits that result from the sales diverted from the rival retailer. Thus, because it internalizes the sales diversion downstream, it is less costly for the merged firm not to reach an agreement with a rival retailer than for the retailer of the merged firms acting independently. This effect increases the bargaining power of the merged firm and enables it to charge a higher price for the upstream product as in Rogerson (2020). Given the increase of the upstream price of the merged firm, upstream rivals may also increase their prices. These increases in upstream prices may lead to higher downstream prices. Consequently, consumer surplus may decline.

A horizontal merger, by allowing the internalization of the diversion of sales between firms that produce substitute products, increases the market power of the merged firm. Similarly, if the merged firm sells production factors to rival retailers and if rival retailers that buy production factors from the merged firm have no alternative equally competitive suppliers, then a vertical merger by allowing the internalization of the diversion of sales between firms that produce complementary products, increases upstream the market power of the merged firm.

Second, a vertical merger may allow the merged firm to eliminate its upstream margin. Let us call this the *double marginalization* effect.[37] Suppose the manufacturer of the merged firm sells production factors to the retailer of the merged firm. Before the merger, the manufacturer and the retailer of the merged firm maximize independently their profits. If there is market power upstream, the manufacturer charges a price above marginal cost. After the merger, the merged firm maximizes the joint profit of its two components—the manufacturer and the retailer—, and internalizes the increase in sales downstream caused by a decrease in the upstream price. Hence, the merged firm assigns to the production factor a price equal to the upstream marginal cost. The decrease in this price reduces the marginal cost of the retailer of the merged firm, and allows it to charge a lower downstream price. Given the decrease of the downstream price of the merged firm, the downstream rivals may respond by lowering their prices. These price decreases may increase consumer surplus.

In terms of social welfare, the bargaining leverage and double marginalization effects operate in opposite directions in the setting described. The net impact of the vertical merger on welfare is thus ambiguous. The increase in bargaining power upstream, in conjunction with the elimination of double marginalization, may give the merged firm a substantial strategic advantage relative to its upstream and downstream rivals. Our main contribution here is to shed light on how to isolate and quantify the bargaining leverage effect.

The bargaining leverage and the double marginalization effects are present in both the creation of a direct-to-consumer channel and a vertical merger. The magnitude of these two effects, however, may differ across these two strategies. The former effect will differ if the new retailer and the retailer of the merged firm have different sizes and their products have

[37] This is the well known result when there are successive monopolies at two layers of production, and dates back to Lerner (1934) (for further references see, *e.g.*, Spengler 1950 and Tirole 1988, pp. 174-6).

different degrees of substitutability with respect to that of the rival retailer. The latter effect will differ, if the new retailer and the retailer of the merged firm have different marginal costs.[38] Furthermore, the creation of a direct-to-consumer channel involves an additional effect: the creation of a new downstream brand. The resulting increase in competition and product variety downstream benefit consumers. The creation of a direct-to-consumer channel is socially preferable to a vertical merger, everything else constant.[39] Nevertheless, as noted above, the bargaining leverage and the double marginalization effects may differ across these two strategies.

5 Concluding Remarks

We develop a model that incorporates direct-to-consumer sales by manufacturers to the workhorse supply model where manufacturers and retailers bargain over wholesale prices. We show that direct sales by manufacturers generate two effects that have opposing welfare implications. First, direct sales generate potential welfare gains to consumers due to additional competition and product variety downstream. Second, there is an increase in the bargaining leverage of the manufacturers selling directly to consumers. We show that the additional bargaining leverage due to direct sales increases the negotiated wholesale prices, thus increasing final prices to consumers and decreasing consumer welfare.

We show how our model can be used to measure these effects. To that end, we estimate our model using a unique dataset from the outdoor advertising industry, where direct sales have been a steady feature. We use the estimated model to simulate counterfactual scenarios assessing the role of direct sales on prices and welfare.

We discuss two main findings from the empirical application. First, direct sales increase manufacturers' bargaining leverage allowing them to increase wholesale prices by 4 percent. The additional bargaining leverage decreases the profits of the retailers substantially by 20 percent. Consumer welfare is reduced due to the resulting increase in consumer retail prices. Second, direct sales generates an overall large increase in both consumer welfare and manufacturers profits in our application, 59 percent and 43 percent, respectively. The share of direct sales in the industry is an important factor influencing the magnitude of the estimates.

We conclude discussing the relevance of the bargaining leverage effect for vertical mergers. For vertical mergers the *bargaining leverage* and *double marginalization* effects operate in opposite directions in terms of welfare. We argue about the importance of specifying a flexible supply model that allows one to measure the additional bargaining leverage that a manufacturer may obtain when merging with a retailer. Our model allows for such quantification. Measuring the additional bargaining leverage of manufacturers due to a merger adds another layer of consideration for vertical merger evaluation.

[38] Creating a new firm involves irreducible uncertainty regarding consumer preferences and efficiency.

[39] This assertion is plausible, if creating a direct-to-consumer channel, *i.e.*, creating a retailer, does not involve substantial costs, and if merging with a retailer involves small costs.

References

Anderson, E., AND A. T. Coughlan (1987): "International Market Entry and Expansion via Indpendent or Integrated Channels of Distribution," *Journal of Marketing*, 51(1), 71–82. (Cited on page 5.)

Arya, A., B. Mittendorf, AND D. E. Sappington (2007): "The bright side of supplier encroachment," *Marketing Science*, 26(5), 651–659. (Cited on page 4.)

Berry, S., J. Levinsohn, AND A. Pakes (1995): "Automobile prices in market equilibrium," *Econometrica*, 63(4), 841–890. (Cited on pages 8 and 21.)

Berry, S. T. (1994): "Estimating discrete-choice models of product differentiation," *The RAND Journal of Economics*, pp. 242–262. (Cited on page 8.)

Bodisch, G. (2009): "Economic effects of state bans on direct manufacturer sales to car buyers," *Economic Analysis Group, Antitrust Division, Department of Justice. Available at: https://www.justice.gov/atr/economic-effects-state-bans-direct-manufacturer-sales-car-buyers (Accessed on July 30, 2019.).* (Cited on page 2.)

Bonnet, C., AND P. Dubois (2010): "Inference on vertical contracts between manufacturers and retailers allowing for nonlinear pricing and resale price maintenance," *The RAND Journal of Economics*, 41(1), 139–164. (Cited on page 7.)

Brenkers, R., AND F. Verboven (2006): "Market definition with differentiated products: lessons from the car market," *in Choi, J.P. (Ed.), Recent Developments in Antitrust: Theory and Evidence*. (Cited on pages 5 and 7.)

Cachon, G. P. (2002): "Supply chain coordination with con-tracts," *University of Pennsylvania*. (Cited on page 4.)

Cai, G. (2010): "Channel Selection and Coordination in Dual-Channel Supply Chains," *Journal of Retailing*, 86(1), 22–36. (Cited on page 4.)

Cattani, K. D., W. G. Gilland, AND J. M. Swaminathan (2004): "Coordinating traditional and internet supply chains," in *Handbook of quantitative supply chain analysis*, pp. 643–677. Springer. (Cited on page 4.)

Cazaubiel, A., M. Cure, B. O. Johansen, AND T. Vergé (2018): "Substitution Between Online Distribution Channels: Evidence from the Oslo Hotel Market," *University of Bergen*. (Cited on pages 5 and 6.)

Chiang, W.-y. K., D. Chhajed, AND J. D. Hess (2003): "Direct Marketing, Indirect Profits: A Strategic Analysis of Dual-Channel Supply-Chain Design," *Management Science*, 49(1), 1–20. (Cited on page 4.)

Choi, S. C. (1991): "Price competition in a channel structure with a common retailer," *Marketing science*, 10(4), 271–296. (Cited on page 4.)

Collard-Wexler, A., G. Gowrisankaran, AND R. S. Lee (2019): ""Nash-in-Nash" bargaining: A microfoundation for applied work," *Journal of Political Economy*, 127(1), 163–195. (Cited on page 2.)

Cotterill, R. W., AND W. P. Putsis (2001): "Do models of vertical strategic interaction for national and store brands meet the market test?," *Journal of Retailing*, 77(1), 83–109. (Cited on page 5.)

Crawford, G. S., R. S. Lee, M. D. Whinston, AND A. Yurukoglu (2018): "The welfare effects of vertical integration in multichannel television markets," *Econometrica*, 86(3), 891–954. (Cited on pages 2, 5, 7, and 11.)

Crawford, G. S., AND A. Yurukoglu (2012): "The welfare effects of bundling in multichannel television markets," *The American Economic Review*, 102(2), 643–685. (Cited on pages 2, 5, and 6.)

Cuesta, J. I., C. Noton, AND B. Vatter (2019): "Vertical Integration between Hospitals and Insurers," *Available at SSRN 3309218*. (Cited on pages 5 and 7.)

Donna, J. D., P. Pereira, T. Pires, AND A. Trindade (2019): "Measuring the Welfare of Intermediaries in Vertical Markets," *Available at SSRN: http://dx.doi.org/10.2139/ssrn.3285205 (accessed on April 28, 2020).* (Cited on pages 5, 6, 7, 8, 9, 18, 19, 20, 21, 22, and 25.)

Draganska, M., D. Klapper, AND S. B. Villas-Boas (2010): "A larger slice or a larger pie? An empirical investigation of bargaining power in the distribution channel," *Marketing Science*, 29(1), 57–74. (Cited on pages 5, 6, 11, and 25.)

Dubois, P., AND M. Sæthre (2016): "On the Role of Parallel Trade on Manufacturers and Retailers Profits in the Pharmaceutical Sector," *Working Paper. Available at: https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=EEAESEM2016&paper_id=1349 (Accessed on June 12, 2017.).* (Cited on page 7.)

Duch-Brown, N., L. Grzybowski, A. Romahn, AND F. Verboven (2017): "The impact of online sales on consumers and firms. Evidence from consumer electronics," *International Journal of Industrial Organization*, 52, 30–62. (Cited on page 5.)

Ellickson, P. B., P. Kong, AND M. J. Lovett (2018): "Private Labels and Retailer Protability: Bilateral Bargaining in the Grocery Channel," *Working Paper*. (Cited on page 7.)

Federal Trade Commission, Press Release (2014): "Missouri and New Jersey Should Repeal Their Prohibitions on Direct-to-Consumer Auto Sales by Manufacturers," *Federal Trade Commission, Press Release. May 16, 2014. Available at: https://perma.cc/9Z2W-989K. Accessed July 30, 2019.* (Cited on page 1.)

Gandhi, A., AND J.-F. Houde (2019): "Measuring substitution patterns in differentiated-products industries," *NBER Working Paper 26375. Available at: https://www.nber.org/system/files/working_papers/w26375/revisions/w26375.rev0.pdf (Accessed on October 20, 2020.).* (Cited on page 20.)

Grennan, M. (2013): "Price discrimination and bargaining: Empirical evidence from medical devices," *The American Economic Review*, 103(1), 145–177. (Cited on pages 2, 5, and 6.)

Hausman, J. A. (1996): "Valuation of new goods under perfect and imperfect competition," in *The economics of new goods*, pp. 207–248. University of Chicago Press. (Cited on page 20.)

Horn, H., AND A. Wolinsky (1988): "Bilateral monopolies and incentives for merger," *The RAND Journal of Economics*, 19(3), 408–419. (Cited on page 11.)

Ingene, C. A., AND M. E. Parry (2004): *Mathematical models of distribution channels*, vol. 17. Springer Science & Business Media. (Cited on page 4.)

Kadiyali, V., P. Chintagunta, AND N. Vilcassim (2000): "Manufacturer-retailer channel interactions and implications for channel power: An empirical investigation of pricing in a local market," *Marketing Science*, 19(2), 127–148. (Cited on pages 5 and 6.)

Krattenmaker, T. G., AND S. C. Salop (1986): "Anticompetitive Exclusion: Raising Rivals' Costs to Achieve Power over Price," *The Yale Law Journal*, 96(2), 209–293. (Cited on page 4.)

Lafontaine, F., AND F. Scott Morton (2010): "Markets: state franchise laws, dealer terminations, and the auto crisis," *Journal of Economic Perspectives*, 24(3), 233–50. (Cited on page 2.)

Lao, M., D. Feinstein, AND F. Lafontaine (2015): "Direct-to-consumer auto sales: It's not just about Tesla," *Federal Trade Commission, News and Events. May 11, 2015. Available at: https://www.ftc.gov/news-events/blogs/competition-matters/2015/05/direct-consumer-auto-sales-its-not-just-about-tesla. Accessed July 30, 2019.* (Cited on page 2.)

Lee, E., AND R. Staelin (1997): "Vertical strategic interaction: Implications for channel pricing strategy," *Marketing Science*, 16(3), 185–207. (Cited on page 4.)
Lerner, A. P. (1934): "The Concept of Monopoly and the Measurement of Monopoly Power," *The Review of Economic Studies*, 1(3), 157–175. (Cited on page 29.)
Luco, F., AND G. Marshall (2020a): "The competitive impact of vertical integration by multiproduct firms," *American Economic Review*, 110(7), 2041–64. (Cited on pages 5, 7, and 17.)
——— (2020b): "Diagnosing Anticompetitive Effects of Vertical Integration by Multiproduct Firms," *Working Paper. https://flucoe.github.io/pdfs/Luco_Marshall_VMG_2020.pdf (accessed on February 3, 2021).* (Cited on page 8.)
McGuire, T. W., AND R. Staelin (1983): "An industry equilibrium analysis of downstream vertical integration," *Marketing science*, 2(2), 161–191. (Cited on page 4.)
Mortimer, J. H. (2008): "Vertical contracts in the video rental industry," *The Review of Economic Studies*, 75(1), 165–199. (Cited on page 7.)
Nevo, A. (2001): "Measuring market power in the ready-to-eat cereal industry," *Econometrica*, 69(2), 307–342. (Cited on pages 8 and 20.)
Pereira, P., AND T. Ribeiro (2018): "Evaluating Partial Divestitures When Vertical Relations are Important," *Review of Industrial Organization*. (Cited on page 8.)
Pozzi, A. (2013): "The Effect of Internet Distribution on Brick-and-mortar Sales," *RAND Journal of Economics*, 44(3), 569–583. (Cited on pages 5 and 6.)
Quan, T. W., AND K. R. Williams (2018): "Product variety, across-market demand heterogeneity, and the value of online retail," *RAND Journal of Economics*, 49(4), 877–913. (Cited on pages 5 and 6.)
Riordan, M. (2008): "Competitive Effects of Vertical Integration," *Handbook of Antitrust Economics*. (Cited on page 4.)
Riordan, M. H., AND S. C. Salop (1995): "Evaluating Vertical Mergers: A Post-Chicago Approach," *Antitrust Law Journal*, 63(2), 513–568. (Cited on page 28.)
Rogerson, W. P. (2003a): "An Economic Analysis of the Competitive Effects of the Takeover of DirecTV by News Corp.," *Submitted as an attachment to Comments of Advance Newhouse, Cable One, Cox and Insight, In the Matter of General Motors Corporation, Transferors and the News Corporation Limited, Transferee, For Authority to Transfer Control, MB Docket 03-124*. (Cited on page 4.)
——— (2003b): "A Further Economic Analysis of the Takeover of DirecTV by News Corp.," *Submitted as an attachment to Notice of Ex-Parte Comments by Advance Newhouse, Cable One, Cox and Insight, In the Matter of General Motors Corporation, Transferors and the News Corporation Limited, Transferee, For Authority to Transfer Control, MB Docket 03-124*. (Cited on page 4.)
——— (2020): "Modeling and Predicting the Competitive Effects of Vertical Mergers due to Changes in Bargaining Leverage: The Bargaining Leverage Over Rivals (BLR) Effect," *Canadian Journal of Economics*. (Cited on pages 4, 5, 28, and 29.)
——— (2021): "The Upstream Pass-Through Rate, Bargaining Power and The Magnitude of the Raising Rivals' Costs (RRC) Effect," *Working Paper, Northwestern University*. (Cited on pages 4 and 5.)
Salop, S. C. (2018): "Invigorating Vertical Merger Enforcement," *Yale Law Journal*, 127(7), 6. (Cited on page 4.)
Salop, S. C., AND D. P. Culley (2016): "Revising the US vertical merger guidelines: policy issues and an interim guide for practitioners," *Journal of Antitrust Enforcement*, 4(1), 1–41. (Cited on page 4.)
Salop, S. C., AND D. T. Scheffman (1983): "Raising rivals' costs," *The American Economic Review*, 73(2), 267–271. (Cited on page 4.)
——— (1987): "Cost-raising strategies," *The Journal of Industrial Economics*, pp. 19–34. (Cited on page 4.)
Spengler, J. J. (1950): "Vertical integration and antitrust policy," *Journal of political economy*, 58(4), 347–352. (Cited on page 29.)
Sudhir, K. (2001): "Structural analysis of manufacturer pricing in the presence of a strategic retailer," *Marketing Science*, 20(3), 244–264. (Cited on pages 5 and 6.)
Texas et al. v. Google LLC (2020): "Case Number: 4:20-cv-00957," *District Of Texas District Court, Filed 12/16/20*. (Cited on page 1.)
Tirole, J. (1988): *The theory of industrial organization*. MIT press. (Cited on page 29.)
Trindade, A. (2015): "Price and variety in supermarkets: Can store competition hurt consumers?," *Available at SSRN 1878830*. (Cited on page 6.)
Tsay, A. A., S. Nahmias, AND N. Agrawal (1999): "Modeling supply chain contracts: A review," in *Quantitative models for supply chain management*, pp. 299–336. Springer. (Cited on page 4.)
United States of America et al. v. Google LLC (2020): "Case Number: 1:20-cv-03010," *District Of Columbia District Court, Filed: 10/20/2020*. (Cited on page 1.)
Villas-Boas, J. M., AND Y. Zhao (2005): "Retailer, manufacturers, and individual consumers: Modeling the supply side in the ketchup marketplace," *Journal of Marketing Research*, 42(1), 83–95. (Cited on pages 5 and 6.)
Villas-Boas, S. B. (2007): "Vertical relationships between manufacturers and retailers: Inference with limited data," *The Review of Economic Studies*, 74(2), 625–652. (Cited on pages 5 and 7.)

Table 1: Market Shares by Manufacturer, Retailer, and Display Format.

Seller		2 m^2 panel				Senior				Other				Total	Total by seller
		m_1	m_2	m_3	m_4	m_1	m_2	m_3	m_4	m_1	m_2	m_3	m_4		
Retailers	r_4^v	0.69	0.61	0.16	–	–	0.91	0.06	–	–	–	0.19	1.52	4.14	55.43
	r_5^v	0.35	0.72	0.18	–	–	0.09	0.15	0.11	–	–	0.10	0.51	2.22	
	r_6^v	2.16	2.08	0.63	0.91	–	1.38	0.12	–	–	–	0.07	2.56	9.91	
	r_7^v	0.93	2.23	0.44	0.18	–	0.69	0.29	–	–	0.08	0.36	8.62	13.83	
	r_8^v	0.12	0.14	–	–	–	0.72	0.10	–	–	0.03	0.14	–	1.25	
	r_9^v	4.51	11.43	2.47	0.06	0.02	3.79	0.34	0.10	0.01	0.32	1.01	0.04	24.09	
Direct Sales	r_1^d	0.99	–	–	–	–	–	–	–	–	–	–	–	0.99	9.65
	r_2^d	–	3.32	–	–	–	2.27	–	–	–	0.14	–	–	5.73	
	r_3^d	–	–	1.05	–	–	–	0.14	–	–	–	1.76	–	2.94	
Total		9.74	20.53	4.92	1.15	0.02	9.85	1.21	0.21	0.01	0.56	3.62	13.25	65.09	
Total by display		36.35				11.29				17.45					65.09

Notes: Each cell corresponds to the percentage of sales to consumers (relative to the market size defined as twenty percent greater than the maximum observed total monthly sales for the year 2013) across all months in the sample by the corresponding combination of Manufacturer, Seller (Retailers and Direct Sales), and Display Format. A cell displays the symbol "–" when no sales are observed for such combination. In Panel B there are a total of 57 cells with positive sales (*i.e* without the symbol "–"), that corresponds to the 57 inside products.

Table 2: Prices by Manufacturer, Seller, and Display Format.

	Wholesale prices						Retail prices					
	Mean unweighted	Mean weighted	St. Dev.	Min.	Median	Max.	Mean unweighted	Mean weighted	St. Dev.	Min.	Median	Max.
Manufacturer:												
- m_1	13.7	9.4	13.5	1.4	9.8	73.4	14.2	8.8	14.7	1.5	9.7	78.4
- m_2	18.7	11.2	23.4	1.0	11.7	247.3	19.0	10.3	20.0	1.1	12.1	132.1
- m_3	21.9	6.7	31.2	0.4	8.5	163.8	23.3	6.4	33.9	0.6	8.3	172.0
- m_4	15.2	1.9	13.5	0.4	13.6	75.2	16.1	2.0	14.3	0.4	14.4	79.0
Seller:												
- r_4^v	18.0	5.5	28.1	0.5	7.5	148.6	18.5	5.7	28.8	0.5	7.8	153.6
- r_5^v	22.4	10.1	23.3	0.9	13.7	124.6	25.0	11.0	27.2	0.9	14.4	172.0
- r_6^v	11.9	2.9	26.2	0.7	4.4	163.8	12.6	3.0	27.3	0.7	4.6	170.0
- r_7^v	13.6	3.6	14.3	0.4	8.2	79.5	14.2	3.7	14.9	0.4	8.6	81.5
- r_8^v	25.7	6.4	30.9	0.4	14.5	158.1	29.9	7.3	34.3	0.6	16.9	165.8
- r_9^v	22.8	11.8	25.9	2.3	15.7	247.3	21.7	10.2	21.0	1.2	14.8	132.1
- r_1^d	–	–	–	–	–	–	13.3	12.4	3.3	9.4	12.0	19.0
- r_2^d	–	–	–	–	–	–	19.8	14.1	17.9	1.4	15.2	66.9
- r_3^d	–	–	–	–	–	–	8.8	6.5	4.9	2.7	7.9	23.0
Display:												
- 2 m^2 panel	11.3	9.8	11.7	0.8	8.4	79.5	11.8	9.1	12.3	0.9	8.7	83.2
- Senior	20.9	10.0	28.2	1.0	13.5	163.8	21.4	9.5	29.5	1.1	13.1	170.0
- Other	25.6	3.5	29.3	0.4	17.1	247.3	27.2	3.4	28.8	0.4	20.7	172.0
All Products:	18.4	8.2	24.2	0.4	10.3	247.3	19.3	7.7	24.7	0.4	10.5	172.0

Notes: The table reports summary statistics for wholesale and retail prices for each manufacturer, retailer, and display format. Unweighted prices correspond to the mean using equal weights. Weighted prices correspond to the mean using the corresponding market shares as weights. Prices are in Euros per m^2.

Table 3: Demand Estimates.

	Logit OLS (1)		**Logit GMM** (2)		**Mixed Logit** (3)	
	Coefficient	St. error	Coefficient	St. error	Coefficient	St. error
Price:						
- Mean (α)	0.04	0.00	0.08	0.01	0.42	0.01
- St. dev. (σ)	–	–	–	–	0.15	0.03
Manufacturer dummy variables:						
- Manufacturer m_1	-0.48	0.21	-0.39	0.25	-0.76	0.28
- Manufacturer m_2	0.90	0.18	1.05	0.21	1.14	0.24
- Manufacturer m_3	-0.20	0.18	0.16	0.21	-0.65	0.24
Seller dummy variables:						
- Retailer r_4^v	0.58	0.46	0.60	0.53	1.14	0.60
- Retailer r_5^v	-0.41	0.21	-0.55	0.24	-1.84	0.27
- Retailer r_6^v	-0.74	0.20	-0.62	0.23	-0.53	0.26
- Retailer r_7^v	0.20	0.29	0.14	0.34	0.00	0.38
- Retailer r_8^v	-0.21	0.20	-0.51	0.24	-2.46	0.27
- Retailer r_9^v	0.34	0.30	-0.36	0.37	-0.75	0.41
- Direct sales r_2^d	-0.19	0.19	-0.47	0.23	-1.13	0.25
- Direct sales r_3^d	-1.56	0.22	-1.32	0.26	-1.71	0.29
Product dummy variables:						
- 2 m^2 panel	0.77	0.15	0.23	0.2	0.08	0.23
- Senior	-0.44	0.15	-0.70	0.18	-0.92	0.20
Number of observations	684		684		684	

Notes: Estimates of selected parameters from the demand model in subsection 2.1. All specifications include dummy variables for manufacturers, sellers/retailers, display format, and months fixed effects (not reported). Model 1 is estimated by OLS. Model 2 and 3 are estimated by GMM. Details about the estimation procedure and the instruments are in subsection 3.2. See subsection 3.1 for details about the data.

Table 4: Supply Estimates.

Statistic or Retailer	Estimate
Panel A: Marginal costs of manufacturers	
Mean	4.78
St. dev.	3.72
Min.	0.00
Median	4.58
Max.	15.20
Panel B: Bargaining weights of retailers	
r_4^v	0.04
r_5^v	0.13
r_6^v	0.07
r_7^v	0.09
r_8^v	0.18
r_9^v	0.07

Notes: Estimates of selected parameters from the demand model in subsection 2.2. All specifications include dummy variables for manufacturers, sellers/retailers, and months fixed effects. Details about the estimation procedure and the instruments are in subsection 3.2. See subsection 3.1 for details about the data.

Table 5: Counterfactual Scenarios.

Percentage change relative to baseline in:	**Manufacturers do not have:** Bargaining leverage from direct sales (1)	Direct sales (2)
Market Shares		
- Direct sales share	-2.33	-100.00
- Retail sales share	12.47	173.87
Consumer prices		
- Direct sales prices	-0.67	-
- Retail sales prices	-2.95	26.17
Wholesale prices	-3.98	2.07
Profits		
- Manufacturers' profits	-0.80	-54.40
- Direct channel profits	-3.07	-100.00
- Vertical channel profits	8.61	135.01
- Retailers' profits	20.46	536.56
Consumer surplus	1.93	-58.61
Total welfare	0.77	-43.37

Notes: The table displays counterfactual scenarios using the estimated model. All numbers in the table represent the percentage change in the counterfactual relative to the baseline. The baseline corresponds to the estimated model with direct sales, tables 3 (model 3) and 4. In counterfactual scenario 1 (no bargaining leverage from direct sales), the direct-sales channel continues to operate as in the baseline but we remove the manufactures' bargaining leverage due to the direct sales ($d_j^D = 0$ in equation 7). In counterfactual scenario 2 (no direct sales), manufacturers' direct-sales are prohibited. See subsection 4.1 for details about the implementation of the counterfactuals. See section 2 for definitions of the market shares, prices, and profits. See subsection 4.1 for the definition of consumer surplus.

Appendix

A Derivation of Bargaining Equations

A.1 Derivation of equation (6)

Solving the maximization problem in (2.2):[40]

$$\lambda_j(\Pi_r - \Pi_{r,-j})^{\lambda_j - 1}(\Pi_m - \Pi_{m,-j})^{1-\lambda_j}\frac{\partial \Pi_r}{\partial w_j} + (1-\lambda_j)(\Pi_r - \Pi_{r,-j})^{\lambda_j}(\Pi_m - \Pi_{m,-j})^{-\lambda_j}\frac{\partial \Pi_m}{\partial w_j} = 0.$$

Because manufacturers and retailers take prices set to consumers as fixed when determining wholesale prices, we have $\frac{\partial \Pi_m}{\partial w_j} = s_j^R M$ and $\frac{\partial \Pi_r}{\partial w_j} = -s_j^R M$. Substituting above and simplifying with $s_j^R > 0$ yields:

$$\lambda_j(\Pi_m - \Pi_{m,-j}) + (1-\lambda_j)(\Pi_r - \Pi_{r,-j})(-1) = 0. \tag{A.1}$$

Reorganizing yields equation (6).

A.2 Derivation of equation (7)

Substituting the profit functions, from the equations in (2) and (3), and the disagreement payoffs, from the equations in (2.2) and (2.2), into equation (A.1) yields:

$$\lambda_j \left[\sum_{k \in \Omega_m^R} (w_k - c_k^m) s_k^R(p) + \sum_{k \in \Omega_m^D} (p_k^D - c_k^m) s_k^D(p) - \sum_{k \in \Omega_m^R | \{j\}} (w_k - c_k^m) s_{k,-j}^R(p_{-j}) - \sum_{k \in \Omega_m^D} (p_k^D - c_k^m) s_{k,-j}^D(p_{-j}) \right]$$
$$- (1-\lambda_j) \left[\sum_{k \in \Omega_r} (p_k^R - w_k) s_k^R(p) - \sum_{k \in \Omega_r | \{j\}} (p_k^R - w_k) s_{k,-j}^R(p_{-j}) \right] = 0.$$

Rearranging:

$$\lambda_j \left[(w_j - c_j^m) s_j^R(p) - \sum_{k \in \Omega_m^R | \{j\}} (w_k - c_k^m) \Delta s_{k,-j}^R(p) - \sum_{k \in \Omega_m^D} (p_k^D - c_k^m) \Delta s_{k,-j}^D(p) \right]$$
$$- (1-\lambda_j) \left[(p_j^R - w_j) s_j^R(p) - \sum_{k \in \Omega_r | \{j\}} (p_k^R - w_k) \Delta s_{k,-j}^R(p) \right] = 0, \tag{A.2}$$

where $\Delta s_{k,-j}^f(p) \equiv s_{k,-j}^f(p_{-j}) - s_k^f(p)$, with $f \in \{\mathrm{R}, \mathrm{D}\}$.

Isolating $w_j s_j(p)$ yields equation (7).

[40] To simplify the notation here, we simply write the retailers' profits as Π_r instead of $\Pi_r(w, w_{-j})$, and $\Pi_{r,-j}$ instead of $\Pi_{r,-j}(w_{-j})$. We also adopt the corresponding notational convention for manufacturers.

B Derivation of the Estimating Marginal Cost Equation

B.1 Derivation of the term $c^m = \mathcal{M}(\lambda)$ in equation (16)

Write in matrix form equation (5) for the necessary first-order conditions of the manufacturers from their direct sales:[41]

$$s + (T_w \odot \Delta_s)(w - c^m) = 0, \tag{B.1}$$

where:

$$T_w(i,j) = \begin{cases} 1 & \text{if } i = j \text{ or } (i \wedge j) \text{ are owned by the same manufacturer} \\ 0 & \text{otherwise,} \end{cases}$$

Δ_s is the matrix of derivatives with respect to price,
w is a $M \times R$ vector such that $w_j = p_j^D$ if j is a product sold directly by manufacturers.

Similarly, write in matrix form equation (7) for the necessary first-order conditions of the wholesale bargaining prices in the vertical channel:

$$(T_w \odot \bar{s})(w - c^m).\lambda - (T_r \odot \bar{s})(p^R - w).(1 - \lambda) = 0, \tag{B.2}$$

where:

$$\bar{s} \text{ is such that } \bar{s}(i,j) = \begin{cases} s_j & \text{if } i = j \\ \text{-}\Delta s_i^{-j} & \text{otherwise,} \end{cases}$$

$$T_r \text{ is such that } T_r(i,j) = \begin{cases} 1 & \text{if } i = j \text{ or } (i \wedge j) \text{ are sold by the same retailer} \\ 0 & \text{otherwise.} \end{cases}$$

Next, sum the equations in (B.1) and (B.2) as follows:

$$I_d[s + (T_w \odot \Delta s)(w - c^m)] + I_v[(T_w \odot \bar{s})(w - c^m).\lambda - (T_r \odot \bar{s})(p^R - w).(1 - \lambda)] = 0, \tag{B.3}$$

where:

$$I_d \text{ is a } J \times J \text{ matrix such that } I_d(i,j) = \begin{cases} 1 & \text{if } i = j \text{ and product } j \text{ is sold directly} \\ 0 & \text{otherwise,} \end{cases}$$

$$I_v \text{ is a } J \times J \text{ matrix such that } I_v(i,j) = \begin{cases} 1 & \text{if } i = j \text{ and product } j \text{ is sold by retailers} \\ 0 & \text{otherwise.} \end{cases}$$

Finally, let:

$$c^m = \mathcal{M}(\lambda) \equiv A^{-1}(\lambda)B(\lambda), \tag{B.4}$$

where:

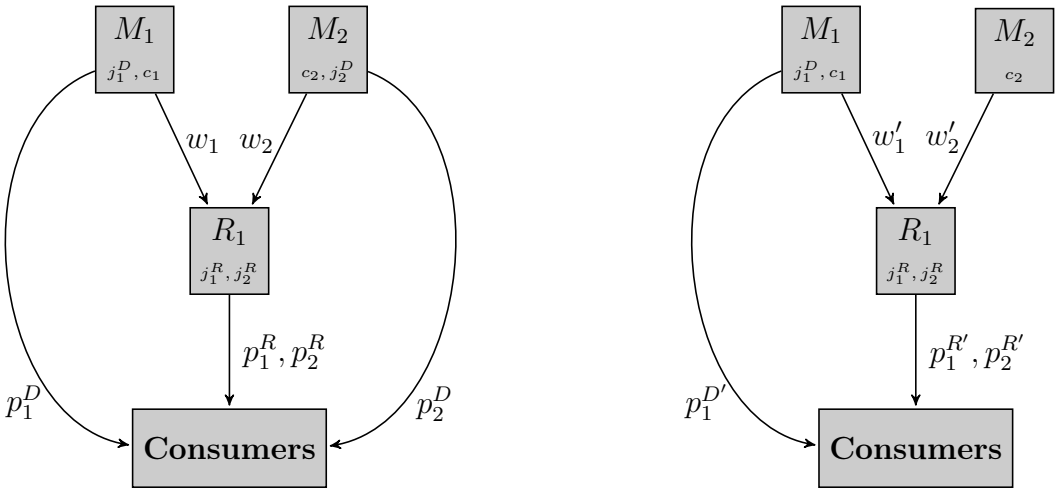
$$A(\lambda) = I_v(T_w \odot \bar{s}).\lambda + I_d(T_w \odot \Delta s),$$
$$B(\lambda) = I_v[(T_w \odot \bar{s})w.\lambda - (T_r \odot \bar{s})(p^R - w).(1 - \lambda)] + I_d(s + (T_w \odot \Delta s)w).$$

[41] Henceforth, denote by "$\odot$" the element-by-element matrix multiplication and by "." the element-by-element vector multiplication.

C Additional Examples

Example 5. No direct sales from one manufacturer.

Figure A1: No direct sales from one manufacturer.



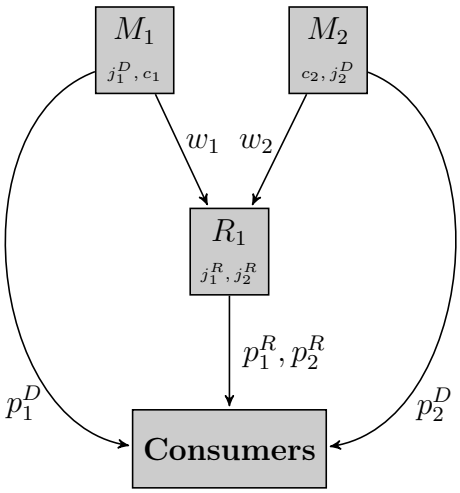
(a) Both M_1 and M_2 sell directly sales.

(b) Only M_1 sells directly to consumers.

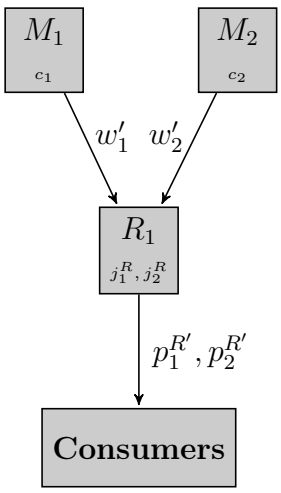
Notes: The figure illustrates the leverage effect of one manufacturer with two manufacturers and one retailer from example 5. Panel a. In the upstream, manufacturers M_1 and M_2 produce, respectively, inputs 1 and 2 at costs c_1 and c_2. These inputs are sold to retailer R_1 at, respectively, the negotiated wholesale prices w_1 and w_2, and used to manufacture products j_1^D and j_2^D. In the downstream, there are three competing firms, M_1, M_2, and R_1. Manufacturers M_1 and M_2 sell, respectively, products j_1^D and j_2^D directly to consumers at prices p_1^D and p_2^D. Retailer R_1 sells products j_1^R and j_2^R at prices p_1^R and p_2^R, respectively. Panel b. Similar to panel a, but now manufacturer M_2 does not sell products j_2^D to consumers.

Example 6. No direct sales from both manufacturers.

Figure A2: No direct sales from both manufacturers.



(a) Both M_1 and M_2 sell directly sales.

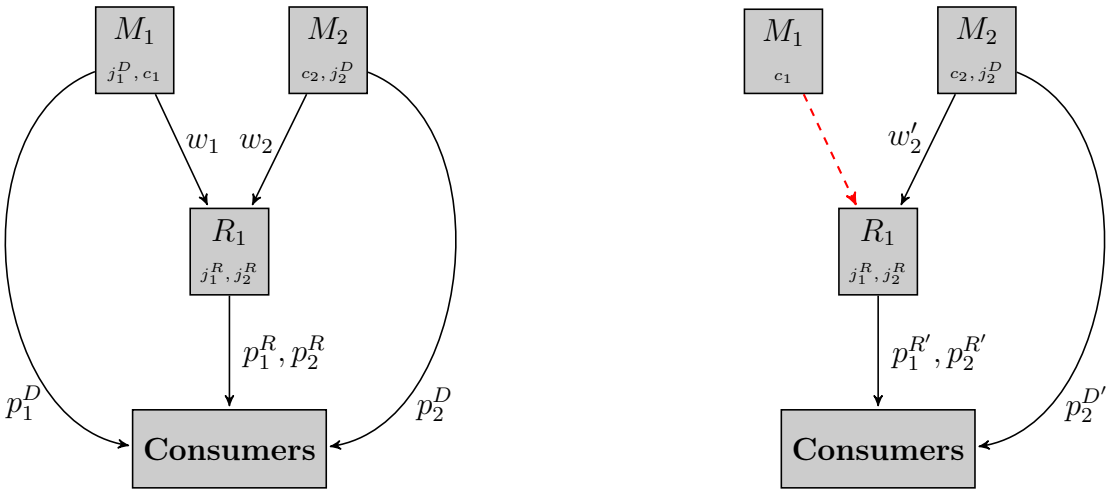


(b) Neither M_1 nor M_2 sell directly to consumers.

Notes: The figure illustrates the leverage effect of one manufacturer with two manufacturers and one retailer from example 6. Panel a. In the upstream, manufacturers M_1 and M_2 produce, respectively, inputs 1 and 2 at costs c_1 and c_2. These inputs are sold to retailer R_1 at, respectively, the negotiated wholesale prices w_1 and w_2, and used to manufacture products j_1^D and j_2^D. In the downstream, there are three competing firms, M_1, M_2, and R_1. Manufacturers M_1 and M_2 sell, respectively, products j_1^D and j_2^D directly to consumers at prices p_1^D and p_2^D. Retailer R_1 sells products j_1^R and j_2^R at prices p_1^R and p_2^R, respectively. Panel b. Similar to panel a, but now manufacturers do not sell products j_1^D and j_2^D to consumers.

Example 7. Direct sales *vs.* vertical integration.

Figure A3: Direct sales *vs.* vertical integration.



(a) M_1 sells directly to consumers.

(b) M_1 vertically integrates with R_1.

Notes: The figure illustrates the leverage effect of one manufacturer with two manufacturers and one retailer from example 7. Panel a. In the upstream, manufacturers M_1 and M_2 produce, respectively, inputs 1 and 2 at costs c_1 and c_2. These inputs are sold to retailer R_1 at, respectively, the negotiated wholesale prices w_1 and w_2, and used to manufacture products j_1^D and j_2^D. In the downstream, there are three competing firms, M_1, M_2, and R_1. Manufacturers M_1 and M_2 sell, respectively, products j_1^D and j_2^D directly to consumers at prices p_1^D and p_2^D. Retailer R_1 sells products j_1^R and j_2^R at prices p_1^R and p_2^R, respectively. Panel b. Similar to panel a, but now the dashed red line denotes vertical integration between M_1 and R_1. The vertically integrated firm sells products j_1^R and j_2^R to consumers at prices p_1^R and p_2^R, respectively