The Welfare Effects of Direct-to-Consumer Sales
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Dissertação para obtenção do grau de mestre apresentada à Escola de Pós-Graduação em Economia

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Abstract

Cutting off the intermediary and selling directly to consumers is an increasingly common strategy by manufacturers in many industries. Its impact on prices, profits and consumer welfare is theoretically ambiguous. It leads to an increase in competition and a larger variety of products, which tends to lower prices and increase consumer welfare. However, it may also strengthen manufacturers’ bargaining leverage when negotiating fees with retailers, which pressures prices upward, potentially offsetting the competition effect and the gains from variety. To understand and quantify this trade-off we use data on the outdoor advertising industry, which permits us to estimate demand for advertising products and a model of wholesale price bargaining and downstream price setting. We then simulate the removal of the direct-to-consumer channel in various scenarios to disentangle the effects above. We find that they are significant, though the competition effect dominates. The effect of direct-to-consumer sales in our setting is lower prices, higher manufacturer profits, lower retailer profits, higher consumer welfare and total welfare.

JEL Codes: L81; L42; M37.

Keywords: Direct-to-consumer sales, bargaining, outdoor advertising.
1 Introduction

Many firms that used to sell their products only through retailers or intermediaries are starting to sell directly to consumers. The opportunities offered by the internet and sites like Amazon have contributed to this rise in direct sales.\footnote{https://www.forbes.com/sites/forbescommunicationscouncil/2017/09/27/the-rise-of-direct-to-consumer-marketing.} Examples include Nike and Adidas selling their products online instead of only using retailers such as Foot Locker; cable company HBO launching its platform HBO Now, where viewers looking for HBO content can subscribe directly to the platform vis-à-vis having to subscribe to cable TV; or Tesla’s recent battle for the right of selling cars directly to consumers in the United States, where the dealership model is the norm\footnote{https://electrek.co/2018/02/14/tesla-pushing-right-to-sell-cars-directly-states/;\ https://www.forbes.com/sites/greatspeculations/2016/03/03/is-the-direct-sales-model-critical-for-tesla-motors.}.

The potential effects of opening this direct-to-consumer channel include circumventing the double marginalization problem that occurs when selling through intermediaries; an increase in variety if both channels continue to be present and products are differentiated among channels; an increase in competition resulting from a larger number of firms selling to consumers; and a bargaining effect, which comes from the additional leverage a manufacturer obtains when negotiating fees with intermediaries. In a given setting, all these effects occur simultaneously and work in opposite directions.

This paper quantifies the welfare effects of direct-to-consumer (DTC) sales in the context of outdoor (or out-of-home) advertising in Portugal. The topic of DTC sales has attracted a lot of attention in the media, as more and more well-established firms such as Nike and L’Oreal have been adopting this strategy\footnote{https://www.bringg.com/blog/industry-trends/cutting-the-middleman-the-growth-of-direct-to-consumer/; \ https://www.visioncritical.com/direct-to-consumer-marketing-channel/.}. Given this phenomenon, understanding its effects on prices, manufacturer and retailer profitability and consumer welfare is of substantial relevance.

The outdoor advertising industry contains features that creates empirical leverage to address our question of interest. There are many firms involved in different steps of the supply chain, making it an interesting setting to analyze interactions between different types of firms. There are also different types of outdoor formats. In addition, there is variation in the type of format manufacturers sell directly or through retailers. We have data on the final prices of the outdoor display formats in both the retail and direct channels, wholesale prices negotiated between manufacturers and retailers, and the quantities sold, all for the year 2013. This dataset allows us to specify and estimate a structural model of consumer demand for advertising products, manufacturer-retailer bargaining for wholesale prices, and downstream Nash-Bertrand competition for the final prices consumers pay for the displays. After estimating our model, we simulate...
counterfactual scenarios to disentangle and assess the magnitude of the different effects that direct-to-consumer sales have on prices and welfare. We consider a scenario where direct sales are present but manufacturers cannot use this to gain a bargaining advantage, and one in which no direct sales are allowed. The difference between them is intended to capture the competitive effect. Also, we compare scenarios with and without allowing the bargaining advantage of direct sales, to isolate the bargaining effect.

We find that the bargaining effect is indeed present: the direct channel gives the manufacturers leverage when negotiating wholesale prices. As a consequence, both wholesale and retail prices increase, and consumer welfare decreases. The competition effect from the introduction of direct sales is also present and relevant: prices are lower, manufacturer and retailer profits are lower and consumer welfare is higher. An increase in variety brought about by direct sales also leads to higher consumer welfare, but the gain comes mostly from the lower prices. The overall impact of direct sales in our context is lower prices, higher manufacturer profits (which comes from the bargaining effect), lower retailer profits and higher consumer welfare.

Our results highlight the importance of taking into account not only the traditional competition effect but also the bargaining effect that stems from selling directly. Indeed, the effects work on opposite directions, making the assessment of its overall impact an empirical question that may vary depending on the institutional setting.

**Related Literature.** There are theoretical papers that address direct-to-consumer sales, mostly in the marketing literature. Chiang, Chhajed, and Hess (2003) study how direct marketing affects profits through the retail channel. Using a game-theoretic model, they show that a direct channel (or the mere threat of direct sales) constrains the retailer’s pricing, which is accompanied by a wholesale price reduction. Direct sales therefore reduce double marginalization and profits both firms. Cai (2010) compares the profitability of different channel structures, and show that it depends on channel base demand and substitutability and channel operational costs.

The papers above, however, consider only one manufacturer and one or two retailers and assumes wholesale price is set by the manufacturer. We complement this literature by taking into account that price is negotiated, which is true in many empirical settings; we consider multiple upstream and downstream firms; and we build a model that allows to identify the mechanisms at work and quantify them, making it possible for us to make a statement about the welfare impact of direct sales.

Our work is related to a few papers that have studied the impact of online sales. Duch-Brown et al. (2017) investigate the impact of e-commerce in the consumer electronics industry in Europe. They find that an online distribution channel increased total sales but also diverted sales
from the traditional channel. They also conclude that both consumers and firms benefit, but the increase in consumer surplus is much larger due to the positive valuation from the additional channel. Pozzi (2013) study 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) also investigate the impact of online retail, but focusing on the gains from increased product variety. Cazaubiel et al. (2018) study the hotel industry and seek to assess the degree of substitution between booking a room from the hotel directly or through online third-party platforms. They simulate the delisting of a hotel chain from a platform and find that consumers would prefer to substitute to other hotels in that platform than to stay loyal to the chain. However, among the consumers who switch channels, most of them would rather book directly from the hotel than through a competing platform.

The papers above study the how the introduction of online sales by a given firm affects offline sales from the same firm. The contribution of this paper is to investigate the effect of direct sales from a manufacturer on sales through intermediaries. Therefore the direct channel in our context can also alter how firms behave towards each other. In particular, it can increase a manufacturer’s bargaining leverage when negotiating wholesale prices with retailers. This is another mechanism that can affect final prices, sales and consumer welfare. A paper that has a similar structure to ours is Ellickson, Kong, and Lovett (2018). They study the effect of private label entry in the brew-at-home coffee industry, taking into account the direct profits a retailer has with the private label but also the indirect profits stemming from the increase in bargaining leverage when negotiating with suppliers. They find that the bargaining effect is of substantial magnitude.

More generally, this paper also adds to the applied work in IO that uses bargaining models to answer a variety of questions. For instance, Crawford and Yurukoglu (2012) investigate the welfare effect of bundling in multichannel TV; Grennan (2013) studies price discrimination in the market for medical devices; Gowrisankaran, Nevo, and Town (2015) study hospital mergers; Ho and Lee (2017) assess the effect of insurer competition in healthcare markets; and Crawford, Lee, et al. (2018) study vertical integration.

Donna et al. (2018) also study the outdoor advertising industry. They seek to understand the welfare effects of the intermediaries’ services. Their focus is on the demand side; they specify a consumer search model and disentangle the sources of consumer welfare. They simulate counterfactuals to quantify the gain from each of the services the intermediaries provide. Our paper, on the other hand, focuses on the supply side; we investigate how a particular characteristic of our setting (direct-to-consumer sales) affects the interaction between firms, and how this alters
prices and ultimately consumer welfare.

Road Map. The rest of this paper is organized as follows. Section 2 presents our theoretical model of the outdoor advertising industry, focusing on how the direct-to-consumer channel can alter bargaining outcomes. Section 3 describes details about the industry, the dataset to be used and the empirical implementation. Section 4 presents our counterfactual simulations, and Section 5 concludes.

2 Theoretical Framework

We begin with a stylized model for the supply-side, which we use to highlight how a direct-to-consumer (DTC) channel affects negotiated fees and how this leads to a theoretically ambiguous impact on prices and hence on welfare. In this section we abstract away from a few details that are relevant to our empirical setting, for the sake of exposition.

There are two types of firms, manufacturers and retailers. Manufacturers are multi-product firms that can either sell their products to retailers, who then sell to consumers, or they can sell their products directly. There are \( m = 1, \ldots, M \) manufacturers and \( r = 1, \ldots, R \) retailers. Let \( J \) be the set of the total (differentiated) products. Denote by \( \Omega^V_m \) the set of products that manufacturer \( m \) sells to retailers, \( \Omega^D_m \) the set of products that manufacturer \( m \) sells directly to consumers and \( \Omega_r \) the set of products that retailer \( r \) sells to the final consumers. We take these objects as given and assume the following timing:

1. (a) The manufacturers and retailers bargain over linear fees \( w \equiv \{w_j\}_{j \in J} \), where \( w_j \) is paid by a retailer to the manufacturer of product \( j \).
   (b) Simultaneously with bargaining over fees, retailers and manufacturers compete via prices \( p \equiv \{p_j\}_{j \in J} \). This vector includes products from the vertical (retailer) channel and the DTC channel.

2. Consumers observe all prices \( \{p_j\}_{j \in J} \) and choose the product that maximizes their utility. This determines market shares \( \{s_j(p)\}_{j \in J} \).

Firms seek to maximize profits when bargaining over fees and setting prices. We assume the profit of retailer \( r \) is

\[
\Pi_r = \sum_{j \in \Omega_r} (p_j - w_j) M s_j(p) \tag{1}
\]

and the profit of manufacturer \( m \) is
\[ \Pi_m = \sum_{j \in \Omega_m^V} (w_j - \mu_j) Ms_j(p) + \sum_{j \in \Omega_m^D} (p_j - \mu_j) Ms_j(p) \]  

(2)

where \( M \) denotes market size and \( \mu_j \) is the manufacturing marginal cost of product \( j \). We assume retailers’ only marginal cost is the wholesale price\(^4\). Note that the profit function of manufacturers contains two terms: the profits from selling the products to retailers and directly.

In the subsequent analysis of this section, we will take demand as primitives and go over each of these in turn: equilibrium determination of retail prices, bargaining over wholesale prices and the leverage a manufacturer with a DTC channel obtains over a retailer.

**Retail Price Setting.** Retail prices are given by Nash-Bertrand equilibrium. The set of necessary first-order conditions are:

\[ s_j + \sum_{k \in \Omega} (p_k - w_k) \frac{\partial s_k(p)}{\partial p_j} = 0 \]  

(3)

for all \( j \) in the vertical channel, and

\[ s_j + \sum_{k \in \Omega_m^V} (w_k - \mu_k) \frac{\partial s_k(p)}{\partial p_j} + \sum_{k \in \Omega_m^D} (p_k - \mu_k) \frac{\partial s_k(p)}{\partial p_j} = 0 \]  

(4)

for all \( j \) in the DTC channel.

The set of equations above yield retail prices as a function of wholesale prices.

**Wholesale Price Setting.** The equilibrium concept for the determination of negotiated fees is Nash equilibrium in Nash bargains, or Nash-in-Nash, first proposed by Horn and Wolinsky (1988). Each negotiated price is the solution of a Nash bargain and all negotiated prices form a Nash equilibrium, i.e., no manufacturer-retailer pair would like to change their negotiated price, given all other agreements. Also, we assume that firms have "passive beliefs", i.e., while bargaining they do not expect other contracts to be renegotiated in case negotiation fails. This assumption has been used in applied work by Crawford, Lee, et al. (2018), Ho and Lee (2017), Draganska, Klapper, and Villas-Boas (2010), among others.

In the Nash-in-Nash framework, the disagreement payoff of a firm in the negotiation of a given product’s price is defined as the amount of profits this firm would earn if that product wasn’t offered, keeping the other prices fixed. These are:

\(^4\)We argue that this assumption has little effect on the results, since we observe small retail margins in the data. Therefore marginal costs would have to be very small to keep margins positive.
\[
\Pi_{r,-j} \equiv \sum_{k \in \Omega_r \setminus \{j\}} (p_k - w_k) M s_k^{-j}(p_{-j})
\]  
\[
\Pi_{m,-j} \equiv \sum_{k \in \Omega_m \setminus \{j\}} (w_k - \mu_k) M s_k^{-j}(p_{-j}) + \sum_{k \in \Omega_m^d} (p_k - \mu_k) M s_k^{-j}(p_{-j})
\]

where \( s_k^{-j}(p_{-j}) \) is the market share of product \( k \) if product \( j \) isn’t offered.

The wholesale price for product \( j \) solves:

\[
\max_w \left[ \Pi_r(w, w_{-j}) - \Pi_{r,-j}(w_{-j}) \right]^{\lambda_j} \left[ \Pi_m(w, w_{-j}) - \Pi_{m,-j}(w_{-j}) \right]^{1-\lambda_j}
\]

where \( \lambda_j \) is the retailer’s bargaining weight vis-à-vis manufacturers. \( GFT_r^j \) and \( GFT_m^j \) stand for gains-from-trade from product \( j \) for retailer \( r \) and manufacturer \( m \), respectively.

The first order condition\(^6\) is given by:

\[
\Pi_r - \Pi_{r,-j} = \frac{\lambda_j}{1 - \lambda_j} \left[ \Pi_m - \Pi_{m,-j} \right]
\]

The equation above gives wholesale prices as a function of retail prices and demand primitives. Equations 3, 4 and 8 yield the equilibrium prices of the industry.

**Bargaining Effect of Direct-to-Consumer Sales.** The equation above can also be written as \(^5\):

\[
w_j s_j(p) = (1 - \lambda_j) [p_j s_j(p) - \sum_{k \in \Omega_r \setminus j} (p_k - w_k) \Delta s_k^{-j}(p)] + \lambda_j [\mu_j s_j(p) + \sum_{k \in \Omega_m \setminus j} (w_k - \mu_k) \Delta s_k^{-j}(p) + \sum_{k \in \Omega_m^d} (p_k - \mu_k) \Delta s_k^{-j}(p)]
\]

Note that we rewrote the manufacturer’s gains-from-trade as \( GFT_m^j = (w_j - \mu_j)s_j - d_j^v - d_j^d \), where \( d_j^v \) and \( d_j^d \) are non-negative terms that represent the additional profits the firm obtains with its other products (from the vertical and direct channel, respectively) when product \( j \) stops being offered. The term \( d_j^v + d_j^d \) represents manufacturer \( m \)'s "opportunity cost" from dealing with retailer \( r \). The presence of a DTC channel then increases this opportunity cost:

Since manufacturer \( m \) has more to gain if the negotiation breaks down, retailer \( r \) pays \( m \) more in

\(^5\)For the case \( 0 < \lambda_j < 1 \). Derivation is in the appendix.

\(^6\)Derivation in the appendix.
equilibrium. This can be seen directly from equation 9: the higher is $d_j^d$, everything else constant, the higher is $w_j s_j(p)$.

When a manufacturer starts selling directly it increases competition downstream, which exerts a downward pressure on prices. However, from equations 3 and 4 retail prices also depend on wholesale prices; if the latter increases with the DTC channel it pressures retail prices upward. Therefore the changes in prices and hence welfare measures from direct sales are ambiguous. In section 4 we will simulate different outcomes, decompose these different effects to show the direction of each one and conclude which one prevails in our setting.

3 Empirical Application

3.1 Institutional Details and Data

In this subsection we give an overview of the data. See Donna et al. (2018) for more details.

The industry we study is the outdoor advertising industry in Portugal. There are three main economic agents in the Portuguese outdoor advertising industry: (i) manufacturers, (ii) retailers, and (iii) consumers. A manufacturer, also called media owner, is a firm that makes, installs and sells equipment for the display of outdoor advertising.

A retailer, also called media group, is an intermediary that buys advertising from the manufacturer on behalf of the consumer. Retailers also offer consumers additional services such as consulting services, advertising planning campaigns, and information about the products of different manufacturers. Finally, the consumer in our setting is a firm that demands advertising to promote its products. A consumer can buy from a retailer or directly from the manufacturer.

We obtained administrative data from all the relevant manufacturers and retailers in the industry for the year 2013 aggregated at the monthly market level. We consider 3 display formats: $2m^2$ panel, Senior, and an additional category aggregating the remaining formats that have negligible weight 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) and 1 additional retailer that aggregates the smaller retailers.

We define a product as a combination of display format, manufacturer, and retailer. Therefore examples of products are: J.C. Decaux Group’s $2m^2$ panels sold by Havas Media Group, and J.C.

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7Panels of $2m^2$ include 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 or transport hubs. Finally, a Special Format is a large panel typically made by special request.
Decaux Group’s seniors sold directly by J.C. Decaux Group. Henceforth, and for confidentiality reasons, 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 5 main retailers as $r_1, ..., r_5$, not necessarily in the order above, and to the additional retailer as $r_6$.

For each month and combination 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 and the wholesale prices paid by retailers to the manufacturers, measured in Euros.

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, outdoor advertising sold by other manufacturers and retailers (e.g. small manufacturers and retailers that operate locally), and not buying outdoor advertising. We consider 12 markets, one for each month of the year, and a continuum of heterogeneous consumers in each market.

Let DSC and VSC stand for direct sales channel and vertical sales channel, respectively. Table 1 shows the average (over the 12 months in the sample) market share for each product. The most popular display formats are $2m^2$ panels. $m_2$ and $r_6$ are respectively the manufacturer and retailer with the highest market shares. Note that the number of inside products in the sample, 57, is lower than the number of potential products in the market, 81. This happens since not all retailers negotiate with all manufacturers and vice-versa, and some manufacturers don’t sell all their products directly.

The market share of the VSC is on average about 6 times higher than the share of the DSC. This reflects the fact that there are 50 products sold by retailers and 7 sold directly by manufacturers. It can be seen in the last entry of Table 1 that the outside option share is on average 34.91%. This is the result of our definition of market size.

Table 2 shows descriptive statistics for wholesale and retail prices. The values are in euros per $m^2$. For each product type (supplier, retailer or display format) we calculate the statistics over all observations of that type. For instance, in the first row the statistics correspond to the prices of all products manufactured by $m_1$ across all 12 months in the sample. Average prices

\[^{8}\text{3 displays x (4 manufacturers x 6 retailers+3 manufacturers' DSC)=81}\]
are weighted by market shares.

Retailers tend to pay more for products supplied by manufacturer $m_2$ and for displays in the "Other" category. Consumers also pay more for $m_2$'s products that are sold directly. On average, consumers pay more for displays of the Senior type. There's substantial price dispersion across suppliers, retailers, displays and sales channels. Note that retail prices are only slightly higher than wholesale prices. Retailers then have a low margin, indicating they have low bargaining power. See section 3.3 for further discussion of this result.

3.2 Demand

Model. We use a random coefficients logit model for individual demand similar to Berry, Levinsohn, and Pakes (1995) and Nevo (2001). We have $t = 1,2,...,T$ markets, each with $i = 1,2,...,I_t$ utility-maximizing consumers. A market will be defined here as a month. 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 given by:

$$u_{ijt} = -\alpha_ip_{jt} + D_{jt}\beta + \xi_{jt} + \epsilon_{ijt}$$ (10)

$i = 1,...,I_t, t = 1,...,T$

where $p_{jt}$ is the price of product $j$ in market $t$; $D_{jt}$ includes fixed effects for display format, manufacturer, retailer and month; $\epsilon_{ijt}$ is a stochastic term assumed to have an Extreme Value Type I distribution. 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 follows:

$$\alpha_i = \alpha + \sigma v_i, \quad v_i \sim P_v \equiv N(0,1)$$ (11)

where $(\alpha, \beta)$ refers to a vector of mean valuations of the price and product characteristics; $v_i$ is a vector of independent random draws from a standard normal distribution, that captures unobserved (by the econometrician) individual heterogeneity; and $\sigma$ is the standard deviation of the random coefficient for price.

Denote by $\delta_{jt} \equiv -\alpha_p p_{jt} + D_{jt}\beta + \xi_{jt}$ the mean utility for product $j$ in market $t$ (i.e. the portion of the utility that is constant across consumer types).

Then $u_{ijt} = \delta_{jt} - \sigma v_i p_{jt} + \epsilon_{ijt}$.

Let $P_{ijt|v_i}$ be the probability that consumer $i$ purchases product $j$ in market $t$, given value $v_i$. 
Since \( \epsilon_{ijt} \) is iid extreme value type I, we have:

\[
P_{ijt|v_i} = \frac{\exp(\delta_{jt} - \sigma v_i p_{jt})}{1 + \sum_{k=1}^{J} \exp(\delta_{kt} - \sigma v_i p_{kt})}
\]

Let \( A_{jt} \) be the set of individuals who choose brand \( j \) in market \( t \). We have:

\[
A_{jt}(x_t, p_t, \delta, \sigma) = \{(v_i, \epsilon_{i0t}, ..., \epsilon_{iJt})|u_{ijt} \geq u_{ilt}, \forall l = 0, 1, ..., J\}
\]

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 brands, respectively.

The market share for product \( j \) is simply\(^9\):

\[
s_{jt}(x_t, p_t, \delta, \sigma) = \int_{A_{jt}} P_{ijt|v} dP_v(v).
\]

**Estimation.** The model is estimated by GMM with moment condition \( E[Z'\omega(\theta^*)] = 0 \), where \( Z \) is a matrix of instruments, \( \omega(.) \) is a structural error term defined below and \( \theta^* = (\alpha, \beta, \sigma) \) is the true value of the parameters. The GMM estimate is:

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

where \( A \) is a consistent estimate of \( E(Z'\omega\omega'Z) \).

For each candidate parameter vector, we use equation 14 to compute the market shares as a function of the parameters. We then find the mean utility levels \( \delta_{jt} \) by solving the system of equations

\[
s_{jt}(p_{jt}, x_{jt}, \delta_{jt}; \sigma) = S_{jt}, \forall j,t
\]

where \( S_{jt} \) are the observed market shares from the data. We use the contraction mapping suggested by Berry, Levinsohn, and Pakes (1995). Then we define the error term as \( \omega_{jt} = \delta_{jt} - (D_{jt}\beta - \alpha p_{jt}) \).

**Identification.** The structural error term in our case is the unobserved (to the econometrician) month-specific deviation from the overall mean valuation of the product. Assuming this is observed by firms, this deviation is correlated with prices. To address the endogeneity of the price coefficient we use prices of the same product in other markets as instruments for the price of the product in the market in question, as in Hausman (1996) and Nevo (2001). We’re assuming month-specific valuations for a product are correlated with its price in a given month, but not

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\(^9\)For the estimation we will approximate the integral in 14 by \( s_{jt} = \frac{1}{NS} \sum_{n=1}^{NS} s_{jt}(v_{ns}), \text{ where } v_{ns}, \text{ for } ns = 1, ..., NS \text{ are draws from } P_v(.) \). We set \( NS = 50 \).
in other months since these valuations are independent across time, when controlling for display format, manufacturer, retailer and month. In particular, to instrument for the price in a given month we use the average of the price of the same product in other months. We use both retail and wholesale prices, yielding two instruments. The instrument set will also include all the fixed effects, which we assume are exogenous.

We construct a "differentiation instrument" to identify the heterogeneity parameter $\sigma$. The procedure is the one given in Gandhi and Houde (2016): Using the instruments for price defined above, we take the fitted value for the price vector $\hat{p}$ and, for each market $t$ and product $j$ define the instrument

$$\sum_{j' \neq j, t} 1\{|d^p_{jt,j'}| < 5\}|d^p_{jt,j'}|$$

where $d^p_{jt,j'}$ is the difference in the fitted value for price between products $j$ and $j'$ in market $t$.

Estimates. Table 3 reports the coefficients and standard errors of the parameters from the demand estimation. Model 1 is a simple logit model using the instruments described in section 3.2. The results from the estimation procedure described in section 3.2 are in the third and fourth columns (Model 2). The coefficients have the expected sign. The mean price coefficient is 0.46 and is statistically different from zero, which indicates that demand is relatively elastic: average own-price elasticity is -1.66 and average cross-price elasticity is 0.02. The dispersion of the price sensitivity across consumers is also statistically different from zero and relatively large in magnitude with a value of 0.14. We will use the results from Model 2 for the remainder of the paper.

3.3 Supply

Estimation. We make the parametrization $\mu = X\gamma + \epsilon$ for marginal costs, where X includes a constant and a set of display, manufacturer and month fixed effects and $\epsilon$ is the component of marginal cost that is unobservable to the econometrician. This assumption is similar to Gowrisankaran, Nevo, and Town (2015). $\theta_s = (\gamma, \lambda)$, the set of supply side parameters, is estimated via OLS using the equations of manufacturer-retailer bargaining.

Rearrange equation 29 to obtain:

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10 We will assume for tractability that the bargaining parameters $\lambda$ vary only by retailer.

11 We do this for simplification. We plan to later on estimate the supply model via GMM taking endogeneity into account.
\[ \lambda_j[(w_j - \mu_j)s_j - \sum_{k \in \Omega_m \setminus j} (w_k - \mu_k)\Delta s_k^{-j} - \sum_{k \in \Omega_m} (p_k - \mu_k)\Delta s_k^{-j}] = (1 - \lambda_j)[(p_j - w_j)s_j - \sum_{k \in \Omega_r \setminus \{j\}} (p_k - w_k)\Delta s_k^{-j}] \] \quad (18)

Substituting for marginal costs and rearranging yields

\[ \xi_j(\theta_s) \equiv \lambda_j[\epsilon_js_j - \sum_{k \mid j} \epsilon_k\Delta s_k^{-j}] = w_js_j - \lambda_j[\sum_{k \in \Omega_m \setminus j} w_k\Delta s_k^{-j} + \sum_{k \in \Omega_m} p_k\Delta s_k^{-j}] - (1 - \lambda_j)[p_js_j - \sum_{k \in \Omega_r \setminus \{j\}} (p_k - w_k)\Delta s_k^{-j}] + \lambda_j[-x'_s\gamma s_j + \sum_{k \in \Omega_m \setminus j} x'_k\gamma \Delta s_k^{-j}] \] \quad (19)

for all products \( j \) in the vertical channel\(^{12} \).

**Identification.** Note that we have \( 600=50 \times 12 \) bargaining equations and 23 parameters (marginal cost fixed effects and retailer bargaining weights) to estimate. We will show how marginal costs and bargaining weights are separately identified assuming a simpler scenario where two manufacturers sell a single type of display format to two retailers in a given market. The vertical relationship then looks like this:

\[
\begin{array}{c}
M1 \\
\downarrow \\
\uparrow \\
R3 \quad M2 \\
\downarrow \\
\uparrow \\
R4
\end{array}
\]

Equation 8 for products 13, 14, 23 and 24 reduces to:

\[
\frac{\lambda_{13}}{1 - \lambda_{13}} = \frac{(p_{13} - w_{13})s_{13} - (p_{23} - w_{23})\Delta s_{23}^{-13}}{(w_{13} - \mu_{13})s_{13} - (w_{14} - \mu_{14})\Delta s_{14}^{-13}} 
\] \quad (20)

\[
\frac{\lambda_{14}}{1 - \lambda_{14}} = \frac{(p_{14} - w_{14})s_{14} - (p_{24} - w_{24})\Delta s_{24}^{-14}}{(w_{14} - \mu_{14})s_{14} - (w_{13} - \mu_{13})\Delta s_{13}^{-14}} 
\] \quad (21)

\[
\frac{\lambda_{23}}{1 - \lambda_{23}} = \frac{(p_{23} - w_{23})s_{23} - (p_{13} - w_{13})\Delta s_{13}^{-23}}{(w_{23} - \mu_{23})s_{23} - (w_{24} - \mu_{24})\Delta s_{24}^{-23}} \] \quad (22)

\(^{12}\)Note that \( x'_s \) is row \( s \) of matrix \( X \).
\[
\frac{\lambda_{24}}{1 - \lambda_{24}} = \frac{(p_{24} - w_{24})s_{24} - (p_{14} - w_{14})\Delta s_{14}^{24}}{(w_{24} - \mu_{24})s_{24} - (w_{23} - \mu_{23})\Delta s_{23}^{24}}
\]

(23)

Since we assume marginal costs for a given manufacturer don’t vary across retailers and bargaining weights for a given retailer don’t vary across manufacturers, we have \(\lambda_{13} = \lambda_{23}\), \(\lambda_{14} = \lambda_{24}\), \(\mu_{13} = \mu_{14}\) and \(\mu_{23} = \mu_{24}\). We then have 4 equations and 4 unknowns.

Both in this example and in our empirical setting, we rely on the complexity of the network structure between upstream and downstream firms and in a few assumptions to identify marginal costs and bargaining weights.

**Estimates.** Table 4 presents the estimates from the supply model. Panel A shows the distribution of the marginal cost estimates, which are relatively low. For instance, the (weighted by sales) average wholesale price in the data is 8.20 euros, while manufacture marginal costs are 0.34 euros, on average. Also, they are relatively homogeneous across display formats, manufacturers and months.

Panel B displays the estimates from the bargaining model. Retailers have very low bargaining power when negotiating fees with manufacturers. To understand this, first we argue that the following expression holds in our setting:

\[
\frac{\lambda_j}{1 - \lambda_j} \approx \frac{p_j - w_j}{w_j}
\]

(24)

for product \(j\).

The ratio of bargaining weights is therefore approximately the ratio of retailer margins and wholesale prices. The latter has a mean of 3.8% in our data.

Note that the highest bargaining power for a retailer is 0.15. This indicates that manufacturers are indeed the leading firms in this industry.

4 The Welfare Effects of Direct-to-Consumer Sales

In this section, we use our model’s estimates to examine how the presence of a direct channel affects negotiated wholesale prices, final prices to consumers, firm profit and consumer welfare. To do so, we simulate counterfactual outcomes under the following three scenarios\(^{13}\):

I. **Direct sales:** This is the outcome with direct sales as observed in the data, but recomputed from the model’s estimates.

\(^{13}\)For these simulations, we set the month dummy variable equal to the average of the month coefficients.
II. **Direct sales with no bargaining advantage:** In this scenario, we follow the same setup as in (I), allowing the direct channel to operate, but set $d_{ij} = 0$ in equation 9. The manufacturers therefore compete with retailers downstream but don’t internalize the profits from direct sales when negotiating wholesale prices with retailers.

III. **No Direct Sales:** In this scenario, we do not allow any manufacturer to sell directly to consumers. The products manufacturers sold directly then "leave" the market. In the vertical sales channel, the firms sell the same set of products as in the data.

For each scenario above, we solve for the set of prices, market shares and negotiated fees that satisfy the necessary equilibrium conditions given by equations (3), (4) and (8).

For the computation of manufacturer and retailer profit, we use the formulas given by equations 1 and 2. For consumer surplus, we use the following expression:

$$\int_{v_i} \frac{1}{\alpha} log\left(1 + \sum_{k=1}^{J} e^{\frac{\delta_{kt} - \sigma v_i p_{kt}}{\epsilon}}\right) dP_{v_i}(v_i)$$  \hspace{1cm} (25)

### 4.1 Potential Effects

Before proceeding to the simulated outcomes, it is instructive to highlight the effects of DTC sales that are captured by our model and that we attempt to quantify. These are:

1. **Bargaining Effect:**

   When a manufacturer has a DTC channel, in a given negotiation with a retailer over wholesale prices it internalizes the increase in profits from the DTC channel in case negotiation fails. The gains-from-trade accruing from bargaining is then lower. This is captured by the term $d_{ij}$ in equation 9 and has an upward pressure on wholesale prices. However, in equilibrium wholesale prices are also affected by changes in retail prices, since the latter alters both manufacturer and retailer’s gains-from-trade.

2. **Competition Effect:**

   Opening a DTC channel brings a new competitor downstream. This tends to lead to lower prices, benefiting consumers of the products in the VSC. This exerts a downward pressure on negotiated fees. Therefore both manufacturers and retailers will have a lower margin on each unit sold. The effect on profits will depend on the change in sales.
3. Gains from additional variety:

A DTC channel also creates more options for consumers. They can prefer buying directly from manufacturers instead of through intermediaries. Also, DTC sales can create a market expansion effect, bringing out consumers from the outside option (firms that bought advertising from another source not in our sample, or that did not buy advertising products at all.).

Even if these effects go in the expected direction\(^{14}\), their magnitudes and overall impact on welfare are empirical questions that our simulations aim to answer for our setting.

4.2 Results

Table 5 reports selected outcomes from the simulations described above. In the level columns, prices are measured in euros per \(m^2\) and are weighted by sales. The profit and welfare variables are in euros/consumer/month. In the other columns, we report the percentage change in the level estimate (vs. another scenario). Each of these columns attempts to isolate a different effect from direct-to-consumer sales. We will go through each one below.

Bargaining Effect. This is highlighted by the third column of Table 5, which displays the percentage difference between the scenario with no bargaining leverage (II) and the baseline (I). The sign is as expected (see discussion on section 2): since the manufacturers don’t use the DTC channel to gain bargaining leverage when negotiating fees, their gains-from-trade increase and wholesale prices decrease (by 1.82%). By consequence (recall that all prices are simultaneously determined in equilibrium) retail prices decrease 1.02% and 1.47% in the DSC and in the VSC, respectively. Manufacturer profits decrease slightly and retailer profits increase 12.68%. Consumer surplus and total welfare increase 0.7% and 0.04%, respectively. Note that the market share of both distribution channels increase, indicating a market expansion effect from lower prices. There’s also a substitution effect from the DSC to the VSC, since prices in the vertical channel are more affected. The magnitude of the changes (except for retailer profit) are relatively low. We believe this is mostly due to the fact that manufacturers sell more products to retailers than directly, as can be seen from Table 1. When negotiation with a retailer fails, the market share from the VSC will increase more than the DSC. The term \(d_i^v\) is then bigger than \(d_j^v\) in equation 9.

Competition Effect. The fifth column of Table 5 reports the percentage difference between the scenarios without DTC sales (III) and and with no bargaining leverage (II). The magnitudes

\(^{14}\)Note that since we remove the DTC channel in the simulations, our results in section 4.2 will be in the direction opposite to the ones discussed in this section.
are higher and have the expected sign: Wholesale prices increase 11.93% and retail prices in
the vertical channel increase 11.68%. Manufacturer profit increase very slightly (0.2%) due to
the increase in profits in the VSC. Retailers are the ones that benefit the most from lower
competition, profits are up by 12.83%. Consumers are worse off due to higher prices and lower
variety of products.

Gains from additional variety.

We seek to understand what fraction of the loss in consumer surplus in the third column of
Table 5 comes from less variety or higher prices. To do so, we make the following decomposition:
\[
\Delta CS = CS_2 - CS_1 = CS_2 - CS_{2,p_1} + CS_{2,p_1} - CS_1
\]
where \(CS_{2,p_1}\) is the consumer surplus in scenario II with retail prices in the VSC fixed at the
level of scenario I. \(\Delta CS_v\) represents the loss from a lower variety of products and \(\Delta CS_p\) is the loss
from higher prices. In our setting these measures are -0.029 and -0.043 euros/household/month,
respectively. The loss from higher prices is then a bit larger in magnitude than the loss from less
variety.

Net Effect. The last column in Table 5 yields the total effect of removing the direct channel
in this industry. Wholesale prices increase 9.9%, retail prices increase by 10.04%, manufacturer
profits decrease by 0.2% (even though the profits stemming from the VSC is higher by 21.64%).
Retailer surplus increase by 27.14%. Consumer welfare is down by 6.69% and total welfare by
0.84%.

The direct-to-consumer channel is therefore beneficial to consumers and manufacturers, but
makes retailers (significantly) worse off because of the additional competition downstream. Inter-
estingly, it is only profitable to manufacturers due to the bargaining effect.

Another relevant measure is the diversion ratio to the outside option when the DSC is re-
moved. Define \(DR \equiv \frac{s^0_i - s^0_j}{\sum_{j \in DSC} s^0_j}\), i.e., the change in the outside option share from the baseline
to counterfactual II divided by the share of the products in the direct channel in the baseline.
We estimate a value of 18.88%. This shows that there’s a relevant market expansion effect with
the introduction of the direct channel. However, the substitution effect has a higher magnitude:
81.12% of the sales of the direct channel in the baseline are diverted to the vertical channel when
the former is removed.
5 Concluding Remarks

In this paper, we used data on the outdoor advertising industry in Portugal to estimate a model of consumer demand for advertising products, manufacturer-retailer bargaining for wholesale prices and Bertrand competition for retail prices, which includes both retailers and manufacturers that sell directly to consumers. We then use the estimates from the model to simulate various counterfactual scenarios to disentangle two main effects: A bargaining effect, which is the gain in leverage a manufacturer obtains with a DTC channel, and a competition effect, which is the additional competition downstream a manufacturer brings when selling directly. We find that the bargaining effect leads to higher prices, higher manufacturer profit, lower retailer profit and lower consumer welfare. On the other hand, the competition effect leads to lower prices, lower manufacturer and retailer profits and higher consumer welfare. There’s also a smaller increase in consumer welfare that comes from larger product variety. The net effect is in the same direction as the competition effect except for manufacturer profits, which increase (because the gain from the bargaining effect offsets the loss from the competitive effect). The bargaining effect is small in our setting, but we argue that it could be larger and even offset the competitive effect in other industries where direct sales has a bigger share relative to sales in the vertical channel. Our results therefore highlight the importance of taking this effect into account when, for instance, making policy decisions involving DTC sales.

A fruitful avenue for future research would be to relax the "passive beliefs" assumption of the bargaining model discussed in section 2. The outside option of the Nash bargain could incorporate the change in the equilibrium outcome if negotiation fails, or the explicit threat of direct sales could be added to the model, similar to what Ho and Lee (2018) do in the context of hospital-insurer networks.
References


6 Appendix

A. Derivation of bargaining equations

A.1. Derivation of equation 8.

Solving problem 7, we have:

$$\lambda_j(\Pi_r - \Pi_{r,-j})^{\lambda_j-1}(\Pi_m - \Pi_{m,-j})^{1-\lambda_j}\frac{\partial \Pi_r}{\partial w_j} + (1 - \lambda_j)(\Pi_r - \Pi_{r,-j})^{\lambda_j}(\Pi_m - \Pi_{m,-j})^{-\lambda_j}\frac{\partial \Pi_m}{\partial w_j} = 0$$ (26)

Since manufacturers and retailers take retail prices as fixed when determining wholesale prices, we have $$\frac{\partial \Pi_m}{\partial w_j} = s_j$$ and $$\frac{\partial \Pi_r}{\partial w_j} = -s_j$$. Substituting above and simplifying yields:

$$\lambda_j(\Pi_m - \Pi_{m,-j}) + (1 - \lambda_j)(\Pi_r - \Pi_{r,-j})(-1) = 0$$ (27)


Substitute the profit formulas 1 and 2 and the disagreement payoffs 5 and 6 in the equation above to find:

$$\lambda_j[\sum_{j \in \Omega_m} (w_j - \mu_j) s_j(p) + \sum_{j \in \Omega_m} (p_j - \mu_j) s_j(p) - \sum_{k \in \Omega_m \setminus \{j\}} (w_k - \mu_k) s_k^{-j}(p) - \sum_{k \in \Omega_m} (p_k - \mu_k) s_k^{-j}(p)] - (1 - \lambda_j)[\sum_{j \in \Omega_r} (p_j - w_j) s_j(p) - \sum_{k \in \Omega_r \setminus \{j\}} (p_k - w_k) s_k^{-j}(p)] = 0$$ (28)

Rearranging:

$$\lambda_j[(w_j - \mu_j) s_j(p) - \sum_{k \in \Omega_m \setminus \{j\}} (w_k - \mu_k) \Delta s_k^{-j}(p) - \sum_{k \in \Omega_m} (p_k - \mu_k) \Delta s_k^{-j}(p)] - (1 - \lambda_j)[(p_j - w_j) s_j(p) - \sum_{k \in \Omega_r \setminus \{j\}} (p_k - w_k) \Delta s_k^{-j}(p)] = 0$$ (29)

where $$\Delta s_k^{-j}(p) \equiv s_k^{-j}(p_{-j}) - s_k(p)$$. Isolating $$w_j s_j(p)$$ yields equation 9.
B. Tables
Table 1: Mean Market Shares by Product

<table>
<thead>
<tr>
<th>2m²</th>
<th>Senior</th>
<th>Other</th>
<th>Total</th>
<th>Total by channel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m₁</td>
<td>m₂</td>
<td>m₃</td>
<td>m₄</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r₁</td>
<td>0.69</td>
<td>0.61</td>
<td>0.16</td>
<td>-</td>
</tr>
<tr>
<td>r₂</td>
<td>0.35</td>
<td>0.72</td>
<td>0.18</td>
<td>-</td>
</tr>
<tr>
<td>r₃</td>
<td>2.16</td>
<td>2.08</td>
<td>0.63</td>
<td>0.91</td>
</tr>
<tr>
<td>r₄</td>
<td>0.93</td>
<td>2.23</td>
<td>0.44</td>
<td>0.18</td>
</tr>
<tr>
<td>r₅</td>
<td>0.12</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>r₆</td>
<td>4.51</td>
<td>11.43</td>
<td>2.47</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retailers</td>
<td>m₁</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Direct Sales</td>
<td>m₂</td>
<td>-</td>
<td>3.32</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>m₃</td>
<td>-</td>
<td>1.05</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>9.74</td>
<td>20.53</td>
<td>4.92</td>
<td>1.15</td>
</tr>
<tr>
<td>Total by display</td>
<td>36.35</td>
<td>11.29</td>
<td>65.09</td>
<td></td>
</tr>
</tbody>
</table>

Each entry is in the table is the average market share across all months in the sample for a given product type. \( r₁, \ldots, r₆ \) are the retailers in this industry; \( m₁, \ldots, m₄ \) are the manufacturers. 2m², Senior and Other are display formats described in section 3.1. The calculation of shares takes into account that we defined market size to be twenty percent greater than the maximum observed total monthly sales for the year 2013. The numbers in the table are percentages.
Table 2: Price Statistics by Manufacturer, Retailer and Display

<table>
<thead>
<tr>
<th></th>
<th>Wholesale prices</th>
<th>Retail prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (unweighted)</td>
<td>Average</td>
</tr>
<tr>
<td>Supplier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$m_1$</td>
<td>13.7</td>
<td>9.4</td>
</tr>
<tr>
<td>$m_2$</td>
<td>18.7</td>
<td>11.2</td>
</tr>
<tr>
<td>$m_3$</td>
<td>21.9</td>
<td>6.7</td>
</tr>
<tr>
<td>$m_4$</td>
<td>15.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Seller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_1$</td>
<td>18.0</td>
<td>5.5</td>
</tr>
<tr>
<td>$r_2$</td>
<td>22.4</td>
<td>10.1</td>
</tr>
<tr>
<td>$r_3$</td>
<td>11.9</td>
<td>2.9</td>
</tr>
<tr>
<td>VSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_4$</td>
<td>13.6</td>
<td>3.6</td>
</tr>
<tr>
<td>$r_5$</td>
<td>25.7</td>
<td>6.4</td>
</tr>
<tr>
<td>DSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$m_1$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$m_2$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$m_3$</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$2m^2$ Panel</td>
<td>11.3</td>
<td>9.8</td>
</tr>
<tr>
<td>Senior</td>
<td>20.9</td>
<td>10.0</td>
</tr>
<tr>
<td>Other</td>
<td>25.6</td>
<td>3.5</td>
</tr>
<tr>
<td>All Products</td>
<td>18.4</td>
<td>8.2</td>
</tr>
</tbody>
</table>

Reported are statistics for wholesale and retail prices for each manufacturer, retailer and display format. For a given product characteristic (i.e., a given row) the statistics are calculated using all observations for products with that characteristic. Average prices are weighted by the corresponding market shares. Prices are in euros per m². VSC and DSC stand for vertical sales channel and direct sales channel, respectively.
<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>Estimate</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>σ</td>
<td>-</td>
<td>0.14</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>α</td>
<td>0.08</td>
<td>0.001</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-3.32</td>
<td>0.028</td>
<td>2.19</td>
</tr>
<tr>
<td><strong>Supplier</strong></td>
<td>m₁</td>
<td>-0.39</td>
<td>0.081</td>
<td>-0.74</td>
</tr>
<tr>
<td></td>
<td>m₂</td>
<td>1.05</td>
<td>0.037</td>
<td>1.11</td>
</tr>
<tr>
<td></td>
<td>m₃</td>
<td>0.16</td>
<td>0.035</td>
<td>-0.62</td>
</tr>
<tr>
<td><strong>Seller</strong></td>
<td>r₁</td>
<td>0.60</td>
<td>0.052</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td>r₂</td>
<td>-0.55</td>
<td>0.036</td>
<td>-1.71</td>
</tr>
<tr>
<td></td>
<td>r₃</td>
<td>-0.62</td>
<td>0.052</td>
<td>-0.52</td>
</tr>
<tr>
<td><strong>VSC</strong></td>
<td>r₄</td>
<td>0.14</td>
<td>0.056</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>r₅</td>
<td>-0.51</td>
<td>0.035</td>
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</tr>
<tr>
<td></td>
<td>r₆</td>
<td>-0.36</td>
<td>0.039</td>
<td>-0.68</td>
</tr>
<tr>
<td><strong>DSC</strong></td>
<td>m₁²</td>
<td>-0.47</td>
<td>0.029</td>
<td>-1.05</td>
</tr>
<tr>
<td></td>
<td>m₂²</td>
<td>-1.32</td>
<td>0.027</td>
<td>-1.63</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>2m² Panel</td>
<td>0.23</td>
<td>0.049</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Senior</td>
<td>-0.70</td>
<td>0.049</td>
<td>-0.86</td>
</tr>
<tr>
<td></td>
<td>GMM Objective</td>
<td>-</td>
<td></td>
<td>6.53</td>
</tr>
</tbody>
</table>

This table reports the results from the demand estimation. Columns 1 and 3 show the coefficients and columns 2 and 4 show the standard errors. Model 1 is a simple logit model using the instruments described in section 3.2. The results from the GMM model are in the third and fourth columns (Model 2). VSC and DSC stand for vertical sales channel and direct sales channel, respectively. r₁,...,r₆ are the retailers in this industry; m₁,...,m₃ are the manufacturers. m₁² and m₂² represent the direct sales from manufacturers 1 and 2. 2m², Senior and Other are display formats described in section 3.1. α is the mean price coefficient and σ is the heterogeneity parameter described in section 3.2.
Table 4: Supply Estimates

<table>
<thead>
<tr>
<th>Panel A: Manufacturer marginal cost</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.34</td>
</tr>
<tr>
<td>Std</td>
<td>0.02</td>
</tr>
<tr>
<td>Min</td>
<td>0.31</td>
</tr>
<tr>
<td>Median</td>
<td>0.35</td>
</tr>
<tr>
<td>Max</td>
<td>0.36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Retailer bargaining weight</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_1$</td>
<td>0.06</td>
</tr>
<tr>
<td>$r_2$</td>
<td>0.09</td>
</tr>
<tr>
<td>$r_3$</td>
<td>0.06</td>
</tr>
<tr>
<td>$r_4$</td>
<td>0.06</td>
</tr>
<tr>
<td>$r_5$</td>
<td>0.15</td>
</tr>
<tr>
<td>$r_6$</td>
<td>0.01</td>
</tr>
</tbody>
</table>

This table reports the results from the supply model described in section 3.3. $r_1, \ldots, r_6$ are the retailers in this industry.
Table 5: Simulated Outcomes

<table>
<thead>
<tr>
<th></th>
<th>I. Baseline</th>
<th>II. No Leverage</th>
<th>III. No DSC</th>
<th>(vs. Baseline)</th>
<th>(vs. No Leverage)</th>
<th>(vs. Baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level</td>
<td>Level</td>
<td>% Δ level</td>
<td>Level</td>
<td>% Δ level</td>
<td>% Δ level</td>
</tr>
<tr>
<td>DSC Share</td>
<td>0.010</td>
<td>0.010</td>
<td>0.23%</td>
<td>0.000</td>
<td>-100.00%</td>
<td>-100.00%</td>
</tr>
<tr>
<td>VSC Share</td>
<td>0.070</td>
<td>0.071</td>
<td>1.55%</td>
<td>0.077</td>
<td>8.89%</td>
<td>10.58%</td>
</tr>
<tr>
<td>Wholesale price</td>
<td>31.610</td>
<td>31.035</td>
<td>-1.82%</td>
<td>34.737</td>
<td>11.93%</td>
<td>9.90%</td>
</tr>
<tr>
<td>DSC price</td>
<td>37.720</td>
<td>37.335</td>
<td>-1.02%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>VSC price</td>
<td>32.510</td>
<td>32.032</td>
<td>-1.47%</td>
<td>35.773</td>
<td>11.68%</td>
<td>10.04%</td>
</tr>
<tr>
<td>$\pi_m^d$</td>
<td>0.120</td>
<td>0.119</td>
<td>-0.81%</td>
<td>0.000</td>
<td>-100.00%</td>
<td>-100.00%</td>
</tr>
<tr>
<td>$\pi_m^v$</td>
<td>0.530</td>
<td>0.528</td>
<td>-0.32%</td>
<td>0.645</td>
<td>22.03%</td>
<td>21.64%</td>
</tr>
<tr>
<td>$\pi_m$</td>
<td>0.650</td>
<td>0.647</td>
<td>-0.40%</td>
<td>0.649</td>
<td>0.20%</td>
<td>-0.20%</td>
</tr>
<tr>
<td>$\pi_r$</td>
<td>0.010</td>
<td>0.011</td>
<td>12.68%</td>
<td>0.013</td>
<td>12.83%</td>
<td>27.14%</td>
</tr>
<tr>
<td>Consumer Surplus</td>
<td>0.580</td>
<td>0.584</td>
<td>0.70%</td>
<td>0.541</td>
<td>-7.33%</td>
<td>-6.69%</td>
</tr>
<tr>
<td>Total Welfare</td>
<td>3.240</td>
<td>3.241</td>
<td>0.04%</td>
<td>3.213</td>
<td>-0.88%</td>
<td>-0.84%</td>
</tr>
</tbody>
</table>

This table reports the counterfactual simulations in the three scenarios described in section 4. In the level columns, prices are measured in euros/month and are weighted by sales. The profit and welfare variables are in euros/consumer/month. In the other columns, we report the percentage change in the level estimate (vs. another scenario). DSC and VSC stand for direct sales channel and vertical sales channel. $\pi_m^d$, $\pi_m^v$ and $\pi_m$ are the manufacturer profits in the DSC, VSC and in total, respectively. $\pi_r$ is retailer profit.