Evaluating Partial Divestitures when Vertical Relations are Important[☆]

Pedro Pereira[a,b,*], Tiago Ribeiro[c,d]

[a] *AdC, Avenida de Berna, nº 19, 7, 1050-037 Lisboa, Portugal*

[b] *CEFAGE*

[c] *Indera - Estudos Económicos, Lda, Rua do Campo Alegre, 1346-01 4150 Porto, Portugal*

[d] *Institute for Choice - University of South Australia, Level 13, 140 Arthur Street, North Sydney NSW 2060*

Abstract

We use the approach of the partial ownership literature to model the partial sale of a firm's productive capacity. The framework is applied to the Portuguese outdoor advertising industry. We develop and estimate, using brand-level data, a differentiated products equilibrium model that: (i) includes a wholesale and a retail level, and (ii) allows firms to have several shareholders. The model is used to perform two types of counterfactual exercises. First, we simulate the impact of a merger between wholesalers. Second, we simulate the impact of several divestitures, intended to remedy the merger. The divestitures involve the sale of the acquired firm's productive capacity to various buyers, instead of the sale of the whole firm to a single buyer, as usually considered in the merger simulation literature. The results show that the impact of a divestiture depends of the identity of the buyers and the amount of capacity sold. But more interestingly, the results also show that a divestiture may have a net anti-competitive impact.

Keywords: *Vertical Relations, Merger simulation, Partial acquisitions.*
JEL Classification: K21, L13.

[☆] We thank W. Beckert, T. Pires, R. Ribeiro, Y. Spigel and S. Villas-Boas for useful comments. The opinions expressed in this article reflect only the authors' views and in no way bind the institutions to which they are affiliated. Pedro Pereira is pleased to acknowledge financial support from Fundação para a Ciência e a Tecnologia and FEDER/COMPETE (grant UID/ECO/04007/2013).

[*] Corresponding author.

Email addresses: `pedro.br.pereira@gmail.com` (Pedro Pereira), `tiago.ribeiro@indera.pt` (Tiago Ribeiro)

URL: `http://www.indera.pt` (Tiago Ribeiro)

December 23, 2015

1. Introduction

The merger simulation literature, e.g., Baker and Bresnahan (1985), Nevo (2000), and Werden and Froeb (1994), typically assumes that the underlying transactions have a discrete nature. For example, a multi-product firm buys all, or some, of the brands of another multiproduct firm. However, in industries like outdoor advertising, retail banking or gasoline stations, acquisitions may not conform to this paradigm. In these cases, a firm may buy a part of another firm's productive capacity, which is a non-discrete object.

In this article, we use the approach of the partial ownership literature, e.g., O'Brien and Salop (2000), to model the partial sale of a firm's productive capacity to several buyers. Subsequently, the framework is applied to the Portuguese outdoor advertising industry. The extended framework is shown to be useful, permitting a very flexible analysis of the impact of capacity divestitures.

As a first step, we develop a differentiated products equilibrium model with two important characteristics, reflecting this industry. First, and as in Brenkers and Verboven (2006), Bonnet and Dubois (2012) and Villas-Boas (2007b), the model includes two levels of activity related vertically: the wholesale and the retail levels. Second, as in O'Brien and Salop (2000), the model allows firms to have several shareholders. Regarding the first characteristic of the model, in industries where wholesalers and retailers are not vertically integrated, ignoring the retail level amounts to assuming that retailers are strategically passive. If the retail level is concentrated, this may be an inadequate assumption. Villas-Boas (2007a) showed that oligopoly equilibrium models that incorporate the strategic interaction between manufacturers and retailers, and models that do not, can produce very different predictions. The same occurs in our case. Regarding the second characteristic of the model, in this industry, wholesalers have a given productive capacity, based on which they make their commercial offers. Hence, a remedy for a merger, in the form of a divestiture, means selling part of the productive capacity, instead of selling discrete objects like brands, as usually considered by the merger simulation literature. This requires using the framework of the partial ownership literature.

Next, we use a brand level, invoice based data set, collected from wholesalers and retailers, to estimate several discrete choice models as in, e.g., Berry et al. (1995), Bierlaire (2006) or McFadden (1978). The demand estimates and the model's equilibrium conditions are used to estimate marginal costs, as in Rosse (1970). In turn, the demand and marginal cost estimates are used to calibrate the model's equilibrium conditions.

The calibrated equilibrium model is used to perform two types of counterfactual exercises. First, to set the stage for our main exercise, we use the model to simulate the impact on prices and social welfare of a hypothetical merger between wholesalers. By design, the merger causes a substantial price increase. Second, we use the model to simulate the impact on prices and social welfare of several divestitures, intended to remedy the merger. These divestitures involve the sale to different buyers of parts of the productive capacity of the acquired firm. The results show that, as expected, the competitive impact of a divestiture depends of the identity of the buyers and the amount of capacity sold. But more interestingly, the results also show that a divestiture may have a net anti-competitive impact. This possibility is usually ignored. A divestiture has two opposing effects. On the one hand, a divestiture reduces the ability of the seller to internalize the diversion of sales, thereby putting downward pressure on prices. On the other hand, a divestiture increases the ability of the buyer to internalize the diversion of sales, thereby putting upward pressure on prices. In some circumstances, the latter effect dominates. Hence, in the context of a merger review, one should not assume that divestitures are always pro-competitive.

Our analysis relates to two literature strands. Firstly, our article relates to the merger simulation literature, which includes: Baker and Bresnahan (1985), Bresnahan (1987), Gowrisankaran et al. (2015), Nevo (2000), Pereira and Ribeiro (2011), Villas-Boas (2007a) and Werden and Froeb (1994). These articles performed merger simulation exercises in various industries, under many modeling contexts, but always assuming that the underlying transactions had a discrete nature. Secondly, our article relates to the partial ownership literature, e.g., O'Brien and Salop (2000), Gilo et al. (2006) and the references therein. These articles analyzed, under various modes of oligopolistic competition, the implications of partial cross ownership between horizontally and vertically related firms. In particular, Brito et al. (2014) developed a differentiated products equilibrium model to evaluate the unilateral effects of the cross-acquisition of producers in the US wet shaving industry. Unlike these authors, we do not distinguish between financial interest and corporate control, but we do model the vertical relation between producers and retailers. In addition, our focus is not partial ownership. We use partial ownership merely as a device to analyze the divestiture of productive capacity.

Our article's contribution is to develop a framework that allows analyzing the impact of the divestiture of productive capacity when vertical relations are important.

The rest of the article is organized as follows. Section 2 gives an overview of the Portuguese industry. Section 3 presents the theoretical framework. Section 4 describes demand estimation, and presents the demand estimates. Section 5 conducts the counterfactual exercises. Section 6 concludes. The Appendix discusses the various price effects of a divestiture.

2. The Outdoor Advertising Industry

In this Section, we give an overview of the Portuguese outdoor advertising industry.

The industry has three main types of economic agents: **(i)** media owners, **(ii)** media groups, and **(iii)** advertisers. An ***advertiser*** is a firm that wants to promote its products through advertising. A ***media owner*** is a firm that installs and exploits commercially equipment for the display of outdoor advertising. A ***media group*** is a firm that, on the behalf of advertisers, plans and buys advertising campaigns from media owners.[1]

The industry players are related vertically as follows. Media owners are wholesalers, media groups are retailers, and advertisers are final consumers. Advertisers make 80% of their purchases through media groups and the remainder directly from media owners.

There is no cross-ownership between media owners, between media groups, or between media owners and media groups. We will use partial ownership only as an artifact to model the divestiture of productive capacity.

To operate, media owners must obtain first from site owners the right to use the space where the display equipment is installed for a given period, either through a public tender or direct contracting.[2] These rights are set by long term contracts that can last up to twenty years. This means that in the short to medium run the productive capacity is fixed.

There are three large national media owners, and many small local media owners. The networks of the three largest media owners overlap geographically. This follows from Portugal being a small country, where the population is concentrated along the cost.

Prices are set on a campaign basis. Demand fluctuates throughout the year. For the period of our sample, one of the media owners always operates below capacity. The other media owners sometimes operate close to capacity, but never at capacity.[3]

There is a large number of display formats, including the following: **(i)** $2m^2$ panels, **(ii)** Seniores, **(iii)** Transport, and **(iv)** Special Formats. The name of the first format is self-explanatory. It

[1]Actually, a media group is set of media agencies and a central purchasing agency with a common owner, where ***media agencies*** plan and buy advertising campaigns and the ***central purchasing agency*** aggregates purchases of media agencies and places orders with media owners. A media group might own several media agencies because they specialize in different industries, or to avoid confidentiality issues with advertisers.

[2]***Site owners*** are the landlords of the physical space where the display equipment is installed and include: local authorities, transit authorities, airports, supermarkets, malls and small private landlords.

[3]The inspection of our data on installed capacity and monthly usage indicates that capacity limits are never attained, and in the case of one of the three largest media owners there is always plenty of free capacity.

includes: city information panels, bus shelters, kiosks, etc. A ***Senior*** is an advertising panel with an area between 8 and 24 m^2. ***Transport*** includes panels on moving vehicles, such as buses, trains or taxis, or transport hubs, such as airports or railway stations. ***Special format*** are very large panels made by special request and displayed, e.g., on buildings' gables.

To sum up, the outdoor advertising industry has two important characteristics. First, wholesalers, i.e., media owners, usually sell to final consumers through retailers, i.e., media groups, and occasionally also directly. Second, media owners dispose of a given productive capacity, fixed on the short to medium run, based on which they make their commercial offers.

3. Theoretical Framework

This Section has two parts. In the first part, we present the industry model that includes: **(i)** demand, **(ii)** supply and **(iii)** equilibrium conditions. The model, based on Brenkers and Verboven (2006), Bonnet and Dubois (2012) and Villas-Boas (2007b), has two important characteristics. First, there are two levels of activity related vertically: the wholesale level, where media owners operate, and the retail level, where media groups operate; final consumers are the advertisers. Second, the game unfolds in two stages: in the first stage wholesalers choose their prices, and in the second stage retailers choose theirs. In the second part of the Section, we present: **(i)** market power measures, and **(ii)** the merger evaluation procedure.

3.1. Industry Model

3.1.1. Demand

We propose the *Generalized Extreme Value* class of discrete choice models to characterize demand. In particular, we estimate *Multinomial Logit* (MNL) and *Nested Logit* (NL) models, which are members of this class.[4] With individual level data, these models characterize the choices of individuals for products with a discrete nature. With aggregate data, as in our case, these models characterize the demand as a function of market shares. Consequently, they are particularly adequate for the type of products under analysis, as well as the data collected.

Denote by p_j the retail price of product j, by α the price coefficient of product j, by $\mathbf{x}_j$ a $\mathcal{K} \times 1$ vector of characteristics of product j excluding price, by β_k the coefficient that captures the

[4] Our approach draws on the discrete choice literature represented by, e.g., Bierlaire (2006), Domencich and McFadden (1975), McFadden (1974), McFadden (1978), and McFadden (1981), or in the industrial organization side by, e.g., Berry (1994), Berry et al. (1995), Goldberg (1995) and Nevo (2001).

consumers' valuation of characteristic k of product j, by ε_j a non-observed component of the utility of product j, and by $\boldsymbol{\theta}$ the vector of coefficients to be estimated.

A consumer derives from alternative $j = 0, 1, ..., \mathcal{J}^{\mathcal{R}}$ utility:

$$U_j(p_j, x_j, \theta) = V_j(p_j, \mathbf{x}_j, \boldsymbol{\theta}) + \varepsilon_j,$$

where

$$V_j(p_j, \mathbf{x}_j, \boldsymbol{\theta}) := p_j\alpha + \sum\nolimits_{k=1}^{\mathcal{K}} x_{jk}\beta_k.$$

Alternative 0 is the outside option of not buying. Let $\boldsymbol{\beta} := (\beta_1, ..., \beta_{\mathcal{K}})$. Then: $\boldsymbol{\theta} := (\alpha, \boldsymbol{\beta})$.

A consumer chooses product j that generates the maximum utility level U_j, i.e., $U_j > U_{j'}$, for all $j \neq j'$. Let $z_j := \exp(V_j)$. Denote by $\mathcal{C}$ the set of alternatives and by K the number of alternatives in $\mathcal{C}$. The class of demand models under analysis can be characterized by the probability generating functions $G(z_1, \ldots, z_K)$, with $G_j := \frac{\partial G}{\partial z_j}$. The probability of alternative j on $\mathcal{C}$ being chosen, i.e., the market share of alternative j, is:[5]

$$P(j|\mathcal{C}) = \frac{z_j G_j(z_1, \ldots, z_K)}{G(z_1, \ldots, z_K)}.$$

Functions $G(\cdot)$ must obey certain properties, namely homogeneity of degree 1.[6] Hence, the expression above can be written as:

$$P(j|\mathcal{C}) = \frac{z_j G_j(z_1, \ldots, z_K)}{G(z_1, \ldots, z_K)} = \frac{\exp(V_j + \ln G_j)}{\sum_{j'} \exp(V_{j'} + \ln G_{j'})}.$$

Different choices of $G(\cdot)$ lead to different demand models.[7]

Let $\mathcal{B}_m$, with $m = 1, \ldots, M$, be mutually exclusive subsets that form a partition of $\mathcal{C}$. The NL model follows from:

$$G(z_1, \ldots, z_K) = \sum\nolimits_{m=1}^{M} \left(\sum\nolimits_{k \in \mathcal{B}_m} z_k^{1/\nu_m}\right)^{\nu_m},$$

where ν_m is a parameter that measures the correlation of consumer preferences for alternatives within the nest m. For the model to be consistent with random utility maximization, it is a sufficient, but not necessary, condition that each ν_m belongs to $[0, 1]$. A higher value of ν_m implies higher independence. If $\nu_m = 0$, all products within the same nest are perfect

[5]In this Section and in Sections 4.1 and 4.2, we use the expressions "market" and "market share" in the usual sense that they are used in the empirical industrial organization literature, which differs from the sense these expressions have in the context of competition policy.

[6]See McFadden (1978) for a complete characterization of functions $G(\cdot)$.

[7]Or alternatively, different choices of the joint distribution of components ε_j lead to different demand models.

substitutes. If $\nu_m = 1$, for all nests, all the alternatives in all nests are independent, and the model reduces to the MNL model.

Let $P_j := P(j|\mathcal{C})$ and $\tilde{P}_j := \nu_m P(j|\mathcal{C}) + (1-\nu_m) P(j|\mathcal{B}_m)$. The price elasticity of demand of product j with respect to the price of product j' is:

$$\varepsilon_{jj'} := \frac{\partial P(j|\mathcal{C})}{\partial p_{j'}} \frac{p_{j'}}{P(j|\mathcal{C})} = \begin{cases} \frac{\alpha}{\nu_m} p_{j'} \left(1 - \tilde{P}_i\right) & \text{if } j = j' \text{ and } j, j' \in \mathcal{B}_m \\ -\frac{\alpha}{\nu_m} p_{j'} P_{j'} \frac{\tilde{P}_j}{P_j} & \text{if } j \neq j' \text{ and } j, j' \in \mathcal{B}_m \\ -\alpha p_{j'} P_{j'} & \text{if } j \neq j' \text{ and } j \in \mathcal{B}_m, \quad j' \in \mathcal{B}_k. \end{cases}$$

3.1.2. Supply

Consider an industry where products are produced by wholesalers that sell them to retailers that, in turn, sell them to final consumers. There are $\mathcal{J}^{\mathcal{W}}$ wholesale products, $\mathcal{J}^{\mathcal{R}}$ retail products, and altogether there are $\mathcal{J} = \mathcal{J}^{\mathcal{W}} + \mathcal{J}^{\mathcal{R}}$ products. Denote by $\mathcal{W}$ the set of wholesale products, and by $\mathcal{R}$ the set of retail products. Each product can be thought of as being a firm.

There are $s = 1, ..., \mathcal{S}$ shareholders, who own the $\mathcal{J}$ products. Let γ_{sj} be the percentage that shareholder s owns of the equity capital of product j. Obviously: $\sum_s \gamma_{sj} = 1$. Each product j is administered by a manager, "manager j".

Denote by ω_j the price of wholesale product j, by ω the $\mathcal{J}^{\mathcal{W}} \times 1$ vector of wholesale prices, by μ_j the marginal cost of wholesale product j, and by μ the $\mathcal{J}^{\mathcal{W}} \times 1$ vector of wholesale marginal costs. The demand of wholesale product j is $D_j(\mathbf{p})$. The profit of wholesale product j is:

$$\pi_j = (\omega_j - \mu_j)\, D_j(\mathbf{p}).$$

Denote by p_j the price of retail product j, by $\mathbf{p}$ the $\mathcal{J}^{\mathcal{R}} \times 1$ vector of retail prices, by ρ_j the marginal cost of retail product j, and by ρ the $\mathcal{J}^{\mathcal{R}} \times 1$ vector of retail marginal costs. The demand of retail product j is $D_j(\mathbf{p})$. The profit of retail product j is:

$$\pi_j = (p_j - \omega_j - \rho_j)\, D_j(\mathbf{p}).$$

The income of shareholder $s = 1, ..., \mathcal{S}$ is: $\mathcal{V}_s := \sum_j^{\mathcal{J}} \gamma_{sj} \pi_j$. Shareholders want to maximize their incomes.

Since shareholders do not manage their products directly, they give managers incentive schemes to ensure that their interests are aligned. Those schemes are the solution of a potentially complex mechanism design problem that in general will depend on: **(i)** shareholders' preferences and wealth, **(ii)** the managers' preferences, **(iii)** Corporate Law, **(iv)** the Company's Statutes and the Shareholders' Agreement, **(v)** Competition Law, and **(vi)** the industry's strategic environment. Since our purpose is to evaluate the competitive impact of the divestiture of a firm's productive capacity, we assume, following the partial ownership literature, that the relevant information of this problem and its solution is encoded in the managers' objective function. Furthermore, we assume that manager j's objective function is the sum of the shareholders income, weighed by their shares of the equity capital:[8]

$$\mathcal{U}_j = \phi_j(\mathcal{V}_1, ..., \mathcal{V}_{\mathcal{S}}) = \sum_{s=1}^{\mathcal{S}} \gamma_{sj} \mathcal{V}_s.$$

Let:

$$\theta_{jk} := \sum_{s=1}^{\mathcal{S}} \gamma_{sj} \gamma_{sk}.$$

Then:

$$\mathcal{U}_j = \sum_{s=1}^{\mathcal{S}} \gamma_{sj} \sum_{k=1}^{\mathcal{J}} \gamma_{sk} \pi_k = \sum_{k=1}^{\mathcal{J}} \left(\sum_{s=1}^{\mathcal{S}} \gamma_{sj} \gamma_{sk} \right) \pi_k = \sum_{k=1}^{\mathcal{J}} \theta_{jk} \pi_k.$$

Let:

$$\lambda_{jk} := \frac{\theta_{jk}}{\theta_{jj}}.$$

By construction $\lambda_{jj} = 1$.

Consequently, the utility of manager j can be redefined as:

$$u_j = \sum_{k=1}^{\mathcal{J}} \lambda_{jk} \pi_k(\mathbf{p}).$$

Manager j maximizes u_j by choosing ω_j if j is a wholesale product, or by choosing p_j if j is a wholesale product.[9]

Denote by $\Lambda^{\mathcal{W}}$ the $\mathcal{J}^{\mathcal{W}} \times \mathcal{J}^{\mathcal{W}}$ matrix with generic element λ_{jk} with j and k on $\mathcal{W}$ and by $\Lambda^{\mathcal{R}}$ the $\mathcal{J}^{\mathcal{R}} \times \mathcal{J}^{\mathcal{R}}$ matrix with generic element λ_{jk} with j and k on $\mathcal{R}$. We will refer to $\Lambda^{\mathcal{W}}$ as the ***wholesale control matrix***, and to $\Lambda^{\mathcal{R}}$ as the ***retail control matrix***. These matrices correspond in our setting to the ownership matrices of the merger simulation literature. However, as the previous discussion showed, in addition to information about the ownership structure, they also embody information about firm governance and the legal environment, which is usually ignored.

---

[8] The careful analysis of the implications of the separation of ownership and control on firm governance, given the legal and strategic environments, requires a more careful specification of the game between shareholders, and the game between shareholders and managers, or at the very least a more careful specification of managers' objective functions. That, however, is beyond the scope of our analysis.

[9] We assume, reflecting the industry, that there is no vertical integration, i.e., no shareholder owns simultaneously products in $\mathcal{W}$ and $\mathcal{R}$.

3.1.3. Equilibrium

The game unfolds in two stages. In the first stage, the ***wholesale game***, the managers of wholesale products choose wholesale prices. In the second stage, the ***retail game***, the managers of the retail products choose retail prices. The equilibrium concept is sub-game perfection. Equilibrium prices will de denoted by the superscript "*".

The equilibrium conditions for the second stage of the game are, for all j on $\mathcal{R}$:

$$\frac{\partial u_j}{\partial p_j} = D_j(\mathbf{p}^*) + \sum\nolimits_{k\in\mathcal{R}} \lambda_{jk} \frac{\partial D_k(\mathbf{p}*)}{\partial p_j}(p_k^* - \omega_k - \rho_k) = 0. \tag{1}$$

System (1) defines retail prices implicitly as a function of wholesale prices:

$$\mathbf{p}^* = \mathcal{P}(\omega). \tag{2}$$

Denote by $\mathbf{D}(\mathbf{p})$ the $\mathcal{J}^{\mathcal{R}} \times 1$ demand vector, and by $\nabla_p \mathbf{D} := \frac{\partial \mathbf{D}}{\partial \mathbf{p}'}$ the associated $\mathcal{J}^{\mathcal{R}} \times \mathcal{J}^{\mathcal{R}}$ Jacobian matrix of first derivatives. The (j,k) generic element of this matrix represents the effect of an increase in the retail price p_k on the quantity demanded D_j. Denote by $\odot$ the element by element product of two matrices, i.e., the Hadamard product. In vectorial notation system (1) is:

$$\mathbf{D}(\mathbf{p}^*) + \left(\Lambda^{\mathcal{R}} \odot [\nabla_p \mathbf{D}]'\right)(\mathbf{p}^* - \omega - \rho) = 0. \tag{3}$$

Given (2), the profit of a wholesale product is, for all j on $\mathcal{W}$:

$$\pi_j = (\omega_j - \mu_j)\, D_j(\mathcal{P}(\omega)).$$

and the equilibrium conditions for the first stage of the game are, for all j on $\mathcal{W}$:

$$\frac{\partial u_j}{\partial w_j} = D_j(\mathcal{P}(\omega^*)) + \sum\nolimits_{k\in\mathcal{W}} \lambda_{jk} \frac{\partial D_k(\mathcal{P}(\omega^*))}{\partial \omega_j}(\omega_k^* - \mu_k) = 0. \tag{4}$$

Denote by $\nabla_\omega \mathcal{P} := \frac{\partial \mathcal{P}}{\partial \omega'}$ the $\mathcal{J}^{\mathcal{W}} \times \mathcal{J}^{\mathcal{W}}$ matrix of first-derivatives of (2). The generic element (j,k) of this matrix represents the effect of an increase in the wholesale price ω_k on the retail price p_j. In vectorial notation system (4) is:

$$\mathbf{D}(\mathcal{P}(\omega^*)) + \left(\Lambda^{\mathcal{W}} \odot [\nabla_p \mathbf{D} \nabla_\omega \mathcal{P}]'\right)(\omega^* - \mu) = 0. \tag{5}$$

The equilibrium $(\omega^*, \mathbf{p}^*)$ is the solution to systems (3) and (5), which we assume exists and is unique.[10]

[10]See Aksoy-Pierson et al. (2013) for conditions for uniqueness in a one stage game. Only local uniqueness is required for our analysis.

Equation (3) can be written as:

$$\mathbf{p} - \omega - \rho = -\left(\Lambda^{\mathcal{R}} \odot [\nabla_p \mathbf{D}]'\right)^{-1} \mathbf{D}(\mathbf{p}); \tag{6}$$

and equation (5) can be written as:

$$\omega - \mu = -\left(\Lambda^{\mathcal{W}} \odot [\nabla_p \mathbf{D} \nabla_\omega \mathcal{P}]'\right)^{-1} \mathbf{D}(\mathbf{p}). \tag{7}$$

Combining equations (6) and (7) gives:

$$\mathbf{p} - \rho - \mu = \left(\Lambda^{\mathcal{R}} \odot [\nabla_p \mathbf{D}]'\right)^{-1} \mathbf{D}(\mathbf{p}) + \left(\Lambda^{\mathcal{W}} \odot [\nabla_p \mathbf{D} \nabla_\omega \mathcal{P}]'\right)^{-1} \mathbf{D}(\mathbf{p}). \tag{8}$$

3.2. Complements

3.2.1. Market Power Measures

The ***total Lerner index*** of product j is:[11]

$$\mathcal{L}_j^t := \frac{p_j - \rho_j - \mu_j}{p_j};$$

the ***retail Lerner index*** of product j is:

$$\mathcal{L}_j^r := \frac{p_j - \omega_j - \rho_j}{p_j};$$

and the ***wholesale Lerner index*** of product j is:

$$\mathcal{L}_j^w := \frac{\omega_j - \mu_j}{p_j}.$$

Given $\left(\mathbf{p}, \mathbf{D}, \nabla_p \mathbf{D}, \Lambda^{\mathcal{R}}\right)$, equation (6) can be used to compute $\omega + \rho$. Given $(\mathbf{D}, \nabla_p \mathbf{D}, \nabla_\omega \mathbf{D}, \Lambda^{\mathcal{W}})$, equation (7) can be used to compute $\omega - \mu$. In addition, given $\left(\mathbf{p}, \mathbf{D}, \nabla_p \mathbf{D}, \nabla_\omega \mathbf{D}, \Lambda^{\mathcal{R}}, \Lambda^{\mathcal{W}}\right)$, equation (8) can be used to compute $\rho + \mu$. With this information one can compute the Lerner indices presented above.

3.2.2. Impact of the Merger

Demand $\mathbf{D}$ is presented in Section 3.1.1, and estimated with the data described in Section 4.1. The estimates are presented in Section 4.3. With the demand estimates one can compute $\nabla_p \mathbf{D}$ and $\nabla_\omega \mathbf{D}$.

---

[11] ***Market Power*** is the ability to profitably increase price above marginal cost. See , e.g., Werden (1983) and Werden (1993) for a discussion of the meaning of "market" in the context of competition policy.

Denote by $\mathbf{p}^0$ the pre-merger retail price vector, by $\mathbf{p}^1$ the post-merger retail price vector, by $\Lambda_0^{\mathcal{W}}$ the pre-merger wholesale control matrix, by ω^0 the pre-merger wholesale price vector, by ω^1 the post-merger wholesale price vector, and by $\Lambda_1^{\mathcal{W}}$ the post merger wholesale control matrix. Given $\left(\mathbf{p}^0, \mathbf{D}, \nabla_p \mathbf{D}, \nabla_\omega \mathbf{D}, \Lambda^{\mathcal{R}}, \Lambda_0^{\mathcal{W}}\right)$, equation (8) can be used to compute $\rho + \mu$, that we shall denote by $\mathbf{c} := \rho + \mu$. Given $\left(\mathbf{c}, \mathbf{D}, \nabla_p \mathbf{D}, \nabla_\omega \mathbf{D}, \Lambda^{\mathcal{R}}, \Lambda_1^{\mathcal{W}}\right)$, equation (8) can be used to compute $\mathbf{p}^1$. Given $\left(\mathbf{D}, \nabla_p \mathbf{D}, \nabla_\omega \mathbf{D}, \Lambda_0^{\mathcal{W}}\right)$, equation (7) can be used to compute $\omega^0 - \mu$. Given $\left(\mathbf{D}, \nabla_p \mathbf{D}, \nabla_\omega \mathbf{D}, \Lambda_1^{\mathcal{W}}\right)$, equation (7) can be used to compute $\omega^1 - \mu$.

The variation of retail prices is: $\Delta \mathbf{p} := \mathbf{p}^1 - \mathbf{p}^0$; and the variation of wholesale prices is: $\Delta\omega := \omega^1 - \mu - (\omega^0 - \mu)$.

The variation of wholesale profits is:

$$\Pi_\omega(\omega^1, \mathbf{p}^1) - \Pi_\omega(\omega^0, \mathbf{p}^0);$$

and the variation of retail profits is:

$$\Pi_r(\omega^1, \mathbf{p}^1) - \Pi_r(\omega^0, \mathbf{p}^0).$$

Consumer surplus is:

$$EC(\cdot) = -\frac{1}{\alpha} \log(G(\cdot)) + \kappa;$$

where κ is a constant of integration. The consumer surplus variation is:

$$EC(\mathbf{p}^1) - EC(\mathbf{p}^0).$$

4. Demand Estimation

In this Section: **(i)** we describe our data, **(ii)** discuss the demand estimation procedure, and **(iii)** present the demand estimates.

4.1. Data

We collected data from the following media owners and media groups:

1. **Media owners**: JCDecaux, CEMUSA, MOP, Aps Media, Dream Media, Publiroda, Publitaxis, Publiradio, and Spetacolor.
2. **Media groups**: Omnicom Media Group, GroupM, Power Media Group, Havas Media Group, and IPG Mediabrands.

For each product and for each month of the year 2013, we obtained: **(i)** the sales value, **(ii)** the quantity sold in number of advertising faces and m^2, **(iii)** the cost of the products transacted, **(iv)** the commissions, fees and rebates, received and paid, and **(v)** the productive capacity for each display format.[12]

A ***product*** is a combination of: **(i)** display format, **(ii)** media owner, and **(iii)** media group.

We will consider three display formats: **(i)** 2 m^2 panels, **(ii)** SENIORs, and **(iii)** OTHERS. ***OTHERS*** aggregates the remaining formats, since individually, each of them has a negligible weight.

We consider four media owners and eight media groups. The media owners are: JCDecaux, CEMUSA, MOP and Others. *"Others"* aggregates the remaining media owners, since individually, each of them has a negligible weight. The media groups are: Omnicom Media Group, WPP, Power Media Group, Havas Media Group, IPG, and three more fictitious media groups. The latter represent the direct sales of each of the three largest media owners.

From hereon, for confidentiality reasons, and not necessarily in the order above, we will refer to the media owners as: W_1,...,W_4; and to the media groups as: R_1,...,R_8. In terms of the language of Section 3.1.2, each one of these entities is a collection of products with a single shareholder. Equivalently, each of these entities is a holding company that owns completely the underlying products and has a single shareholder.

Table A.1 illustrates some possible combinations of what constitutes a product.

[*Table A*.1]

Our data set includes 65 products with a meaningful expression throughout the 12 months of the sample.

Tables A.2-A.4 present the value and quantity shares for different subsets of products in our sample.[13]

[*Table* A.2]

[*Table* A.3]

[*Table* A.4]

[12]From the media owners we obtained data from the first week of each month of the year 2013.

[13]We estimate that the data collected corresponds in the very least to 95%, and probably 98%, of the industry.

4.2. Preliminary Issues

With the information described in Section 4.1, we built a data set of the products sold in each month of the year 2013, and their characteristics. An observation is a market share of a product, as defined in Section 4.1, in a given month. We consider 12 different markets, one for each month of the year, and a representative consumer in each one of these markets.

For each type of display format, prices vary across media owners and media groups due to the different levels of discounts and rebates offered. Besides, prices vary over time due to seasonality of demand, and thus due to the restrictions imposed by the productive capacity.

The explanatory variables of the estimated model are: **(i)** price, **(ii)** dummy variables for the display type, **(iii)** dummy variables for the media owners, **(iv)** dummy variables for the media groups, and **(v)** dummy variables for the months.

In the NL models we included a nest for display format.

For both the MNL and the NL models, we used three estimators: **(i)** ordinary least squares (OLS), **(ii)** instrumental variables (IV), and **(iii)** the generalized method of moments (GMM).

We used the OLS procedure as a reference.

We used the IV procedure to address a potential endogeneity problem. Given that our data consists of observations from a market which is assumed to be in equilibrium, the price variable is potentially endogenous. We used as instrumental variables: the average prices of the products of other groups, and the average price of other groups and other media owners.

We used the GMM procedure to incorporate restrictions of economic theory. In particular, we built moments of orthogonality among the observed variables and the residuals that follow from the equilibrium condition defined in equation (3), which allowed incorporating the observed price-marginal cost margins in the estimation. In general terms, the GMM moments originating from first order conditions are $Z'\varepsilon(\beta)$, where: $\varepsilon(\beta) := \mathbf{D}(\beta) + \left(\Lambda^{\mathcal{R}} \odot [\nabla_p \mathbf{D}(\beta)]'\right)(pcm)$, pcm are the observed retail price cost margins, and Z are the observed exogenous variables. To these moments we appended the standard moments originating from the demand function. The GMM estimator was obtained by minimizing a quadratic function of these moments, weighed by the inverse of a consistent estimate of their variance. See Newey and McFadden (1994) for a general treatment, and Berry et al. (1995) and Nevo (2001) for industrial organization applications.

4.3. Demand Estimates

The models presented in Section 3.1.1 were estimated with the data set described in Section 4.1.[14] Table A.5 presents the results.

[*Table A*.5]

Given the significance of the nest parameter, we reject the MNL models in favor of the NL models.

We experimented with other specifications, but they produced no improvements. For example, we considered a media owner nest, in addition to the display format nest. However, the simultaneous inclusion of two nests led to a loss of empirical identification. We also did a Lagrange multiplier tests for the significance of the mixing coefficients associated with the variables of the model.[15] For all variables except the dummy variables for display format and media owner, the test failed to reject the null hypothesis that the mixing coefficients are equal to zero.[16] The model retained for further analysis is also consistent with the general practice of media agencies of, for a given campaign, proposing to their client a portfolio of display formats. The substitution between different suppliers within each display format is likely to be simpler than the change in the mix of display formats proposed.

The value of the objective function shows that the estimates other than the GMM do not provide a good enough fit to the economic constraints embedded in the equilibrium first-order conditions. In addition, estimation through GMM produces results with a more conservative economic meaning, since the associated price elasticities of demand are higher.[17]

As a consequence of the previous discussion, we chose the GMM estimates of the NL model for the subsequent analysis.

[14]All models were estimated with MATLAB.

[15]See McFadden and Train (2000).

[16]It is well known that the Mixed Multinomial Logit model can approximate arbitrarily well any discrete choice model derived from random utility maximization. However, a parsimonious approximation requires a judicious choice of a specific mixing distribution. One possible adaptive approach to building such a parsimonious mixing distribution is to use specification tests to identify the presence of certain mixing components. See McFadden and Train (2000). The failure to reject the insignificance of the mixing coefficients on discrete dummy variables for the groups associated with the nests is consistent with the nest structure used in the NL model, and can be seen as providing evidence for these models. Mixture models that emphasize the correlations associated with the nests can be seen as mimicking these models. Alternatively, one can interpret the NL model as a mixture model with a particular choice of mixing destitutions that captures the same pattern of correlations between alternatives. See Berry (1994).

[17]In the context of competition policy, this characteristic of the estimators is desirable.

4.4. Price Elasticities of Demand

Tables A.6, A.7 and A.8 present the price-elasticities of demand for various subsets of products.

[*Table A*.6]

[*Table A*.7]

[*Table A*.8]

5. Analysis

In this Section, we perform two types of counterfactual exercises. First, we simulate the impact on prices and social welfare of a hypothetical merger between two wholesalers. The merger, which by design causes a substantial price increase, sets the stage for our next and main exercise. Second, we simulate the impact on prices and social welfare of several divestitures, intended to remedy the merger. These divestitures involve the sale to different buyers of parts of the productive capacity of the acquired firm.

As explained in Section 2, media owners obtain from site owners the right to install equipment for the display of outdoor advertising. It is then based on this productive capacity that they make their commercial offers. Hence, in the context of this industry, a remedy in the form of a divestiture means selling a part of the productive capacity, instead of selling discrete objects like brands, as usually considered in the merger simulation literature, e.g., Nevo (2000). We will use the framework of Section 3.1.2, inspired by the partial ownership literature, e.g., O'Brien and Salop (2000), to model the partial sale of a firm's productive capacity.

We will use the model and procedures of Section 3 and the demand estimates of Section 4.3.

5.1. Merger

Suppose that shareholder S_3 buys firm W_4 from shareholder S_4.

[*Table A*.10]

[*Table A*.9]

[*Table A*.11]

[*Table A*.12]

Tables A.10−A.12 present the results of the merger simulation.[18]

According to the first and last columns of Table A.9, after the merger, on average, the equilibrium retail prices of 2 m^2 panels would increase 11.8%, and equilibrium retail prices overall would increase 10.3%. According to the last and fifth column of Table A.10, for the merging firms, after the merger, on average, the equilibrium retail prices of 2 m^2 panels would increase 15.1%, and equilibrium retail prices overall would increase 13.5%. Table A.11 has similar information about average equilibrium retail price increases for media groups.

Finally, according to Table A.12, after the merger, the profits of the media owners would increase 3.5 million euros per year, the profits of the media groups would decrease 0.4 million euros per year, and consumer surplus would decrease 4.3 million euros per year. Social welfare would decrease 1.2 million euros per year. In addition, comparing the Lerner indices, the market power of retailers would decrease and the market power of wholesalers would increase.

To sum up, after the merger, on average, equilibrium retail prices of 2 m^2 panels would increase 11.8%, and equilibrium retail prices overall would increase 10.3%. Social welfare would decrease 1.2 million euros per year.[19]

5.2. Divestitures

We start by describing the framework under which the divestiture counterfactuals will be conducted. To simplify the exposition, in this Section we will interpret entities $W_1, ..., W_4$ as holding companies, which are the exclusive owners of the underlying products and initially have a single shareholder each, designated by $S_1, ..., S_4$, respectively.[20]

Consider the two following extreme cases as references. One involves entry, the other does not.

(R1) Shareholder S_3 buys all the equity capital of W_4, and afterwards sells part of it to S_2.

(R2) Shareholder S_3 buys all the equity capital of W_4, and afterwards sells part of it to a

[18]For more details on merger simulation see, e.g., Nevo (2000) or Pereira and Ribeiro (2011).

[19]An application of the equilibrium price increase version of the small but significant and non-transitory increase in price test, as in, e.g., Pereira et al. (2013), would have shown that 2 m^2 panels are a relevant product market, in the sense of competition policy. See the "1984 Merger Guidelines of the U.S. Department of Justice", or the "2010 Merger Guidelines of the U.S. Department of Justice". Both versions are available on the internet. For other versions of the test see Pereira et al. (2013).

[20]In addition, to convey better the intuition of the remedies and their impact, in the analysis of the divestitures we will adopt a language that suggests a sequential flow of actions. However, the model is static.

shareholder that has just entered the industry, similar to S_4, labeled for convenience "S_4".[21]

$[Figure\ B.1]$

Case (R1) can be modeled by letting $(\gamma_{14}, \gamma_{24}, \gamma_{34}, \gamma_{44}) = (0, \tau_2, 1 - \tau_2, 0)$, with τ_2 varying on $[0, 1]$.[22] Case (R2) can be modeled by letting $(\gamma_{14}, \gamma_{24}, \gamma_{34}, \gamma_{44}) = (0, 0, 1 - \tau_4, \tau_4)$, with τ_4 varying on $[0, 1]$.[23] These two cases can be summarized by letting $(\gamma_{14}, \gamma_{24}, \gamma_{34}, \gamma_{44}) = (0, \tau_2, 1 - \tau_2 - \tau_4, \tau_4)$, with τ_2 and τ_4 varying on $[0, 1]$, which also allows for intermediate cases. Figure B.1 represents cases (R1) and (R2).

$[Table\ A.13]$

$[Table\ A.14]$

Table A.13 presents the average equilibrium retail price increases for 2 m^2 panels for various cases of $(0, \tau_2, 1 - \tau_2 - \tau_4, \tau_4)$, compared with the situation prior to the proposed merger.[24] Table A.14 adds complementary information for some of the cases in the previous Table.

Next we discuss five particular cases.

First, note that the case discussed in Section 5.1 corresponds to S_3 buying all the equity capital of W_4 and divesting none, i.e., $(\gamma_{14}, \gamma_{24}, \gamma_{34}, \gamma_{44}) = (0, 0, 1, 0)$.

Second, if S_3 bought all of the equity capital of W_4, and afterwards sold half of the acquired equity capital to S_2, i.e., $(\gamma_{14}, \gamma_{24}, \gamma_{34}, \gamma_{44}) = \left(0, \frac{1}{2}, \frac{1}{2}, 0\right)$, on average, the equilibrium retail prices of 2 m^2 panels would increase 12.5%, and industry equilibrium retail prices would increase 10.4%. Social welfare would decrease 1.0 million euros per year.

Third, if S_3 bought all of the equity capital of W_4, and afterwards sold increasingly large parts to S_2, i.e., as one moves from the right to the left along the last row of Table A.13, the average equilibrium increase in the retail prices of 2 m^2 panels would first raise from 11.8% to 13.6%, and then fall to 2.0%. The same occurs on the last four rows of this Table, i.e., if $\gamma_{44} \leq 0.3$.

[21] Labeling the entrant "S_4" is obviously an abuse of notation. However, it enables the presentation of the two reference cases, as well as the intermediate situations, in a unified way. The entrant could be a shareholder that is currently out of the industry, or one of the atomistic shareholders that we aggregate in S_4.

[22] Case (R1) is equivalent to shareholder S_4 leaving the industry, selling $1 - \tau_2$ of the equity capital of W_4 to shareholder S_3, and the remainder τ_2 to shareholder S_2.

[23] Case (R2) is equivalent to shareholder S_4 leaving the industry, selling $1 - \tau_4$ of the equity capital of W_4 to shareholder S_3, and the remainder τ_4 to a shareholder that has just entered the industry, similar to S_4. Alternatively, it is equivalent to shareholder S_4 selling $1 - \tau_4$ of the equity capital of W_4 to shareholder S_3, keeping τ_4.

[24] I.e., compared with the case where $\Lambda^{\mathcal{W}} = I_4$.

Fourth, if S_3 bought all of the equity capital of W_4, and afterwards sold half of the acquired equity capital to an entrant similar to S_4, i.e., $(\gamma_{14}, \gamma_{24}, \gamma_{34}, \gamma_{44})' = \left(0, 0, \frac{1}{2}, \frac{1}{2}\right)$, on average, the equilibrium retail prices of 2 m^2 products would increase 6.2%, and industry equilibrium retail prices would increase 5.6%. Social welfare would decrease 0.5 million euros per year.

Fifth, if S_3 bought all of the equity capital of W_4, sold 25% of the acquired equity capital to S_2 and 50% to an entrant similar to S_4, i.e., $(\gamma_{14}, \gamma_{24}, \gamma_{34}, \gamma_{44}) = \left(0, \frac{1}{4}, \frac{1}{4}, \frac{1}{2}\right)$, on average, the equilibrium retail prices of 2 m^2 panels would increase 4.6%, and industry equilibrium retail prices would increase 4.2%. Social welfare would decrease 0.2 million euros per year.

$[Figure\ B.2]$

Figure B.2 reproduces the information of Table A.13, and represents combinations of percentages of equity capital ownership of W_4 by S_3, S_2 and a entrant similar to S_4, $(\gamma_{24}, \gamma_{34}, \gamma_{44})$, that generate identical price increases. It shows that, if the acquirer was S_2, instead of an entrant similar to S_4, to achieve the same price reduction, it would be necessary to sell a larger part of the productive capacity of W_4.

Next we discuss several conclusions that may be gleaned from the previous cases. First, as expected, the impact on the price decrease of a divestiture depends of the identity of the buyer and the amount of capacity sold. If capacity is assigned to an entrant rather than to a shareholder already present in the industry, the price reduction is larger. In addition, the larger the amount of capacity divested, the larger the price reduction. But more interestingly, a divestiture may reduce prices, but rather increase them, as illustrated by the third case above. This possibility is usually ignored. A divestiture has two opposing effects. On the one hand, a divestiture reduces the ability of the seller to internalize the diversion of sales, leading the seller to decrease its prices. On the other hand, a divestiture increases the ability of the buyer to internalize the diversion of sales, leading the buyer to increase its prices. In some circumstances the latter effect may dominate.

To put these effects in perspective, consider a triopoly where each firm is owned by a different shareholder. Suppose that one of the shareholders buys all of the equity capital to one of its two rivals. This merger is equivalent to perfect collusion between these two firms. In the absence of cost synergies it will increases prices. If after the merger the owner of the two firms sells all of the recently acquired firm to a shareholder that just entered the industry, the impact of the merger is completely reversed.[25] Now assume, instead, that after the merger, the owner of the two firms sells only a part of the productive capacity of the acquired firm to the third rival.

[25]If after the merger the owner sells all of the recently acquired firm to the third rival, the impact of the merger may, or may not, be mitigated.

This divestiture is equivalent to partial collusion between the three firms in the industry. It will have a pro-competitive effect on the behavior of the seller, and a anti-competitive effect of the behavior of the buyer. The net competitive impact on the industry is potentially ambiguous. It is possible that in a triopoly, perfect collusion between two firms represents a more competitive environment than partial collusion between the three firms.

The policy implication is straightforward, but is worth emphasizing. In the context of merger review, one should not assume that divestitures are always pro-competitive. Different divestitures may have very different competitive impacts, and some may even be anti-competitive.

These conclusions where derived in the context of a particular way on implementing a divestiture of productive capacity, that draws from the partial ownership literature. However, the underlying principles are more general, and are potentially present as long as capacity has a positive impact in the managers' marginal utility of price. The Appendix discusses these issues in more detail.

6. Conclusion

We used the approach of the partial ownership literature to model the partial sale of a firm's productive capacity, in a context where vertical relations are important. Afterwards, the framework was applied to a hypothetical merger in outdoor advertising industry. The extended framework was shown to be useful for the analysis of the impact of possible remedies, which involved the divestiture of part of the acquired firm's productive capacity, rather than the divestiture of discrete assets like brands, as usually considered in the merger simulation literature.

Appendix A. Tables

Table A.1: Examples of Products

N	M. Owner	M. Group	Type	Description
1	JCD	Havas	2 m^2 panels	JCD 2 m^2 panels sold by Havas
2	CEMUSA	WPP	SENIOR	CEMUSA SENIORs sold by WPP
3	JCD	JCD	2 m^2 panels	JCD 2 m^2 panels sold directly
...				

Table A.2: Display Format Shares

Format	% Value	% Quant.
2m^2 panels	0.5998	0.6660
SENIOR	0.2027	0.2290
OTHERS	0.1976	0.1050

Quantity shares refers to share of the total display area in m^2. Source: data collected and estimated by the authors.

Table A.3: Media Owner Shares

Media Owner	% Value	% Quant.
W_1	0.1683	0.1027
W_2	0.1252	0.1678
W_3	0.5383	0.5270
W_4	0.1682	0.2025

Quantity shares refers to share of the total display area in m^2. Source: data collected and estimated by the authors.

Table A.4: Media Group Shares

Media Group	% Value	% Quant.
R_1	0.1508	0.1413
R_2	0.1534	0.0927
R_3	0.1728	0.3102
R_4	0.3166	0.2830
R_5	0.0619	0.0509
R_6	0.0296	0.0382
R_7	0.0967	0.0708
R_8	0.0183	0.0128

Quantity shares refers to share of the total display area in m^2. Source: Data collected and estimated by the authors.

Table A.5: Demand Models

	Multinomial Logit						Nested Logit					
	OLS		IV		GMM		OLS		IV		GMM	
Variable	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
price	-0.098	-15.92 **	-0.110	-5.04 **	-0.249	-9.08 **	-0.003	-3.00 **	-0.051	-7.83 **	-0.226	-4.58 **
R_2	0.467	2.70 **	0.533	2.58 **	1.188	4.18 **	0.025	0.90	0.254	6.17 **	1.337	3.52 **
R_3	0.082	0.48	0.029	0.15	-0.801	-2.77 **	0.011	0.41	0.014	0.43	-0.714	-2.93 **
R_4	0.582	3.27 **	0.578	3.26 **	0.366	1.34 †	0.037	1.39 †	0.275	7.21 **	0.353	0.64
R_5	-0.799	-4.04 **	-0.763	-3.66 **	-0.481	-1.65 *	-0.012	-0.45	-0.340	-7.00 **	0.057	1.15
R_6	0.027	0.13	-0.023	-0.10	-0.833	-2.37 **	0.018	0.43	-0.005	-0.10	-0.708	-2.40 **
R_7	-0.157	-0.41	-0.202	-0.52	-1.008	-1.68 *	0.004	0.09	-0.091	-1.95 *	-0.941	-2.04 *
R_8	-0.755	-1.59 †	-0.726	-1.53 †	-0.420	-0.80	-0.030	-0.56	-0.333	-5.26 **	0.134	1.51 †
W_1	-1.176	-5.64 **	-0.987	-2.54 **	1.463	2.58 **	1.728	50.33 **	0.550	3.52 **	2.534	4.56 **
W_2	-1.493	-8.98 **	-1.410	-6.32 **	-0.236	-0.66	1.705	50.78 **	0.341	2.06 *	0.798	2.26 *
W_3	-0.207	-1.16	-0.058	-0.19	1.907	4.17 **	1.749	59.59 **	0.967	8.92 **	2.602	5.90 **
W_4	-1.540	-7.19 **	-1.424	-4.61 **	0.137	0.34	1.733	54.23 **	0.353	2.10 *	1.256	2.86 **
SENIOR	-1.395	-9.59 **	-1.362	-8.68 **	-1.022	-5.38 **	-1.097	-52.72 **	-1.211	-44.97 **	-0.802	-2.61 **
OTHERS	-0.234	-1.44 †	-0.079	-0.24	1.753	4.54 **	-1.781	-76.50 **	-1.018	-9.80 **	1.467	2.29 *
fev	0.147	0.89	0.169	1.00	0.448	1.51 †	-0.002	-0.21	0.075	4.84 **	0.436	1.44 †
mar	-0.013	-0.07	-0.001	-0.01	0.156	0.55	0.022	1.70 *	0.013	0.96	0.187	0.83
apr	0.102	0.62	0.116	0.70	0.303	1.19	0.024	1.35 †	0.066	3.49 **	0.293	1.12
may	-0.148	-0.81	-0.150	-0.83	-0.186	-0.70	0.024	0.97	-0.053	-2.01 *	-0.131	-0.37
jun	-0.095	-0.54	-0.115	-0.64	-0.376	-1.39 †	0.021	2.25 *	-0.041	-3.11 **	-0.370	-1.52 †
jul	-0.037	-0.17	-0.050	-0.23	-0.210	-0.69	-0.024	-0.96	-0.037	-1.46 †	-0.229	-0.99
aug	0.331	2.05 *	0.347	2.16 *	0.562	2.08 *	0.118	4.39 **	0.220	7.33 **	0.512	1.63 †
sep	0.115	0.67	0.127	0.74	0.270	1.11	-0.019	-1.40 †	0.046	2.89 **	0.247	0.94
oct	-0.287	-1.71 *	-0.294	-1.73 *	-0.391	-1.86 *	-0.148	-4.69 **	-0.213	-6.52 **	-0.354	-1.52 †
nov	-0.020	-0.11	-0.023	-0.13	-0.069	-0.28	0.059	1.83 *	0.023	0.71	-0.051	-0.21
dec	-0.015	-0.08	-0.026	-0.14	-0.164	-0.71	-0.048	-1.16	-0.039	-0.94	-0.191	-1.08
σ							0.981	168.21 **	0.549	11.02 **	0.370	2.27 *
N	635		635		635		635		635		635	
GMM Obj.	4200		3380		5175		3575		3558		3268	

Significance levels: † : 10% $*$: 5% $**$: 1%. The correlation between two alternatives of the same nest is given by: $1-(1-\sigma)^2$.

Table A.6: Elasticities by Media Group

		∂P							
		R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
∂Q	R_1	-2.168	1.123	0.450	0.736	0.150	0.020	0.056	0.017
	R_2	0.575	-3.740	0.428	0.641	0.249	0.037	0.088	0.014
	R_3	0.540	0.923	-1.891	0.666	0.225	0.032	0.078	0.015
	R_4	0.546	0.912	0.439	-2.855	0.226	0.037	0.088	0.015
	R_5	0.414	1.165	0.473	0.734	-3.702	0.029	0.074	0.017
	R_6	0.405	1.172	0.369	0.823	0.174	-2.585	-0.050	0.020
	R_7	0.440	1.107	0.384	0.784	0.188	-0.016	-4.762	0.019
	R_8	0.556	0.893	0.438	0.649	0.233	0.038	0.091	-4.680

Retail elasticities.

Table A.7: Elasticities by Media Owner

		∂P			
		W_1	W_2	W_3	W_4
∂Q	W_1	-3.747	0.305	1.870	0.319
	W_2	0.352	-2.507	2.032	0.329
	W_3	0.443	0.371	-1.603	0.349
	W_4	0.431	0.337	1.819	-2.786

Retail elasticities.

Table A.8: Elasticities by Display Type

		∂P		
		$2m^2$ panels	SENIOR	OTHERS
∂Q	$2m^2$ panels	-2.024	0.992	0.399
	SENIOR	2.780	-3.012	0.399
	OTHERS	2.780	0.992	-4.399

Retail elasticities.

Table A.9: Merger Impact I

$2m^2$ panels	SENIOR	OTHERS	Total
11.8	9.0	3.4	10.3

Table A.10: Merger Impact II

All products					Only 2 m^2 panels				
W_1	W_2	W_3	W_4	$W_3 + W_4$	W_1	W_2	W_3	W_4	$W_3 + W_4$
0.9	0.8	7.2	44.8	13.5	1.1	1.0	5.5	46.4	15.1

Table A.11: Merger Impact III

R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
9.0	7.5	10.9	15.0	9.3	1.3	4.8	25.0

Table A.12: Merger Impact IV

$\mathcal{L}^r$		$\mathcal{L}^w$		$\Delta\Pi^r$ †	$\Delta\Pi^w$	ΔEC
pre	post	pre	post			
41	37	57	61	-0.389	3.548	-4.323

† : 10^6 €/year

Table A.13: Merger Impact with Remedies - Increase in the Price of 2 m^2 Panels

	% of the remainder of W_4 owned by S_3										
% of W_4 owned by S_4	0	10	20	30	40	50	60	70	80	90	100
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.2	1.3
80	0.4	0.6	0.9	1.1	1.4	1.6	1.8	2.0	2.2	2.3	2.5
70	0.6	1.0	1.4	1.8	2.2	2.5	2.8	3.1	3.3	3.6	3.8
60	0.8	1.4	2.0	2.5	3.0	3.5	3.9	4.3	4.6	4.8	5.0
50	1.0	1.8	2.6	3.4	4.0	4.6	5.1	5.5	5.8	6.1	6.2
40	1.2	2.3	3.3	4.3	5.1	5.8	6.4	6.9	7.2	7.3	7.4
30	1.4	2.8	4.1	5.3	6.3	7.2	7.9	8.3	8.6	8.6	8.5
20	1.6	3.3	4.9	6.4	7.7	8.8	9.5	9.9	10.1	10.0	9.6
10	1.8	3.9	5.9	7.7	9.3	10.5	11.3	11.7	11.6	11.3	10.7
0	2.0	4.5	6.9	9.2	11.1	12.5	13.3	13.6	13.3	12.7	11.8

Simulation of the sale of the equity capital of W_4 to S_3, S_2 and the entrant S_4. The vertical axis represents the % of W_4 owned by the entrant S_4. The remainder can be divided in two parts: one owned by S_3, and another owned by S_2. The horizontal axis represents the % of the remainder that is owned by S_3.

Table A.14: Merger Impact with Remedies

W_4 owned by S_4	W_4 owned by S_3	Δp %				$\Delta\Pi^r$ †	$\Delta\Pi^w$	ΔEC
%	%	$W_3 + W_4$	m^2 panels	SENIOR	Total			
0	50	13.5	12.5	7.6	10.4	-0.370	3.535	-4.126
0	100	13.5	11.8	9.0	10.3	-0.389	3.549	-4.322
50	25	5.3	4.6	3.8	4.2	-0.180	1.952	-2.004
50	50	7.3	6.2	5.4	5.6	-0.238	2.383	-2.635

Simulation of the sale of the equity capital of W_4 to S_3, S_2 and the entrant S_4. The first column presents the % of 2 m^2 panels of W_4 owned by the entrant S_4, and the second column the % of 2 m^2 panels of W_4 owned by S_3. † : 10^6 €/year.

Appendix B. Figure

Figure B.1: Ownership Structure

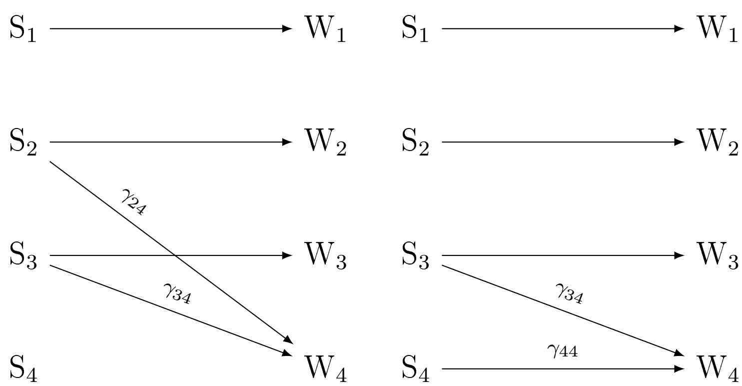
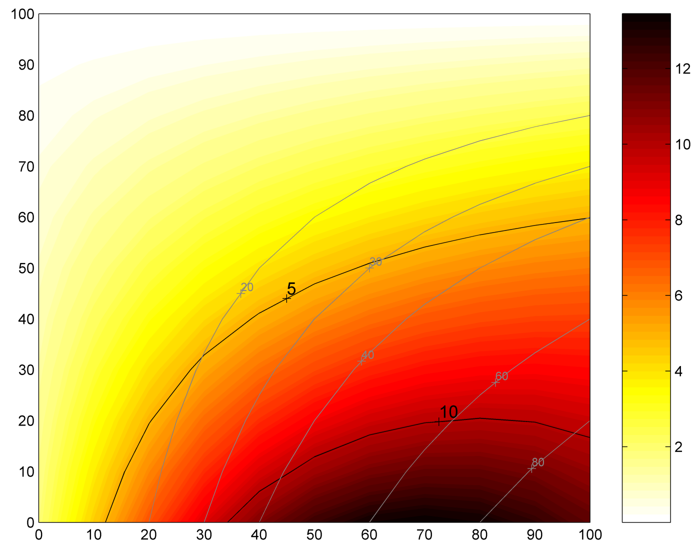


Figure B.2: Impact of the Merger with Remedies - Increase in the price of m^2 panels



Simulation of the sale of W_4 to S_3, S_2 and the entrant S_4. The vertical axis represents the % of the remainder of the equity capital of W_4 owned by the entrant S_4. The horizontal axis represents the % of the equity capital of W_4 owned by S_3 . The remainder is owned by S_2. The Figure reproduces visually the information contained in Table A.13. The colors indicate the intensity of the price variation. The black lines indicate points of equal price variation and the gray lines indicate points of equal ownership of W_4 by S_3 (γ_{34} of Figure B.1).

Appendix C. Appendix

Next, we discuss the various price effects of a divestiture.

To simplify the exposition, assume, without loss of generality, that initially: **(i)** $\mathcal{J}^{\mathcal{W}} = 0$, **(ii)** $\mathcal{S} = \mathcal{J}$, **(iii)** $\omega_j = 0$, for all j, **(iv)** $\gamma_{jj} = 1$, for $j = 1, ..., \mathcal{J}$.

Then suppose that S_1 acquires all the equity capital of brand $\mathcal{J}$ from $S_{\mathcal{J}}$, keeps a fraction $\gamma := \lambda_{1\mathcal{J}}$, and sells a fraction $1-\gamma := \lambda_{2\mathcal{J}}$ to S_2. After the merger, brand $\mathcal{J}$ continues to exist as a brand.

Then:

$$\Lambda = \begin{bmatrix} 1 & 0 & 0 & ... & 0 & \gamma \\ 0 & 1 & 0 & ... & 0 & 1-\gamma \\ 0 & 0 & 1 & ... & 0 & 0 \\ ... & ... & ... & & ... & ... \\ 0 & 0 & 0 & ... & 1 & 0 \\ \frac{\gamma}{1-2\gamma(1-\gamma)} & \frac{1-\gamma}{1-2\gamma(1-\gamma)} & 0 & ... & 0 & 1 \end{bmatrix}$$

The following Observation, stated without proof, collects some useful results.

Observation: **(i)** $\frac{\partial \lambda_{1\mathcal{J}}}{\partial \gamma} = -\frac{\partial \lambda_{2\mathcal{J}}}{\partial \gamma} = 1$. **(ii)** If $\gamma \in [0, 0.71]$, then $\frac{\partial \lambda_{\mathcal{J}1}}{\partial \gamma} \geq 0$. **(iii)** If $\gamma \in [0, 0.29]$, then $\frac{\partial \lambda_{\mathcal{J}2}}{\partial \gamma} \geq 0$. **(iv)** If $\gamma \in [0, 0.29]$, then $\frac{\partial \lambda_{\mathcal{J}1}}{\partial \gamma} > 0$ and $\frac{\partial \lambda_{\mathcal{J}2}}{\partial \gamma} \geq 0$. If $\gamma \in [0.71, 1]$, then $\frac{\partial \lambda_{\mathcal{J}1}}{\partial \gamma} \leq 0$ and $\frac{\partial \lambda_{\mathcal{J}2}}{\partial \gamma} < 0$. ■

Let:$\mathcal{M}_{kj}(\mathbf{p}) := (p_k - \rho_k)\frac{\partial D_k(\mathbf{p})}{\partial p_j}$. The equilibrium conditions are, for all $j = 1, 2, ..., \mathcal{J}$:

$$\begin{cases} \frac{\partial u_1}{\partial p_1} = D_1 + \mathcal{M}_{11} + \lambda_{1\mathcal{J}}\mathcal{M}_{\mathcal{J}1} = 0, \\ \frac{\partial u_2}{\partial p_2} = D_2 + \mathcal{M}_{22} + \lambda_{2\mathcal{J}}\mathcal{M}_{\mathcal{J}2} = 0, \\ \frac{\partial u_j}{\partial p_j} = D_j + \mathcal{M}_{jj} = 0, \ j = 3, ..., \mathcal{J} - 1 \\ \frac{\partial u_{\mathcal{J}}}{\partial p_{\mathcal{J}}} = D_{\mathcal{J}} + \mathcal{M}_{\mathcal{J}\mathcal{J}} + \lambda_{\mathcal{J}1}\mathcal{M}_{1\mathcal{J}} + \lambda_{\mathcal{J}2}\mathcal{M}_{2\mathcal{J}} = 0. \end{cases}$$

As it is well known, the pricing game is supermodular.

In addition:

$$\begin{aligned}
\frac{\partial^2 u_1}{\partial\gamma\partial p_1} &= \mathcal{M}_{\mathcal{J}1} > 0, \\
\frac{\partial^2 u_2}{\partial\gamma\partial p_2} &= -\mathcal{M}_{\mathcal{J}2} < 0, \\
\frac{\partial^2 u_j}{\partial\gamma\partial pj} &= 0,\ j = 3, ..., \mathcal{J} - 1 \\
\frac{\partial^2 u_{\mathcal{J}}}{\partial\gamma\partial p_{\mathcal{J}}} &= \mathcal{M}_{1\mathcal{J}}\frac{\partial\lambda_{\mathcal{J}1}}{\partial\gamma} + \mathcal{M}_{2\mathcal{J}}\frac{\partial\lambda_{\mathcal{J}2}}{\partial\gamma}.
\end{aligned}$$

Hence, a divestiture, i.e., a decrease in γ, has: **(i)** a direct negative impact on p_1, **(ii)** a direct positive impact on p_2, **(iii)** no direct impact on p_j, $j = 3, ..., \mathcal{J} - 1$, and **(iv)** a potentially ambiguous direct impact on $p_{\mathcal{J}}$. For example, if γ is on $[0.71, 1]$, a divestiture, has a direct positive impact on $p_{\mathcal{J}}$.

An alternative way of obtaining similar results would be to assume that each brand disposes of a given productive capacity, κ_j. Demand depends on productive capacity, $D_j(\mathbf{p}; \kappa_j)$, such that: **(i)** $\frac{\partial D_j(\mathbf{p};\kappa_j)}{\partial\kappa_j} > 0$, and **(ii)** $\frac{\partial D_j(\mathbf{p};\kappa_j)}{\partial\kappa_j\partial p_j} > 0$. This assumption can be justified as follows. The larger a firm's productive capacity is, the higher the degree of coverage of a firm's network, and hence the more valued its products are. Assume that after the merger, brand $\mathcal{J}$ ceases to exist, and its capacity is reassigned to the brands of the new shareholders, S_1 and S_2, as follows: $\kappa_1^a = \kappa_1 + \gamma\kappa_{\mathcal{J}}$, and $\kappa_2^a = \kappa_2 + (1 - \gamma)\kappa_{\mathcal{J}}$. The capacities of the remaining firms stays unchanged. Under these circumstances, results similar to those above follow.

Appendix D. References

Aksoy-Pierson, M., Allon, G., Federgruen, A., 2013. Price competition under mixed multinomial logit demand functions. Management Science 59 (8), 1817–1835.

Baker, J. B., Bresnahan, T. F., 1985. The gains from merger or collusion in product-differentiated industries. The Journal of Industrial Economics, 427–444.

Berry, S., 1994. Estimating discrete-choice models of product differentiation. RAND Journal of Economics 25 (2), 242–262.

Berry, S., Levinsohn, J., Pakes, A., 1995. Automobile prices in market equilibrium. Econometrica 63 (4), 841–90.

Bierlaire, M., 2006. A theoretical analysis of the cross-nested logit model. Annals of Operations Research 144, 287–300.

Bonnet, C., Dubois, P., 2012. Inference on vertical contracts between manufacturers and retailers allowing for non linear pricing and resale price maintenance. Rand Journal of Economics 41 (1), 139–164.

Brenkers, R., Verboven, F., 2006. Liberalizing a distribution system: the european car market. Journal of the European Economic Association 4 (1), 216–251.

Bresnahan, T., 1987. Competition and collusion in the american automobile industry: The 1955 price war. Journal of Industrial Economics 35 (4), 457–482.

Brito, D., Ribeiro, R., Vasconcelos, H., 2014. Measuring unilateral effects in partial horizontal acquisitions. International Journal of Industrial Organization 33 (0), 22 – 36.
URL `http://www.sciencedirect.com/science/article/pii/S0167718713001306`

Domencich, T., McFadden, D., 1975. Urban Travel Demand: A Behavioral Analysis. North-Holland Publishing.

Gilo, D., Moshe, Y., Spiegel, Y., 2006. Partial cross ownership and tacit collusion. RAND Journal of Economics 37 (1), 81–99.

Goldberg, P. K., 1995. Product differentiation and oligopoly in international markets: The case of the u.s. automobile industry. Econometrica 63 (4), 891–951.
URL `http://www.jstor.org/stable/2171803`

Gowrisankaran, G., Nevo, A., Town, R., 2015. Mergers when prices are negotiated: Evidence from the hospital industry. American Economic Review 105 (1), 172–203.

McFadden, D., 1974. Conditional logit analysis of qualitative choice behavior. In: Zarembka, P. (Ed.), Frontiers in econometrics. Academic Press: New Yo, Ch. 4, pp. 105–142.

McFadden, D., 1978. Modeling the choice of residential location. In: Karlkvist, A., Lundkvist, L., Snickars, F., Weibull, J. (Eds.), Spatial interaction theory and planning models. North-Holland, Amsterdam, pp. 75–96.

McFadden, D., 1981. Structural discrete probability models derived from theories of choice. In: Manski, C. F., McFadden, D. L. (Eds.), Structural Analysis of Discrete Data and Econometric Applications. Cambridge: The MIT Press, Ch. 5.

McFadden, D., Train, K., Dec 2000. Mixed mnl models for discrete response. Journal of Applied Econometrics 15 (5), 447–470.

Nevo, A., 2000. Mergers with differentiated products: The case of the ready-to-eat cereal industry. RAND Journal of Economics 31 (3), 395–421.

Nevo, A., 2001. Measuring market power in the ready-to-eat cereal industry. Econometrica 69 (2), 307–42.

Newey, W. K., McFadden, D., 1994. Large sample estimation and hypothesis testing. Handbook of econometrics 4, 2111–2245.

O'Brien, D. P., Salop, S. C., 2000. Competitive effects of partial ownership: Financial interest and corporate control. Antitrust Law Journal, 559–614.

Pereira, P., Ribeiro, T., 2011. The impact on broadband access to the internet of the dual ownership of telephone and cable networks. International Journal of Industrial Organization 29 (2), 283–93.

Pereira, P., Ribeiro, T., Vareda, J., 2013. Delineating markets for bundles with consumer level data: The case of triple-play. International Journal of Industrial Organization 31 (6), 760–773.

Rosse, J., 1970. Estimating cost function parameters without using cost data: Illustrated methodology. Econometrica 38 (2), 256–275.

Villas-Boas, S., 2007a. Using retail scanner data for upstream merger analysis. Journal of Competition Law and Economics 3 (4), 689–715.

Villas-Boas, S., 2007b. Vertical relationships between manufacturers and retailers: Inference with limited data. The Review of Economic Studies 74 (2), 625–652.

Werden, G., 1983. Market delineation and the justice department's merger guidelines. duke law journal, 3, 514-579.). Duke Law Journal 3, 514–579.

Werden, G., 1993. Market delineation under the merger guidelines: a tenth anniversary retrospective. The Antitrust Bulletin, 517–600.

Werden, G., Froeb, L., 1994. The effects of mergers in differentiated products industries: Logit demandand merger policy. Journal of Competition Law and Economics 10 (2), 407–426.