

# Mergers of retailers with limited selling capacity\*

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## Abstract

We consider two (symmetric) upstream firms producing independent goods that sell to consumers through symmetric retailers. The distinguishing feature of retailers is that they have a selling capacity, in the sense, that there is an upper limit in the total units of the two goods they can sell. For low enough capacity levels, we obtain that wholesale prices are increasing in the capacity and therefore we find cases where profits of retailers increase by restricting capacity. Keeping constant the industry selling capacity, we study the profitability of the merger of all retailers. For low capacity levels we obtain that wholesale prices increase with the merger and therefore the merger of retailers is not profitable.

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# 1 Introduction

Buyer power can be defined as the ability of retailers to obtain better deals from suppliers. Lately, competition authorities have become suspicious about the ways retailers try to increase their buyer power for their possible negative effect on welfare. For example, Gabrielsen and Sorgard (1999) Dana (2006), Inderst and Shaffer (2007a) and Fauli-Oller (2007) has shown that retailers can obtain buyer power by restricting the number of goods they are selling. In this way, retailers increase competition among suppliers and increase the rents they obtain. An obvious negative effect of this type of policy is that it reduces the variety of goods available to consumers.

However, one of the shortcomings of those papers is that they do not make explicit which mechanism retailers use to commit to restrict the number of goods they want to sell. In this paper, we take seriously this commitment problem and introduce as a key parameter the dimension of the shop of retailers. The dimension determines the total number of units of all goods that the retailer can sell. Therefore the dimension of a shop refers to the selling capacity of a retailer. Given a capacity, we pose the question whether retailers want to restrict its selling capacity.

In the benchmark case, we consider two (symmetric) upstream firms producing independent goods that sell to consumers through  $n$  symmetric retailers. For low enough capacity levels, we obtain that wholesale prices are increasing in the capacity and therefore we find cases where profits of retailers would increase by restricting capacity.

In the second part of the paper we contribute to the debate on the effect of downstream mergers over buyer power. Many different reasons has been provided by the literature to explain why size obtained through merger can allow retailers to obtain better deals from suppliers. Greater size can allow retailers to break collusion among suppliers (Snyder, 1996), it may also allow retailers to threaten suppliers to vertically integrate (Katz (1987); Inderst and Wey (2007b)

and in the case of convex costs can allow retailers to obtain advantages over suppliers, because they compete less "on the margin" (Chipty and Snyder (1999)).

Keeping constant the industry selling capacity, we compare the situation with one retailer with the case with  $n$  symmetric retailers. In contrast to previous results, we find that the effect of the merger on wholesale prices depends on the level of capacity. For low capacity levels we obtain that wholesale prices increase with the merger and therefore the merger of retailers is not profitable. For high capacity levels, instead, wholesale prices decrease with the merger and the merger is profitable.

In the next Section, we study, given a level of capacity, the contracting game for the case of linear wholesale prices. Then we study the profitability of mergers to monopoly in the retailing sector. In the third Section we study the effect of selling capacity for the case of general supply contracts. We obtain that a monopolist retailer finds profitable to restrict strategically capacity. Final comments put the paper to an end.

## 2 Model

Assume we have two producers (1 and 2). Producer 1 (2) produces good 1 (2). Goods 1 and 2 are independent. Demand of good  $i$  ( $i=1,2$ ) is given by  $P_i = a - Q_i$ , where  $P_i$  and  $Q_i$  are respectively the price and the quantity sold of good  $i$ . Upstream firms sell the goods through retailers. There are  $n$  retailers. Each retailer is denoted with a natural number from 1 to  $n$ . The distinguishing characteristic of each retailer is that it has a limited shelf space. In particular, we assume that the total units of the two goods that she can sell is lower than  $X$ . In particular, if  $x_i^j$  denotes the quantity that the retailer  $j$  sells of good  $i$ , we must have that  $x_1^j + x_2^j \leq \frac{X}{n}$ .

We analyze the following two stage game. In the first stage, producer  $i$  ( $i = 1, 2$ ) chooses its wholesale price  $w_i \leq a$ . In the second stage, retailers compete à la Cournot taking into account

that for all  $j$  we must have that  $x_1^j + x_2^j \leq \frac{X}{n}$ .

## 2.1 Second stage

It is well-known that, without selling capacity constraints, each retailer would sell  $x_1^j = \frac{a - w_1}{n + 1}$  and  $x_2^j = \frac{a - w_2}{n + 1}$ . Then those will be the sales in equilibrium when

$$\frac{a - w_1}{n + 1} + \frac{a - w_2}{n + 1} = \frac{2a - w_1 - w_2}{n + 1} \leq \frac{X}{n}$$

When this constraint is satisfied we say that we are in Region 1. If we are not in Region 1, we are in Region 2, where retailers sell up to capacity. Then the maximization program of the retailer is:

$$\begin{aligned} & \underset{x_1^j}{Max} (a - x_1^j - \sum_{k \neq j} x_1^k - w_1)x_1^j + (a - (\frac{X}{n} - x_1^j) - \sum_{k \neq j} (\frac{X}{n} - x_1^k) - w_2)(\frac{X}{n} - x_1^j) \\ s.t. & 0 \leq x_1^j \leq \frac{X}{2} \end{aligned}$$

The equilibrium of this game where retailers play up to capacity is symmetric and it is the following:

$$x_1^j = \frac{-w_1 + w_2 + X \left(\frac{n+1}{n}\right)}{2(n+1)} \text{ and } x_2^j = \frac{-w_2 + w_1 + X \left(\frac{n+1}{n}\right)}{2(n+1)} \text{ if } -w_1 + w_2 + X \left(\frac{n+1}{n}\right) > 0 \text{ and } -w_2 + w_1 + X \left(\frac{n+1}{n}\right) > 0 \text{ (Region 2i).}$$

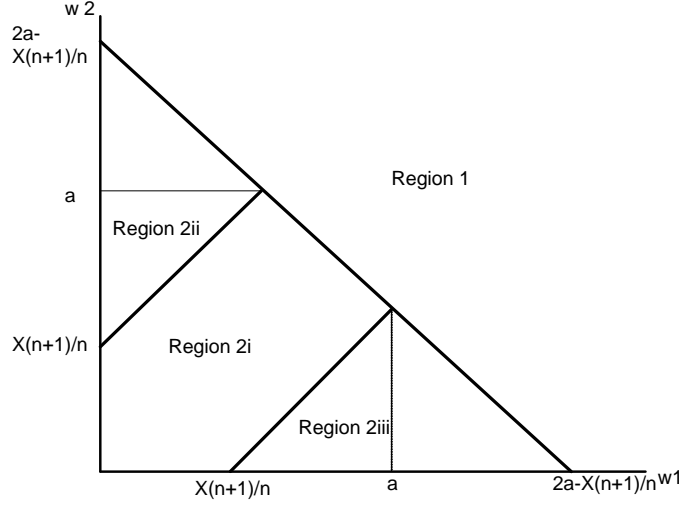
$$x_1^j = \frac{X}{n} \text{ and } x_2^j = 0 \text{ if } -w_2 + w_1 + X \left(\frac{n+1}{n}\right) \leq 0 \text{ (Region 2ii)}$$

$$x_1^j = 0 \text{ and } x_2^j = \frac{X}{n} \text{ if } -w_1 + w_2 + X \left(\frac{n+1}{n}\right) \leq 0 \text{ (Region 2iii).}$$

The four Regions are depicted in Figure 1:

## 2.2 First stage

Without selling capacity constraints, the equilibrium wholesale prices are given by  $w_1^* = w_2^* = \frac{a}{2}$  and retailers sell  $x_i^j = \frac{a}{2(n+1)}$ . If  $\frac{a}{(n+1)} \leq \frac{X}{n}$ , this will still be the equilibrium of the present



game, because deviation profits can not increase with the presence of selling capacity constraints. Next, we solve the model for the case  $\frac{a}{(n+1)} > \frac{X}{n}$ . Observe that in Figure 1 this condition was satisfied.

We analyze the optimal wholesale price of supplier 1 given  $w_2$ . The previous picture gives us an idea about the problems involved in the maximization process. For example, if  $\frac{X(n+1)}{n} < w_2 < a$ , by increasing  $w_1$  from 0 we move from region 2ii, where retailers are constrained and sells only good 1, to Region 2i, where retailers are constrained but sell both goods and finally to Region 1 where retailers are unconstrained.

The first thing to notice is that the supplier 1 will never choose a  $w_1$  such that it is in the interior of Region 2ii. By increasing slightly price profits will increase, because sales will remain constant<sup>1</sup>. She will never choose a  $w_1$  such that it is in Region 2iii. In this way, she sells nothing and can obtain sales reducing the price to Region 2i. Then we have to study the optimal decisions in Regions 2i and Region 1.

In the interior of Region 1 the maximizer should be  $\frac{a}{2}$ . The maximizer in Region 2i can be

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<sup>1</sup>In Region 2ii,  $w_1 \leq w_2 - \left(\frac{n+1}{n}\right)X$ . Then  $\frac{a-w_1}{2} \geq \left(\frac{a-w_2 + \left(\frac{n+1}{n}\right)X}{n+1}\right) = \frac{a-w_2}{n+1} + \frac{X}{n}$ .

in the interior, in the frontier between Region 2i and 2ii or in the frontier between Region 2i and Region 1. (The actual shape of the best response of producer 1 is in the Appendix). However, the equilibrium can not be in the interior of Region 1, because  $(\frac{a}{2}, \frac{a}{2})$  is not located in Region 1. The equilibrium can not be in the frontier between Region 2i and 2ii, because then producer 2 sells nothing and it can not be behaving optimally. Therefore the equilibrium must lie in the interior of Region 2i or in the frontier between Region 2i and Region 1. This is formalized in the next proposition:

**Proposition 1** *The equilibrium wholesale prices are given by  $w_1^* = w_2^* = \frac{(n+1)X}{n}$  if  $0 < \frac{X}{n} < \frac{2a}{3(n+1)}$  and  $w_1^* = w_2^* = a - \frac{(n+1)X}{2n}$  if  $\frac{2a}{3(n+1)} \leq \frac{X}{n} \leq \frac{a}{n+1}$ .*

As a reference, consider the situation where producers merge. Then it is very easy to derive the optimal wholesale prices<sup>2</sup>. The merged firm will set the same wholesale price for each good  $w^*$ , that satisfies that it is the highest wholesale price such that retailers sell up to capacity.

$$\begin{aligned} 2 \left( \frac{a - w^*}{n+1} \right) &= \frac{X}{n} \\ w^* &= a - \frac{(n+1)X}{2n} > \frac{a}{2} \end{aligned}$$

In this case, wholesale prices decrease with capacity and increase with competition downstream. Then wholesale prices are the same with competition and with monopoly upstream if selling capacity is high. Competition has an effect only when selling capacity is significantly scarce.

When capacity is low, the equilibrium lies in the interior of Region 2i where we have that  $\frac{X}{n} < \frac{a - w_1}{n+1} + \frac{a - w_2}{n+1}$ . In this case, wholesale prices are increasing in capacity and decreasing in  $n$ . The reason for this result is that the demand of the intermediate input is more sensitive to price the higher the competition in the downstream sector. The demand of retailers of good

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<sup>2</sup>We consider the case with low capacity,  $\frac{X}{n} \leq \frac{a}{n+1}$ . For  $\frac{X}{n} > \frac{a}{n+1}$ , the equilibrium is like the case without capacity constraints  $w_1^* = w_2^* = \frac{a}{2}$ .

$i$  in Region 2i is given by:

$$X_i = \frac{n(-w_i + w_j) + (n+1)X}{2(n+1)}$$

$$\left| \frac{\partial X_i}{\partial w_i} \right| = \frac{n}{2(n+1)} \quad (1)$$

It is easy to see that (1) is increasing in  $n$ . This means that the higher  $n$  the more profitable is to undercut the rival producer. This explains that the equilibrium wholesale price decreases with  $n$ .

To understand this counterintuitive result we are going to analyze two extreme cases. The sales reactions of a monopolist and a competitive retailer (obtained in our model when  $n$  tends to infinity). If wholesale prices are the same for both goods they will sell of each good half of their capacity. Think that now upstream  $i$  reduces the wholesale price. In the case of a competitive retailer the equilibrium condition implies that price margins should be equalized across markets. If  $x_i^C$  are the sales of a competitive firm of good  $i$  we have:

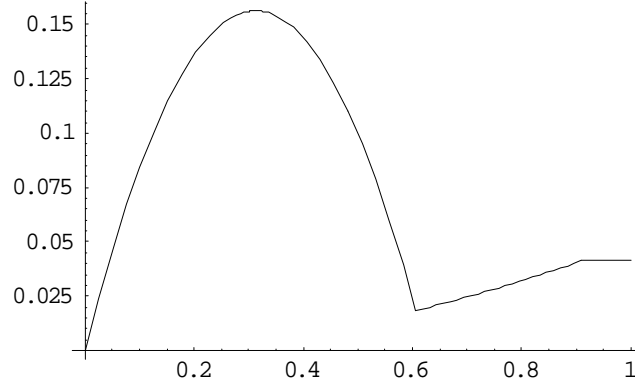
$$\begin{aligned} a - x_i^C - w_i &= a - (X - x_i^C) - w_j \\ x_i^C &= \frac{w_j - w_i + X}{2} \end{aligned}$$

However, a monopolist will increase the sales of good  $i$  but not to the point to equalize margins, because as she sells more of good  $i$  she prefers to have a higher margin in good  $i$ . If  $x_i^M$  are the sales of a competitive firm of good  $i$  we have:

$$\begin{aligned} a - x_i^M - w_i &> a - (X - x_j^M) - w_j \\ x_i^M &< \frac{w_j - w_i + X}{2} \end{aligned}$$

This implies that sales of good  $i$  will be higher for the competitive retailer.

$$x_i^M < x_i^C$$



For the general  $n$ , we will have that price margins are closer the lower the sales of the retailer i.e. the higher  $n$ . This implies that the increase in the sales of good  $i$  will be higher the higher  $n$ . The fact that, for low capacity levels, wholesale prices decrease with  $n$ , has its counterpart in the result below that mergers to monopoly may not be profitable.

### 2.3 Downstream mergers

The industry downstream profits as a function of  $X$  are given by:

$$\Pi^D(n) = \begin{cases} X(a - \frac{3X}{2} - \frac{X}{n}) & \text{if } 0 \leq \frac{X}{n} \leq \frac{2a}{3(n+1)} \\ \frac{X^2}{2n} & \text{if } \frac{2a}{3(n+1)} < \frac{X}{n} \leq \frac{a}{n+1} \\ \frac{a^2n}{2(n+1)^2} & \text{otherwise} \end{cases}$$

The typical shape of the industry profits downstream is presented in Figure 2.

It is concave for low capacities, then increasing and finally constant when retailers are unconstrained. The concave part reflects a trade-off. For low capacities, increasing capacity has the positive effect on profits of increasing sales but the negative effect of increasing the wholesale prices. The decreasing part of the function identifies a region where retailers would be better-off if they would agree to restrict capacity.

Next we study the profitability of the merger of all downstream firms. A merger is said to be profitable if it increases the profits of the downstream firms. Then we have to compare  $\Pi^D(1)$  with  $\Pi^D(n)$ . The merger has the positive effect of reducing competition only if capacity is high ( $X > \frac{a}{2}$ ), because otherwise firms sell up to capacity in any market structure. If  $X > \frac{a}{2}$ , the merger is profitable, because it reduces competition and the wholesale prices do not increase with the merger. If  $X < \frac{a}{2}$ , the merger will be profitable if it reduces wholesale prices. Using Proposition 1, this will be the case when  $a - X < \left(\frac{n+1}{n}\right) X$ . Next proposition states the result on profitability.

**Proposition 2** *With competition upstream, the merger to monopoly of downstream firms is not profitable if  $0 < \frac{X}{n} \leq \frac{a}{2n+1}$  and profitable otherwise.*

It is very easy to find the counterpart of proposition 3 for the case where producers merge.

As we have said before, the wholesale price is given by

$$w^* = \begin{cases} a - \frac{(n+1)X}{2n} & \text{if } \frac{X}{n} \leq \frac{a}{n+1} \\ \frac{a}{2} & \text{otherwise} \end{cases} .$$

If  $\frac{X}{n} > \frac{a}{n+1}$ , the merger is profitable because it restricts sales. If  $\frac{X}{n} \leq \frac{a}{n+1}$ , the merger is profitable because it reduces wholesale prices. Next proposition summarizes.

**Proposition 3** *Without competition upstream, the merger to monopoly of downstream firms are always profitable.*

Putting together propositions 3 and 4, we obtain that the merger of the upstream firms stimulate the merger of downstream firms. This is coherent with the empirical fact that parallel processes of consolidation in both upstream and downstream sectors are observed.

### 3 General supply contracts

In this Section, we study the effect of constraints on the selling capacity when supply contracts are general. We focus on the case of a monopolist retailer to be able to import results from Bernheim and Whinston (1998). Their main focus is on exclusive contracts, but to know their effect they also study the situation where they are not possible. This is the case we are interested in.

We consider that selling capacity is  $X < a$  and study the following contracting game. In the first stage, producers (1 and 2) offer supply contracts  $P_i(x_i)$  ( $i = 1, 2$ ). Each contract is a function that maps the sales of good  $i$   $x_i$  to a monetary payment. In the second stage, the retailer decides whether to accept the contract or not. In the third stage, the retailer chooses the level of sales.

Before stating the equilibrium, we introduce the following definitions. Given sales  $(x_1, x_2)$ , total industry profits are given by:

$$R(x_1, x_2) = (a - x_1)x_1 + (a - x_2)x_2.$$

We have that

$$(x^*, x^*) = \arg \max_{x_1, x_2} \{R(x_1, x_2) \text{ s.t. } x_1 + x_2 \leq X\} = \left(\frac{X}{2}, \frac{X}{2}\right)$$

$$y^* = \arg \max_{x_1} \{R(x_1, 0) \text{ s.t. } x_1 \leq X\} = \begin{cases} X & \text{if } X \leq \frac{a}{2} \\ \frac{a}{2} & \text{otherwise} \end{cases}$$

$$z^* = \arg \max_{x_2} \{R(0, x_2) \text{ s.t. } x_2 \leq X\} = \begin{cases} X & \text{if } X \leq \frac{a}{2} \\ \frac{a}{2} & \text{otherwise} \end{cases}$$

Observe that symmetry implies that  $y^* = z^*$ .

Then the maximal profits at the industry level are  $\Pi = R(x^*, x^*)$  and the maximal profits if the retailer can only trade with producer  $i$  is  $\Pi^i = R(y^*, 0) = R(z^*, 0)$ . Observe that  $X < a$  implies that

$$\Pi < \Pi^1 + \Pi^2$$

that is Assumption B2 in Bernheim and Whinston (1998)<sup>3</sup>. Then, we rewrite Proposition 2 in Bernheim and Whinston (1998).

**Proposition 4** (*Proposition 2 Bernheim and Whinston (1998)*) *There is an equilibrium of the contracting game in which the retailer accepts both manufacturer's contracts and chooses  $(x^*, x^*)$ . The payoff of the retailer is  $\Pi^1 + \Pi^2 - \Pi$ . Furthermore, this equilibrium weakly dominates (for the manufacturer) any other equilibrium of this game.*

The payoff of the retailer is given by:

$$\Pi^1 + \Pi^2 - \Pi = \begin{cases} X(a - \frac{3X}{2}) & \text{if } X \leq \frac{a}{2}. \\ \frac{a^2}{2} - (a - \frac{X}{2})X & \text{otherwise.} \end{cases}$$

The important thing is that this payoff is concave with a maximum at  $X = \frac{a}{3}$ . Therefore, it holds that by making shelf space scarce, the retailer can increase the rents obtained from the vertical structure. Next proposition summarizes.

**Proposition 5** *Assume that the retailer can choose the selling capacity before the contracting game and its equilibrium is the one in Proposition 4. Then she would restrict capacity to  $X = \frac{a}{3}$ .*

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<sup>3</sup>Observe that in our case Assumption B1 in Bernheim and Whinston (1998) holds with equality. Footnote 12 in the paper clarifies that in this case all the results still hold.

## 4 Conclusion

In the present paper, we have explicitly modelled the dimension of retailers. This has shed light on its possible strategic use vis-à-vis suppliers. We have showed that by restricting capacity retailers increase the competition of suppliers for the scarce shelving space. Suppliers react to it by lowering their wholesale prices. Furthermore, we have showed that when industry capacity is low and retailers are constrained, mergers increase wholesale prices. The reason is that the demand of suppliers become more elastic as competition downstream increases.

In future work, I would like to study the strategic choice of selling capacity in oligopoly. The optimal capacity will be the result of the balance of two effects: on the one hand, reducing capacity reduces wholesale prices and, on the other hand, increasing capacity increases sales. If we assume that suppliers can not price discriminate and therefore price concessions are granted to any retailer, we can easily conclude that the noncooperative effort to reduce wholesale prices will be lower than the one that maximizes retailers profits. This will result in the capacity level be higher than the one that maximizes retailers profits.

This can be connected with the existing laws in different countries that impose legal limits to the creation of new selling capacity. For example, in France, la Loi Raffarin impose legal requirements that result in delays in the enlargement and creation of shopping centers. In Spain, many regional governments, i.e. Catalonia, establish periods of time where no new hypermarket can be created. Those laws are justified as a a means of protecting small retailers. However, they may have the side-effect of increasing the profits of incumbent big retailers at the expense of suppliers.

## 5 Appendix

The best response of supplier 1 is given by.

$$\text{If } 0 < \frac{X}{n} \leq \frac{a}{3(n+1)}$$

$$B_1(w_2) \begin{cases} \frac{nw_2 + (n+1)X}{2n} & \text{if } 0 \leq w_2 \leq \frac{3(n+1)X}{n} \\ w_2 - \frac{(n+1)X}{n} & \text{if } \frac{3(n+1)X}{n} < w_2 \leq a \end{cases}$$

$$\text{If } \frac{a}{3(n+1)} \leq \frac{X}{n} \leq \frac{a}{2(n+1)}$$

$$B_1(w_2) = \begin{cases} \frac{nw_2 + (n+1)X}{2n} & \text{if } 0 \leq w_2 \leq \frac{4a}{3} - \frac{(n+1)X}{n} \\ 2a - \frac{(n+1)X}{n} - w_2 & \text{if } \frac{4a}{3} - \frac{(n+1)X}{n} < w_2 \leq a \end{cases}$$

$$\text{If } \frac{a}{2(n+1)} \leq \frac{X}{n} \leq \frac{a}{n+1}$$

$$B_1(w_2) = \begin{cases} \frac{nw_2 + (n+1)X}{2n} & \text{if } 0 \leq w_2 \leq \frac{4a}{3} - 2X \\ 2a - 2X - w_2 & \text{if } \frac{4a}{3} - \frac{(n+1)X}{n} < w_2 \leq \frac{3a}{2} - \frac{(n+1)X}{n} \\ \frac{a}{2} & \text{if } \frac{3a}{2} - \frac{(n+1)X}{n} < w_2 \leq a \end{cases}$$

Given  $X$ , this reaction function crosses the 45 degree line only once. This crossing point determines the equilibrium in wholesale prices that is stated in proposition 1.

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