Buyer power of retailers with limited selling capacity*

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29th of May 2018

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. The merger between upstream firms weakly increases wholesale prices. The lower the number of retailers the lower the wholesale prices, except when we have competition upstream and capacity is low. This is also the only case where the merger of all downstream firms is not profitable. The reason is that the merger increases wholesale prices.

JEL Classification: L13;L41;L42

keywords: retailing, mergers, selling capacity

*I acknowledge financial support from the Spanish Ministerio de Economía y Competitividad and FEDER funds ECO2015-65820-P (MINECO/FEDER) and from Generalitat Valenciana grant PROMETEO/2013/037. I thank Miguel González-Maestre, Joel Sandonis and Luis Ubeda and two anonymous referees of this Journal for helpful comments that have allowed me to improve the paper. I am also grateful to seminar audiences in Universitat de València and University of Alicante. The usual disclaimer applies. Part of this research was written while I was visiting the Institut d’Anàlisi Econòmica (CSIC).

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1 Introduction

Concentration in a market is usually associated with high prices. However, a theory, first stated by Galbraith (1952), says that having big retailers may be a good thing, because they can counteract the power of suppliers and allow retailers to obtain better deals. If these better deals are passed to consumers as lower retail prices, big retailers will be associated with higher welfare. In this paper, in particular, we study how wholesale prices change with the size of retailers. There are plenty of papers (Von Ungern-Sternberg (1996), Dobson and Waterson (1997), Iozzi and Valetti (2014)) that look at this issue so the novelty we propose is on the type of retailers we consider. We consider that retailers face capacity constraints.

We find many cases in the literature where retailers are capacity constraint. For example, when a retailer invokes an exclusive dealing clause as if it restricted its capacity to accommodate only one good (Gabrielsen and Sorgard (1999)). O’Brien and Shaffer (1997) obtain that a retailer has incentives to limit her shelf space in order to reduce the number of goods she can sell. Shaffer (1991), Moner-Colonques (2006) and Inderst and Shaffer (2007) consider that shelf space is scarce and therefore retailers can not sell all the available goods.

In all those papers the restriction on capacity affects the number of goods the retailer can sell. Instead in our case, capacity will put a limit on the units of the goods the retailer can sell. The following citation explains the difference between the two approaches. "We have in mind a situation in which each good requires a minimum amount of shelf space (at least one shelf facing) for display to consumers. In that case, it is the width of the shelf space that matters, and not the depth, as units of the same good can be stacked one behind the other". (O’Brien and Shaffer (1997) p. 774). So far papers have put the emphasis on the width of the shelf space, whereas in our case is the depth of the shelf space that matters.

Each retailer will not be able to sell more than \( \frac{X}{n} \) units of all goods, where \( X \) is the industry selling capacity and \( n \) the number of retailers. We perform the following comparative statics analysis. We keep constant the industry selling capacity and we allow the number of symmetric retailers to vary. This allows us to assess the validity of the countervailing power theory, because the lower the number of retailers the bigger their size, measured by their selling capacity. We obtain that the lower the number of retailers, the lower the wholesale prices, as the countervailing power theory would suggest, except when we have competition upstream and industry capacity is low.

In the second part of the paper we contribute to the debate on the effect of downstream mergers over buyer power. Many different reasons have been provided by the literature to explain why size obtained through merger can allow retailers to obtain better deals from suppliers. For example, Katz (1987) and Inderst and Wey (2011) suppose that buyers, by investing a fixed cost, can integrate backwards to produce the good sold by suppliers. This possibility is
more profitable and therefore it allows the buyer to obtain better deals from suppliers, the larger the size of the buyer, because then it can spread this fixed cost over a larger production. Chipty and Snyder (1999) study the case where one supplier sells an homogeneous good to \( n \) retailers that are monopolists in their local markets. Then the merger of retailers does not change the quantities sold in each local market but it affects the marginal contribution of each retailer to industry profits. This contribution increases more than proportionally with the quantity traded when the unit cost of the supplier is increasing. Then the merger of retailers is profitable. In Snyder (1996) greater size can allow retailers to break collusion among suppliers.

Keeping constant the industry selling capacity, we compare the situation with one retailer with the case with \( n \) symmetric retailers. With monopoly upstream we obtain that the merger is always profitable. With competition upstream, 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.

For low capacity levels, we obtain an interesting relationship between market structure upstream and market structure downstream. The upstream merger makes profitable the downstream merger. This is consistent with the empirical evidence provided by Kastrinaki and Stoneman (2011) when they state that "[w]e thus have evidence for all the studied countries, except the Netherlands, that merger activity in manufacturing has led to merger activity in retailing" p. 476.

In the next Section, we set the model and study the relationship between the size of retailers and wholesale prices. In Section 3, we study the profitability of a merger to monopoly and relate it to the market structure upstream. In the last Section 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. Inverse 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 symmetric retailers. Retailers transform one unit bought to the upstream firm into one unit sold to final consumers. 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 \( \frac{X}{n} \). In particular, if \( x_i^j \) denotes the quantity that the retailer \( j \) sells of good \( i \), we must have that \( x_1^j + x_2^j \leq \frac{X}{n} \). For
both upstream and downstream firms, all other costs are constant (with loss of
generality) and normalized to zero (with no loss of generality).

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 \(x_1^j + x_2^j \leq \frac{X}{n}\). As a matter of comparison, we will also consider the case where producer 1 and 2 have merged (upstream monopoly).

### 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 \(j\) is:

\[
\max_{x^j_i} \left( a - x^j_i - \sum_{k \neq j} x^k_i - w_1 \right) x^j_i + (a - \left( \frac{X}{n} - x^j_i \right) - \sum_{k \neq j} \left( \frac{X}{n} - x^k_i \right) - w_2 \left( \frac{X}{n} - x^j_i \right)
\]

s.t. \(0 \leq x^j_i \leq \frac{X}{n}\)

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

\(x^j_1 = \frac{-w_1 + w_2 + X \left( \frac{n+1}{n} \right)}{2(n+1)}\) and \(x^j_2 = \frac{-w_2 + w_1 + X \left( \frac{n+1}{n} \right)}{2(n+1)}\) if \(-w_1 + w_2 + X \left( \frac{n+1}{n} \right) > 0\) and \(-w_2 + w_1 + X \left( \frac{n+1}{n} \right) > 0\) (Region 2i).

\(x^j_1 = \frac{X}{n}\) and \(x^j_2 = 0\) if \(-w_1 + w_2 + X \left( \frac{n+1}{n} \right) \leq 0\) (Region 2ii)

\(x^j_1 = 0\) and \(x^j_2 = \frac{X}{n}\) if \(-w_1 + w_2 + X \left( \frac{n+1}{n} \right) \leq 0\) (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 \(x^j_i = \frac{a}{2(n+1)}\). 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. Then, wholesale
prices do not depend on the number of retailers. Profits of the upstream firms are given by \( \frac{a^2 n}{2(n+1)} \). They are increasing in \( n \).

Next, we solve the model for the case \( X < \frac{an}{(n+1)} \). First we consider the case where producer 1 and 2 have merged (upstream monopoly) and then the case where producer 1 and 2 are independent firms (upstream competition).

### 2.2.1 Upstream monopoly

It is very easy to derive the optimal wholesale prices (for a formal proof see Appendix 1). The merged firm will set the same wholesale price \( w^* \) for each good that satisfies that it is the highest wholesale price such that retailers sell up to capacity.

\[
2 \left( \frac{a - w^*}{n+1} \right) = \frac{X}{n} \\
\Rightarrow w^* = a - \frac{(n + 1)X}{2n} > \frac{a}{2}
\]

Proposition 1 summarizes:

\(^1\)In Figure 1 we have that \( \frac{X(n+1)}{n} < a \). Rearranging terms we have \( X < \frac{an}{(n+1)} \) that it is the condition we assume to hold in the discussion that follows.
Proposition 1  The equilibrium wholesale prices with monopoly upstream are given by 
\[ w_1^* = w_2^* = a - \frac{(n+1)X}{2n} \] if \( 0 < X < \frac{an}{n+1} \).

The main purpose of the paper is to check whether big retailers receive discounts from suppliers. Given that retailers are symmetric, their size decreases with the number of firms. Next proposition compares wholesale prices for different values of the number of retailers.

Proposition 2  With monopoly upstream, the wholesale prices with \( n_1 \) retailers are lower than the wholesale prices with \( n_2 \) retailers if \( n_1 < n_2 \).

Therefore the countervailing power theory holds: bigger retailers are charged lower wholesale prices.

2.2.2  Competition upstream

In order to obtain the equilibrium of the first stage, we proceed to obtain the best response function of producer 1 (the one of producer 2 is symmetric) i.e. the optimal wholesale price of supplier 1 \( w_1 \) given that supplier 2 chooses \( w_2 \). The actual shape of the best response of producer 1 is stated in Appendix 2. To understand it we are going to show how the profit of firm 1 changes as \( w_1 \) changes, taking as given \( w_2 \) and \( X \). Although in Figure 1 we have 4 different regions\(^2\), we focus on what happens in Region 2i and Region 1. As it can be checked in Figure 1, for low values of \( w_1 \) we are in Region 2i. Retailers would like to sell a large quantity of both goods, but they cannot because of the small capacity they have. For high values of \( w_1 \), we are in Region 1. Retailers want to sell a small amount of both goods and they are not capacity constrained.

The profit of firm 1 in Region 2i is given by 
\[ P_{1i}(w_1) = \left( -w_1 + w_2 + X \frac{(n+1)}{n} \right)n w_1. \]
It is strictly concave and it is maximized in 
\[ w_{1i} = \frac{nw_2 + (n+1)X}{2n}. \]

The profit of firm 1 in Region 1 is 
\[ P_i(w_1) = nw_1 \left( \frac{a - w_1}{n+1} \right). \]
It is strictly concave and it is maximized in 
\[ w_i^* = \frac{a}{2}. \]
The profit of firm 1 is continuous but it has a kink in 
\[ w_I = 2a - \frac{(n+1)}{n}X - w_2, \]
the wholesale price that separates Region 2i from Region 1. In this case the unconstrained sales coincide with the capacity retailers have.

There are two important differences between the profits in Region 2i and the profits in Region 1. The profits in Region 2i are increasing in the capacity \( X \)

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\(^2\)The equilibrium can not lie neither in Region 2ii nor in Region 2iii. In Region 2ii firm 2 obtains zero profits because it sells nothing. It can increase its profits by lowering \( w_2 \) such that wholesale prices lie in Region 2i, where firm 2 makes positive sales. A symmetric argument holds for Region 2iii.
and increasing on the wholesale price set by supplier 2 $w_2$, whereas in Region 1 profits do not depend neither in $X$ nor in $w_2$. The reason for this difference is that in Region 2i, retailers are capacity constrained (i.e. they would like to sell a quantity of both goods higher than their capacity), whereas in Region 1 they are not. Then, in Region 2i, the sales of firm 1 increase when capacity increases. This fact is crucial to explain one of the main results of the paper namely that wholesale prices may increase with the level of capacity. Furthermore, in Region 2i when $w_2$ increases the sales of firm 1 increase. In Region 2i, retailers would like to sell more of both good 1 and good 2 but they cannot, because they are capacity constrained. Then if $w_2$ increases, they decide to sell less of good 2 and more of good 1. The fact that demands are interdependent (in Region 2i goods behave as if they were gross substitutes) is at first sight surprising because goods are independent, but this is explained by the fact that retailers are capacity constrained.

With these preliminaries, we are able to understand the derivation of the best response of firm 1 in the first stage, whose full expression is stated in Appendix 2. If $w_2$ is low we have $w^*_1 \leq \bar{w}_1$. This is the case because $w^*_1$ increases with $w_2$ and $\bar{w}_1$ decreases with $w_2$. Then the optimal choice is $w^*_1$, because then we have $w^*_1 < \bar{w}_1$, meaning that for $w_1 > \bar{w}_1$, profits are decreasing in $w_1$. If $w_2$ is high, we have $w^*_1 > \bar{w}_1$ and the optimal choice is $\max\{\bar{w}_1, w^*_1\}$ i.e. it is located in the frontier between Region 2i and Region 1 or in the interior of Region 1. This reasoning explains the actual shape of the best response of producer 1 and explains that it is divided in different parts. Given $X$, this best response function crosses the 45 degree line only once. This crossing point determines the equilibrium in wholesale prices that is stated in proposition 3.

**Proposition 3** The equilibrium wholesale prices with competition upstream are given by $w^*_1 = w^*_2 = \frac{(n+1)X}{n}$ if $0 \leq X < \frac{2an}{3(n+1)}$ and $w^*_1 = w^*_2 = a - \frac{(n+1)X}{2n}$ if $\frac{2an}{3(n+1)} \leq X < \frac{an}{n+1}$.

In Region 2i, retailers are capacity constrained. They would like to sell more than the capacity they have. This implies that their sales increase with capacity. Then suppliers adjust their optimal wholesale prices upwards when industry capacity increases. This explains the first part of Proposition 3 where wholesale prices increase with $X$. On the contrary, when capacity is large, wholesale prices decrease with $X$. In this case, we are in the frontier between Region 1 and Region 2i where the unconstrained sales coincide with the capacity retailers have. Then, when capacity increases, wholesale prices should decrease to keep the equality between the unconstrained sales and capacity constant. This explains the second part of Proposition 3.

Wholesale prices are the same with competition as with monopoly upstream if selling capacity is high. Competition upstream has an effect only when selling capacity is significantly scarce i.e. $X < \frac{2an}{3(n+1)}$. In this case, wholesale
prices are higher with monopoly upstream than with competition upstream. Therefore, competition upstream (weakly) reduces wholesale prices. This result corresponds to the one obtained in Horn and Wolinsky (1988) and Iozzi and Valetti (2014).

Let \( \omega[\varphi] \) be the equilibrium wholesale price as a function of the level of capacity. It is a linear piecewise function with two kinks: one where \( \varphi_1 = \frac{2\alpha}{3(n+1)} \) and the second one where \( \varphi_2 = \frac{\alpha}{n+1} \). We have that \( X_1 < X_2 \). \( \omega[X] \) is linear and increasing from \( X = 0 \) to \( X = X_1 \). Then we have \( \omega[X_1] = \frac{2a}{3} \). It is continuous but decreasing and linear from \( X_1 \) to \( X_2 \). We have that \( \omega[X_2] = \frac{a}{2} \).

For \( X > X_2 \) we are in the unconstrained case and \( \omega[X] = \frac{a}{2} \). We have that both \( X_1 \) and \( X_2 \) are increasing in \( n \). Figure 2 plots the equilibrium wholesale prices as a function of capacity (X) for the case \( n = 3 \) and \( n = 15 \) (bold line), setting \( a = 1 \).

We want to study how the number of retailers (i.e. their size) affect the equilibrium wholesale prices. Suppose that \( n_1 < n_2 \). We want to know when

\[
\text{wholesale price}
\]

\[
\begin{align*}
\text{Figure 2: Equilibrium wholesale price.}
\end{align*}
\]
the wholesale prices will be higher either when the number of retailers is \( n_1 \)
or when the number of retailers is \( n_2 \). The countervailing power theory wouldsuggest that wholesale prices should be higher with \( n_2 \) because then retailersare smaller. We are going to see that this is not always the case. Functions

\[
a - \frac{(n_1 + 1)X}{2n_1} \quad \text{and} \quad \frac{(n_2 + 1)X}{2n_2}
\]
cross in \( \tilde{X} = \frac{2an_1n_2}{2n_1 + n_2 + 3n_1n_2} \). We have that

\[
\frac{2an_1}{3(n_1 + 1)} < \tilde{X} < \frac{an_1}{n_1 + 1}.
\]

This implies that the wholesale price is higher with \( n_1 \) than with \( n_2 \) if \( 0 < X < \tilde{X} \) and lower if \( \tilde{X} < X < \frac{an_2}{n_2 + 1} \). In Figure 2,we can check that the wholesale price for \( n = 15 \) is lower than the wholesaleprice for \( n = 3 \) for low capacities and higher for high capacities. Proposition 4summarizes:

**Proposition 4** With competition upstream and \( n_1 < n_2 \), wholesale prices with\( n_1 \) retailers are higher than the wholesale prices with \( n_2 \) retailers if \( 0 < X < \tilde{X} \)

where \( \tilde{X} = \frac{2an_1n_2}{2n_1 + n_2 + 3n_1n_2} \). Wholesale prices with \( n_1 \) retailers are lower thanthe wholesale prices with \( n_2 \) retailers if \( \tilde{X} < X < \frac{an_2}{n_2 + 1} \).

Then countervailing power theory does not hold when capacity is low. Itwould be interesting to find an intuition for this result. When capacity is scarce,the equilibrium lies in the interior of Region 2i. The demand of retailers of good\( i \) in Region 2i is given by:

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

The elasticity of demand with respect to \( w_i \) is given by:

\[
\varepsilon_i = \left. \frac{\partial X_i}{\partial w_i} \right|_{w_i = \frac{nw_i}{X + n(-w_i + w_j + X)}} = \frac{nw_i}{X + n(-w_i + w_j + X)}
\]

The previous expression is increasing in \( n \). This means that the higher \( n \),the more elastic the demand, and therefore the more profitable is to undercutther rival producer. This explains that the equilibrium wholesale price decreaseswith \( n \).

To understand this counterintuitive result, that occurs in Region 2i, we aregoing to analyze two extreme cases. We are going to compare how a monopolistretailer (\( n = 1 \)) and a competitive retailer (\( n = \infty \)) adjust their sales whenupstream firm \( i \) decreases its wholesale price. The starting point is such thatboth producers set the same wholesale prices and therefore in both cases retailerssell of each good half of their capacity. Think that now upstream \( i \) reduces itswholesale price. In the case of a competitive retailer the equilibrium conditionimplies that price margins should be equalized across markets. If \( x_i^C \) are the
sales of good $i$ and $x_j^C$ the sales of good $j$ of the competitive retailer after $w_i$ has decreased, we have:

$$a - x_j^C - w_i = a - x_j^C - w_j$$

As we are in Region 2i the retailer sells up to capacity and therefore $x_j^C = X - x_i^C$. Then we have:

$$a - x_i^C - w_i = a - (X - x_i^C) - w_j$$

Solving for $x_i^C$ we obtain

$$x_i^C = \frac{w_j - w_i + X}{2}$$

A monopolist retailer instead, 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 monopolist retailer of good $i$ we have:

$$a - x_i^M - w_i > a - (X - x_i^M) - w_j$$

$$x_i^M < \frac{w_j - w_i + X}{2}$$

This implies that the increase in the sales of good $i$ will be higher with the competitive retailer than with the monopolist retailer because:

$$\frac{X}{2} < x_i^M < x_i^C.$$

Then producer $i$ will be more interested in cutting the wholesale price $w_i$ when she faces a competitive retailer than when she faces a monopolist retailer. Therefore, wholesale prices will be lower in the former case. The two extreme cases we have analyzed illustrate the general result that in Region 2i increasing competition downstream reduces wholesale prices, because it increases the incentives of suppliers to reduce their wholesale prices.

### 3 Downstream mergers

The industry downstream profits as a function of $X$ are given by:\textsuperscript{3}

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

\textsuperscript{3}In Appendix 3, we present the industry downstream profits as a function of $n$. 

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Figure 3: Downstream profits.
The typical shape of the industry profits downstream is presented in Figure 3.

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 collectively 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 \( \Pi^D(1) > \Pi^D(n) \). Inspecting \( \Pi^D(n) \) we can check that it increases in \( n \) for low capacities and it decreases in \( n \) for intermediate and high capacities. Then we have that \( \Pi^D(1) = \Pi^D(n) \) if \( X = \frac{an}{2n+1} \). Then the merger will not be profitable if capacity is low \( X \leq \frac{an}{2n+1} \) and profitable if capacity is high \( X > \frac{an}{2n+1} \).

Proposition 5 With competition upstream, the merger to monopoly of downstream firms is not profitable if \( 0 < X \leq \frac{an}{2n+1} \) and profitable otherwise.

It is very easy to find the counterpart of proposition 5 for the case where producers have merged. Given the wholesale prices identified in Proposition 1 we can write down the downstream industry profits for this case:

\[
\Pi^M(n) = \begin{cases} 
\frac{X^2}{2n} & \text{if } X \leq \frac{an}{n+1} \\
\frac{a^2n}{2(n+1)^2} & \text{otherwise}
\end{cases}
\]

In this case, downstream industry profits are always decreasing in \( n \). Therefore, \( \Pi^D(1) > \Pi^D(n) \) holds for any level of capacity. Next proposition summarizes.

Proposition 6 With monopoly upstream, the merger to monopoly of downstream firms is always profitable.

Putting together propositions 5 and 6, we obtain that the merger of the upstream firms may stimulate the merger of downstream firms. This is coherent

\[\text{Proposition 5} \quad \text{With competition upstream, the merger to monopoly of downstream firms is not profitable if } 0 < X \leq \frac{an}{2n+1} \text{ and profitable otherwise.}\]

\[\text{Proposition 6} \quad \text{With monopoly upstream, the merger to monopoly of downstream firms is always profitable.}\]

\[\text{Putting together propositions 5 and 6, we obtain that the merger of the upstream firms may stimulate the merger of downstream firms. This is coherent.}\]
with the empirical fact that parallel processes of consolidation in both upstream and downstream sectors are observed. (*"We thus have evidence for all the studied countries, except the Netherlands, that merger activity in manufacturing has led to merger activity in retailing" p. 476 (Kastrinaki and Stoneman (2011)).

4 Extensions

4.1 General supply contracts

The extension of the model to general supply contracts that put no restriction on the relationship between the quantity sold of good $i$ and a monetary payment is not straightforward. The analysis becomes very cumbersome with interlocking relationships even when restricting to two-part tariffs (Rey and Vergé (2010)). So the only possibility to include non-linear supply contracts in the model is to restrict attention to the case of a monopolist retailer ($n = 1$). But this situation has already been studied in Fauli-Oller (2017) where he adapts the results in Bernheim and Whinston (1998) to the situation of the present paper. Focussing on the equilibria Pareto undominated for the suppliers, the equilibrium payoff of the retailer as a function of $X$ can be calculated. Then, Fauli-Oller (2017) studies the endogenous capacity choice by the retailer assuming that there is no cost for building capacity. It turns out that the level of capacity that maximizes retailer’s profit is far below the level that would maximize total industry profits. If we considered the capacity choice game for $n = 1$, in the case of the present paper with linear supply contracts, the result would be that the retailer would not restrict capacity.

4.2 Existence of an alternative supply

So far we have measured the countervailing power of retailers by the number of symmetric retailers $n$. As $n$ decreases, retailers become bigger and their countervailing power increases. We have shown that, for low capacities, countervailing power increases wholesale prices. As explained in Caprice and Shekhar (2017), there are other ways of measuring countervailing power. For example, the possibility that retailers may buy the goods from an inefficient alternative supply. The more efficient this alternative supply the higher the bargaining power of retailers. We want to check, in our setting, how do wholesale prices evolve when we add this possibility. We will focus on the case of two retailers ($n = 2$) that can buy the goods from a competitive fringe whose cost is $c = \frac{a}{2}$. We choose this value for the cost because then the equilibrium without binding capacity constraints ($X \geq \frac{2a}{3}$) does not change: each supplier charges $w_i = \frac{a}{2}$ to the retailers.

Given the alternative competitive supply, firms will not charge wholesale prices higher than $\frac{a}{2}$, because they would lose all customers if they did. To obtain the equilibrium in the first stage, we derive the best response of firm 1 (the
one of firm 2 is symmetric; see Appendix 4) taking into account the restriction on wholesale prices imposed by the existence of the competitive supply namely that \( w_i \leq \frac{a}{2} \) \((i = 1, 2)\). This leads to the following result.

**Proposition 7** The equilibrium wholesale prices when retailers can buy the goods at price \( \frac{a}{2} \) from a competitive supply and \( n = 2 \) are given by \( w_1^* = w_2^* = \frac{3X}{2} \) if \( 0 \leq X \leq \frac{a}{3} \) and \( w_1^* = w_2^* = \frac{a}{2} \) otherwise.

Therefore the existence of an alternative supply for the goods reduces equilibrium wholesale prices when \( \frac{a}{3} < X < \frac{2a}{3} \). So in our model, the countervailing power obtained by the reduction in the costs of a competitive supply from \( \infty \) (the case analyzed so far in the paper) to \( \frac{a}{2} \) has the effect of (weakly) decreasing wholesale prices. So the countervailing power hypothesis holds in our model in this case.

## 5 Conclusion

We have considered two independent goods that are sold to consumers through retailers. Retailers can not sell more than \( X \) units of both goods. \( X \) is known as the industry selling capacity. We consider possible different market structures. As far as the upstream sector is concerned, we consider both the possibility that the two goods are produced by the same firm (upstream monopoly) and the possibility that they are produced by different firms (upstream competition). As far as the downstream sector is concerned, we consider the general case of \( n \) symmetric retailers i.e. all retailers have the same selling capacity \( \frac{X}{n} \).

The objective of this paper has been to test the effect of retailers size on the linear wholesale prices set by producers. The reference point is the countervailing power theory that implies a negative correlation between wholesale prices and retailers size. This is what we obtain in this paper except when we have competition upstream and the selling capacity is small. This also explains that the merger of all retailers is always profitable except when we have competition upstream and selling capacity is low, because then the merger increases wholesale prices.

It is important to check the validity of the countervailing power theory in order to be able to assess correctly the effect of increases in concentration in the downstream market on the overall industry. Our contribution has shed some light on this issue for the case where the selling capacity of retailers is low with respect to market demand. The type of capacity constraints first introduced in this paper may be used fruitfully in future papers to discuss related issues.
6 Appendix

6.1 Appendix 1

- The upstream monopolist will not choose the input prices in the interior of Region 2i. In this Region we have:

\[
\frac{a - w_1}{n + 1} + \frac{a - w_2}{n + 1} > \frac{X}{n}
\]

She can increase the profits by raising slightly the input prices: she sells the same but a higher price.

In Region 2ii, we have \( \frac{a - w_1}{n + 1} > \frac{X}{n} \), then again it can increase slightly input prices and increase profits, because it sells the same but at a higher price. The same argument applies to Region 2iii.

- The upstream monopolist will not choose input prices in the interior of Region 1. We have

\[
\frac{a - w_1}{n + 1} + \frac{a - w_2}{n + 1} < \frac{X}{n} < \frac{a}{n + 1}
\]

So the maximization program of the monopolist is

\[
M_{\max} \Pi = n w_1 \left( \frac{a - w_1}{n + 1} \right) + n w_2 \left( \frac{a - w_2}{n + 1} \right)
\]

Then, we have

\[
\frac{\partial \Pi}{\partial w_1} + \frac{\partial \Pi}{\partial w_2} = \left( \frac{2n}{n + 1} \right) (a - w_1 - w_2) < 0
\]

Given the restriction, the two FOCs cannot be satisfied. Therefore there are no input prices in Region 1 that maximize profits.

- So the optimal prices should be in the frontier between Region 2i and Region 1. Then we have:

\[
\frac{a - w_1}{n + 1} + \frac{a - w_2}{n + 1} = \frac{X}{n}
\]

\[
w_2(w_1) = 2a - w_1 - X \left( \frac{n + 1}{n} \right)
\]

Profits can be written as a function of \( w_1 \) only:

\[
\Pi = n w_1 \left( \frac{a - w_1}{n + 1} \right) + n w_2(w_1) \left( \frac{a - w_2(w_1)}{n + 1} \right)
\]

It is maximized in \( w_1 = a - \frac{(n + 1)X}{2n} \) and \( w_2(a - \frac{(n + 1)X}{2}) = a - \frac{(n + 1)X}{2n} \). Those are the optimal wholesale prices.
6.2 Appendix 2

The best response of supplier 1 is given by.

If \( 0 < X \leq \frac{an}{3(n+1)} \)

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

If \( \frac{an}{3(n+1)} \leq X \leq \frac{an}{2(n+1)} \)

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

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 3. The equilibrium is symmetric and it will be in Region 2i or in the frontier between Region 2i and Region 1. The portion of the reaction function in Region 2i is: \( \frac{n w_2 + (n+1)X}{2n} \) and the one that lies in the frontier of Region 2i and Region 1 is: \( 2a - \frac{(n+1)X}{n} - w_2 \). The former expression crosses the 45 degree line in \( \frac{(n+1)X}{n} \) and the latter expression crosses the 45 degree line in \( a - \frac{(n+1)X}{2n} \). It will be the equilibrium the one that first crosses the 45 degree line. The equilibrium will be \( \frac{(n+1)X}{n} \) if \( \frac{(n+1)X}{n} < a - \frac{(n+1)X}{2n} \) (This holds if \( X < \frac{2an}{3(n+1)} \)) and \( a - \frac{(n+1)X}{2n} \) otherwise.
6.3 Appendix 3

We write down industry downstream profits as a function of n:

If $X \leq \frac{a}{3}$

$$\Pi^D(n) = X(a - \frac{3X}{2} - \frac{X}{n})$$

if $n \geq 1$.

If $\frac{a}{3} < X < \frac{a}{2}$

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

If $\frac{a}{2} \leq X < \frac{2a}{3}$

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

If $\frac{2a}{3} \leq X < a$

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

Next we study the profitability of the merger to monopoly. If $X \leq \frac{a}{3}$, profits are increasing in n. Therefore the merger to monopoly is not profitable. If $\frac{2a}{3} \leq X < a$, profits are decreasing in n and therefore the merger to monopoly is profitable. If $\frac{a}{3} < X < \frac{a}{2}$, the merger will not be profitable if $X^2 - X \leq X(a - \frac{3X}{2} - \frac{X}{n})$. This holds if $n \geq \frac{X}{a-2X}$. If $\frac{a}{2} \leq X < \frac{2a}{3}$, the merger is profitable, because $\frac{a^2}{8} > X(a - \frac{3X}{2} - \frac{X}{n})$ for any n. Summarizing the merger to monopoly is not profitable either when $X \leq \frac{a}{3}$ or when $\frac{a}{3} < X < \frac{a}{2}$ and $n \geq \frac{X}{a-2X}$. It corresponds to the result in Proposition 5 where the result on profitability is expressed in terms of capacity $X$. 

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6.4 Appendix 4

The best response of firm 1 when there are two retailers and they can obtain the goods from an alternative supply at cost $\frac{a}{2}$ is given by:

If $0 < X \leq \frac{a}{3}$

$$B_1(w_2) = \begin{cases} 
2w_2 + 3X & \text{if } 0 \leq w_2 \leq \frac{9X}{2} \\
\frac{4}{w_2 - \frac{3X}{2}} & \text{if } \frac{9X}{2} < w_2 \leq \frac{a}{2} 
\end{cases}$$

If $\frac{a}{9} < X \leq \frac{a}{3}$

$$B_1(w_2) = \begin{cases} 
2w_2 + 3X & \text{if } 0 \leq w_2 \leq \frac{a}{2} 
\end{cases}$$

If $\frac{a}{3} < X < \frac{2a}{3}$

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

7 References


