Countervailing Power Hypothesis and Anti-Waterbed Effects

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Abstract

The common belief is that buyers' "countervailing power" is good for consumers since it lowers purchasing costs of retailers, and thus lowers retail prices. However, when retailers are asymmetric, lowering the purchasing price for a powerful retailer might lead to higher purchasing prices for weak retailers, so called "waterbed effects". This paper analyzes the validity of these antitrust concerns with a dominant retailer facing competitive fringe firms, where the fringe firms are offered a wholesale price by the supplier, whereas the dominant retailer negotiates its contract terms including a unit price and a fixed fee. When the dominant retailer's bargaining power is significant, we show that, the supplier allows the less efficient fringe firms to be active to increase its outside option and thereby to capture more rent from the dominant retailer, at the expense of lowering their bilateral profit. Moreover, the supplier offers a lower wholesale price to the fringe if the dominant retailer's bargaining power increases, that is, there are *anti-waterbed effects*. The equilibrium retail price might increase in the dominant firm's bargaining power. This would be the case if the fringe firms' supply is sufficiently concave, that is, if the fringe firms become less inefficient when they sell more.

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1 Introduction

Retail markets have been characterized by high concentration ratios,[1] economies of scale, the existence of few large or dominant retailers which possess significant buyer power vis-à-vis their suppliers and many small or weak retailers which do not have significant buyer power. The competition authorities in the US, in the UK and in Europe have conducted several detailed studies on the grocery market, focusing heavily on the welfare implications of retailers' buyer power.[2] There has been much recent work in this area.[3] One important research agenda is to understand the primitives of buyer power: where does it come from, why does size matter[4], what other factors affect buyer power, e.g., suppliers' production technology[5], retailers' gatekeeper position[6], etc. Another strand of the literature wants to know the effects of an increase in buyer power on consumers and on other (weak/small) retailers while taking buyer power as given (Chen, 2003) or relating it to size (Majumdar, 2006; Inderst and Valletti, 2011; Inderst and Wey, 2003, 2007; Inderst, 2007).[7] The latter literature is particularly important for policy makers who must balance the interests of these disparate groups when they make their decisions (e.g., whether to allow a particular merger).[8]

Our paper falls within this latter strand of the literature analyzing how buyer power affects consumers and rival retailers. The common belief is that the exercise of buyers' "countervailing power" is good for consumers since it lowers purchasing costs of retailers, and thus lowers retail prices.[9] The intuition that buyer power is good appears to rely on an implicit assumption of linear supply contracts. In case of a bilateral monopoly with linear supply contracts, buyer power is good

[1] The concentration ratio of the five largest retailers (C5) in the 15 member countries of the EU is on average 50% (IGD European Grocery Retailing, 2005). The UK's top 4 grocery retailers account for 75% of total retail sales (the Competition Commission, 2008). In the US, C4 is 31% (The US Census Bureau, Retail Trade, 2002).

[2] See the Federal Trade Commission reports (2001, 2003) in the US, the Competition Commission reports (2000, 2008) in the UK, and the European Commission (EC) report (1999).

[3] See Inderst and Mazzarotto (2008) for an overview of the major developments in the recent work on buyer power.

[4] Katz (1987), Sheffman and Spiller (1992), Snyder (1996).

[5] Chipty and Snyder (1999), Inderst and Wey (2003).

[6] Mazzarotto (2003).

[7] Another wave of literature focuses on the long-term implications of buyer power and analyzes how the exercise of buyer power changes the suppliers' incentives to invest in quality (Batigalli, Fumagalli and Polo, 2007), in variety (Chen, 2004; Inderst and Shaffer, 2007) or in innovation (Inderst and Wey, 2009). Alternatively, Inderst and Valetti (2009) show how the ban of discriminatory pricing in the intermediate market may reduce downstream firms' incentives to invest in cost reduction.

[8] Buyer power considerations have played an important role in the EC's decisions for merger cases Kesko/Tuko (1997), Rewe/Meinl (1999) and Carrefour/Promodes (2000). See also Inderst and Shaffer (2008) for a more general discussion on buyer power as a merger defence.

[9] This goes back to Galbraith's (1952) argument that countervailing power of retailers might be good for the society.

because it mitigates double marginalization by reducing the supplier's margin. In case of symmetric downstream oligopoly with linear contracts, buyer power is good because firms negotiate lower wholesale prices, some of which then get passed to consumers. When there is bilateral monopoly with two-part tariff contracts, buyer power affects fixed fees only, so it has no effect on consumers.[10] If we consider symmetric downstream oligopoly with non-linear supply contracts, it is not clear why downstream firms would want to use their bargaining power to obtain wholesale price concessions when they know these concessions will at least be partially passed through to consumers.[11] It may be that they will use their bargaining power to reduce their fixed fees (possibly make them negative).

When contracts are non-linear, it appears as though,[12] buyer power has neutral effects or could even be harmful to consumers. And the situation is even more complex if downstream firms are asymmetric—because then one has to worry about possible adverse effects on other (weak/small) downstream firms— e.g., may have "waterbed effect", where lower purchasing costs for powerful retailers might be at the expense of higher costs for other retailers.[13] Buyer power may not be so good after all.

This paper analyzes the implications of buyer power in the context of asymmetric downstream firms: a dominant retailer facing competitive fringe firms, where the fringe firms have no buyer power and so could buy the good of a supplier at a wholesale price determined by the supplier, whereas the dominant retailer negotiates its contract terms, including a unit price and a fixed fee, with the supplier. We model the dominant retailer's buyer power as its ability to capture a larger share of the gains from trade with the supplier. To capture the industry fact that dominant retailers are mostly large retail chains which have substantial efficiency advantages compared to small/weak stores, we assume that the fringe firms are less efficient than the dominant retailer.[14]

[10] See Stigler (1954).

[11] See Bedre-Defolie and Caprice (2011)

[12] Empirical studies find evidence that manufacturers and retailers use non-linear supply contracts in the markets for bottled water in France (Bonnet and Dubois, 2010) and for yoghurt in the US (Villas-Boas, 2007). The supplier survey conducted by the GfK Group (2007), on the behalf of the Competition Commission, supports the use of complex non-linear supply contracts in the UK grocery market.

[13] The EC recognizes the possibility of waterbed effects in its Guidelines on horizontal agreements: "the supplier would try to recover price reductions for one group of customers by increasing prices for other customers ..." (2001, par. 126). However, the Competition Commission's report (2008) states that there is no strong evidence of "waterbed effect to be operating in UK grocery retailing".

[14] In Section 5, we also illustrate that the case where the fringe firms were more efficient than the dominant retailer is not interesting, since then the supplier would prefer to sell only to the more efficient fringe firms.

When the dominant retailer has very low bargaining power, we find that the supplier prefers to block the activity of the inefficient fringe firms to maximize its bilateral profit with the dominant retailer. The resulting retail price would be the one maximizing the industry profit and the dominant firm's wholesale price is sat at zero. In this case, the prices are independent of the dominant firm's buyer power.

When the dominant retailer has significant buyer power vis-à-vis the supplier, we show that the supplier prefers to sell to the less efficient fringe firms to increase its disagreement payoff and thereby to capture more rent from the dominant retailer at the expense of decreasing its bilateral profit with the dominant retailer. In this case, if the dominant retailer's bargaining power increases, the supplier puts more weight on its disagreement payoff, and therefore reduces its wholesale price to the less efficient fringe firms, that is, there are *anti-waterbed effects*.

We find that the effects of the dominant retailer's buyer power on its wholesale price and on the retail price are not straightforward. On one hand, buyer power leads to more intense downstream competition by allowing more fringe firms to be active, on the other hand it reduces the productive efficiency since the fringe firms are less efficient than the dominant retailer. The resulting effects depend on the concavity of the fringe firms' supply.

If the fringe firms' supply is sufficiently concave, we find that the dominant retailer's wholesale price and the retail price increase in the dominant retailer's bargaining power. Intuitively, in this case, a decrease in the fringe firms' wholesale price increases the fringe firms' supply. If their supply is sufficiently concave, fringe firms become less and less inefficient, since they sell more. This in turn induces the supplier and the dominant retailer to raise their wholesale price, and so to implement a higher retail price allowing the fringe firms to supply more. When the dominant retailer's buyer power increases, the fringe firms' wholesale price decrease, this therefore increases the dominant retailer's wholesale price and the retail price. As a result, the consumer welfare decreases due to the buyer power. Symmetrically, when the fringe firms' supply is weakly convex, we find the opposite results: the dominant retailer's buyer power decreases its wholesale price and the retail price, and so increases the consumer welfare.

Regarding the equilibrium profits, we show that the dominant retailer's profit decreases in its bargaining power if it has already very high bargaining power, because, in this case, having a larger share of the trade gains is not sufficient to compensate the losses due to the reduced wholesale price of the fringe (increasing the supply of the fringe firms). The supplier's profit decreases and the fringe firms' profits increase in the dominant retailer's bargaining power.

Few papers have looked at buyer power in the context of asymmetric downstream firms and of those that do, contracts are typically assumed to be linear.[15] Chen (2003) is an exception. Chen looks at the case of a dominant retailer and competitive fringe, where the fringe firms are offered take-it-or-leave-it two-part tariff contracts whereas the dominant retailer can negotiate its contract terms. He finds in his model that an increase in bargaining power has no effect on the dominant firm's wholesale price but nevertheless results in a lower retail price because, in equilibrium, the upstream firm reacts to the increase in bargaining power of the dominant retailer by lowering its wholesale price to the fringe. Consumers are better off and the playing field becomes more level. Buyer power is good.

Our results differ from Chen's in several aspects. First, we show that the dominant retailer's buyer power could be bad for consumers, even though it decreases the wholesale price to the weak retailers. Second, the mechanism behind our results is different from Chen. In our setup, in reaction to an increase in the dominant retailer's buyer power, the supplier reduces the fringe's wholesale price to increase its disagreement payoff (out-of-equilibrium profit) at the expense of reducing its bilateral profit with the dominant retailer (on-equilibrium profit). However, Chen finds that when the dominant retailer has higher bargaining power, the supplier prefers to sell more to the fringe firms in equilibrium. Finally, we show that the dominant retailer's wholesale price is affected by its buyer power through the wholesale price received by the fringe and this could lead in some environments to a higher retail price for consumers. The main reason behind these differences is that in modeling the bargaining between the upstream firm and dominant retailer, we account for the surplus (the wholesale price of the fringe times the quantity sold by the fringe) that the upstream firm receives from the fringe firms.

The rest of the paper is organized as follows. Section 2 presents our framework. In Section 3, we conduct the equilibrium analysis. Section 4 presents the comparative statics of the equilibrium prices and profits with respect to the dominant retailer's bargaining power. In Section 5 we discuss the possible effects of relaxing some of our assumptions. We conclude in Section 6. The technical

[15] Considering linear supply contracts, Majumdar (2006), Inderst (2007), Inderst and Valetti (2011) show that waterbed effects exist in the sense that a larger retailer pays a lower wholesale price at the expense of smaller retailers paying higher wholesale prices.

proofs are presented in the Appendix.

2 The model

There is one supplier selling its product to $n+1$ retailers, which in turn resell the product to consumers. The supplier has a constant marginal cost of production, which is normalized to zero. Retailers face a decreasing demand function, denoted by $D(p)$ with $D'(p) < 0$. Retailers are assumed to be asymmetric in the sense that there is one dominant retailer and n competitive fringe firms. The dominant retailer sets the market price, p,[16] and the fringe firms decide whether to be active in the retail market at the given price. If the dominant retailer is not active in the market, the retail price is determined by the competitive market equilibrium where the fringe supply is equal to the market demand.

The dominant firm incurs a constant marginal cost of retailing, denoted by c. Each fringe firm has a rising marginal cost, denoted by $MC(q_f)$ with $MC'(q_f) > 0$.

We assume that the dominant retailer negotiates its supply contract, which includes a fixed fee and a wholesale price, (F_d, w_d), with the manufacturer. However, the fringe retailers do not have bargaining power to negotiate their supply contracts, instead the supplier makes a take-it-or-leave-it wholesale price offer, w_f, to the fringe firms. We interpret w_f as the list price of the supplier, and so assume that it is known by all retailers.[17]

In the negotiation between the supplier and the dominant retailer, we assume the Nash bargaining solution so that the parties share their gains from trade[18] according to sharing rule γ, where $\gamma \in [0,1]$ denotes the dominant retailer's share, and so measures the dominant retailer's exogenous bargaining power vis-à-vis the supplier. If $\gamma = 0$, the dominant retailer has no bargaining power, and if $\gamma = 1$, the dominant retailer has all bargaining power. When γ increases, this means that the dominant retailer gets more powerful in bargaining.

The timing of the interactions is the following:

[16] For the sake of simplicity, we assume that the dominant retailer has all market power, so could determine the market price. Our qualitative arguments would go through if we considered oligopolistic dominant retailers facing competitive fringe.

[17] In Section 5, we discuss why our qualitative results would be robust if we allowed the dominant retailer to purchase at the list price in case of a disagreement with the supplier.

[18] The gains from trade are defined as the difference between the parties' bilateral profit if they trade and their bilateral profit if they have no agreement, in which case the parties receive their disagreement payoffs.

1. The supplier offers a wholesale price, w_f, to the fringe firms..
2. The supplier negotiates a two-part tariff contract, (F_d, w_d), with the dominant retailer.
3. The dominant retailer sets the market price, p, and then fringe firms decide whether to be active in the downstream market.

Each fringe firm sells until the point where the retail price is equal to the sum of its marginal cost and the wholesale price: $p = MC(q_f) + w_f$. The supply of a fringe firm is defined as

$$s(p - w_f) \equiv q_f = MC^{-1}(p - w_f). \tag{1}$$

The total supply by the fringe is thus equal to $ns(p - w_f)$. If the dominant retailer has a contract with the supplier, it supplies the rest of the market demand: $D(p) - ns(p - w_f)$. Otherwise, the fringe supplies all the market demand, in which case the retail price, denoted by $p^o(w_f)$, is given by the competitive market equilibrium:

$$D(p^o) = ns(p^o - w_f). \tag{2}$$

To ensure the second-order condition of the dominant retailer's problem in every sub-game, we assume that

Assumption 1. The market demand and the demand for the dominant retailer are log-concave: $\log(D(p))$ and $\log\left(D(p) - ns(p - w_f)\right)$ are concave.

We moreover assume that the market demand and the fringe supply satisfy the necessary and sufficient condition for the convexity of the supplier's and the dominant retailer's optimization problem in negotiation:

Assumption 2. $2D'(p) + (p - c)D''(p) - n\left[2s'(p - w_f) + (p - w_f - c)s''(p - w_f)\right] < 0.$

The aim is to analyze the role of the dominant retailer's bargaining power on the equilibrium outcome of the above setup. To capture the industry fact that dominant retailers are mostly large retail chains which have substantial efficiency advantages compared to small/weak stores, we assume that the fringe firms are less efficient than the dominant retailer.

Assumption 3. The dominant firm is more efficient than the competitive fringe firms: $MC(0) = c$.

This assumption also allows us to focus on the interesting case where the dominant retailer's bargaining power might play an important role on the equilibrium outcome.[19] As a first benchmark, we define the price maximizing the industry profit, p^m, if the fringe firms are not active and the dominant firm is the monopoly retailer:

$$p^m = \arg\max_p (p - c)\, D(p), \tag{3}$$

The monopoly price is characterized by the first-order condition:[20]

$$D(p^m) + (p^m - c)D'(p^m) = 0. \tag{4}$$

Another benchmark is the case where the dominant retailer has no contract and the fringe firms supply all the market. In this case, we define the wholesale price maximizing the supplier's profit as[21]

$$w_f^o = \arg\max w_f n s(p^o(w_f) - w_f). \tag{5}$$

3 Equilibrium analysis

First, we compare the prices of the two benchmarks, p^m and $p^o(w_f^o)$, and show that

Lemma 1 *The wholesale price maximizing the supplier's profit from the fringe induces a retail price which is above the monopoly price without the fringe firms:* $p^o(w_f^o) > p^m$.

Figure 1 illustrates the benchmark prices and corresponding quantities. Intuitively, if the fringe firms supply all the market demand, the equilibrium price is equal to the total unit cost of a fringe firm. The supplier would then set the fringe's wholesale price at w_f^o to maximize its profit. This

[19] If the fringe firms were more efficient than the dominant retailer, the supplier would prefer to sell only to the fringe firms, and so, in this case, the dominant firm's bargaining power does not have any impact on the equilibrium outcome. For the proof of this claim see Section 5.

[20] Log-concavity of $D(p)$ (Assumption 1) ensures the second-order condition.

[21] To ensure the second-order condition of this problem, we assume that the fringe's supply $s(.)$ is not too convex, that is,

$$-2s'(p^o - w_f)\left(1 - \frac{\partial p^o}{\partial w_f}\right) + w_f s''(p^o - w_f)\left(1 - \frac{\partial p^o}{\partial w_f}\right)^2 + w_f s'(p^o - w_f)\frac{\partial^2 p^o}{\partial w_f^2} < 0.$$

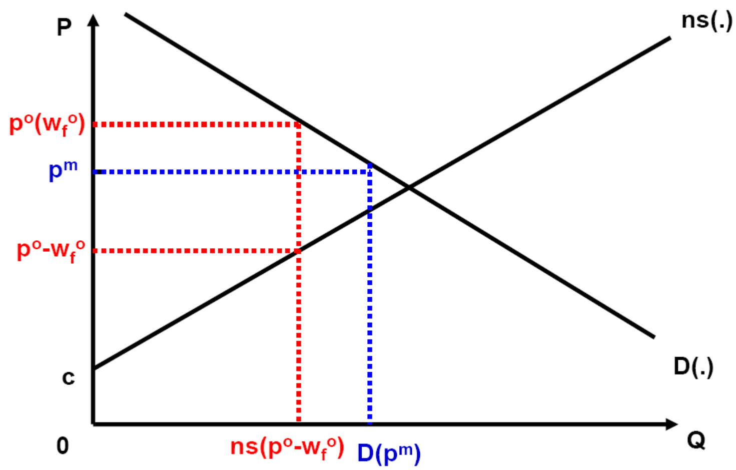

Figure 1: Benchmarks

would induce the retail price maximizing the industry profit where the cost would be equal to the marginal cost of a fringe firm, which is above c (since the fringe firms are less efficient than the dominant retailer). Hence, the resulting retail price would be above the monopoly price when the dominant retailer is the only retailer. Since the monopoly profit with a more efficient retailer (the dominant retailer) must be higher than the one with a less efficient retailer, we obtain the following corollary:

Corollary 1 *When the dominant retailer has no bargaining power vis-à-vis the supplier, that is, when $\gamma = 0$, the supplier earns more under the monopoly of the dominant retailer than the case where only the fringe firms are active, that is,*

$$(p^m - c)\, D(p^m) > w_f^o ns(p^o(w_f^o) - w_f^o).$$

We now look for a Sub-game Perfect Nash Equilibrium of the sequential game by backward induction. At the end, we analyze how the bargaining power of the dominant retailer influences the equilibrium outcome; the retail prices, the wholesale prices and the firms' profits.

3.1 Retail price equilibrium

We analyze first the equilibrium behavior of the dominant retailer at the last stage of the game where it sets a retail price to maximize its profit. In this problem, the dominant retailer has two options:

1. **Limit pricing:** Setting p sufficiently low to limit the activity of the fringe firms: $p \leq c + w_f$.

2. **No limit pricing:** Setting p sufficiently high to accommodate some supply by the fringe firms: $p > c + w_f$.

In the first option, the dominant retailer would be the monopoly retailer earning:

$$\pi_d^L(p) = (p - c - w_d)\, D(p), \tag{6}$$

and would maximize its profit subject to the limit pricing constraint, that is,

$$\max_p \pi_d^L(p) \qquad st. \qquad p \leq c + w_f.$$

The unconstrained optimal price of limit pricing, denoted by p^{L*}, is characterized by the first-order condition:[22]

$$D(p^{L*}) + (p^{L*} - w_d - c) D'(p^{L*}) = 0, \tag{7}$$

and so is a function of the dominant retailer's wholesale price, w_d. If $p^{L*}(w_d)$ satisfies the limit pricing constraint, it would be the candidate equilibrium price of limit pricing. Otherwise, the dominant retailer would set the price equal to $c + w_f$. To sum up, the candidate equilibrium price of limit pricing would be

$$p^L(w_d, w_f) = \begin{Bmatrix} p^{L*}(w_d) \text{ if } p^{L*}(w_d) \leq c + w_f, \\ c + w_f \qquad\qquad \text{otherwise.} \end{Bmatrix}. \tag{8}$$

In the second option, that is, allowing some supply by the fringe firms, the dominant retailer would earn

$$\pi_d^{noL}(p) = (p - c - w_d) \left[D(p) - ns(p - w_f) \right], \tag{9}$$

and set the price maximizing its profit subject to the participation constraint of the fringe, that is,

$$\max_p \pi_d^{noL}(p) \qquad st. \qquad p > c + w_f.$$

[22] The second-order condition is satisfied since the demand is log-concave (Assumption 1).

The unconstrained optimal price, denoted by p^*, is characterized by the first-order condition:[23]

$$D(p^*) - ns(p^* - w_f) + (p^* - w_d - c)\left[D'(p^*) - ns'(p^* - w_f)\right] = 0, \tag{10}$$

and so is a function of the wholesale prices w_d and w_f. If $p^*(w_d, w_f)$ satisfies the participation constraint of the fringe, it would be the candidate equilibrium price of no limit pricing. Otherwise, the dominant retailer would set the minimum price at which the fringe firms' supply would be slightly positive, that is, $c + w_f + \varepsilon$, where ε is a positive number very close to zero. Hence, the candidate equilibrium price of no limit pricing would be

$$p^{noL}(w_d, w_f) = \left\{ \begin{matrix} p^*(w_d, w_f) \text{ if } p^*(w_d, w_f) > c + w_f, \\ c + w_f + \varepsilon \qquad\qquad\qquad \text{otherwise.} \end{matrix} \right\}. \tag{11}$$

Comparing the definitions of p^{L*}, (7), of p^*, (10), and of p^m,(4), the following lemma shows the ranking of these prices:

Lemma 2 *For given w_d and w_f, the interior solution of the no limit pricing option lies below the interior solution of limit pricing:*

$$p^*(w_d, w_f) < p^{L*}(w_d).$$

For any $w_d \geq 0$, the interior solution of limit pricing is above the monopoly price:

$$p^{L*}(w_d) \geq p^m.$$

When there is no limit pricing, the retailer has to leave some consumers to the fringe firms, so its unconstrained optimal price, $p^*(w_d, w_f)$, should be below the unconstrained optimal price of limit pricing, $p^{L*}(w_d)$, where the dominant retailer would be the monopoly. In the latter case, if the dominant retailer's wholesale price is above zero, the retail price would be above the price maximizing the industry profit, $p^{L*}(w_d) > p^m$, due to the distortion created by the double mark-up. Figure 2 illustrates the equilibrium retail prices when there is no limit pricing and when there is limit pricing.

[23] Assumption 1 ensures that the second-order condition holds.

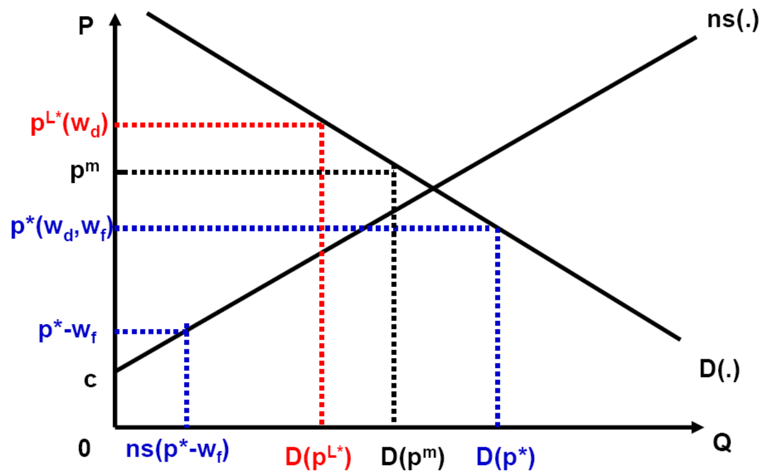

Figure 2: Retail price equilibrium

By comparing the dominant retailer's profit under the two options, the following lemma characterizes the equilibrium preferences of the dominant retailer for given wholesale prices w_d and w_f:

Lemma 3 *If $p^*(w_d, w_f) > w_f + c$, the dominant retailer prefers that the fringe firms supply some of the demand (no limit pricing) and sets price $p^*(w_d, w_f)$, which is given by (10). Otherwise, the dominant retailer prefers limit pricing and sets price $p^L(w_d, w_f)$, which is characterized by (8) and (7).*

When $p^* > w_f + c$, in the option without limit pricing, the unconstrained optimal price could be implemented, but the dominant retailer would have to set $c+w_f$ in the limit pricing option, since at the unconstrained optimal price p^{L*}, the fringe firms would be active because $p^{L*} > c+w_f$ (using $p^{L*} > p^*$ from Lemma 2). Symmetrically, when $p^{L*} \leq w_f + c$, in the option without limit pricing, the dominant retailer would have to set the price at $c + w_f + \varepsilon$, since at the unconstrained optimal price p^*, the fringe firms would not be active because $p^* < c + w_f$. However, in this case, it could implement the unconstrained optimal price of limit pricing and block the activity of the fringe. Intuitively, in both cases, the dominant retailer chooses the option where it could implement its unconstrained optimal price. When the dominant retailer faces the constrained optimum in both options, that is, when $p^* - c \leq w_f < p^{L*} - c$, if it chooses limit pricing, the equilibrium price would be $c + w_f$ and if it chooses no limit pricing, the equilibrium price would be $c + w_f + \varepsilon$. The dominant retailer is slightly better off with limit pricing, since avoiding competition of the fringe is more profitable than an incremental price increase.

3.2 Equilibrium contract between the dominant retailer and the supplier

Anticipating the continuation of the game, the supplier and the dominant retailer negotiate the terms of their supply contract, (F_d, w_d). The supplier's disagreement payoff is defined as the profit that the supplier would earn if it had no agreement with the dominant retailer and it sold only to the competitive fringe, in which case the retail price would be the competitive market price, $p^o(w_f)$. The supplier's disagreement payoff is therefore equal to $w_f ns(p^o(w_f) - w_f)$. Since the dominant retailer does not have any alternative supplier, its disagreement payoff is zero.

If limit pricing is the equilibrium outcome, the dominant retailer and the supplier would earn

$$\pi_s^L + \pi_d^L = \left(p^L - c\right) D(p^L),$$

and if some fringe firms are active in equilibrium, their bilateral profit would be the sum of the profit driven from the activity of the dominant retailer and the supplier's profit from the fringe:

$$\begin{aligned}\pi_s^{noL} + \pi_d^{noL} &= (p^* - c)\left[D(p^*) - ns(p^* - w_f)\right] + w_f ns(p^* - w_f). \\ &= (p^* - c)\, D(p^*) - (p^* - c - w_f)\, ns(p^* - w_f).\end{aligned}$$

Comparing these bilateral profits, it is straightforward to see that they earn more in the limit pricing equilibrium if $p^L = p^m$, since $(p^* - c - w_f)\, ns(p^* - w_f) > 0$ by definition of p^* and that p^m is the maximizer of $(p - c)\, D(p)$. Moreover, at $p^L = p^m$, their bilateral profit would be higher than the maximum value of the supplier's disagreement payoff (by Corollary 1), and so they prefer to have an agreement. We now analyze under which condition we would have $p^L = p^m$, and so the limit pricing equilibrium prevails.

Consider first the sub-game equilibrium path on which the dominant retailer and the supplier reach an agreement and set their contract terms such that in the continuation of the game the dominant retailer prefers limit pricing and the equilibrium price is p^{L*}, that is, $p^{L*}(w_d) \leq c + w_f$.

In this sub-game, the bilateral profit of the supplier and the dominant retailer would be

$$\pi_s^{L*} + \pi_d^{L*} = \left(p^{L*} - c\right) D(p^{L*}).$$

This could be an equilibrium only if their bilateral profit is higher than the supplier's disagreement payoff, that is, only if there are positive gains from trade:

$$\left(p^{L*} - c\right) D(p^{L*}) - w_f ns(p^o - w_f) \geq 0.$$

In this case, through fixed fee F_d^{L*}, they share their gains from trade with respect to the relative bargaining power:

$$\begin{aligned} \pi_s^{L*} &= w_f ns(p^o - w_f) + (1-\gamma)\left[\left(p^{L*} - c\right) D(p^{L*}) - w_f ns(p^o - w_f)\right], \\ \pi_d^{L*} &= \gamma\left[\left(p^{L*} - c\right) D(p^{L*}) - w_f ns(p^o - w_f)\right]. \end{aligned} \tag{12}$$

and set the wholesale price to maximize their bilateral profit subject to the limit pricing constraint:

$$\max_{w_d} \left(p^{L*} - c\right) D(p^{L*}) \qquad st. \qquad p^{L*} \leq c + w_f.$$

The unconstrained optimal wholesale price, w_d^{L*}, is implicitly determined by the first-order condition:[24]

$$\left[D(p^{L*}) + (p^{L*} - c)D'(p^{L*})\right] \frac{\partial p^{L*}}{\partial w_d} = 0.$$

Using the definition of p^{L*}, (7), we re-write the latter condition as

$$w_d^{L*} D'(p^{L*}) = 0$$

which implies that $w_d^{L*} = 0$ and $p^{L*} = p^m$. These prices would be the equilibrium of this sub-game if they satisfy the limit pricing constraint, that is, if $p^m \leq c + w_f$. Otherwise, the supplier and the

[24]The second-order condition is ensured by the log-cancavity of the demand.function, Assumption 1.

dominant retailer would set w_d^L, which is characterized by

$$p^{L*}\left(w_d^L\right) = w_f + c.$$

Hence, we conclude that if $w_f \geq p^m - c$, in the sub-game equilibrium where the dominant retailer chooses limit pricing, the equilibrium price would be $p^L = p^m$. But then, the dominant retailer and the supplier prefer to sign a contract which induces the limit pricing equilibrium. This proves the following lemma.

Lemma 4 *If $w_f \geq p^m - c$, the dominant retailer and the supplier set $w_d^{L*} = 0$ to induce the limit pricing equilibrium $p^{L*} = p^m$.*

Suppose now that $w_f < p^m - c$ and consider the sub-game equilibrium path on which the dominant retailer and the supplier reach an agreement and set their contract terms such that in the continuation of the game the dominant retailer prefers no limit pricing, that is, $p^*\left(w_d, w_f\right) > w_f + c$. In this sub-game, the bilateral profit of the supplier and the dominant retailer would be

$$\pi_s^{noL} + \pi_d^{noL} = \left(p^* - c\right)\left[D(p^*) - ns(p^* - w_f)\right] + w_f ns(p^* - w_f).$$

This could be an equilibrium only if their bilateral profit is higher than the supplier's disagreement payoff:

$$\left(p^* - c\right)\left[D(p^*) - ns(p^* - w_f)\right] + nw_f\left[s(p^* - w_f) - s(p^o - w_f)\right] \geq 0. \tag{13}$$

In this case, through fixed fee F_d^*, they share their bilateral profit with respect to their relative bargaining power:

$$\pi_s^{noL} = w_f ns(p^o - w_f) + (1-\gamma)\left[\left(p^* - c\right)\left[D(p^*) - ns(p^* - w_f)\right] + nw_f\left[s(p^* - w_f) - s(p^o - w_f)\right]\right], \tag{14}$$

$$\pi_d^{noL} = \gamma\left[\left(p^* - c\right)\left[D(p^*) - ns(p^* - w_f)\right] + nw_f\left[s(p^* - w_f) - s(p^o - w_f)\right]\right],$$

and set the wholesale price to maximize their bilateral profit subject to the participation constraint of the fringe:

$$\max_{w_d} \left[(p^* - c)\left[D(p^*) - ns(p^* - w_f)\right] + w_f ns(p^* - w_f)\right] \qquad st. \qquad p^* > w_f + c. \tag{15}$$

The unconstrained optimal wholesale price, w_d^*, is implicitly determined by the first-order condition:[25]

$$D(p^*) - ns(p^* - w_f) + (p^* - c)\left[D'(p^*) - ns'(p^* - w_f)\right] + w_f ns'(p^* - w_f) = 0. \tag{16}$$

Using the definition of p^*, (10), we re-write the latter condition as

$$w_d^* = \frac{-ns'(p^* - w_f)}{D'(p^*) - ns'(p^* - w_f)} w_f. \tag{17}$$

which implies that $w_d^* < w_f$, since the demand is decreasing and the fringe's supply is increasing. The unconstrained optimum would be the equilibrium of this sub-game if it satisfies the participation constraint of the fringe, that is, if

$$p^*\left(w_d^*, w_f\right) > w_f + c.$$

The latter inequality would hold if and only if we have (using the definition of w_d^*, (16), and the concavity of the dominant firm's and the supplier's joint profit):

$$\frac{\partial\left(\pi_s^{noL} + \pi_d^{noL}\right)}{\partial p} \Big|_{p = w_f + c} > 0$$

which can be re-written as (using $s(c) = 0$):

$$D(w_f + c) + w_f D'(w_f + c) > 0$$

The definition of p^m, (3), and the log-concavity of $D(p)$ imply that the latter inequality holds if and only if

$$w_f + c < p^m,$$

[25] The second-order condition is satisfied by Assumption 2.

which was our starting assumption. Hence, we conclude that when $w_f < p^m - c$, the unconstrained solution to the negotiation problem, (15), satisfies the participation constraint of the fringe, the supplier and the dominant retailer therefore set w_d^* satisfying (16) in the candidate equilibrium of no limit pricing, where the dominant retailer's wholesale price is lower than the fringe's, $w_d^* < w_f$.

On the other hand, in the sub-game equilibrium where the dominant retailer chooses limit pricing, the equilibrium price would be $p^L = w_f + c$, the dominant retailer and the supplier would earn

$$\pi_s^L + \pi_d^L = w_f D(w_f + c).^{26}$$

Since $p^* (w_d^*, w_f)$ maximizes their bilateral profit when some fringe firms are active, we have, for $\varepsilon > 0$,

$$\pi_s^{noL} + \pi_d^{noL} \geq (w_f + \varepsilon) \left[D(w_f + \varepsilon + c) - ns(c + \varepsilon) \right] + w_f ns(c + \varepsilon),$$

In the limit, when ε goes to zero, this implies that

$$\pi_s^{noL} + \pi_d^{noL} > w_f D(w_f + c) = \pi_s^L + \pi_d^L.$$

Moreover, in footnote 26 we show that there would be trade gains at $p^L = w_f + c$, that is $w_f D(w_f + c) \geq w_f ns(p^o - w_f)$. Since the supplier and the dominant retailer earn more without limit pricing, their bilateral profit must be above the disagreement payoff of the supplier, that is, condition (13) holds in equilibrium. We thereby show the following lemma.

Lemma 5 *If $w_f < p^m - c$, the dominant retailer and the supplier set their wholesale price at w_d^* to induce price p^*, where p^* and w_d^* are characterized by (10) and (16), so some fringe firms would be active and we have $w_d^* < w_f$ in equilibrium.*

3.3 Equilibrium wholesale price to the fringe

Now we analyze the supplier's equilibrium offer to the fringe firms.

[26] Note that at $p^L = c + w_f$, there would be positive gains from trade:

$$w_f D(w_f + c) \geq w_f ns(p^o - w_f) = w_f D(p^o - w_f),$$

since, by the definition of p^o, we have

$$ns(p^o - w_f) = D(p^o - w_f) > 0,$$

and so $p^o > w_f + c$.

If the supplier sets $w_f < p^m - c$, as we show in Lemma 5, in equilibrium there is no limit pricing and the price would be $p^{noL} = p^*(w_f)$. In this case, the supplier would get (from (14))

$$\pi_s^{noL}(w_f, \gamma) = \gamma w_f ns(p^o - w_f) + (1-\gamma)\left[(p^* - c)\left[D(p^*) - ns(p^* - w_f)\right] + nw_f s(p^* - w_f)\right]. \quad (18)$$

In this case, the supplier's optimal wholesale price to the fringe firms, denoted by w_f^*, would be the solution to

$$\max_{w_f} \pi_s^{noL}(w_f, \gamma) \qquad st. \qquad w_f < p^m - c. \quad (19)$$

The supplier's profit, (18), illustrates its trade-off between maximizing its disagreement payoff and maximizing its bilateral profit with the dominant retailer. When the dominant retailer has nearly no bargaining power, as $\gamma \to 0$, to maximize the bilateral profit with the dominant retailer, the supplier would set the fringe's wholesale price very close to $p^m - c$, in which case the fringe firms' supply is very close to zero and the dominant retailer sells nearly its monopoly quantity. When the dominant retailer has nearly all bargaining power, as $\gamma \to 1$, to maximize its disagreement payoff, the supplier would set the fringe firms' wholesale price very close to w_f^o.

Using the Envelope theorem and the optimality condition of the negotiation between the supplier and the dominant retailer, (16), we obtain the optimality condition characterizing w_f^*:

$$\gamma \frac{\partial\left[w_f ns(p^o - w_f)\right]}{\partial w_f} + (1-\gamma)\Big[(p^* - c - w_f)\, ns'(p^* - w_f) + ns(p^* - w_f)\Big] = 0 \quad (20)$$

which brings us the following result:

Proposition 1 *In the candidate equilibrium where there is no limit pricing, for $\gamma \in (0,1)$, the fringe firms' wholesale price is characterized by (20) and strictly decreasing in the level of the dominant retailer's bargaining power, $\frac{\partial w_f^*}{\partial \gamma} < 0$. We moreover have $w_f^o < w_f^* < p^m - c$ and the supplier earns $\pi_s^{noL}(\gamma) = \pi_s^{noL}(w_f^*, \gamma)$.*

As the dominant retailer's bargaining power increases, the supplier puts more weight on its disagreement payoff to capture more rent from the dominant retailer. Therefore, the supplier lowers the fringe's wholesale price towards the wholesale price maximizing its disagreement payoff.

If the supplier sets $w_f \geq p^m - c$, as we show in Lemma 4, the limit pricing equilibrium prevails and the equilibrium price would be $p^L = p^m$. In this case, the supplier would prefer to set $w_f^L = p^m - c$, since its disagreement payoff decreases in w_f given that $p^m - c > w_f^o$ (from Proposition 1). This proves the following proposition:

Proposition 2 *In the candidate equilibrium where there is limit pricing, the supplier sets* $w_f^L = p^m - c$ *in order to induce* $w_d^L = 0$ *and thereby* $p^L = p^m$*. As a result the supplier earns*

$$\pi_s^L(\gamma) = \gamma w_f^L ns(p^o(w_f^L) - w_f^L) + (1-\gamma)(p^m - c) D(p^m).$$

To see the supplier's trade-off between the candidate equilibrium without limit pricing and the candidate limit pricing equilibrium, consider the two extreme cases of the dominant retailer's bargaining power.

When $\gamma = 0$, the dominant retailer has no bargaining power, and so the supplier earns the industry profit, which would be greater under the limit pricing option,

$$\pi_s^L(0) = (p^m - c) D(p^m) > \pi_s^{noL}(0) = (p^* - c) D(p^*) - \left(p^* - c - w_f^{noL}\right) ns(p^* - w_f^{noL})$$

by the definition of p^m, (3), and the fact that $\left(p^* - c - w_f^{noL}\right) ns(p^* - w_f^{noL}) > 0$. The supplier would therefore set $w_f^L = p^m - c$ to induce the limit pricing equilibrium $p^L = p^m$.

When $\gamma = 1$, the dominant retailer has all bargaining power vis-à-vis the supplier, and so the supplier earns its disagreement payoff in equilibrium of the both options:

$$\begin{aligned} \pi_s^L(1) &= w_f^L ns(p^o(w_f^L) - w_f^L) \\ \pi_s^{noL}(1) &= w_f^{noL} ns(p^o(w_f^{noL}) - w_f^{noL}) \end{aligned}$$

The supplier would therefore set w_f^o to maximize its disagreement payoff. Since $w_f^o < p^m - c$ (from Proposition 1), some fringe firms would then be active and the equilibrium price would be $p^{noL} = p^*(w_f^o)$. This discussion and the continuity of the supplier's profit in the dominant retailer's bargaining power proves the following result:

Proposition 3 *There exists an intermediate level of the dominant retailer's bargaining power,* $\overline{\gamma} \in (0,1)$*, above which the supplier prefers the equilibrium without limit pricing (characterized by*

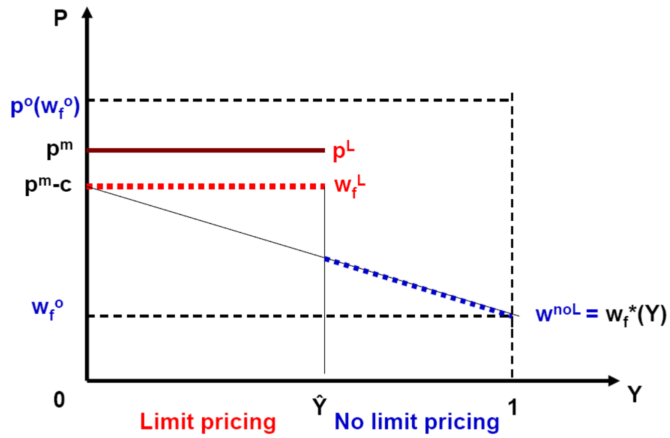

Figure 3: Equilibrium

Proposition 1) and below which the supplier prefers the equilibrium with limit pricing (characterized by Proposition 2).

When the dominant retailer has sufficiently low bargaining power, the supplier prefers to limit the activity of the less efficient fringe firms, because it could earn higher profits from the monopoly of the dominant retailer. However, when the dominant retailer has sufficiently high bargaining power, the supplier prefers to allow the less efficient firms to be active in order to increase its disagreement payoff to capture more rent from the dominant retailer, even though this reduces its bilateral profit with the dominant retailer. Intuitively, the supplier prefers to get a larger share of a smaller pie when the dominant retailer has significant bargaining power. In Figure 3, the red dashed line represents the wholesale price of the fringe and the red solid line represents the retail price when there is limit pricing equilibrium. The blue dashed line shows the fringe's wholesale price when there is no limit pricing.

4 Comparative statics with respect to the dominant retailer's bargaining power

We now analyze how the dominant retailer's bargaining power affects the equilibrium prices and profits. Proposition 2 implies that

Corollary 2 *When there is limit pricing in equilibrium, the wholesale prices and the retail price do not depend on the level of the dominant retailer's bargaining power, γ.*

Proposition 1 characterizes the equilibrium with no limit pricing where the retail price, $p^*(w_d, w_f)$, is characterized by (10), the wholesale price of the dominant retailer, w_d^*, is characterized by (16) and the fringe's wholesale price, w_f^*, is characterized by (20). The retail price depends on the dominant retailer's bargaining power through the wholesale prices:

$$\frac{\partial p^*}{\partial \gamma} = \frac{\partial p^*}{\partial w_d}\frac{\partial w_d^*}{\partial \gamma} + \frac{\partial p^*}{\partial w_f}\frac{\partial w_f^*}{\partial \gamma},$$

where the dominant retailer's wholesale price depends on its bargaining power indirectly through the fringe's wholesale price:

$$\frac{\partial w_d^*}{\partial \gamma} = \frac{\partial w_d^*}{\partial w_f}\frac{\partial w_f^*}{\partial \gamma}.$$

In Proposition 1, we show that the fringe's wholesale price decreases in the dominant retailer's bargaining power. By applying the Implicit Function theorem to the optimality condition of w_d^*, (16), we derive

$$\frac{\partial w_d^*}{\partial w_f} = -\frac{2s'(p^* - w_f^*) + (p^* - c - w_f^*)s''(p^* - w_f^*)}{\frac{\partial^2(\pi_d^* + \pi_s^*)}{\partial p^2}\left(\frac{\partial p^*}{\partial w_d}\right)^2}.$$

Since the denominator is negative by the second-order condition, the dominant retailer's wholesale price is decreasing in the fringe's wholesale price, $\frac{\partial w_d^*}{\partial w_f} < 0$, if and only if the numerator is negative:

$$2s'(p^* - w_f^*) + (p^* - c - w_f^*)s''(p^* - w_f^*) < 0.$$

By applying the Implicit Function theorem to the optimality condition of p^*, (10), we obtain

$$\frac{\partial p^*}{\partial w_f} = -\frac{s'(p^* - w_f^*) + (p^* - c - w_d^*)s''(p^* - w_f^*)}{\frac{\partial^2 \pi_d^*}{\partial p^2}},$$

$$\frac{\partial p^*}{\partial w_d} = \frac{D'(p^*) - s'(p^* - w_f^*)}{\frac{\partial^2 \pi_d^*}{\partial p^2}} > 0.$$

where both denominators are negative by the second-order condition. From Lemma 5 , we know that the dominant retailer's wholesale price should be smaller than the fringe's: $w_d^* < w_f^*$. This implies that the retail price decreases in the fringe's wholesale price, $\frac{\partial p^*}{\partial w_f} < 0$, if the dominant retailer's price decreases in the fringe's wholesale price, $\frac{\partial w_d^*}{\partial w_f} < 0$. This proves the following result:

Proposition 4 *When there is no limit pricing in equilibrium, the dominant retailer's wholesale price and the retail price increase in the dominant retailer's bargaining power, respectively,* $\frac{\partial w_d^*}{\partial \gamma} > 0$ *and* $\frac{\partial p^*}{\partial \gamma} > 0$, *if the fringe's supply is sufficiently concave, that is,*

$$2s'(p - w_f) + (p - c - w_f)s''(p - w_f) < 0,$$

in which case the dominant retailer's bargaining power reduces the consumer surplus.

Intuitively, at a lower wholesale price to the fringe increases the supply of the fringe firms. If the fringe's supply is highly concave, the fringe firms become less inefficient when they sell a larger quantity. As a reaction to this, the dominant retailer and the supplier set a higher wholesale price to induce a higher retail price, since then the losses due to the fringe's inefficiency would be less at the margin. In this case, the dominant retailer's bargaining power leads to a higher retail price, and therefore a lower consumer surplus.

On the other hand, if the fringe firms' supply is weakly convex, the fringe firms become more inefficient when they sell more. In this case, if the supplier sets a lower wholesale price to the fringe, the dominant retailer and the supplier react by negotiating a lower wholesale price to induce a lower retail price, in order to keep the more inefficient fringe's supply low.

Corollary 3 *When there is no limit pricing in equilibrium, the dominant retailer's wholesale price and the retail price decrease in the dominant retailer's bargaining power, respectively,* $\frac{\partial w_d^*}{\partial \gamma} < 0$ *and* $\frac{\partial p^*}{\partial \gamma} < 0$, *if the fringe's supply is weakly convex, that is* $s''(p) \geq 0$, *in which case the dominant retailer's bargaining power increases the consumer surplus.*

When there is limit pricing in equilibrium, fringe firms are not active, and so always earn zero profit. In this case, the supplier and the dominant retailer earn, respectively, (from (12))

$$\begin{aligned}
\pi_s^L(\gamma) &= \gamma w_f^L ns(p^o(w_f^L) - w_f^L) + (1-\gamma)(p^m - c) D(p^m), \\
\pi_d^L(\gamma) &= \gamma (p^m - c) D(p^m).
\end{aligned}$$

It is straightforward to show that the supplier's profit decreases and the dominant retailer's profit increases in the bargaining power of the dominant retailer:

$$\begin{aligned}\frac{\partial \pi_s^L}{\partial \gamma} &= -\left[(p^m - c)\, D(p^m) - w_f^L ns(p^o(w_f^L) - w_f^L)\right] < 0,\\ \frac{\partial \pi_d^L}{\partial \gamma} &= (p^m - c)\, D(p^m).\end{aligned}$$

where the first inequality holds because there are positive gains from trade in equilibrium, as $(p^m - c)\, D(p^m) > \max_{w_f} w_f ns(p^o(w_f) - w_f)$ by Corollary 1.

When there is no limit pricing in equilibrium, we show that the wholesale price of the fringe decreases in the bargaining power of the dominant retailer (see Proposition 1). Hence, the fringe firms are better off when the dominant retailer becomes more powerful in its bargaining with the supplier. The supplier and the dominant retailer earn, respectively, (from (14))

$$\begin{aligned}\pi_s^{noL}(\gamma) &= \gamma w_f^* ns(p^o - w_f^*) + (1-\gamma)\left[(p^* - c)\left[D(p^*) - ns(p^* - w_f^*)\right] + nw_f s(p^* - w_f^*)\right],\\ \pi_d^{noL}(\gamma) &= \gamma\left[(p^* - c)\left[D(p^*) - ns(p^* - w_f^*)\right] + nw_f s(p^* - w_f^*)\right]\end{aligned}$$

In this case, by applying the Envelope theorem, we show that the supplier's profit decreases in the dominant retailer's bargaining power,

$$\frac{\partial \pi_s^{noL}}{\partial \gamma} = -\left[(p^* - c)\left[D(p^*) - ns(p^* - w_f^*)\right] + nw_f^*\left(s(p^* - w_f^*) - s(p^o - w_f^*)\right)\right] < 0,$$

since, in equilibrium, there are positive gains from trade between the supplier and the dominant retailer (see the discussion before Lemma 5). By applying the Envelope theorem, we derive the dominant retailer's profit with respect to its bargaining power:

$$\begin{aligned}\frac{\partial \pi_d^{noL}}{\partial \gamma} = {} & \left[(p^* - c)\left[D(p^*) - ns(p^* - w_f^*)\right] + nw_f s(p^* - w_f^*)\right] + \\ & \gamma\left[(p^* - c - w_f)\, ns'(p^* - w_f^*) + ns(p^* - w_f^*)\right]\frac{\partial w_f^*}{\partial \gamma}\end{aligned}$$

which shows that the dominant retailer might lose due to its bargaining power, since it increases its share over the trade gains with the supplier (the first term of the latter equation is positive), but decreases its sales in the downstream market (the second term of the latter equation is negative), since the fringe firms' wholesale price decreases in the dominant retailer's bargaining power. The latter effect would dominate if the dominant firm's bargaining power is sufficiently high.

The following proposition summarizes the comparative statics of the equilibrium profits with respect to the dominant firm's bargaining power:

Proposition 5 *The supplier's equilibrium profit decreases in the dominant retailer's bargaining power. In equilibrium without limit pricing, the dominant retailer's profit decreases in its bargaining power if and only if it has already sufficiently high bargaining power. And each fringe firm's profit increases in the dominant retailer's bargaining power. When there is limit pricing in equilibrium, the dominant retailer's bargaining power increases its profit and the fringe firms earn zero.*

5 Discussion of the assumptions

5.1 The dominant retailer's disagreement payoff

In the benchmark, we assume that the dominant retailer has zero disagreement payoff and we interpret the fringe's wholesale price as the list price of the supplier. We, indeed, could have allowed the dominant retailer to purchase at the list price if it fails its negotiation with the supplier. In this case, the dominant retailer's disagreement payoff would be

$$\pi_d^o(p, w_f) = (p - w_f - c)\left[D(p) - ns(p - w_f)\right]$$

and the dominant retailer sets price p to maximize its profit. The first-order condition characterizes the optimal price, $p(w_f)$,

$$D(p) - ns(p - w_f) + (p - w_f - c)\left[D'(p) - ns'(p - w_f)\right] = 0 \tag{21}$$

Its maximized disagreement payoff would therefore be above zero[27] and would decrease in the list price (by the Envelope theorem):

$$\frac{\partial \pi_d^o(p(w_f), w_f)}{\partial w_f} = -D(p) + ns(p - w_f) + (p - w_f - c)\, ns'(p - w_f) < 0,$$

since we have

$$ns(p - w_f) + (p - w_f - c)\, ns'(p - w_f) = D(p) + (p - w_f - c)\, D'(p)$$

from the first-order condition, (21). Our analysis would follow the same lines as the benchmark framework, except for the supplier's choice of the list price (the first stage of the game). Only in the candidate equilibrium without limit pricing, the gains from trade between the supplier and the dominant retailer would change to reflect the dominant retailer's disagreement payoff:

$$(p^* - c)\left[D(p^*) - ns(p^* - w_f)\right] + nw_f\left[s(p^* - w_f) - s(p^o - w_f)\right] - \pi_d^o(p(w_f), w_f)$$

The first-order condition characterizing the optimal list price, w_f^*, would become:

$$\gamma \frac{\partial\left[w_f ns(p^o - w_f)\right]}{\partial w_f} + (1-\gamma)\left[(p^* - c - w_f)\, ns'(p^* - w_f) + ns(p^* - w_f) - \frac{\partial \pi_d^o(p(w_f), w_f)}{\partial w_f}\right] = 0$$

The supplier would set a higher list price than the benchmark, since now the list price has an extra effect on the supplier's profit, that is, it lowers the value of the dominant retailer's disagreement payoff and, by this way, increases the supplier's profit. The supplier would reduce its list price as a reaction to an increase in the dominant retailer's bargaining power: $\frac{\partial w_f^*}{\partial \gamma} < 0$. Hence, the qualitative impact of buyer power on the list price, on the dominant retailer's wholesale price and on the retail price would still be valid.

5.2 Efficiency of the fringe firms

If the fringe firms were more efficient than the dominant retailer, that is, $MC(q_f) \leq c$ for any q_f, the supplier would prefer to exclude the less efficient dominant retailer and sell only to the fringe

[27] Since the dominant retailer's wholesale price is the same as the fringe firms', the dominant retailer would not block the activity of the fringe firms, since otherwise it would earn zero as well.

firms. This is because, the supplier could earn higher profits than the maximized industry profit with the dominant retailer. If the supplier sells only to the more efficient fringe firms, it would set w_f^o to maximize its profit, and so get

$$\pi_s^o = w_f^o ns(p^o(w_f^o) - w_f^o),$$

Since at equilibrium, the price is equal to the total unit cost of a fringe firm and the fringe firms supply all the market demand, we have

$$\begin{aligned} w_f^o &= p^o(w_f^o) - MC(q_f^o), \\ ns(p^o(w_f^o) - w_f^o) &= D(p^o(w_f^o)). \end{aligned}$$

Using the latter equalities, we re-write the supplier's profit as

$$\pi_s^o = \left[p^o(w_f^o) - MC(q_f^o)\right] D(p^o(w_f^o))$$

Since w_f^o is the maximizer of the supplier's profit, it would induce the price maximizing the industry profit where the marginal cost is equal to the fringe's marginal cost. If the dominant retailer is less efficient than the fringe firms, we have

$$\pi_s^o \geq (p^m - c)\, D(p^m).$$

Hence, the supplier prefers to exclude the dominant retailer and earn π_s^o, since then it could get at least the maximum industry profit.

6 Conclusion

This paper analyzes the implications of buyer power on the final price and on weak/small retailers when a dominant retailer has buyer power and negotiates a two-part tariff contract with the supplier, but competitive fringe firms are price takers and so could buy the good at the supplier's list price. We show that the dominant retailer's buyer power induces the supplier to sell to the less efficient competitive fringe firms. As a reaction to an increase in buyer power, the supplier lowers its wholesale price to the fringe, that is, there are anti-waterbed effects. However, under some plausible conditions, we find that buyer power increases the dominant retailer's wholesale price and the retail price, and so lowers the consumer welfare.

Our results imply that in polarized retail markets with few dominant retailers which enjoy efficiency advantage and buyer power advantage over many small/weak stores, the suppliers might strategically lower their list price to increase the value of their disagreement payoff with the dominant retailers (so to capture more of the trade gains). This would reduce the purchasing price of the weak retailers. Our analysis therefore illustrate a mechanism through which a dominant retailer's buyer power generates anti-waterbed effects on weak retailers. Anti-waterbed effects increase supply by the less efficient small stores and thereby, in some environments, might increase the retail price.

Appendix

Proof of Lemma 1.

Price p^m is implicitly defined by

$$D(p^m) + (p^m - c)D'(p^m) = 0,$$

Wholesale price w_f^o is implicitly defined by

$$ns(p^o - w_f) + w_f^o ns'(p^o - w_f)\left(\frac{\partial p^o}{\partial w_f} - 1\right) = 0.$$

Moreover, from the definition of p^o, we have

$$D(p^o) = ns(p^o - w_f)$$

and so we derive

$$\frac{\partial p^o}{\partial w_f} = -\frac{ns'(p^o - w_f)}{D'(p^o) - ns'(p^o - w_f)}.$$

Observe that the latter equality is between 0 and 1, since $D'(p^o) - ns'(p^o - w_f) < -ns'(p^o - w_f)$.

Using these, we rewrite the definition of w_f^o as

$$D(p^o(w_f^o)) + w_f^o D'(p^o(w_f^o))\left(-\frac{ns'(p^o(w_f^o) - w_f^o)}{D'(p^o(w_f^o)) - ns'(p^o(w_f^o) - w_f^o)}\right) = 0$$

which implies that

$$D(p^o(w_f^o)) + w_f^o D'(p^o(w_f^o)) < 0.$$

Since $w_f^o < p^o(w_f^o) - c$, the latter inequality implies that

$$D(p^o(w_f^o)) + (p^o(w_f^o) - c)D'(p^o(w_f^o)) < 0$$

and so $p^o(w_f^o) > p^m$.

Proof of Lemma 2.

Comparing the first-order conditions (7) and (10), it is straightforward to see that, for given w_d and w_f,

$$p^*(w_d, w_f) < p^{L*}(w_d),$$

since $ns(p^* - w_f) + (p^* - w_d - c)ns'(p^* - w_f) > 0$. Moreover, comparing the definition of p^m, (4), and the definition of p^{L*}, (7), gives us

$$p^{L*}(w_d) \geq p^m,$$

as long as $w_d \geq 0$.

Proof of Lemma 3.

To see which option the dominant retailer prefers in sub-game equilibrium, we analyze each possible scenario:

- If $w_f < p^* - c$, we also have $w_f < p^{L*} - c$, since $p^* < p^{L*}$. In the sub-game where the dominant retailer chooses limit pricing, the equilibrium price would be $p^L = c + w_f$ and the dominant retailer would earn

  $$\pi_d^L\left(c + w_f\right) = \left(w_f - w_d\right) D(c + w_f).$$

  In the sub-game where the dominant retailer chooses no limit pricing option, the equilibrium price would be $p^{noL} = p^*$ and the dominant retailer would earn

  $$\pi_d^{noL}\left(p^*\right) = \left(p^* - c - w_d\right)\left[D(p^*) - ns(p^* - w_f)\right].$$

  Our claim is that the dominant retailer prefers the sub-game equilibrium of no limit pricing to the sub-game equilibrium of limit pricing, that is,

  $$\pi_d^{noL}\left(p^*\right) > \pi_d^L\left(c + w_f\right).$$

By definition of p^*, $\pi_d^{noL}(p)$ is maximized at p^*, we have

$$\pi_d^{noL}(p^*) \geq \pi_d^{noL}(c+w_f+\varepsilon) = (w_f+\varepsilon-w_d)\left[D(c+w_f+\varepsilon)-ns(c+\varepsilon)\right].$$

for any positive number ε. This in turn implies that

$$\pi_d^{noL}(p^*) > \lim_{\varepsilon\to 0} \pi_d^{noL}(c+w_f+\varepsilon) \tag{22}$$

Observe that at a price very close to $c+w_f$, the fringe's supply goes to zero:

$$\lim_{\varepsilon\to 0} ns(c+\varepsilon) = 0.$$

We therefore show that

$$\lim_{\varepsilon\to 0} \pi_d^{noL}(c+w_f+\varepsilon) = \pi_d^{L}(c+w_f).$$

Using inequality (22), this in turn proves our claim. Hence, in this case, the equilibrium price is equal to p^*.

- If $w_f \geq p^{L*}-c$, we also have $w_f \geq p^*-c$, since $p^* < p^{L*}$. In the sub-game where the dominant retailer chooses limit pricing, the equilibrium price would be p^{L*} and the dominant retailer would earn

$$\pi_d^{L}\left(p^{L*}\right) = \left(p^{L*}-c-w_d\right)D(p^{L*})$$

In the sub-game where the dominant retailer chooses the no limit pricing option, the equilibrium price would be $p^{noL} = c+w_f+\varepsilon$ and the dominant retailer would earn

$$\pi_d^{noL}(c+w_f+\varepsilon) = (w_f+\varepsilon-w_d)\left[D(c+w_f+\varepsilon)-ns(c+\varepsilon)\right]$$

Our claim is that the dominant retailer prefers the sub-game equilibrium of limit pricing to the sub-game equilibrium of no limit pricing, that is,

$$\pi_d^{L}\left(p^{L*}\right) > \pi_d^{noL}(c+w_f+\varepsilon).$$

By definition of p^{L*}, $\pi_d^L(p)$ is maximized at p^{L*}, we have

$$\pi_d^L\left(p^{L*}\right) \geq \pi_d^L\left(c+w_f\right) = \left(w_f - w_d\right) D(c+w_f). \tag{23}$$

As shown previously, at a price very close to $c + w_f$, the fringe supply goes to zero:

$$\lim_{\varepsilon \to 0} ns(c+\varepsilon) = 0.$$

The profit from no limit pricing increases as ε approaches to zero since then the price decreases towards the unconstrained optimal price, p^*. We thereby show that

$$\lim_{\varepsilon \to 0} \pi_d^{noL}\left(c+w_f+\varepsilon\right) = \pi_d^L\left(c+w_f\right) > \pi_d^{noL}\left(c+w_f+\varepsilon\right).$$

Using inequality (23), this in turn proves our claim. Hence, in this case, the equilibrium price is equal to p^{L*}.

- Suppose now that $p^* - c \leq w_f < p^{L*} - c$. In the sub-game where the dominant retailer chooses limit pricing, the equilibrium price would be $c + w_f$ and the retailer would earn $\pi_d^L\left(c+w_f\right)$. In the sub-game where the dominant retailer chooses no limit pricing, the equilibrium price would be $c+w_f+\varepsilon$ and the retailer would earn $\pi_d^{noL}\left(c+w_f+\varepsilon\right)$. As we have shown previously, we have

$$\pi_d^L\left(c+w_f\right) = \lim_{\varepsilon \to 0} \pi_d^{noL}\left(c+w_f+\varepsilon\right) > \pi_d^{noL}\left(c+w_f+\varepsilon\right),$$

  and therefore prove that the dominant retailer prefers the sub-game equilibrium of limit pricing to the sub-game equilibrium of no limit pricing. Hence, in this case, the equilibrium price is equal to $c + w_f$.

Proof of Proposition 1.

In a candidate equilibrium with no limit pricing, some fringe firms should be active at the retail price. This requires that $p^* - c - w_f > 0$, since otherwise no fringe firm would be active. Using the optimality condition of the supplier's problem, (20), we obtain that, for $\gamma \in (0,1)$,

$$\gamma \frac{\partial \left[w_f ns(p^o - w_f)\right]}{\partial w_f} \Big|_{w_f = w_f^*} < 0.$$

But then the definition of w_f^o implies that $w_f^* > w_f^o$ for $\gamma \in (0,1)$. Moreover, by the Implicit Function theorem and using (20), we derive

$$\frac{\partial w_f^*}{\partial \gamma} = -\frac{\frac{\partial\left[w_f ns(p^o - w_f)\right]}{\partial w_f}\Big|_{w_f = w_f^*} - \left[(p^* - c - w_f)\, ns'(p^* - w_f) + ns(p^* - w_f)\right]}{\frac{\partial^2 \pi_s^{noL}}{\partial w_f^2}}$$

Since the denominator is negative by the second-order condition and numerator is negative by the previous inequality and that $p^* - c - w_f > 0$, we show that $\frac{\partial w_f^*}{\partial \gamma} < 0$ for $\gamma \in (0,1)$.
The optimality condition, (20), implies moreover that

$$\begin{aligned} \lim_{\gamma \to 0} \left[\left(p^*(w_f^*) - c - w_f^*\right) ns'(p^*(w_f^*) - w_f^*) + ns(p^*(w_f^*) - w_f^*)\right] &= 0, \\ \lim_{\gamma \to 1} \frac{\partial \left[w_f^* ns(p^o(w_f^*) - w_f^*)\right]}{\partial w_f} &= 0, \end{aligned}$$

or, respectively, that

$$\lim_{\gamma \to 0} w_f^* = p^m - c \qquad \lim_{\gamma \to 1} w_f^* = w_f^o.$$

But then we must have $w_f^o < w_f^* < p^m - c$. Hence, the unconstrained optimal wholesale price, w_f^*, satisfies the participation constraint of the fringe and the supplier sets w_f^* in the candidate no limit pricing equilibrium.

Proof of Proposition 3

Comparing the supplier's profit at the equilibrium with no limit pricing and the one with limit pricing shows that the supplier's disagreement payoff is higher at the former equilibrium:

$$w_f^* ns(p^o(w_f^*) - w_f^*) > w_f^L ns(p^o(w_f^L) - w_f^L),$$

since the disagreement payoff is maximized at w_f^o, see (5), we have $w_f^o < w_f^* < p^m - c$ (from

Proposition 1) and $w_f^L = p^m - c$ (from Proposition 2). On the other hand, the bilateral profit of the supplier and the dominant retailer is higher at the equilibrium with limit pricing since

$$(p^m - c)\, D(p^m) > \left(p^*(w_f^*) - c\right) D(p^*(w_f^*)) - \left(p^*(w_f^*) - c - w_f^*\right) ns(p^*(w_f^*) - w_f^*)$$

due to the definition of p^m, (3). This implies that, when $\gamma = 0$, the supplier prefers the equilibrium with limit pricing and, when $\gamma = 1$, the supplier prefers the equilibrium with no limit pricing. By the continuity of the supplier's profit in γ, there exists $\overline{\gamma} \in (0,1)$ such that the supplier is indifferent between the two equilibrium outcomes:

$$\pi_s^L(\overline{\gamma}) = \pi_s^{noL}(\overline{\gamma})$$

Proof of Corollary 1

When $\gamma < \overline{\gamma}$, in Proposition 3, we show that the supplier prefers the equilibrium with limit pricing, and so we have $w_f^L = p^m - c, w_d^L = 0$, and $p^L = p^m$, which are constant in γ.

Proof of Proposition 4

When $\gamma \geq \overline{\gamma}$, the supplier prefers the equilibrium without limit pricing where the retail price $p^*(w_d, w_f)$ is characterized by (10), the wholesale price of the dominant retailer w_d^* is characterized by (16) and the wholesale price of the fringe, w_f^*, is characterized by (20). The derivative of the retail price with respect to the dominant retailer's bargaining power is given by

$$\frac{\partial p^*}{\partial \gamma} = \left(\frac{\partial p^*}{\partial w_d}\frac{\partial w_d^*}{\partial w_f} + \frac{\partial p^*}{\partial w_f}\right)\frac{\partial w_f^*}{\partial \gamma}.$$

In Proposition 3 we show that $\frac{\partial w_f^*}{\partial \gamma} < 0$. By applying the Implicit Function theorem to the optimality condition of w_d^*, (16), we obtain

$$\frac{\partial w_d^*}{\partial w_f} = -\frac{2s'(p^* - w_f^*) + (p^* - c - w_f^*)s''(p^* - w_f^*)}{\frac{\partial^2\left(\pi_d^* + \pi_s^*\right)}{\partial p^2}\left(\frac{\partial p^*}{\partial w_d}\right)^2},$$

where the denominator is negative by the second-order condition. This shows that when the fringe's supply is sufficiently concave,

$$2s'(p) + (p - c)s''(p) < 0,$$

the numerator of $\frac{\partial w_d^*}{\partial w_f}$ is negative, and so the dominant retailer's wholesale price is decreasing in the fringe's wholesale price, $\frac{\partial w_d^*}{\partial w_f} < 0$.

Moreover, by applying the Implicit Function theorem to the optimality condition of p^*, (10), we obtain

$$\frac{\partial p^*}{\partial w_f} = -\frac{s'(p^* - w_f^*) + (p^* - c - w_d^*)s''(p^* - w_f^*)}{\frac{\partial^2 \pi_d^*}{\partial p^2}}.$$

Since we have $w_d^* < w_f^*$, from (17), we conclude that $\frac{\partial p^*}{\partial w_f} < 0$ if $\frac{\partial w_d^*}{\partial w_f} < 0$. Hence, in this case, we show that $\frac{\partial p^*}{\partial \gamma} > 0$.

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