Countervailing Power Hypothesis and 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 purchasing prices 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 in a framework developed on the setup of Chen (2003) with a dominant retailer and competitive fringe, where the fringe firms are offered take-it-or-leave-it two-part tariff contracts by the supplier, whereas the dominant retailer negotiates its contract terms. Chen (2003) shows that an increase in a dominant retailer's buyer power does not affect its wholesale price, but lowers the wholesale price of the fringe retailers and thereby reduces the retail price. As opposed to Chen, we find that whether the dominant retailer's bargaining power leads to an increase or decrease in retail prices depends on the 'pass-through rate' of the fringe firms' wholesale prices on retail prices. Moreover, the negotiated wholesale price of the dominant retailer will, in general, depend on the wholesale prices received by the fringe firms and this could lead, in some environments, to both a waterbed effect and a higher retail price for consumers. Our results are different than Chen's since, in modeling the bargaining between the upstream firm and dominant retailer, we take into account the surplus that the upstream firm receives from the fringe firms, which is ignored by Chen.

JEL classifications: L11; L13; L42.

Key words: Buyer power, asymmetric retailers, non-linear supply contracts, pass-through rate.

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1 Introduction

Buyer power is important and there has been much recent work in this area.[1] 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] One important research agenda is to understand the primitives of buyer power: where does it come from, why does size matter[3], what other factors affect buyer power, e.g., suppliers' production technology[4], retailers' gatekeeper position[5], 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, 2009a; Inderst and Wey, 2003, 2007; Inderst, 2007).[6] 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).[7]

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.[8] In case of a bilateral monopoly with linear supply contracts, buyer power is good because it mitigates double marginalization. In case of symmetric downstream oligopoly with linear contracts, buyer power is good because firms negotiate lower wholesale prices, which then get passed to consumers. On the other hand, when there is bilateral monopoly with non-linear supply contracts, buyer power effects fixed fees only, so it has no effect on consumers.[9] If we consider symmetric downstream oligopoly with non-linear supply contracts, it is not clear why downstream firms would want to use their

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

[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] Katz (1987), Sheffman and Spiller (1992), Snyder (1996, 1999).

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

[5] Mazzarotto (2003).

[6] 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 (2006)), in variety (Chen (2004), Inderst and Shaffer (2007)) or in innovation (Inderst and Wey (2008)). Alternatively, Inderst and Valetti (2006) show how the ban of discriminatory pricing in the intermediate market may reduce downstream firms' incentives to invest in cost reduction.

[7] 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 (2005) for a more general discussion on buyer power as a merger defence.

[8] This constitutes the main basis of Galbraith's (1952) arguments.

[9] See Inderst and Mazzarotto (2008).

bargaining power to obtain wholesale price concessions when they know these concessions will at least be partially passed through to consumers.[10] It may be that they will use their bargaining power to reduce their fixed fees (possibly make them negative).

The problem is that the intuition that buyer power is good appears to rely on an implicit assumption of linear contracts. When contracts are non-linear, it appears as though[11] 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.[12] Buyer power may not be so good after all.

Few papers have looked at buyer power in the context of asymmetric downstream firms (e.g., a dominant retailer and competitive fringe), and of those that do, contracts are typically assumed to be linear.[13] Chen (2003) is an exception.[14] 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 lower retail prices because, in equilibrium, the upstream firm reacts to the increase in bargaining power of the dominant retailer by lowering its wholesale prices to the fringe (the opposite of the waterbed effect). Consumers are better off and the playing field becomes more level. Buyer power is good.

Chen's result that the dominant retailer's wholesale price is independent of its bargaining power is surprising because, among other things, it implies that it is also independent of the wholesale price received by the fringe firms. He finds this because, in modeling the bargaining between the upstream firm and dominant retailer, he ignores the surplus (the wholesale price of the fringe times the quantity sold by the fringe) that the upstream firm receives from the fringe firms. When this is corrected, the negotiated wholesale price of the dominant retailer

[10] See Bedre-Defolie and Caprice (2008, 2009)

[11] 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 (Berto 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.

[12] 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".

[13] Considering linear supply contracts, Majumdar (2006), Inderst (2007), Inderst and Valetti (2008) 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.

[14] Bedre-Defolie and Caprice (2008, 2009) are among other exceptions which consider non-linear supply contracts and asymmetric retailers. Different from this paper, they relate buyer power to size.

will, in general, depend on the wholesale price received by the fringe firms and, as we will show below, this could lead in some environments to both a waterbed effect and a higher retail price for consumers.

We adopt the framework and the timing used in Chen (2003) but suppose that in negotiations the upstream firm receives a share of its maximized bilateral surplus with the dominant retailer subject to earning at least its outside option.[15] We find that when the dominant retailer's bargaining power improves, an increase or decrease in retail prices depends on the 'pass-through rate' of the fringe firms' wholesale price on the retail price.

If the pass-through rate is positive and less than one, an increase in buyer power is always good for consumers and leads to a lower wholesale price for the fringe. But if the pass-through rate is greater than one, an increase in buyer power harms consumers and leads to a higher wholesale price for the fringe. For negative pass-through rates, an increase in buyer power leads to a lower wholesale price for the fringe, but harms consumers. The effect of buyer power on the wholesale price of the dominant retailer is less clear cut. Bargaining power may lead to a higher or a lower wholesale price for the dominant firm, depending on, among other things, the curvature of demand and of the fringe firms' supply curve. Under some conditions, it is possible for the wholesale price of the dominant retailer to decrease while the wholesale price of the fringe firms and the retail price increase, i.e., it is possible to have a waterbed effect.

To derive clear policy implications from our analysis, one needs to determine at which rate retailers pass wholesale price changes on to consumer prices: Are pass-through rates above or below one? As opposed to the commonly held belief that pass-through rates are far below one, some emprical studies find that for some product categories (e.g., beer, dish detergent and oat cereal), pass-through rates of input prices could be above one.[16] In general, the literature shows that the level of pass-through rates in retail markets are positively related to the market share of the manufacturer's product[17] or negatively related to the level of competitiveness in the product category.[18] Hence, the emprical literature conjectures that for brands holding large market shares and/or for highly differentiated products, the pass-through rates of input prices are more likely to be above one. In those cases our findings anticipate that the dominant retailer's buyer power harms consumers as well as the fringe

[15] Binmore, Shaked and Sutton (1989) show the game theoretic foundations of this form of sharing rule, which is referred to as "deal-me-out bargaining".

[16] See Besanko, Dubé and Gupta (2005), who study the pass-through rates of wholesale price changes on retail prices in eleven key product categories of a major Chicago supermarket chain.

[17] Besanko et al. (2005).

[18] Berck, Leibtag, Villas-Boas and Solis (2009) show that the pass-through rates of flour on cereal prices are above 1, whereas the pass-through rates of chicken-feed on chicken prices are below one, and explain this result by the fact that the former product category is less competitive than the latter.

retailers who do not have power to negotiate their contracts with the supplier.

The rest of the paper is organized as follows. Section 2 presents our framework. In Section 3, we conduct the equilibrium analysis and present our main results. Section 4 extends our model to the case where the dominant retailer competes against a weak retailer who purchases the manufacturer's product at the listed prices. We conclude in Section 5.

2 The Model

Our framework develops on the setup of Chen (2003). There is one supplier selling its product to $n+1$ retailers, which in turn resell the product to consumers. Retailers are assumed to be asymmetric in the sense that there is one dominant firm setting the retail price p and n competitive fringe firms supplying the retail market at the given price p. Retailers face a decreasing demand function, denoted by $D(p)$ with $D'(p) < 0$.

The supplier has a constant marginal cost of production, which is normalized to zero. The dominant firm incurs a constant marginal cost of retailing, denoted by c, whereas fringe firms have rising marginal costs, denoted by $MC(q_f)$ with $MC'(q_f) > 0$ and $MC(0) = 0$. This assumption implies that the competitive fringe is more efficient than the dominant firm in retailing a small quantity, while the dominant firm is more efficient at a large scale.

Each retailer pays a fixed fee to the supplier at the signature of its contract and then pays a wholesale price per unit purchased. Fringe retailers do not have bargaining power to negotiate the terms of their supply contracts. Instead, they either accept or decline the two-part tariff offer made by the supplier, which we denote by (F_f, w_f). On the other hand, the dominant retailer has power to negotiate, secretly, another contract, denoted by (F_d, w_d), with the supplier after observing the supplier's offer to the fringe firms.

Each fringe firm sells until the market price is equal to its marginal cost, $p = MC(q_f)+w_f$. The supply of a fringe firm is defined as $s(p-w_f) \equiv q_f = MC^{-1}(p-w_f)$. The total supply by the fringe is thus equal to $ns(p-w_f)$.

When defining the bilateral profits of the supplier with the dominant retailer, Chen (2003) ignores the supplier's profits coming from the competitive fringe. Different from Chen, we take into account these profits. The bilateral profits of the supplier and the dominant retailer is equal to

$$(p-c)\left[D(p) - ns(p-w_f)\right] + n\left[F_f + w_f s(p-w_f)\right],$$

where the first term represents the bilateral profits driven from the activity of the dominant retailer and the second term refers to the supplier's profits from the fringe.

Since we assume that fringe retailers pay their fixed fees at contract signing, the supplier gets nF_f whatever happens in the negotiation with the dominant retailer. The variable part of the bilateral profits, $(p-c)\left[D(p)-ns(p-w_f)\right]+nw_f s(p-w_f)$, is affected by the negotiation between the supplier and the dominant retailer, and accrue when retail sales take place.

We assume that the supplier and the dominant retailer share their anticipated bilateral profits according to sharing rule γ, where $\gamma \in (0,1)$ denotes the dominant retailer's share over the bilateral profits. We moreover assume that the outside options do not affect the sharing unless they are binding, i.e., where the agents share their anticipated bilateral profits not the gains from trade. If the supplier's share is higher than its outside option, the supplier gets its share over the anticipated bilateral profits. The supplier gets its outside option and the dominant retailer gets the rest of the bilateral profits as long as there are positive gains of trade. Otherwise, the negotiation breaks down, the supplier and the dominant retailer get their respective outside options.

The outside option of the supplier is defined as the profits 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 one at which the fringe supplies the whole market demand. We denote this price by p^o satisfying $D(p^o)=ns(p^o-w_f)$. The supplier's outside option is therefore equal to $n\left[F_f+w_f s(p^o-w_f)\right]$. Since the dominant retailer does not have any alternative supplier, its outside option is zero. The profit sharing between the supplier and the dominant retailer would result in the following profits:

$$\pi_s = nF_f + (1-\gamma)\left[(p-c)\left[D(p)-ns(p-w_f)\right]+nw_f s(p-w_f)\right],$$
$$\pi_d = \gamma\left[(p-c)\left[D(p)-ns(p-w_f)\right]+nw_f s(p-w_f)\right],$$

if the supplier's outside option is not binding, i.e., if

$$(1-\gamma)\left[(p-c)\left[D(p)-ns(p-w_f)\right]+nw_f s(p-w_f)\right] \geq nw_f s(p^o-w_f).$$

Otherwise, the supplier gets its outside option and the dominant retailer gets the rest of the trade surplus

$$\pi_s = n\left[F_f + w_f s(p^o-w_f)\right], \quad \pi_d = (p-c)\left[D(p)-ns(p-w_f)\right]+nw_f\left[s(p-w_f)-s(p^o-w_f)\right].$$

as long as there are positive gains from trade so that $\pi_d \geq 0$. If they do not have any gains from trading,

$$(p-c)\left[D(p)-ns(p-w_f)\right]+nw_f\left[s(p-w_f)-s(p^o-w_f)\right]<0,$$

they fail to agree on a contract, in which case they obtain their respective outside options:

$$\pi_s = n\left[F_f + w_f s(p^o - w_f)\right], \quad \pi_d = 0.$$

This form of sharing rule, which is also known as "the deal-me-out bargaining outcome", has game theoretic foundations. Binmore, Shaked and Sutton (1989) justify, theoretically, the deal-me-out bargaining outcome by considering a modified form of Binmore, Rubinstein and Wolinsky's (1986) alternating offers game: after an offer is made by one party, the other party has three options: i) Accepts the offer, ii) Rejects it and makes a counter offer, iii) Leaves negotiations and gets its outside option. They show that (in Appendix 1) the equilibrium of this sort of extensive form game where agents are impatient, i.e., discount future payoffs, is the deal-me-out bargaining outcome, but not the conventional split-the difference outcome.

Through setting the wholesale price w_d, the dominant retailer and the supplier indirectly determine the retail price p. We could therefore simplify the analysis by assuming that the supplier and the dominant retailer negotiate a contract specifying retail price p and fixed fee F_d. The timing of the interactions is the following:

Timing

1. The supplier makes a take-it-or-leave-it two-part tariff supply offer (F_f, w_f) to the fringe firms. If a fringe firm accepts the supplier's offer, it pays fixed fee F_f.
2. The supplier and the dominant retailer negotiate fixed fee F_d to be paid by the dominant retailer and retail price p. At the given retail price p, retailers compete for consumers.

Chen (2003) assumes that the demand and supply functions satisfy the following conditions:

C1. $D'(p) + (p-c)D''(p) < 0$,

C2. $s'(p-w_f) + (p-w_f-c)s''(p-w_f) > 0$,

which are sufficient to ensure that the second-order conditions of the optimization problems are satisfied.

Different from Chen, we assume the necessary and sufficient condition for the convexity of the problems:

Assumption 1. $2D'(p) + (p-c)D''(p) - \left[2s'(p-w_f) + (p-w_f-c)s''(p-w_f)\right] < 0.$ (1)

3 Equilibrium Analysis

As a benchmark we first define the price maximizing the channel profits of the supplier with the dominant retailer:

$$p^m \equiv \arg\max_p \left\{(p-c)\left[D(p) - ns(p-w_f)\right]\right\},$$

which is the solution to the first-order condition:

$$D(p^m) - ns(p^m - w_f) + (p^m - c)\left[D'(p^m) - ns'(p^m - w_f)\right] = 0. \tag{2}$$

It is well-known from the literature that by setting the wholesale price at the marginal cost of the supplier, $w^m = 0$, the vertical chain could prevent the double-marginalization problem and implement the price maximizing its channel profits, p^m.

We now solve the sequential game described above by backward induction. We look for a Subgame Perfect Nash Equilibrium.

3.1 Contracting with the dominant retailer

We analyze first the equilibrium behavior of the supplier and the dominant retailer taking the fringe's contract, (F_f, w_f), as given. The supplier and the dominant retailer set p to maximize their anticipated bilateral profits since they could share the maximized profits through F_d. They determine p by

$$\max_p \left[(p-c)\left[D(p) - ns(p-w_f)\right] + nw_f s(p-w_f)\right].$$

The first-order condition determines implicitly the equilibrium price, denoted by p^*, as a function of w_f :

$$D(p^*) - ns(p^* - w_f) + (p^* - c)\left[D'(p^*) - ns'(p^* - w_f)\right] + nw_f s'(p^* - w_f) = 0, \tag{3}$$

given that the second-order condition is satisfied by Assumption 1 given in (1).

By taking the total derivative of the first-order condition given in (3), we calculate the pass-through rate of the fringe's wholesale price on the equilibrium price:

$$\frac{\partial p^*}{\partial w_f} = -\frac{2ns'(p^* - w_f) + (p^* - c - w_f)ns''(p^* - w_f)}{2D'(p^*) + (p^* - c)D''(p^*) - \left[2ns'(p^* - w_f) + (p^* - c - w_f)ns''(p^* - w_f)\right]}, \tag{4}$$

The sign of the pass-through rate is the same as the nominator's sign since the denominator is negative by the second-order condition (see (1)). However, the nominator's sign is not clear, but depends on the convexity of the fringe's supply curve. Assumption $C2$ of Chen (2003) prevents the supply function from being too concave and makes the nominator positive, which results in a positive pass-through rate. If the supply function is sufficiently concave, the nominator is negative, and so is the pass-through rate. This observation brings us our first result:

Lemma 1. *When the fringe's supply curve is not too concave such that C2 holds, the equilibrium retail price is increasing in the wholesale price of the fringe retailers. The opposite is true if the fringe's supply is sufficiently concave.*

Comparing (2) with (3) shows that the equilibrium price differs from the price maximizing the channel profits, p^m, due to the distortion term $nw_f s'(p - w_f)$. Intuitively, when determining the retail price, the supplier and the dominant retailer take into account changes in the supplier's profits from the fringe with respect to the price. Since the fringe has increasing marginal costs, the supply by the fringe is increasing in retail price and thus the distortion term is positive, which implies that $p^* > p^m$. In other words, the supplier and the dominant retailer would like to raise the retail price above p^m since this increases their expected bilateral profits by $nw_f s'(p - w_f)$.

We thereby show that the supplier and the dominant retailer set their wholesale price above the marginal cost of the supplier, $w_d^* > 0$, to induce retail price p^*, which is greater than p^m.

Now we are interested in how the distortion term changes with respect to changes in w_f. The derivative,

$$\frac{\partial}{\partial w_f}\left[nw_f s'(p - w_f)\right] = ns'(p - w_f) - nw_f s''(p - w_f), \tag{5}$$

does not have a straightforward sign. The distortion term decreases in w_f if the supply function is sufficiently convex, precisely if,

$$s'(p - w_f) \leq w_f s''(p - w_f).$$

In this case the equilibrium price approaches p^m, and therefore the dominant retailer's wholesale price, w_d^*, decreases in w_f, going towards zero. Otherwise, raising w_f increases the distortion meaning that p^* goes further above p^m and w_d^* increases in w_f. For instance, linear supply functions fall into the second category where the dominant retailer's wholesale price increases in the fringe's wholesale price. The following lemma summarizes this finding.

Lemma 2. *The dominant retailer's wholesale price is positive and depends on the fringe's wholesale price. If the fringe's supply curve is sufficiently convex, the dominant retailer's wholesale price decreases in the fringe's wholesale price. The opposite is true otherwise.*

3.2 Contracting with the competitive fringe

Now consider the supplier's problem to determine which supply terms to offer to the fringe. We focus on an interior solution where the supplier's break-even constraint is not binding:

$$(1-\gamma)\left[(p-c)\left[D(p)-ns(p-w_f)\right]+nw_f s(p-w_f)\right] \geq nw_f s(p^o-w_f).$$

We assume that this condition holds for the equilibrium prices.[19]

The supplier determines its contract offer to the fringe retailers, (w_f, F_f), by taking into account the equilibrium behavior in the following stage and by maximizing its profit subject to the participation constraint of the fringe retailers:

$$\max_{w_f, F_f} \pi_s = nF_f + (1-\gamma)\left[(p^*-c)\left[D(p^*)-ns(p^*-w_f)\right]+nw_f s(p^*-w_f)\right]$$
$$s.t. \qquad \int_0^{p^*-w_f} s(x)dx - F_f \geq 0.$$

Since the supplier's profit π_s is increasing in F_f, in equilibrium the constraint is binding, i.e., the supplier sets $F_f = \int_0^{p^*-w_f} s(x)dx$ to capture all expected profits of the fringe and sets w_f to maximize its resulting profits:

$$\max_{w_f} \pi_s = n\int_0^{p^*-w_f} s(x)dx + (1-\gamma)\left[(p^*-c)\left[D(p^*)-ns(p^*-w_f)\right]+nw_f s(p^*-w_f)\right].$$

By using the optimality condition of the contracting with the dominant retailer (equation (3)), we derive the first-order condition:

$$ns(p^*-w_f^*)(\frac{dp^*}{dw_f}-1)+(1-\gamma)\left[\left(p^*-c-w_f^*\right)ns'(p^*-w_f^*)+ns(p^*-w_f^*)\right]=0, \qquad (6)$$

which implicitly characterizes the equilibrium wholesale price of the fringe, providing that the second order condition holds, i.e., $\frac{\partial^2\pi_s}{\partial w_f^2}<0$, which we assume to be the case.

[19] In the alternative scenario, the supplier gets its outside option. But then the dominant retailer's bargaining power would not affect the supplier's profits. This implies that the wholesale price of the fringe and the retail price do not depend on the dominant retailer's bargaining power. This makes the alternative situation uninteresting.

By taking the total derivative of the optimality condition given in (6) we calculate how the equilibrium wholesale price of the fringe changes in the bargaining power of the dominant retailer:

$$\frac{\partial w_f^*}{\partial \gamma} = \frac{\left(p^* - c - w_f^*\right) ns'(p^* - w_f^*) + ns(p^* - w_f^*)}{\partial^2 \pi_s / \partial w_f^2}. \tag{7}$$

Equation (6) implies that the nominator of $\frac{\partial w_f^*}{\partial \gamma}$ has the opposite sign of $\left(\frac{dp^*}{dw_f} - 1\right)$. Since the denominator is negative by the second-order condition, we get that

$$sign\left(\frac{\partial w_f^*}{\partial \gamma}\right) = sign\left(\frac{dp^*}{dw_f} - 1\right).$$

Intuitively, the pass-through rate of the fringe's wholesale price on the retail price determines whether the wholesale price of the fringe increases in the dominant retailer's bargaining power. We thereby obtain our first main result:

Proposition 1. *If the pass-through rate of the fringe's wholesale price on the retail price is higher than one, the fringe retailers pay a higher wholesale price when the dominant retailer's bargaining power improves. The opposite is true if the pass-through rate is below one.*

To see how the retail price reacts to changes in the bargaining power of the dominant retailer, we derive the retail price with respect to γ:

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

which shows that the impact of changes in γ on the equilibrium retail price depends on two considerations: How the wholesale price of the fringe affects the retail price and how γ affects the fringe's wholesale price. Equation (4) shows that the retail price increases in the fringe's wholesale price, $\frac{\partial p^*}{\partial w_f} > 0$, under C2, in which case the retail price reacts to the bargaining power of the dominant retailer, γ, in the same way as the fringe's wholesale price. The opposite is true when the retail price decreases in the fringe's wholesale price, $\frac{\partial p^*}{\partial w_f} < 0$, which is the case if C2 is violated.

As we mentioned earlier, the supplier and the dominant retailer indeed set the wholesale price w_d^* to induce p^*. In the analysis of their pricing decision, we show that they distort their wholesale price above zero to induce a price above the level maximizing their channel profits. The reason behind this distortion was the term accounting for the changes in the supplier's variable profits from the fringe: $nw_f s'(p^* - w_f)$. Any increase in this term leads to an increase in the dominant retailer's wholesale price. To determine how the dominant retailer's wholesale price changes in its bargaining power, we derive the distortion term with respect to γ :

$$
\begin{aligned}
sign\left(\frac{\partial w_d^*}{\partial \gamma}\right) &= sign\left(\frac{\partial\left[n w_f s'(p^* - w_f^*)\right]}{\partial \gamma}\right) \\
&= sign\left(\frac{\partial\left[n w_f s'(p^* - w_f^*)\right]}{\partial w_f}\frac{\partial w_f^*}{\partial \gamma}\right).
\end{aligned}
$$

Equation (5) shows that the manner in which the distortion changes with w_f depends on the convexity of the fringe's supply function. For supply functions which are sufficiently convex, the distortion decreases in w_f and therefore the dominant retailer's wholesale price moves to the opposite direction to the fringe's wholesale price when γ changes.

The signs of $\frac{\partial w_f^*}{\partial \gamma}$, $\frac{\partial p^*}{\partial \gamma}$ and $\frac{\partial w_d^*}{\partial \gamma}$ are not straightforward and depend on concavity/convexity of the demand and fringe's supply curves. The choice of assumptions to satisfy the second-order condition of the optimal contract with the dominant retailer, (1), is therefore critical for the conclusions. Recall that $C1$ and $C2$, which are assumptions of Chen (2003), are sufficient for the second-order condition to hold. Condition $C1$ is satisfied if the demand, $D(.)$, is not too convex and condition $C2$ holds if the fringe's supply, $s(.)$, is not too concave. We obtain three possible outcomes by relaxing either $C1$ or $C2$ while ensuring the second-order condition:

Case I. When both C1 and C2 hold, we have $0 < \frac{dp^*}{dw_f} < 1$ (see equation (4)), which implies that $\frac{\partial w_f^*}{\partial \gamma} < 0$ and $\frac{\partial p^*}{\partial \gamma} < 0$. In this case, both the wholesale price of the fringe and the retail price decrease in the bargaining power of the dominant retailer. The results of this case are the same as Chen (2003) except for our finding that the wholesale price of the dominant retailer is affected by its bargaining power. If the fringe's supply curve is not very convex, we have $\frac{\partial w_d^*}{\partial w_f} > 0$ from (5), and therefore we get $\frac{\partial w_d^*}{\partial \gamma} < 0$. The opposite is true otherwise.

Case II. When C2 holds and we have

$$2D'(p) + (p-c)D''(p) > 0,$$

in which case C1 does not hold, the second-order condition, (1), implies that $\frac{dp^*}{dw_f} > 1$, and therefore that $\frac{\partial w_f^*}{\partial \gamma} > 0$ and $\frac{\partial p^*}{\partial \gamma} > 0$. If, moreover, the fringe's supply curve is sufficiently convex, we have $\frac{\partial w_d^*}{\partial w_f} < 0$ from (5), and therefore $\frac{\partial w_d^*}{\partial \gamma} < 0$. Since the dominant retailer's bargaining power lowers its wholesale price at the expense of raising the fringe firms' wholesale price, we conclude that there are "waterbed effects". The results of this case are contrary to Chen's findings.

Case III. When C1 holds and we have

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

in which case $s(.)$ is necessarily concave and C2 does not hold, the second-order condition, (1), implies that $-1 < \frac{dp^*}{dw_f} < 0$, and therefore that $\frac{\partial w_f^*}{\partial \gamma} < 0$ and $\frac{\partial p^*}{\partial \gamma} > 0$. The concavity of the fringe's supply implies that $\frac{\partial w_d^*}{\partial w_f} > 0$ (see (5)), and therefore $\frac{\partial w_d^*}{\partial \gamma} < 0$. Here we have different results than Chen.

For other cases (when C2 holds, C1 does not hold but $2D'(p) + (p - c)D''(p) \leq 0$, or when C1 holds, C2 does not hold but $2s'(p - w_f) + (p - c)s''(p - w_f) \geq 0$) the conclusions of Case I apply. The following proposition summarizes these results:

Proposition 2. *How the dominant retailer's buyer power affects the equilibrium prices depends on the pass-through rate of the fringe's wholesale price on the retail price,* $\frac{dp^*}{dw_f}$:

As $\gamma \uparrow$	w_f^*	p^*	w_d^*
if $\frac{\partial p^*}{\partial w_f} \in (0,1)$	$\searrow$	$\searrow$	$\searrow$ if $s(.)$ is not too convex, $\nearrow$ otherwise.
if $\frac{\partial p^*}{\partial w_f} > 1$	$\nearrow$	$\nearrow$	$\searrow$ if $s(.)$ is not too convex, $\nearrow$ otherwise.
if $\frac{\partial p^*}{\partial w_f} < 0$	$\searrow$	$\nearrow$	$\searrow$

Compared to the findings of Chen,

CHEN:	w_f^*	p^*	w_d^*
As $\gamma \uparrow$	$\searrow$	$\searrow$	no effect

we obtain similar results when the pass-through of the fringe's wholesale price on to the retail price is between zero and one: The buyer power of the dominant retailer is good for the fringe firms and also for consumers. When the pass-through of the fringe's wholesale price is above one, contrary to Chen, we show that the buyer power of the dominant retailer is bad for the fringe firms and for consumers. For negative pass-through rates, different from Chen, we illustrate that the buyer power of the dominant retailer brings benefits to the fringe firms, but harms consumers. As opposed to Chen's suprising result that the dominant retailer's wholesale price is independent of its buyer power, we find that the dominant retailer's wholesale price could increase or decrease in its buyer power depending on the concavity/convexity of the fringe's supply curve.

Considering the impact of the buyer power on the equilibrium profits, we show the following:

Proposition 3. *When the dominant retailer's bargaining power increases, the profit of the supplier decreases, whereas the profit of the dominant retailer and the industry profits increase.*

We define the social welfare as the sum of the consumer surplus and the total industry profits:

$$W = \int_{p}^{\infty} D(x)dx + \pi_s + \pi_d \tag{8}$$

and show that

Proposition 4. *The social welfare decreases in the dominant retailer's bargaining power if and only if the pass-through of the fringe's wholesale price on the retail price is above one,*

$$\frac{\partial p^*}{\partial w_f} > 1,$$

or

$$\frac{\partial p^*}{\partial w_f} < 0 \text{ and } \gamma < \frac{D(p^*)}{ns(p^* - w_f^*)} \frac{\partial p^*/\partial w_f}{\partial p^*/\partial w_f - 1}.$$

Examples of above one pass-through rates: For homogeneous goods, sufficiently convex demands satisfy the condition to have above one pass-through rate:

$$2D'(p) + (p - c)D''(p) > 0.$$

A good example of this type of demand functions is Fabinger and Weyl (2008)'s "cost amplifying" demand functions,

$$D(p) = \frac{(a + p)^{-\alpha}}{b}$$

where $a+p > 0$, $b > 0$, $\alpha > 1$. Considering differentiated goods, empirical studies[20] find that for highly diffentiated product categories, the pass-through of input prices are above one. The given examples of such product categories are beer, dish detergent, and oat cereals.

One should be careful while interpreting the pass-through rate of the fringe's wholesale price on to the retail price because we consider asymmetric retailers in the sense that the dominant retailer first observes the wholesale price of the fringe listed by the supplier and

[20] See Besanko, Dubé and Gupta (2005); and Berck, Leibtag, Villas-Boas and Solis (2009).

then negotiates the retail price with the supplier, whereas the fringe firms are price-takers both in the upstream and downstream markets. To clarify the implications of our results, next section extends our framework to the case where the retailers are assumed to be asymmetric only in the downstream market:

4 Extension

Suppose that in the upstream market there is one supplier and in the downstream market there are two retailers competing in prices. The retailers are asymmetric in the sense that one of them, which is called as "dominant" retailer, is able to negotiate a contract with the supplier, whereas the other retailer, which we refer to as "weak" retailer, cannot negotiate a supply contract, but could only accept or reject the offer made by the supplier. The timing of the interactions is the following:

Stage I. The supplier makes a take-it-or-leave-it offer, (w_w, F_w), to the weak retailer, which in turn either accepts or rejects the offer. If the offer is accepted, contract (w_w, F_w) is signed and the retailer pays F_w.

Stage II. The supplier and the dominant retailer negotiate a contract that specifies the retail price of the dominant retailer, p_d, and the fixed fee to be paid by the retailer, F_d. Simultaneously, the weak retailer sets its retail price, p_w, and downstream competition takes place.

Let $D_i(p_d, p_w)$ denote the demand for retailer i's product, for $i = d, w$, when the dominant retailer's price is p_d and the weak retailer's price is p_w. In the Appendix, we solve the above game by backward induction and obtain the following result:

Proposition 5. *If the pass-through rate of the weak retailer's wholesale price on the dominant firm's retail price is high enough, more precisely if*

$$\frac{\partial p_d}{\partial w_w} > -\frac{\frac{\partial D_w}{\partial p_w}}{\frac{\partial D_w}{\partial p_d}} \equiv \psi,$$

the weak retailer's wholesale price, and thus the retail prices, are increasing in the bargaining power of the dominant retailer. Otherwise, the weak retailer's wholesale price, and thus the retail prices, are decreasing in the bargaining power of the dominant retailer.

Proposition 5 shows that to determine the implications of the dominant retailer's bargaining power on its weak rival's wholesale price and on the retail prices, one needs to determine whether the dominant retailer's pass-through of its rival's wholesale price on to its retail price is sufficiently high. If the retailers' products are perfect substitutes, $\frac{\partial D_w}{\partial p_w} = -\frac{\partial D_w}{\partial p_d}$, the threshold for the pass-trough rate, ψ, is then 1, which is the same as the threshold we have in our original setup where the dominant firm sets the retail price and the fringe retailers are price takers.

5 Conclusion

This paper analyzes how the buyer power of a dominant retailer affects consumers and its rivals when supply contracts are allowed to be non-linear and the dominant retailer faces a competitive fringe. Our framework builds on the setup of Chen (2003) where the supplier makes a take-it-or-leave-it two-part tariff supply offer to the fringe retailers, whereas the dominant retailer could negotiate its supply terms, secretly. Different from Chen, we find that the impact of the dominant retailer's buyer power (on the retail price, on the wholesale price of the fringe, and on the social welfare) depends on the pass-through rate of the fringe's wholesale price on to the retail price. If the pass-through rate is positive and below one, we get similar results to Chen's: The dominant retailer's buyer power is good for consumers as well as for the fringe retailers, since it reduces the retail price and the fringe's wholesale price. In this case, the social welfare (the sum of the consumer surplus and the industry profits) increases in the dominant retailer's bargaining power. On the other hand, if the pass-through rate is above one, we obtain the opposite: The dominant retailer's buyer power harms consumers and leads to a higher wholesale price for the fringe retailers. In this case, the social welfare is decreasing in the bargaining power of the dominant retailer. Moreover, if the fringe's supply function is sufficiently convex, the dominant retailer's wholesale price decreases in its buyer power. We therefore obtain a waterbed effect. For negative pass-through rates, we show that the buyer power of the dominant retailer harms consumers, even though it reduces the fringe's wholesale price and the dominant retailer's wholesale price. When the bargaining power of the dominant retailer is sufficiently low, the social welfare decreases in the dominant firm's buyer power. The opposite is true otherwise.

Looking at how the equilibrium profits change when the bargaining power of the dominant retailer increases, we show that, parallel to Chen's finding, the profit of the supplier decreases; different from Chen, the profit of the dominant retailer *always* increases; and as opposed to Chen's result, the industry profits increases.

Our framework is very similar to Chen's, but our results are different because, in modeling the bargaining between the upstream firm and dominant retailer, we take into account the surplus that the upstream firm receives from the fringe firms, which is ignored by Chen. Moreover, we assume that the dominant retailer and the supplier share their anticipated profits given that the supplier gets at least its outside option.

To derive policy implications from our results, it is necessary to determine whether the pass-through rate of the fringe firms' (or, in general, of the weak retailer's) wholesale price on to the dominant retailer's price is above one (or in general sufficiently high). For a product category where the pass-through rates are more likely to be above one, our results conjecture that the buyer power of a dominant retailer would be harmful to consumers, lead to higher input prices for weak retailers and reduce the total welfare. The opposite conclusions hold if the pass-through rates of input prices are positive and below one. Hence, we suggest a new tool, pass-through rate of input prices, to identify possible adverse effects of dominant retailers' buyer power. For homogeneous goods, sufficiently convex demands satisfy the condition to have above one pass-through rate. Empirical evidence shows that for product categories where products are highly differentiated, pass-through of input prices are very likely to be above one-for-one.

APPENDIX

Proof of Proposition 3.

We derive the profits in equilibrium with respect to the dominant retailer's bargaining power, γ. Applying the Envelope theorem to the supplier's equilibrium profit, we show that its derivative is negative:

$$\begin{aligned}\frac{\partial \pi_s^*}{\partial \gamma} &= -\left[(p^*-c)\left[D(p^*)-ns(p^*-w_f^*)\right]+nw_f s(p^*-w_f^*)\right] \\ &= -[+] < 0.\end{aligned}$$

By applying the Envelope Theorem to the dominant retailer's equilibrium profit, the derivative of the dominant retailer's profit is written as

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

Using the equilibrium condition (6), we rewrite the first term of the derivative and obtain

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

The results of Proposition 2 imply that the latter derivative is always positive. Finally, we calculate the derivative of the industry profit by summing up the two latter derivatives, since the fringe firms always get zero in equilibrium, and show that the industry profits increase in the buyer power of the dominant retailer: $\frac{\partial \pi_s^*}{\partial \gamma} + \frac{\partial \pi_d^*}{\partial \gamma} > 0$.

Proof of Proposition 4.

We derive the social welfare, (8),with respect to the dominant retailer's bargaining power at the equilibrium prices. Using the derivative of the industry profits (calculated in the proof of Proposition 3), we derive

$$\frac{\partial W^*}{\partial \gamma} = -D(p^*)\frac{\partial p^*}{\partial \gamma} + \gamma ns(p^* - w_f^*)\left[\frac{\partial p^*}{\partial w_f} - 1\right]\frac{\partial w_f^*}{\partial \gamma}$$

and by substituting partial derivative $\frac{\partial p^*}{\partial \gamma}$ by its equality, $\frac{\partial p^*}{\partial w_f}\frac{\partial w_f^*}{\partial \gamma}$, we get

$$\frac{\partial W^*}{\partial \gamma} = \left(-\left[D(p^*) - \gamma ns(p^* - w_f^*)\right]\frac{\partial p^*}{\partial w_f} - \gamma ns(p^* - w_f^*)\right)\frac{\partial w_f^*}{\partial \gamma}.$$

If $\frac{\partial p^*}{\partial w_f} > 1$, from Proposition 2, we have $\frac{\partial w_f^*}{\partial \gamma} > 0$ and therefore $\frac{\partial W^*}{\partial \gamma} < 0$. If $0 < \frac{\partial p^*}{\partial w_f} < 1$, Proposition 2 implies that $\frac{\partial w_f^*}{\partial \gamma} < 0$, and therefore that $\frac{\partial W^*}{\partial \gamma} > 0$. If $\frac{\partial p^*}{\partial w_f} < 0$, from Proposition 2, we have $\frac{\partial w_f^*}{\partial \gamma} < 0$, in which case $\frac{\partial W^*}{\partial \gamma} < 0$ if and only if the bargaining power of the dominant retailer is sufficiently low:

$$\gamma < \frac{D(p^*)}{ns(p^* - w_f^*)}\frac{\partial p^*/\partial w_f}{\partial p^*/\partial w_f - 1}.$$

The Solution to the Extension:

Stage II: Equilibrium retail prices: Taking (w_w, F_w) as given, the supplier and the dominant retailer set p_d to maximize their bilateral profits, Π_d, since they could share the maximized channel profits through F_d. They negotiate p_d by

$$\max_{p_d} \Pi_d = (p_d - c)\, D_d(p_d, p_w) + w_w D_w(p_d, p_w) \tag{9}$$

The first-order condition is

$$FOC_{p_d} : \frac{\partial \Pi_d}{\partial p_d} = D_d + (p_d - c)\frac{\partial D_d}{\partial p_d} + w_w \frac{\partial D_w}{\partial p_d} = 0, \tag{10}$$

which determines p_d as a function of w_w and p_w: $p_d(w_w, p_w)$. The distortion term $w_w \frac{\partial D_w}{\partial p_d} > 0$ would imply that $w_d^* > 0$.

Taking (w_w, F_w) as given, the weak retailer sets p_w by

$$\max_{p_w} \pi_w = (p_w - w_w) D_w(p_d, p_w) - \int_0^{D_w(p_d,p_w)} MC(x)dx \tag{11}$$

The first-order condition is

$$FOC_{p_w} : \frac{\partial \pi_w}{\partial p_w} = D_w + [p_w - w_w - MC(D_w(p_d, p_w))] \frac{\partial D_w}{\partial p_w} = 0, \tag{12}$$

which determines p_w as a function of w_w and p_d: $p_w(w_w, p_d)$.

Solving FOC_{p_d} and FOC_{p_w} together, we get the retail prices as functions of the weak retailer's wholesale price: $p_d(w_w)$ and $p_w(w_w)$.

To determine how the dominant retailer's wholesale price changes in its bargaining power, we derive the distortion term change with respect to w_w:

$$\frac{\partial}{\partial w_w}\left(w_w \frac{\partial D_w}{\partial p_d}\right) = \frac{\partial D_w}{\partial p_d} + w_w \left(\frac{\partial^2 D_w}{\partial p_d^2}\frac{\partial p_d}{\partial w_w} + \frac{\partial^2 D_w}{\partial p_d \partial p_w}\frac{\partial p_w}{\partial w_w}\right)$$

To calculate the partial derivatives of p_d and p_w with respect to w_w, we take the derivatives of FOC_{p_d} and FOC_{p_w}, and get respectively

$$SOC_{p_d}\frac{\partial p_d}{\partial w_w} + \frac{\partial^2 \Pi_d}{\partial p_d \partial p_w}\frac{\partial p_w}{\partial w_w} + \frac{\partial D_w}{\partial p_d} = 0$$

$$\frac{\partial^2 \pi_w}{\partial p_w \partial p_d}\frac{\partial p_d}{\partial w_w} + SOC_{p_w}\frac{\partial p_w}{\partial w_w} - \frac{\partial D_w}{\partial p_w} = 0$$

Solving together the latter equalities, we obtain

$$\frac{\partial p_d}{\partial w_w} = -\frac{SOC_{p_w}\frac{\partial D_w}{\partial p_d} + \frac{\partial^2 \Pi_d}{\partial p_d \partial p_w}\frac{\partial D_w}{\partial p_w}}{SOC_{p_d}SOC_{p_w} - \frac{\partial^2 \pi_w}{\partial p_w \partial p_d}\frac{\partial^2 \Pi_d}{\partial p_d \partial p_w}} \tag{13}$$

$$\frac{\partial p_w}{\partial w_w} = \frac{SOC_{p_d}\frac{\partial D_w}{\partial p_w} + \frac{\partial^2 \pi_w}{\partial p_w \partial p_d}\frac{\partial D_w}{\partial p_d}}{SOC_{p_d}SOC_{p_w} - \frac{\partial^2 \pi_w}{\partial p_w \partial p_d}\frac{\partial^2 \Pi_d}{\partial p_d \partial p_w}} \tag{14}$$

Prices are strategic complements if

$$\frac{\partial^2 \pi_w}{\partial p_w \partial p_d} > 0 \qquad \frac{\partial^2 \Pi_d}{\partial p_d \partial p_w} > 0,$$

which is assumed to be case. We moreover assume that the second-order effects of own price dominates the second-order effects of the rival's price:

$$|SOC_{p_d}| > \frac{\partial^2 \Pi_d}{\partial p_d \partial p_w} \qquad |SOC_{p_w}| > \frac{\partial^2 \pi_w}{\partial p_w \partial p_d}$$

We therefore show that

$$\frac{\partial p_d}{\partial w_w} > 0 \qquad \frac{\partial p_w}{\partial w_w} > 0.$$

First stage contracting: The supplier sets (w_w, F_w) by maximizing its profit subject to the weak retailer's participation constraint:

$$\max_{w_w, F_w} \pi_s = F_w + (1-\gamma)\Pi_d \qquad s.t. \qquad \pi_w - F_w \geq 0 \tag{15}$$

where the bilateral profit with the dominant retailer is

$$\Pi_d = (p_d - c)\, D_d(p_d, p_w) + w_w D_w(p_d, p_w)$$

and the weak retailer's gross profit is

$$\pi_w = (p_w - w_w) D_w(p_d, p_w) - \int_0^{D_w(p_d, p_w)} MC(x) dx.$$

Since the supplier's profit π_s is increasing in F_w, in equilibrium the constraint is binding, i.e., the supplier sets $F_w = \pi_w$ and w_w by

$$\max_{w_w} \pi_s = \pi_w + (1-\gamma)\Pi_d$$

The first-order condition is

$$FOC_{w_w} : \frac{\partial \pi_s}{\partial w_w} = \frac{\partial \pi_w}{\partial p_w}\frac{\partial p_w}{\partial w_w} + \frac{\partial \pi_w}{\partial p_d}\frac{\partial p_d}{\partial w_w} - D_w(p_d, p_w) + (1-\gamma)\left[\frac{\partial \Pi_d}{\partial p_w}\frac{\partial p_w}{\partial w_w} + \frac{\partial \Pi_d}{\partial p_d}\frac{\partial p_d}{\partial w_w} + D_w(p_d, p_w)\right] = 0$$

Substituting the first-order conditions of Stage II, equations (10) and (12), we get

$$FOC_{w_w} : \frac{\partial \pi_w}{\partial p_d}\frac{\partial p_d}{\partial w_w} - D_w(p_d, p_w) + (1-\gamma)\left[\frac{\partial \Pi_d}{\partial p_w}\frac{\partial p_w}{\partial w_w} + D_w(p_d, p_w)\right] = 0, \tag{16}$$

which implicitly characterizes the equilibrium wholesale price of the weak retailer, providing that the second order condition holds, $SOC_{w_w} : \frac{\partial^2 \pi_s}{\partial w_w^2} < 0$.

By taking the total derivative of FOC_{w_w}, we calculate how the equilibrium wholesale price of the weak retailer changes in the bargaining power of the dominant retailer:

$$\frac{\partial w_w}{\partial \gamma} = \frac{\frac{\partial \Pi_d}{\partial p_w}\frac{\partial p_w}{\partial w_w} + D_w(p_d, p_w)}{SOC_{w_w}}. \tag{17}$$

From FOC_{w_w}, equation (16), we have

$$sign\left(\frac{\partial \Pi_d}{\partial p_w}\frac{\partial p_w}{\partial w_w} + D_w(p_d, p_w)\right) = -sign\left(\frac{\partial \pi_w}{\partial p_d}\frac{\partial p_d}{\partial w_w} - D_w(p_d, p_w)\right)$$

We therefore get

$$sign\left(\frac{\partial w_w}{\partial \gamma}\right) = sign\left(\frac{\partial \pi_w}{\partial p_d}\frac{\partial p_d}{\partial w_w} - D_w(p_d, p_w)\right)$$

From FOC_{p_w}, equation (12), we have

$$D_w(p_d, p_w) = -\left[p_w - w_w - MC(D_w(p_d, p_w))\right]\frac{\partial D_w}{\partial p_w}.$$

Substituting

$$\frac{\partial \pi_w}{\partial p_d} = \left[p_w - w_w - MC(D_w(p_d, p_w))\right]\frac{\partial D_w}{\partial p_d}$$

and the equality of D_w into $\frac{\partial w_w}{\partial \gamma}$, we get

$$sign\left(\frac{\partial w_w}{\partial \gamma}\right) = sign\left(\left[p_w - w_w - MC(D_w(p_d, p_w))\right]\left[\frac{\partial D_w}{\partial p_d}\frac{\partial p_d}{\partial w_w} + \frac{\partial D_w}{\partial p_w}\right]\right)$$

Since $p_w - w_w - MC(D_w(p_d, p_w) > 0$, we conclude that

Case I. If $0 < \frac{\partial p_d}{\partial w_w} < -\frac{\frac{\partial D_w}{\partial p_w}}{\frac{\partial D_w}{\partial p_d}}$, then $\frac{\partial w_w}{\partial \gamma} < 0$, which implies that $\frac{\partial p_d}{\partial \gamma} < 0$ and that $\frac{\partial p_w}{\partial \gamma} < 0$.

Case II. If $\frac{\partial p_d}{\partial w_w} > -\frac{\frac{\partial D_w}{\partial p_w}}{\frac{\partial D_w}{\partial p_d}}$, then $\frac{\partial w_w}{\partial \gamma} > 0$, which implies that $\frac{\partial p_d}{\partial \gamma} > 0$ and that $\frac{\partial p_w}{\partial \gamma} > 0$.

References

[1] Battigalli, P., Fumagalli, C., and M. Polo (2007): "Buyer Power and Quality Improvement," Research in Economics, 61, 45–61.

[2] Bedre-Defolie, Ö. and S. Caprice (2008): "Inefficient Buyer Mergers To Obtain Size Discounts", Working Paper, Toulouse School of Economics and Ecole Polytechnique.

[3] Bedre-Defolie, Ö. and S. Caprice (2009): "Non-linear Supply Contracts and Retailers' Size Discounts", Working Paper, Toulouse School of Economics and Ecole Polytechnique.

[4] Berck, P., Leibtag, E. S., Villas-Boas, S. B. and Solis, A. (2009): "Patterns of Pass-through of Commodity Price Shocks to Retail Prices," UC Berkeley: Department of Agricultural and Resource Economics, UCB. CUDARE Working Paper No. 1082.

[5] Besanko, D., Dubé, J-P and S. Gupta (2005): "Own-Brand and Cross-Brand Retail Pass-Through," Marketing Science, 24(1), 123-137.

[6] Binmore, K., Rubinstein, A., and A. Wolinsky (1986): "The Nash Bargaining Solution in Economic Modelling," RAND Journal of Economics, 17, 176-188.

[7] Binmore, K., Shaked, A. and J. Sutton (1989): "An Outside Option Experiment," The Quarterly Journal of Economics, 104(4), pp. 753-770.

[8] Bonnet, C. and P. Dubois (2010): "Inference on Vertical Contracts between Manufacturers and Retailers Allowing for Non Linear Pricing and Resale Price Maintenance," Rand Journal of Economics, 41(1), 139-164.

[9] Chen, Z. (2003): "Dominant Retailers and the Countervailing Power Hypothesis," RAND Journal of Economics, 34, 612–625.

[10] Chipty, T. and C.M. Snyder (1999): "The Role of Firm Size in Bilateral Bargaining: A Study of the Cable Television Industry," Review of Economics and Statistics, 81, 326–340.

[11] The Competition Commission (2000): "Supermarkets: A report on the supply of groceries from multiple stores in the United Kingdom," Cm 4842, October.

[12] The Competition Commission (2007): "Research on Suppliers to the UK Grocery Market", prepared by GfK NOP, January.

[13] The Competition Commission (2008): "Market investigation into the supply of groceries in the UK," April.

[14] Dobson, P.W., Clarke, R., Davies, S., and M. Waterson (2001): "Buyer Power and its Impact on Competition in the Food Retail Distribution Sector of the European Union," Journal of Industry, Competition, and Trade, 1(3), 247-281.

[15] Dobson, P. W. and R. Inderst (2007): "Differential Buyer Power and the Waterbed Effect," European Competition Law Review, 28, 393-400.

[16] The European Commission (1999): "Buyer Power and Its Impact on Competition in the Food Retail Distribution Sector of the European Union," prepared by Dobson and Consulting, DGIV Study Contract No.IV/98/ETD/078.

[17] The European Commission (2001): "Guidelines on the Applicability of Article 81 of the EC Treaty to Horizontal Agreements," Office Journal C31/5-18.

[18] Fabinger, M. and G. Weyl (2008): "Pass-Through as an Economic Tool", working paper, Harvard University.

[19] The Federal Trade Commission (2001): "Report on the FTC Workshop on Slotting Allowances and Other Marketing Practices in the Grocery Industry."

[20] The Federal Trade Commission (2003): "Slotting Allowances in the Retail Grocery Industry: Selected Case Studies in Five Product Categories."

[21] Inderst, R. (2007): "Leveraging Buyer Power," International Journal of Industrial Organization, 25, 908-924.

[22] Inderst, R. and N. Mazzarotto (2008): "Buyer Power in Distribution," chapter for the ABA Antitrust Section Handbook, Issues in Competition Law and Policy , ed. W.D. Collins.

[23] Inderst, R and G. Shaffer (2007): "Retail merger, buyer power and product variety," Economic Journal 117-516, 45-67.

[24] Inderst, R. and G. Shaffer (2008): "The Role of Buyer Power in Merger Control," chapter for the ABA Antitrust Section Handbook, Issues in Competition Law and Policy , ed. W.D. Collins.

[25] Inderst, R. and T.M. Valletti (2009a): "Buyer Power and the 'Waterbed Effect'," Journal of Industrial Economics, forthcoming.

[26] Inderst, R. and T.M. Valletti (2009b): "Price Discrimination in Input Markets" The RAND Journal of Economics, 40(1), 1-19.

[27] Inderst, R. and C. Wey (2003): "Bargaining, Mergers, and Technology Choice in Bilaterally Oligopolistic Industries," The RAND Journal of Economics, 34(1), 1-19.

[28] Inderst, R. and C. Wey (2007): "Buyer Power and Supplier Incentives," European Economic Review, 51, 641–667.

[29] Inderst, R. and C. Wey (2009): "Countervailing Power and Dynamic Efficiency," Journal of European Economic Association, forthcoming.

[30] Katz, M.L. (1987): "The Welfare Effects of Third-Degree Price Discrimination in Intermediate Good Markets," The American Economic Review, 77, 154–167.

[31] Galbraith, J.K. (1952), American Capitalism: The Concept of Countervailing Power. Boston: Houghton Mifflin.

[32] Majumdar, A. (2006): "Waterbed effects, 'gatekeepers' and buyer mergers," mimeo.

[33] Mazzarotto, N. (2003): "Retail Mergers and Buyer Power," mimeo.

[34] O'Brien, D.P. and G. Shaffer (1992): "Vertical Control with Bilateral Contracts," RAND Journal of Economics, 23, 299-308.

[35] Segal, I. (1999): "Contracting with Externalities," The Quarterly Journal of Economics, 114(2), 337-388.

[36] Sheffman, D.T. and P.T. Spiller (1992): "Buyers' Strategies, Entry Barriers, and Competition," Economic Inquiry, 30, 418–436.

[37] Villas-Boas, S. B. (2007): "Vertical Relationships Between Manufacturers and Retailers: Inference With Limited Data," Review of Economic Studies, 74(2), 625-652.