



# Leveraging buyer power <sup>☆</sup>

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## Abstract

This paper analyzes the different channels through which the exercise of buyer power can both trigger and accelerate further concentration in the downstream (or retail) industry. We show how the existence of size-related discounts creates higher incentives for those buyers that are already large to grow even further, either through acquisitions or through investing in a more competitive offering. In addition, larger buyers gain additional market share as their rivals' purchasing terms deteriorate. We also investigate how, even though no firm exits the market, the growing concentration of the retail market can harm consumers.

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## 1. Introduction

The retailing industry has undergone a rapid pace of consolidation. As the presence of tight planning restrictions makes it often hard or even impossible to open up new outlets, growth is increasingly achieved via the acquisition of smaller competitors.<sup>1</sup> A two-pronged strategy that major retail chains seem to have adopted in order to still achieve growth is to both expand across borders and to move into new retail segments. Increasingly, shoppers may thus find that the large store that they patronize for their one-stop shopping trips is now operated by a foreign chain (say, by Wal-Mart, Lidl, Carrefour, or Tesco, to name but a few of the global players) or that their local

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<sup>1</sup> In the UK, four chains account for over 65% of total retail sales. The five-firm concentration ratio, a standard benchmark, is still higher in, for instance, Sweden, Denmark, and Switzerland, while the EU-15 average is around 50% (according to data from IGD European Grocery Retailing, 2005).

convenience store may now be an outlet of one of their national retail champions. In particular, the latter development seems to have considerably gathered pace more recently, with chains that previously only operated large store formats moving into the convenience store segment.

This seems particularly evident in the UK. In a recent report, the [Office of Fair Trading \(2006\)](#) writes that “... evidence suggests that the grocery market is evolving rapidly. The four largest supermarkets ... have moved into the convenience store sector, competing directly with smaller chains and independent stores.” This trend is clearly not confined to the UK alone<sup>2</sup>, though there it seems to have played a role in triggering yet another market inquiry into the grocery industry. Two of the key issues in this inquiry are the exercise of buyer power by the largest chains and whether competition can be distorted if they “leverage” their buyer power into other market segments.

Though the main issues raised in this paper extend beyond the area of retailing, for concreteness we chose to develop the model in the spirit of the literature on retailing. Our first ingredient is thus the “workhorse model” of Hotelling competition between outlets. Furthermore, our model has also several independent (geographically separated) markets. In the model, a firm can then grow either by making its offering more attractive in a given (local) market, thereby capturing a larger market share, or by acquiring outlets in other markets. In the case of an acquisition, absent coordinated effects that could arise from multi-market contact, horizontal concerns should not arise given that markets are independent. However, we show that through the exercise of buyer power even acquisitions in independent markets will have implications for welfare and consumer surplus.

A first implication of our model is that both types of growth, i.e., both organic growth in a given market and growth through acquisitions, lower the respective firm’s input price but increase that of competing outlets. Our focus in this paper is, however, on the role that buyer power can play in accelerating or even inducing a growing concentration in the downstream market. We find that buyers that already obtain a discount due to their size have higher incentives than their rivals to grow even further. This manifests itself, first, through a higher willingness to pay for the acquisition of another downstream firm, e.g., of another outlet or, likewise, of a plot of land to be developed in the case of retailing. Second, through size related discounts incentives to invest in a more competitive offering are higher for buyers that are already larger and more competitive while such incentives are stifled for their smaller rivals. Importantly, if a buyer controls several firms or outlets, then this holds even if the investment must be undertaken separately at each individual outlet, which precludes direct benefits from economies of scale.

Taken together, we thus find that the exercise of buyer power leads to a growing concentration of the downstream market through two different channels. First, the already larger buyer obtains an additional advantage, while the terms of trade of its rivals deteriorate, which further exacerbates differences in market share and size. Second, we find that the already larger buyer has higher incentives to grow even further, be it organically through investment in its own offering or through acquisition. Even if smaller rivals stay in the market, we would thus predict a creeping concentration, which is triggered and accelerated through the exercise of buyer power and through the thereby obtained differential purchasing terms.<sup>3</sup>

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<sup>2</sup> Though this only provides anecdotal evidence, it is telling that the UK’s market leader Tesco seems to have finally decided to enter the US market via the convenience store segment (“Wal-Mart, Kroger, Safeway Better Watch Out. The British Are Coming!”, CNNMoney.com, February 27, 2006).

<sup>3</sup> This abstracts from the possibility that over time there could arise alternative sources of competition, e.g., through different shopping formats in the case of retailing.

The papers most closely related are von Ungern-Sternberg (1996) and Dobson and Waterson (1997). These papers consider a single downstream market in which two firms merge, though after the merger all firms still have the same market share and pay the same wholesale price. Chen (2003) considers an exogenous shift in the bargaining power of a single large retailer and shows that a supplier may then wish to strategically set first a lower wholesale price for a competitive market fringe. Finally, several papers have analyzed the long-term implications of buyer power for product variety as well as product and process innovation (e.g., Chen, 2005; Battigalli et al., 2005; Inderst and Wey, 2005; Inderst and Shaffer, in press).<sup>4</sup>

The rest of this paper is organized as follows. Section 2 introduces the model. Section 3 analyzes the implications of the exercise of buyer power, taking first as exogenous the growth of a given buyer. In contrast, Section 4 makes growth endogenous. Section 5 concludes.

## 2. The basic model

We envisage  $n = 1, \dots, N$  symmetric markets. In each market, two firms or outlets, to which we refer to as  $A_n$  and  $B_n$ , compete in prices for the patronage of the mass one of consumers, each characterized by his “location” or preference  $x \in [0, 1]$ . A consumer purchases at most one unit of the good and derives the net utility  $u_n^A - p_n^A - xt$  when patronizing outlet  $A_n$  and paying the price  $p_n^A$ . Likewise, the consumer’s net utility is  $u_n^B - p_n^B - (1-x)t$  in case he patronizes outlet  $B$ .

Outlet  $A_n$  operates with constant marginal cost  $k_n^A$ , which consists of the outlet’s own marginal cost,  $c_n^A$ , and the marginal purchasing (or wholesale) price  $w_n^A$ . (We comment below in detail on the assumption of linear pricing.) If marginal costs are common knowledge and if some market  $m$  is fully covered, then the analysis of the retail equilibrium is straightforward.

First, for given prices  $p_n^A$  and  $p_n^B$ , the marginal consumer, who is just indifferent, is given by

$$\hat{x}_n = \frac{1}{2} + \frac{(u_n^A - p_n^A) - (u_n^B - p_n^B)}{2t}. \tag{1}$$

Next, in equilibrium the margins  $p_n^m - k_n^m$ , where  $m \in \{A, B\}$ , equal

$$p_n^m - k_n^m = t + \frac{(u_n^m - k_n^m) - (u_n^{m'} - k_n^{m'})}{3}. \tag{2}$$

The resulting equilibrium profits are finally given by

$$\pi_n^m = \frac{1}{2t} \left[ t + \frac{(u_n^m - k_n^m) - (u_n^{m'} - k_n^{m'})}{3} \right]^2. \tag{3}$$

Note that in the Hotelling framework, profits depend only on  $t$  and on the differences  $u_n^m - k_n^m$  and  $u_n^{m'} - k_n^{m'}$ . One part of our analysis will consider the possibility that a firm invests so as to improve its offering to consumers. As profits depend only on these differences, it will be inconsequential whether the investment of firm  $m$  goes into a reduction of own marginal cost  $c_n^m$  or an increase of  $u_n^m$ . To streamline the exposition, we will thus stipulate that  $u_n^m = u$  such that any differentiation is via firms’ costs.

<sup>4</sup> See Snyder (2005) or Inderst and Shaffer (2005) for an overview of other, less related contributions dealing with the formation and exercise of buyer power.

All outlets will be supplied by the same (incumbent) supplier in equilibrium. We also stipulate that one unit of the supplier's good is turned into one unit of final output by downstream firms. For simplicity, we also set the supplier's constant marginal cost equal to zero.

The supplier offers each downstream firm a potentially different constant wholesale price. If all outlets are independently owned, then each of them receives a separate offer  $w_n^m$ . If some outlets are owned by the same firm, then this buyer will obtain a single offer for all its outlets.

In our analysis, given linear wholesale prices it will be inconsequential whether the offer that another firm receives is observed by its competitors or not. Also, with linear wholesale prices buyer power manifests itself in a competitive advantage given that some of the resulting discount will be passed through to consumers. We can offer the following justifications for our assumption. First, even though retailing contracts are indeed often more complex, casual evidence suggests that for a wide range of products negotiated discounts are passed on, sometimes even immediately, to consumers.<sup>5</sup> Systematic evidence (e.g., as gathered for the UK in the [Competition Commission's 2000 Supermarket report](#)) documents also how large retailers enjoy substantial discounts. Second, we are aware of cases where for some products contracts between even large suppliers and retailers are fully linear, specifying a constant price per package or gallon. Third, in a competitive environment even lump-sum discounts, just as lower fixed costs, can be expected to be at least partially passed on to consumers in the long run. Finally, though this is outside the present model, from a theoretical perspective [Iyer and Villas-Boas \(2003\)](#) and [Milliou et al. \(2004\)](#) offer some support for the use of simple, linear contracts.

In our model, following [Katz \(1987\)](#) larger buyers will obtain a discount as they have a more attractive alternative source of supply. Precisely, we specify that the alternative supply option allows to procure a good of the same quality at a constant price of  $W_n^m$ , resulting thus for outlet  $m$  in market  $n$  in the new marginal cost  $K_n^m := c_n^m + W_n^m$ . (Note that we reserve capital letters for the respective values under the outside option.) We will let  $W_n^m$  depend on the respective buyer's choice of (off-equilibrium) investment, which could consist of setting up own production facilities, financing another supplier that may then produce a private-label variant of the good, or searching and locating an alternative supplier. Realizing a value  $W_n^m = \bar{W} - \Delta_n^m$  comes at expenditures  $e(\Delta_n^m)$ . We discuss properties of the function  $e$  below. Note, however, that the same technology applies to all downstream firms.

### 3. Two sources of growth and buyer power

#### 3.1. Organic growth

We now take first the growth of a buyer, which will result in a further discount, as exogenous. Moreover, we first let buyers differ only in own efficiency. It is then also convenient to drop for the time being the subscript  $n$ . Using expression (3), the profit of outlet  $m$  in the considered market would thus be equal to

$$\Pi^m := \frac{1}{2t} \left[ t + \frac{k^{m'} - k^m}{3} \right]^2$$

<sup>5</sup> As an anecdotal evidence, following a huge volume discount negotiated by Asda, a fully owned UK subsidiary of Wal-Mart, with DelMonte, it has been reported that Asda started a prolonged price war by cutting the price of loose bananas from 1.08 to 0.94 lb/kg (cf. [DFID, 2004](#)).

in case both outlets accept the supplier’s offer. If outlet  $m$  rejects the offer, then its profit is given by

$$\widehat{\Pi}^m := \max \left\{ \frac{1}{2t} \left[ t + \frac{k^{m'} - (c^m + \bar{W} - \Delta^m)}{3} \right]^2 - e(\Delta^m) \right\}, \tag{4}$$

where we have already substituted for  $W^m = \bar{W} - \Delta^m$ . Provided that outside options are sufficiently attractive, both wholesale prices  $w^m$  will be uniquely pinned down by the binding participation constraints (cf. the Proof of Proposition 1):

$$\Pi^m \geq \widehat{\Pi}^m \text{ for } m = A, B. \tag{5}$$

The supplier is now able to set a wholesale price  $w^m$  strictly above his own marginal cost of zero for two reasons. First, even if off equilibrium a firm chooses a corner solution with  $W^m = 0$ , thus matching the supplier’s own marginal costs, this comes at investment costs  $e(\Delta^m) > 0$ . The supplier can thus add a margin without losing the respective buyer. In addition, if such a corner solution is not optimal, then from  $W^m > 0$  the supplier can charge an even higher margin.

In what follows, we restrict for now the analysis to the case of a corner solution such that all buyers find it optimal to match the supplier’s (zero) marginal costs after investing  $e(\bar{W}) = \bar{e}$ . As will become clear in the Proof of Proposition 1, this allows to capture the attractiveness of the outside option by a single variable, namely the respective investment costs  $e$ . Below we show that if such a corner solution is not always optimal, then the discount for larger buyers becomes even higher, which strengthens our results.

We derive next two auxiliary results in Lemmas 1 and 2.

**Lemma 1.** *Holding wholesale prices constant we have that*

$$\left| \frac{\partial \widehat{\Pi}^m}{\partial c^m} \right| > \left| \frac{\partial \Pi^m}{\partial c^m} \right|. \tag{6}$$

**Proof.** We have that

$$\frac{\partial \Pi^m}{\partial c^m} = -\frac{1}{3t} \left[ t + \frac{k^{m'} - (c^m + w^m)}{3} \right],$$

$$\frac{\partial \widehat{\Pi}^m}{\partial c^m} = -\frac{1}{3t} \left[ t + \frac{k^{m'} - c^m}{3} \right],$$

such that the assertion follows immediately from our previous observation that  $w^m > W^m = 0$ .  $\square$

For an intuition for Lemma 1 note first that as profits are strictly convex in a firm’s marginal costs, a further reduction in own marginal costs has a larger impact on profits if marginal costs are already low. Lemma 1 then follows immediately as we already know that  $w^m > W^m = 0$  given that the supplier will optimally charge an additional margin so as to make the buyer just indifferent.

**Lemma 2.** *Holding a firm’s own wholesale price constant, we have that*

$$\left| \frac{\partial \widehat{\Pi}^m}{\partial k^{m'}} \right| > \left| \frac{\partial \Pi^m}{\partial k^{m'}} \right|. \tag{7}$$

**Proof.** The assertion follows immediately from  $w^m > W^m = 0$  and

$$\frac{\partial \Pi^m}{\partial k^{m'}} = -\frac{1}{3t} \left[ t + \frac{k^{m'} - (c^m + w^m)}{3} \right],$$

$$\frac{\partial \hat{\Pi}^m}{\partial k^{m'}} = -\frac{1}{3t} \left[ t + \frac{k^{m'} - c^m}{3} \right]. \quad \square$$

Lemma 2 relies now on the observation that a firm loses more from a reduction of its competitor's marginal costs if the firm has itself lower marginal costs. This observation together with the fact that  $w^m > W^m = 0$  then imply Lemma 2. Importantly, properties (6) and (7) are not specific to the Hotelling model. In contrast, the respective properties of the (reduced) profit functions hold quite generally and are used also in different strands of the literature, most notably in games of R&D competition. [Athey and Schmutzler \(2001\)](#) provide a detailed discussion of these conditions as well as a list of functional specifications, including the Hotelling model, for which they hold.

Lemmas 1 and 2 are now key for the following result.

**Proposition 1.** *In the case where downstream firms differ only in their own efficiency, there is a unique equilibrium for wholesale and retail prices. In a given market, the more efficient firm pays a lower wholesale price  $w^m$ , while following a reduction in its own marginal cost  $c^m$  its own wholesale price further decreases and that of its rival increases.*

**Proof.** See Appendix.

Proposition 1 follows intuitively from Lemmas 1 and 2. To see this, take firm  $m$  and hold first the wholesale price of its competitor  $w^{m'}$  fixed. We know from Lemma 1 that a reduction of  $c^m$  then increases  $\hat{\Pi}^m$  by more than  $\Pi^m$ . Consequently, to still satisfy the firm's participation constraint (5), the supplier has to reduce the respective wholesale price  $w^m$ . The firm's total marginal costs  $k^m$  decrease thus both due to the exogenous reduction in  $c^m$  and due to the subsequent reduction in the wholesale price  $w^m$ . Turning now to the competitor  $m'$ , we know from Lemma 2 that the reduction in  $k^m$  reduces  $\hat{\Pi}^{m'}$  by more than  $\Pi^{m'}$ . That is, the competitor's participation constraint is now slack. Consequently, the supplier will optimally raise the respective wholesale price  $w^{m'}$ . Note, in particular, that before the reduction in  $c^m$  (and the subsequent reduction also in  $w^m$ ) an increase in the competitor's wholesale price  $w^{m'}$  would not have been possible as the supplier already raised the price until the participation constraint was binding. It is the fact that firm  $m$  becomes more competitive, thereby also taking away market share from firm  $m'$ , which allows the supplier to increase  $w^{m'}$ .

We should note at this point that the Proof of Proposition 1 also makes precise the parameter restrictions that we must employ in order to ensure that all market shares, both on and off equilibrium, are interior and that the outside option sufficiently constrains the supplier.<sup>6</sup> In particular, what is required is that  $|c^A - c^B| < 3t$  and that the (off-equilibrium) investment costs  $\bar{e}$  are not too large.

Turning finally to retail prices, for the adversely affected firm there are two conflicting forces at work: the incentives to pass on some of the higher marginal costs into higher retail prices and the incentives to match its competitor's lower retail price, where the second effect depends on the fact that in the Hotelling model firms' strategies are strategic complements. From implicit differentiation of  $\Pi^B = \hat{\Pi}^B$  we have<sup>7</sup>

$$\frac{dw^{m'}}{dk^m} = -\frac{w^{m'}}{3t + k^m - k^{m'}}. \tag{8}$$

<sup>6</sup> For a broader discussion of such a “waterbed effect” see [Dobson and Inderst \(2007\)](#).

<sup>7</sup> Note that we use here and in what follows that currently the off-equilibrium marginal supply costs are  $W^m = 0$ .

Substituting into Eq. (8) the equilibrium prices for Eq. (2), we obtain

$$\frac{dw^{m'}}{dk^m} = -\frac{1}{6t} \frac{w^{m'}}{1-\hat{x}}, \tag{9}$$

where  $1-\hat{x}$  is the market share of firm  $B$ . Using once again the equilibrium Hotelling prices, we finally have

$$\frac{dp^{m'}}{dk^m} = \frac{1}{3} \left( 1 + 2 \frac{dw^{m'}}{dk^m} \right) = \frac{1}{9t} \frac{(1-\hat{x})3t - w^{m'}}{1-\hat{x}}. \tag{10}$$

We know from Lemma 2 that  $w^{m'}$  is higher the lower  $k^m$ , implying also a reduction in the market share  $1-\hat{x}$ . Hence, the numerator in Eq. (10) is strictly smaller the lower  $k^m$ . In particular, as the market share of firm  $m'$  becomes very small, we thus have that  $dp^{m'}/dk^m < 0$ . In other words, in this case the retail price of the competing outlet  $m'$  increases as  $m$  becomes more efficient and realizes, in addition, a larger discount. We make this formal in the following result.<sup>8</sup>

**Corollary 1.** *As one firm in a given market becomes increasingly efficient, e.g., as  $c^{m'} - c^m > 0$  becomes sufficiently large, then a further reduction in  $c^m$  will raise not only its rival's wholesale price  $w^{m'}$  but also its retail price  $p^{m'}$ .*

### 3.2. Growth through acquisitions

To focus on the case where a buyer grows through acquiring more (previously independent) firms or outlets, we stipulate now that all firms are equally efficient with  $c_n^m = c$ . There is also only one potentially large buyer owning a “chain” of  $n_C$  outlets. Consequently, the supplier has now three different participation constraints to consider, namely that for the chain, that for independent outlets competing with an outlet of the chain, and finally that for outlets in all other markets where only independent outlets compete. For the chain, the respective profits realized when accepting and when rejecting the supplier’s offer of  $w_C$ , while the competing independent outlets all accept  $w_1$ , are

$$\Pi_C := \frac{n_C}{2t} \left[ t + \frac{w_1 - w_C}{3} \right]^2,$$

$$\hat{\Pi}_C := \frac{n_C}{2t} \left[ t + \frac{w_1}{3} \right]^2 - \bar{e}.$$

Note that the chain only incurs the costs  $\bar{e}$  once when turning to its outside option. From his observation it already follows intuitively that the chain has (per unit) a more attractive outside option and should, therefore, command better purchasing conditions.

For the independent outlets we have next that

$$\Pi_1 := \frac{1}{2t} \left[ t + \frac{w_C - w_1}{3} \right]^2,$$

$$\hat{\Pi}_1 := \frac{1}{2t} \left[ t + \frac{w_C}{3} \right]^2 - \bar{e}.$$

<sup>8</sup> It can be shown as well that once  $c^B - c^A > 0$  becomes sufficiently large, implying that  $1-\hat{x}$ , becomes sufficiently small, then also the average price and total consumer surplus decrease.

Taken together, the equilibrium offers  $w_C$  and  $w_I$  for the  $n_C$  markets in which the chain operates are then pinned down by the two binding participation constraints  $\Pi_C = \bar{\Pi}_C$  and  $\Pi_I = \bar{\Pi}_I$ . For all other markets where only independent outlets compete the derivation is the same as previously.

**Proposition 2.** *In the case where firms differ in the number of outlets they control there exists a unique equilibrium for wholesale and retail prices. The chain, which controls more than one outlet, obtains the lowest wholesale price  $m_C$ . The independent outlets that compete with the chain pay strictly higher wholesale prices than both the chain and those outlets that compete against other independent outlets:  $w_C < w_{NC} < w_I$ . As the chain expands, its own wholesale price decreases while that of all other outlets that compete with the chain increases.*

**Proof.** See Appendix.

Recall that retail prices for the independent outlets that compete against outlets of the chain are affected by two conflicting forces as the chain grows further, namely a higher own wholesale price and a lower retail price prevailing at the chains' outlets. Recall that to determine which effect was stronger, we previously decomposed the overall change as follows. We considered a reduction in the total marginal cost of the chain, i.e., in the respective  $k_C = w_C + c$ , and derived the resulting increase in the rival's wholesale price  $w_I$  by moving along the participation constraint of the independent outlet. We can clearly adopt the same procedure now, which then results in condition (10) for the change in the independent firm's retail price. It should, however, be noted that if growth is achieved solely through acquisition, then the respective total marginal costs  $k_C$  and  $k_I$  are only affected by changes in the wholesale price. An immediate implication of this is that with respect to welfare, if size derives only from the number of outlets a buyer controls then any further acquisition will reduce welfare. In the Hotelling model, this follows immediately from the observation that welfare is maximized in case total "shoe-leather" cost are minimized (i.e., at  $\hat{x}=0.5$ ). If size derives instead from differences in own efficiency, then it is also well-known that with uniform wholesale prices the market share of the more efficient and thus larger firm would actually be too small, implying that at least a not too large discount would now be welfare increasing.<sup>9</sup>

We have finally the following result in analogy to Corollary 1.

**Corollary 2.** *If the market share of independent outlets that compete with an outlet of the chain is already sufficiently low, then a further acquisition undertaken by the chain will raise not only its rivals' wholesale price  $w^I$  but also their retail price  $p_I$ .*

### 3.3. Discussion

So far we stipulated that for all downstream firms it was optimal to invest (off equilibrium) into a reduction of the respective marginal costs of supply up to  $W_n^m = 0$ . As we argue now, if this was not the case then an increase in buyer power through growth would lead to an even greater difference in wholesale prices.

We take first the case where larger buyers are more efficient. If firms now optimally choose an interior solution  $0 < \Delta^m < \bar{W}$  and thus likewise  $0 < W^m < \bar{W}$ , then a reduction in one firm's own marginal cost  $c^m$  will lead to a lower value  $W^m$  but a higher value  $W^{m'}$ . To show this, we specify for the associated expenditures that  $e(0) = e'(0) = 0$  and that  $e' > 0$  for all values  $\Delta > 0$ . Furthermore,

<sup>9</sup> Unfortunately, as we do not obtain explicit solutions for wholesale prices, we can not establish whether for larger differences the shift in market share to the more efficient firm can become too excessive.

$e$  is assumed to be “sufficiently convex”, while to ensure an interior solution we stipulate that  $e' \rightarrow \infty$  as  $\Delta \rightarrow \bar{W}$ . Using Eq. (4), we can then apply the first-order condition for  $\Delta^m$

$$\frac{1}{3t} \left[ t + \frac{k^{m'} - (c^m + \bar{W}) + \Delta^m}{3} \right] - e'(\Delta^m) = 0, \tag{11}$$

from which we have with  $\Delta^m = \bar{W} - W^m$  that

$$\begin{aligned} \frac{dW^m}{dc^m} &= -\frac{d\Delta^m}{dc^m} = -\frac{1}{\text{SOC}} > 0 \\ \frac{dW^{m'}}{dk^{m'}} &= -\frac{d\Delta^{m'}}{dk^{m'}} = \frac{1}{\text{SOC}} < 0, \end{aligned} \tag{12}$$

where we use the second-order condition  $\text{SOC} = 1 - 9te''(\Delta^m) \leq 0$ .

To capture the difference between the case with a corner solution as  $W^m = 0$  and that where  $W^m$  is interior, we must make the following distinction. If we only consider a marginal change in  $c^A$  or  $k^A$ , by the envelope theorem we can ignore the adjustment of  $W^m$  when considering a change in  $\hat{I}^m$ . Otherwise, however, the change in  $\hat{I}^m$  is now larger (in absolute terms) as the optimal choice of  $W^m$  adjusts as well. This follows in turn as  $d^2\hat{I}^m / (dW^m dk^m) > 0$ . Consequently, in the case of organic growth where  $c^m$  is reduced, to still satisfy the participation constraint of firm  $m$  the supplier must reduce  $w^m$  by even more. This also leads to a larger increase in the competitor’s wholesale price  $w^{m'}$ .

We can now apply a similar argument to the case where growth is through acquisitions. This time the optimal choice of  $W^m$ , if interior, adjusts as the increase in the number of controlled outlets makes it optimal to invest in a more efficient alternative source of supply.

#### 4. Endogenous growth and leverage of buyer power

##### 4.1. Growth through acquisitions

We consider now firms’ incentives to grow and how these are affected by the exercise of buyer power. Here, it proves convenient to start the analysis with the case where (further) growth is through acquisitions. Precisely, we stipulate that firms can acquire a previously independent outlet and ask how incentives change with the size of the buyers. Here, we do not allow the immediate competitor of the firm to bid as this would lead to a monopolization of the market. Consequently, differences in firms’ willingness to pay are entirely driven by how this (differentially) affects wholesale prices through the exercise of buyer power.

In the first part of the analysis we suppose that firms currently differ in size only as they operate at different levels of efficiency in a given local market (cf. Section 3.2). Moreover, for brevity, namely to reduce the number of potential bidders, we further restrict consideration to the case with  $N=2$  independent markets.

Suppose thus that one outlet in market  $n=2$ , say outlet  $A_2$ , is up for sale. As a merger to monopoly in market  $n=2$  is ruled out, the two possible bidders are the firms controlling outlets  $A_1$  and  $B_1$ . Without loss of generality we suppose that  $A_1$  is operated more efficiently such that  $c_1^A < c_1^B$ .<sup>10</sup>

<sup>10</sup> Note that this excludes the case where both firms in market  $n=1$  have equal own marginal costs. Rather trivially, in this case both equilibria where either of the two firms makes the acquisition exist.

We abstract from the somewhat trivial case where  $A_1$  has a higher willingness to bid for outlet  $A_2$  as it can subsequently deploy also there a more efficient technology. We thus suppose that the acquisition leaves unaffected the efficiency at all outlets. Nevertheless, we find that the more efficient and thus already larger firm will have a higher willingness to pay. Unless this was prevented by antitrust authorities or local planning restrictions, the larger firm would then grow even further through the acquisition.

The higher willingness to pay originates from two sources. The first reason is that the already larger firm can lever an already lower wholesale price also into the new market. This follows intuitively from our previous arguments and is formalized next.

**Lemma 3.** *If the already larger firm operating in market  $n=1$ , namely firm  $A_1$  as  $c_1^A < c_2^A$ , takes over outlet  $A_2$ , then this leads to a larger reduction of the wholesale price paid by  $A_2$ .*

**Proof.** See Appendix.

The second argument for why  $A_1$  will end up making the acquisition relates to price changes in the home market,  $n=1$ . We know that the firm that makes the acquisition will enjoy a reduction in its own wholesale price, while the wholesale price of its competitor will increase. If the firm that is already larger and obtains thus a lower wholesale price also acquired the additional outlet, then this would further amplify the differences in marginal costs. In contrast, if the smaller firm caught up by making the acquisition, then this would reduce the differences in marginal costs. In the latter case, competition would increase and total industry profits would be strictly lower than in the former case. This effect provides the already larger and thus more competitive firm with an additional advantage when bidding for outlet  $A_2$ .<sup>11</sup>

**Proposition 3.** *In equilibrium, the larger firm in market  $n=1$ , namely firm  $c_1^A < c_2^A$  will take over outlet  $A_2$ .*

**Proof.** See Appendix.

Proposition 3 points to an interesting complementarity between the two possible sources of buyer power in our model. By Proposition 3, the firm that already realizes a larger share of the business in market  $n=1$  will in equilibrium grow further through the acquisition of the outlet in market  $n=2$ , given that it is willing to outbid its rival. The larger firm's already lower wholesale price will thus reduce even further, while that of its rival will increase.

Note now that the two arguments that lead to Proposition 3 did not rely on the source of the additional advantage of the larger firm. Consequently, they still apply if one firm already enjoys lower total marginal costs as it already operates a larger number of outlets and can thus command once again over a lower wholesale price. In an application of the previous arguments, it then follows that when two firms with the same level of efficiency but different numbers of outlets bid for the acquisition of an independent outlet, then the larger chain will end up making the acquisition. For brevity we omit a formal proof of this result, which follows closely that of Proposition 3.

**Proposition 4.** *If two firms only differ in the number of outlets that they already control, then the larger chain will end up taking over an outlet in an unrelated market that is up for acquisition.*

<sup>11</sup> Strictly speaking, the argument that total industry profits are lower presumes here that regardless of which firm takes over  $A_2$ , the respective changes in wholesale prices would be the same. However, using the explicit expressions for profits in the Hotelling model, this argument still survives when taking into account that the changes in wholesale prices are actually different depending on the identity of the acquirer.

#### 4.2. Endogenous organic growth

The results in the previous section concerned only one part of the complementarity between growth through acquisition and organic growth. We show that a chain that already operates more outlets has also more incentives to invest so as to reduce own costs.

To focus on the role of size measured by the number of controlled outlets, we suppose again that all outlets have initially the same level of efficiency. To obtain firms' incentives to become more efficient, it is important to recall that in our model a downstream firm's payoff is equal to the payoff that the firm derives from its outside option. Consequently, marginal incentives are obtained from differentiating the value of the respective outside option. For independent firms operating in markets  $n > n_C$ , where only independent outlets compete, the marginal benefits from reducing  $c_n^m = c$  are then given by

$$-\frac{d\widehat{\Pi}_{NC}}{dc_n^m} = \frac{1}{3t} \left[ t + \frac{w_{NC}}{3} \right], \quad (13)$$

where we used that both outlets pay the same wholesale price  $w_{NC}$  and have originally the same level of efficiency. It is interesting to note that incentives are increasing in the prevailing wholesale price. This is, however, only due to the fact that  $w_{NC}$  applies also to the competing outlet. In markets  $n \leq n_C$ , we have instead for the independent outlet the marginal incentives

$$-\frac{d\widehat{\Pi}_I}{dc_n^m} = \frac{1}{3t} \left[ t + \frac{w_C}{3} \right] \quad (14)$$

and for the chain the marginal incentives

$$-\frac{d\widehat{\Pi}_C}{dc_n^m} = \frac{1}{3t} \left[ t + \frac{w_I}{3} \right]. \quad (15)$$

Using from Proposition 2 that  $w_C < w_I < w_{NC}$ , we have from Eqs. (13)–(15) the following results.

**Proposition 5.** *The chain has higher marginal incentives to increase efficiency at each of its outlets than any of the independent outlets.*

Formally, Proposition 5 follows immediately from Lemma 2, where we noted that the benefits from a reduction in own marginal costs are higher if a competitor has higher marginal costs. As we start from a situation where all outlets initially operate at the same level of efficiency, the difference in total marginal costs is thus entirely due to the exercise of buyer power by the chain.

Taken together, Propositions 3, 4 and 5 thus point to a natural complementarity between organic growth and growth through acquisitions, which are mutually reinforcing through the creation and exercise of buyer power, resulting in ever lower wholesale prices for the ever larger buyer and ever higher wholesale prices at competing outlets.

## 5. Conclusion

The objective of this paper is twofold. First, we analyze how through a change in buyer power the growth of a downstream firm affects wholesale and retail prices at competing firms. Second,

we study the implications of this for firms’ incentives to grow further, both organically through investing in a more competitive offering to consumers and through acquisitions. Our particular application is to retailing, where the expansion of chains through the acquisition of previously independent outlets is of increasing concern to antitrust authorities even though it often does not entail any immediate lessening of competition.

Our analysis focuses on the short run, where product variety and quality as well as the number and location of outlets is taken to be fixed. Also, we keep our analysis simple by employing a particularly parsimonious model of buyer power in the spirit of Katz (1987). Here, larger buyers obtain a discount as their outside option is relatively more attractive. Both organic growth and growth through acquisitions then allow a firm to obtain additional discounts from its supplier. We show that at the same time the wholesale prices that the supplier can charge. to competing outlets will increase.

We also find that firms that are already larger have higher incentives to grow even further, which is triggered and amplified by the wholesale price difference between larger and smaller buyers. This also applies to both organic growth, i.e., to the incentives to invest in improving a firm’s offering to consumers, and to growth through acquisitions. In fact, these two dimensions of growth prove to be complementary. Our results thus point towards the potential for a creeping concentration of the downstream market, which is triggered and then further accelerated through the exercise of buyer power. The impact on consumers can be negative even if smaller firms still stay in the market. On the other hand, for these results we fully abstract from competition that could originate from entry or other sources, say other retail formats that develop over time. In particular, if a creeping concentration process would ultimately lead to a reduction in competition and to higher retail prices, consumers may be drawn to other retail formats.

## Appendix A

**Proof of Proposition 1.** We first establish conditions for when the equilibrium offers are uniquely pinned down by the two binding participation constraints in each of the  $N$  markets. Note again that for the moment, where each outlet is operated independently, we can treat all markets independently and have therefore dropped the respective subscript  $n$ . Note also that we conduct the argument for the case where off equilibrium each buyer chooses the corner solution by spending  $\bar{e} = e(\bar{W}) > 0$  in order to realize marginal costs of supply  $W^m = 0$ . Using that  $W^A = W^B = 0$  and expression (3) for profits, for firm  $m$  the participation constraint  $\Pi^m \geq \hat{\Pi}^m$  becomes

$$w^m [6t + 2(c^{m'} + w^{m'} - c^m) - w^m] \leq 18t\bar{e}. \tag{16}$$

If Eq. (16) is binding, then we obtain from total differentiation immediately expression (8) from the main text, namely that

$$\frac{dw^m}{dk^{m'}} = -\frac{w^m}{3t + k^{m'} - k^m}. \tag{17}$$

From Eq. (16) we can also obtain a first upper boundary on  $w^m$  by substituting  $w^{m'} = 0$  to obtain the requirement that

$$w^m \leq (3t + (c^{m'} - c^m)) - \sqrt{[3t + (c^{m'} - c^m)]^2 - 18t\bar{e}}. \tag{18}$$

Importantly, this upper boundary for  $w^m$  goes to zero as  $\bar{e} \rightarrow 0$ . Note also that we can now appeal to Eq. (18) to obtain for sufficiently low values of  $\bar{e}$  that, together with  $|c^A - c^B| < 3t$ , both on and off equilibrium both firms' market share is strictly positive. We argue next that for low  $\bar{e}$  both participation constraints must also bind. For this note first that the supplier's total profits  $V := \hat{\lambda} w^A + (1 - \hat{\lambda}^m) w^B$  and thus by

$$V = \left( \frac{1}{2} + \frac{(c^B + w^B) - (c^A + w^A)}{6t} \right) w^A + \left( \frac{1}{2} + \frac{(c^A + w^A) - (c^B + w^B)}{6t} \right) w^B$$

such that the sign of the (unconstrained) derivative w.r.t.  $w^A$  is given by

$$3t + (c^B - c^A) + 2(w^B - w^A). \tag{19}$$

For Eq. (20) we obtain again a lower boundary by substituting  $w^B = 0$  and for  $w^A$  the upper boundary from Eq. (18). This obtains for Eq. (19) the lower boundary

$$2\sqrt{[3t + (c^B - c^A)]^2 - 18t\bar{e}} - (3t + (c^B - c^A)), \tag{20}$$

which is always strictly positive if  $\bar{e}$  is sufficiently small. Hence, the requirement that Eq. (20) is strictly positive together with the symmetric requirement for  $w^B$  provide sufficient conditions to ensure that at least one participation constraint must bind. To show that both constraints must bind, we need, however, a stronger condition. We argue here to a contradiction and suppose that only the participation constraint for  $m=A$  binds. When increasing  $w^A$  in case the participation constraint for  $B$  already binds, we must lower  $w^B$  as prescribed by Eq. (17). The sign of  $dV/dw^A$  is then given by

$$[3t + (c^B - c^A) + 2(w^B - w^A)] - w^B \left( \frac{3t + (c^A - c^B) + 2(w^A - w^B)}{3t + (c^A - c^B) + (w^A - w^B)} \right). \tag{21}$$

While requiring that Eq. (20) be strictly positive is no longer sufficient for also Eq. (21) to be strictly positive, we know that the first term is bounded away from zero as  $\bar{e}$  decreases, while the second (negative) term goes to zero. This indeed implies that the total expression is again strictly positive for sufficiently low values of  $\bar{e}$ .

We show next for low values of  $\bar{e}$  that the solution to the system of the two binding participation constraints (16) is also unique.<sup>12</sup> For this we establish that the Jacobian matrix is strictly positive definite, which holds in turn if all principal minors are positive. To see that this is the case, note first that the derivative with respect to the own purchasing price  $w^m$  is strictly positive from  $k^m - k^{m'} < 3t$ . The determinant is next

$$D := 4 \prod_{m=A,B} [k^m - k^{m'} + 3t] - 4 \prod_{m=A,B} w^m, \tag{22}$$

which is also strictly positive, at least for low  $\bar{e}$ , as the first term is bounded away from zero while from Eq. (18) the second term converges to zero as we decrease  $\bar{e}$ .

<sup>12</sup> It is straightforward to establish existence after noting that the two binding participation constraints define two continuous mappings between  $w^A$  and  $w^B$  and that from our previous arguments it must hold that  $w^m \in [0, \bar{w}]$  for some upper boundary  $\bar{w}$  for  $m \in A, B$ .

To complete the proof we have to show the asserted monotonicity of  $w^A$  and  $w^B$  in  $c^m$ . For this it proves to be more instructive to use directly Lemmas 1 and 2 instead of substituting the explicit expressions for on- and off-equilibrium profits. That is, using  $\Pi^m - \hat{\Pi}^m = 0$  for  $m=A,B$  we then have first that

$$\frac{dw^m}{dc^m} = \frac{\frac{\partial \Pi^{m'}}{\partial k^{m'}} \left[ \frac{\partial \hat{\Pi}^m}{\partial k^m} - \frac{\partial \Pi^m}{\partial k^m} \right] + \left[ \frac{\partial \hat{\Pi}^m}{\partial k^{m'}} - \frac{\partial \Pi^m}{\partial k^{m'}} \right] \left[ \frac{\partial \hat{\Pi}^{m'}}{\partial k^m} - \frac{\partial \Pi^m}{\partial k^m} \right]}{D} > 0,$$

where we used that  $D > 0$  together with  $\frac{\partial \Pi^{m'}}{\partial k^{m'}} < 0$  and  $\frac{\partial \hat{\Pi}^m}{\partial k^m} < \frac{\partial \Pi^m}{\partial k^m}$  from Lemma 1. Next, we have that

$$\frac{dw^m}{dc^{m'}} = \frac{\frac{\partial \Pi^{m'}}{\partial k^{m'}} \left[ \frac{\partial \hat{\Pi}^m}{\partial k^{m'}} - \frac{\partial \Pi^m}{\partial k^{m'}} \right] + \left[ \frac{\partial \hat{\Pi}^{m'}}{\partial k^m} - \frac{\partial \Pi^m}{\partial k^m} \right] \left[ \frac{\partial \hat{\Pi}^m}{\partial k^{m'}} - \frac{\partial \Pi^m}{\partial k^{m'}} \right]}{D} < 0,$$

where we now used again that  $D > 0$  next to  $\frac{\partial \hat{\Pi}^m}{\partial k^{m'}} > \frac{\partial \Pi^m}{\partial k^{m'}}$  from Lemma 2.  $\square$

**Proof of Proposition 2.** Note first that the determination of wholesale prices ( $w_C, w_I$ ) is independent from that of  $w_{NC}$ . Regarding the determination of ( $w_C, w_I$ ), we can clearly still apply all derivations from the proof of Proposition 1 to show for low  $e$  that a unique solution is pinned down by the two binding participation constraints, now for the chain and the competing independent outlets. Moreover, note that though  $n_C$  is a discrete variable, the respective expressions  $\Pi_C$  and  $\hat{\Pi}_C$  are defined for all real-valued  $n_C$ .

We can next derive in analogy to (22) the determinant

$$D := 4 \prod_{n=C,I} [k_n - k_{n'} + 3t] - 4 \prod_{n=C,I} w^n > 0,$$

which always holds for low  $e$  and where we use  $n=C,I$  in a slight abuse of notation. We have next that

$$\begin{aligned} \frac{dw_C}{dn_C} &= - \frac{d(\bar{e}/n_C)}{dn_C} \frac{\partial \Pi_I}{\partial k_I} \frac{1}{D} < 0, \\ \frac{dw_I}{dn_C} &= - \frac{d(\bar{e}/n_C)}{dn_C} \left( \frac{\partial \hat{\Pi}_I}{\partial k_C} - \frac{\partial \Pi_I}{\partial k_C} \right) \frac{1}{D} > 0, \end{aligned} \tag{23}$$

where we also make use of Lemma 2. Note finally that  $w_C < w_{NC}$  and  $w_I > w_{NC}$  follow immediately from applying the derivatives in Eq. (23).  $\square$

**Proof of Lemma 3.** We now have to combine the derivations in Proposition 1, where firms differed only in their efficiency, and Proposition 2, where firms differed only in the number of outlets they control. If  $w_C$  denotes again the wholesale price that the chain, i.e., the combination of an outlet in market  $n=1$  and outlet  $A_2$ , pays then the assertion in Lemma 3 follows if  $w_C$  is both increasing in the own marginal costs of the acquiring outlet and decreasing in the own marginal costs of the competing outlet in market  $n=1$ . To show this, we can without loss of generality suppose that  $A_1$  acquires  $A_2$  such that we have to show that  $d^{w_C}/dc_1^A > 0$  and  $d^{w_C}/dc_1^B < 0$ .

The complication is that we now have to simultaneously derive the three wholesale prices ( $w_C, w_1^B, w_2^B$ ), which given that the chain operates in both markets are all interdependent. (Note that in

Proposition 2 all independent outlets with which the chain competed were symmetric.) For the independent outlets in markets  $n=1,2$ , the participation constraint is now  $\Pi_n^B \geq \widehat{\Pi}_n^B$  with

$$\Pi_n^B := \frac{1}{2t} \left[ t + \frac{(c_n^A - c_n^B) + (w_C - w_n^B)}{3} \right]^2,$$

$$\widehat{\Pi}_n^B := \frac{1}{2t} \left[ t + \frac{(c_n^A - c_n^B) + w_C}{3} \right]^2 - \bar{e}$$

Next, for the chain we define in a slight abuse of notation

$$\Pi_C = \sum_{n=1,2} \Pi_{C,n} \text{ with } \Pi_{C,n} = \frac{1}{2t} \left[ t + \frac{(c_n^B - c_n^A) + (w_n^B - w_C)}{3} \right]^2$$

and likewise

$$\widehat{\Pi}_C = \sum_{n=1,2} \widehat{\Pi}_{C,n} - \bar{e} \text{ with } \widehat{\Pi}_{C,n} = \frac{1}{2t} \left[ t + \frac{(c_n^B - c_n^A) + w_n^B}{3} \right]^2$$

to obtain again the requirement that  $\Pi_C \geq \widehat{\Pi}_C$ .

As in the Proof of Proposition 1, the first steps are again to show that for low  $\bar{e}$  all participation constraints are indeed binding by optimality and that this gives rise to a unique solution. For brevity’s sake we omit the first step, where the arguments are analogous to those in the proof of Proposition 1. Furthermore, to show that the Jacobian matrix of the system of now three equations is positive definite, we restrict ourselves to showing that the determinant of the whole system is strictly positive for low  $\bar{e}$ . As the expressions become otherwise rather unwieldy, define the functions  $\varphi_C := \widehat{\Pi}_C - \Pi_C$  and likewise  $\varphi_n^B := \widehat{\Pi}_n^B - \Pi_n^B$  to obtain for the determinant

$$D = \frac{\partial \varphi_C}{\partial w_C} \frac{\partial \varphi_1^B}{\partial w_1^B} \frac{\partial \varphi_2^B}{\partial w_2^B} - \frac{\partial \varphi_1^B}{\partial w_C} \frac{\partial \varphi_C}{\partial w_1^B} \frac{\partial \varphi_2^B}{\partial w_2^B} - \frac{\partial \varphi_2^B}{\partial w_C} \frac{\partial \varphi_C}{\partial w_2^B} \frac{\partial \varphi_1^B}{\partial w_1^B}. \tag{24}$$

The first term in Eq. (24) is strictly positive and bounded away from zero for low  $\bar{e}$ . In contrast, using that  $\partial \varphi_C / \partial w_n^B = 2w_C$  and  $\partial \varphi_n^B / \partial w_C = 2w_n^B$  we have again that the second and third term in Eq. (24) converge to zero as  $\bar{e}$  becomes small.

We next have  $dw_C/dc_1^A = -D_C/D$ , which is strictly negative as asserted given that

$$D_C = \frac{\partial \varphi_C}{\partial c_1^A} \frac{\partial \varphi_1^B}{\partial w_1^B} \frac{\partial \varphi_2^B}{\partial w_2^B} - \frac{\partial \varphi_1^B}{\partial c_1^A} \frac{\partial \varphi_C}{\partial w_1^B} \frac{\partial \varphi_2^B}{\partial w_2^B} < 0,$$

where we use again Lemmas 1 and 2. Finally, from Lemmas 1 and 2 we also obtain  $dw_C/dc_1^B = -D_B/D < 0$  with

$$D_B = \frac{\partial \varphi_C}{\partial c_1^B} \frac{\partial \varphi_1^B}{\partial w_1^B} \frac{\partial \varphi_2^B}{\partial w_2^B} - \frac{\partial \varphi_1^B}{\partial c_1^B} \frac{\partial \varphi_C}{\partial w_1^B} \frac{\partial \varphi_2^B}{\partial w_2^B} > 0. \quad \square$$

**Proof of Proposition 3.** To deal with both possible cases, namely that where either  $A_1$  acquires outlet  $A_2$  or that where this is done by  $B_1$ , we have to introduce some additional notation. If  $A_1$

undertakes the acquisition, we now denote the resulting equilibrium input prices at the various outlets by  $\hat{w}_n^m$ , where  $\hat{w}_1^A = \hat{w}_2^A$ , while for an acquisition by  $B_1$  we denote the respective input prices by  $\tilde{w}_n^m$ , where now  $\tilde{w}_1^B = \tilde{w}_2^A$ . Consequently, for  $A_1$  the willingness to pay for the acquisition is the difference between the profits after the acquisition

$$\frac{1}{2t} \left[ t + \frac{(c_1^B - c_1^A) + \hat{w}_1^B}{3} \right]^2 + \frac{1}{2t} \left[ t + \frac{(c_2^B - c_2^A) + \hat{w}_2^B}{3} \right]^2 - \bar{e}$$

and the profits

$$\frac{1}{2t} \left[ t + \frac{(c_1^B - c_1^A) + \tilde{w}_1^B}{3} \right]^2 - \bar{e}$$

if  $B_1$  makes the acquisition. Rearranging terms, this difference transforms to

$$\frac{1}{2t} \left[ t + \frac{(c_2^B - c_2^A) + \hat{w}_2^B}{3} \right]^2 + \left[ \frac{1}{2t} \left[ t + \frac{(c_1^B - c_1^A) + \hat{w}_1^B}{3} \right]^2 - \frac{1}{2t} \left[ t + \frac{(c_1^B - c_1^A) + \tilde{w}_1^B}{3} \right]^2 \right]. \tag{25}$$

Proceeding likewise, we have for  $B_1$  the willingness to pay

$$\frac{1}{2t} \left[ t + \frac{(c_2^B - c_2^A) + \tilde{w}_2^B}{3} \right]^2 + \left[ \frac{1}{2t} \left[ t + \frac{(c_1^A - c_1^B) + \tilde{w}_1^A}{3} \right]^2 - \frac{1}{2t} \left[ t + \frac{(c_1^A - c_1^B) + \hat{w}_1^A}{3} \right]^2 \right] \tag{26}$$

We want to show that Eq. (25) strictly exceeds Eq. (26). This in turn holds surely if both

$$\left[ t + \frac{(c_2^B - c_2^A) + \hat{w}_2^B}{3} \right]^2 > \left[ t + \frac{(c_2^B - c_2^A) + \tilde{w}_2^B}{3} \right]^2 \tag{27}$$

and

$$\left[ t + \frac{(c_1^B - c_1^A) + \hat{w}_1^B}{3} \right]^2 - \left[ t + \frac{(c_1^B - c_1^A) + \tilde{w}_1^B}{3} \right]^2 > \left[ t + \frac{(c_1^A - c_1^B) + \tilde{w}_1^A}{3} \right]^2 - \left[ t + \frac{(c_1^A - c_1^B) + \hat{w}_1^A}{3} \right]^2. \tag{28}$$

Note first that Eq. (27) holds if  $\hat{w}_2^B > \tilde{w}_2^B$ , which follows from Lemma 3. In the rest of the proof, we show that also Eq. (28) holds.

Rearranging we obtain

$$\left[ t + \frac{(c_1^B - c_1^A) + \hat{w}_1^B}{3} \right]^2 + \left[ t + \frac{(c_1^A - c_1^B) + \hat{w}_1^A}{3} \right]^2 > \left[ t + \frac{(c_1^B - c_1^A) + \tilde{w}_1^B}{3} \right]^2 + \left[ t + \frac{(c_1^A - c_1^B) + \tilde{w}_1^A}{3} \right]^2, \tag{29}$$

which reflects the comparison of industry profits under the two scenarios. If we substitute now more generally  $(w^A, w^B)$  on either side of Eq. (29), then the sign of the total derivative w.r.t. the two wholesale prices is given by

$$(dw^A - dw^B)(c_1^A - c_1^B) + dw^A w^A + dw^B w^B. \quad (30)$$

By our previous results we know that for low  $\bar{e}$  the sign of Eq. (30) is only determined by the first term given that  $w^A$  and  $w^B$  are close to zero. From  $c_1^A < c_1^B$  the sign is then always negative whenever  $dw^A > 0$  or  $dw^B < 0$ . Note finally that from  $\hat{w}_1^A < \tilde{w}_1^A$  and  $\hat{w}_1^B > \tilde{w}_1^B$  we indeed arrive at the right-hand side of Eq. (29) by a decrease in  $w^B$  and an increase in  $w^A$ .  $\square$

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