Non-linear Supply Contracts and the Implications of Retailers' Size Discounts

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Abstract

How does buyer power of retailers affect consumers? It is a big debate among economists and competition authorities. We contribute to this debate by introducing widely used non-linear supply contracts in the analysis. We measure buyer power of a retailer by its endogenous size. Assuming diseconomies of scale upstream, we show that a larger retailer gets size discounts (or lower average tariff) from the supplier. A buyer merger between outlets active in different markets is therefore profitable When the merging outlets are from symmetric retail markets, different from the literature we show that size discounts are neutral for consumer prices because non-linear supply contracts simply transfer profits from the supplier to the large retailer (or the merged entity) without altering the marginal purchasing cost of the merging parties. In this case, the size discounts for the large retailer do not change profits of smaller retailers. Going further beyond the literature, we show how and when size discounts affect consumer prices if the merging parties are from retail markets that are asymmetric in their degree of competition. In this case, the buyer merger, and thus size discounts, change retail prices if retailers could observe their rival's contract before competing. If retail competition is in price (quantity), the buyer merger decreases (increases) the consumer surplus from the less competitive market and increases (decreases) the consumer surplus from the more competitive market. Overall, the buyer merger results in a lower total quantity regardless of the type of retail competition. Discounts to the large retailer result in lower profits for its small rival, i.e., there exists a waterbed effect, in the more competitive market only if retail competition is in price. Otherwise, there are anti-waterbed effects, i.e. smaller retailers earn more post-merger.

Keywords Non-linear supply contracts, size discounts, buyer merger, waterbed effects.

JEL Classifications D43, K21, L11, L13, L42.

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1 Introduction

In the last decades, the grocery retailing has become increasingly consolidated both in Europe and in the US[1], mainly because of continuous acquisitions and mergers.[2] This process has given rise to many large retail chains, like Wal-Mart, Carrefour, Tesco, improving retailers' bargaining position (or buyer power) vis-à-vis their suppliers. Many studies have analyzed the implications of buyer power on consumers[3] and whether (and when) it might raise concerns for competition authorities.[4] The mainstream argument is that the exercise of buyer power results in lower purchasing costs for retailers which in turn lead to lower consumer prices.[5] However, this is not necessarily true if supply contracts are multi-part tariff,[6] since buyer power might not lower the marginal cost of the retailer, given that the retailer could obtain discounts from its supplier in forms of lower fixed fees.

Our analysis contributes to this debate by introducing non-linear supply contracts in the analysis.[7] Since the *size* of a retailer is seen as a main determinant of its buyer power,[8] we measure buyer power by size. As in Chipty and Synder (1999)[9]; convex production costs of the manufacturer result in discounts for a larger buyer (size discounts). To focus on the effects of a retailer's *endogenous* size on its supply contract, we introduce a large retailer through a merger between two outlets active in different retail markets (a *buyer merger*).[10] When the merging outlets are from symmetric retail markets, we illustrate that size discounts are neutral for the marginal purchasing cost of the merging parties, and thus neutral for consumer prices. Going further beyond the literature, we show how and when

[1]The concentration ratio of the five largest retailers (C5) in the 15 member countries of the EU is on average 50%, whereas C5 is around 70% in Sweden, Denmark and Switzerland (IGD European Grocery Retailing, 2005). According to the Competition Commission's report (2008), the UK's top 4 grocery retailers account for 75% of total retail sales. In the US, C4 is 31% (The US Census Bureau, Retail Trade, 2002).

[2]See the European Commission's report (1999) (p.55-78).

[3]For a recent survey on these issues, see Inderst and Mazzarotto (2008) or Caprice and Schlippenbach (2008).

[4]See the FTC reports (2001, 2003) in the US, the CC's reports (2000, 2008) in the UK, and the EC's report (1999). Dobson et al. (2001) provide a nice overview of the European retail industry and policy reactions to retailers' buyer power.

[5]This argument is also known as "countervailing-power hypothesis" (see Galbraith (1952), Chen (2003)).

[6]Bonnet and Dubois (2008), and Berto Villas-Boas (2007) find evidence that manufacturers and retailers use non-linear supply contracts in France and in the US. Parallel to their results, the supplier survey conducted in the UK shows strong evidence for non-linear supply contracts (the CC (2007)).

[7]See also Bedre and Caprice (2009) who consider quantity-forcing supply contracts. Chen (2003) considers two-part tariff supply contracts. However, different from our analysis, he measures bargaining power by an exogeneous variable and does not model downstream competition as oligopoly, but instead considers a price-setter dominant firm competing against price-taker fringe firms.

[8]See e.g. the EC's analyses on merger cases Rewe/Meinl (1999) and Carrefour/Promodes (2000).

[9]The literature measures buyer power mostly by size, e.g.,Katz (1987), Sheffman and Spiller (1992), Inderst and Wey (2007a). Alternatively, Chen (2003) measures buyer power by the buyer's exogeneous share over the gains from trade with the supplier.

[10]Such a merger does not raise any horizontal concerns, so we could easily isolate effects of buyer power on vertical contracts.

size discounts affect consumer prices if the merging parties are from retail markets that are asymmetric in terms of their degree of competition. In this case, the buyer merger, and thus size discounts, change retail prices if retailers could observe their rival's contract before competing. The impact of the buyer merger on the consumer surplus depends on the type of retail competition. If retail competition is in price, the merger decreases the consumer surplus from the less competitive market and increases the consumer surplus from the more competitive market. If retail competition is in quantity, the merger decreases the consumer surplus from the more competitive market and increases the consumer surplus from the less competitive market. Overall, the buyer merger results in a lower total quantity in the retail markets regardless of the type of retail competition.

The EC Guidelines argue that lower purchasing costs for powerful buyers are at the expense of higher costs for other buyers, since "the supplier would try to recover price reductions for one group of customers by increasing prices for other customers ..."[11] This mechanism, which is also known as a *waterbed effect*, has recently received some theoretical foundations[12]. A waterbed effect is mostly defined in terms of changes in wholesale prices. Considering non-linear supply contracts, this definition would be misleading since it ignores the possible changes in the average supply tariff. We instead say that there is a waterbed effect when lower purchasing costs of a large retailer (the merged entity) lead to lower equilibrium profits for a small retailer. In the case of symmetric retail markets, we have found no waterbed effect at work, mainly because non-linear supply contracts transfer profits from the supplier to the larger buyer without affecting consumer prices. Our results therefore support the UK Competition Commission's claim: "with multi-part tariffs, waterbed effects would less likely to be materialized". On the other hand, when the retail markets are asymmetric in their competitiveness, we show that when retail competition is in price, the buyer merger results in a waterbed effect only in the more competitive market, whereas it leads to anti-waterbed effects in the less competitive market. Under quantity competition, the buyer merger results in anti-waterbed effects in both markets.

We consider one monopoly manufacturer supplying two locally competitive retail markets and two retailers competing in each local market.[13] We suppose that retailers offer simultaneously two-part tariff contracts, including a unit price and a fixed fee, to the manufacturer, which in turn either accepts or rejects each offer. If a contract is accepted, the corresponding retailer pays the fixed fee at the signature of the contract, and then sets its instrument (price or quantity) competing in the retail market. We consider two possible situations for a retailer's information on its rival's contract: secret contracts and ex-post observable contracts.

[11] Guidelines in the applicability of Article 81 of the EC Treaty to horizontal cooperation agreements (2001/C3/02), paragraph 126.

[12] See Inderst (2007), Inderst and Valetti (2008), Majumdar (2006).

[13] Note that our results could easily be extended to $m > 2$ locally competitive retail markets and $n > 2$ retailers competing in each market.

In the former case, retailers do not observe the terms of their rival's contract. In equilibrium, each retailer sets its wholesale price at the marginal cost of the manufacturer to maximize its bilateral profit with the supplier taking other supply contracts as given. After the buyer merger, the equilibrium wholesale prices are again at the marginal cost of the manufacturer (so retail prices are the same as before), the merging parties pay a lower average tariff, and other retailers pay the same average tariff than before. In the case of secret contracts, the result that size discounts are neutral for retail prices is robust whether retailers compete in prices or quantities, and whether retail markets are symmetric or asymmetric. In the case of ex-post observable supply contracts, each retailer observes the terms of its rival's contract before competition takes place in the retail market. When retailers compete in prices (respectively in quantities), they set wholesale prices above (respectively below) the marginal cost of the manufacturer to signal a more aggressive behavior in the following retail competition. Whether the buyer merger affects the equilibrium wholesale prices (and thus retail prices) depends on whether the retail markets are symmetric or asymmetric. When retail markets are symmetric, the buyer merger, and thus size discounts, are neutral for wholesale prices, and thus for retail prices, since the large retailer sells the same quantity at each of its stores. However, when retail markets are asymmetric such that one market is more competitive than the other, the large retailer sets a wholesale price between the pre-merger wholesale price of the less competitive retail market and that of the more competitive market. Before the merger, in Bertrand (respectively Cournot) competition, the wholesale price would be higher (respectively lower) in the more competitive retail market. When retailers compete in price, the buyer merger raises (respectively lowers) the wholesale price, and thus the retail price, of the merging party in the less (respectively more) competitive market. However, for quantity competition, the merger raises (respectively lowers) the wholesale price, and thus the retail price, of the merging party in the more (respectively less) competitive market. The prices of smaller retailers react to these changes according to the type of retail competition.

In general, our paper is related to the literature of vertical contracting with externalities.[14] Like in Martimort and Stole (2003), Marx and Shaffer (2004), and Miklos-Thal, Rey, and Vergé (2008), while making a supply contract offer to a common manufacturer, each retailer has incentives to free-ride on the margin of its rival by lowering its wholesale price below the level that would induce the vertically integrated monopoly prices. Different from this literature, we analyze how the size of a retailer (or a buyer merger) impacts its supply contract and how this affects the equilibrium retail prices.

Section 2 presents our general framework. In section 3, we characterize the equilibrium supply contracts and retail prices when supply contracts are secret. Section 4 presents the analysis of ex-post observable contracts. We give our main results in Section 5, where we

[14] See Segal (1999), Segal and Whinston (2003), Hart and Tirole (1990), O'Brien and Shaffer (1992), and McAfee and Schwartz (1994).

introduce a buyer merger and illustrate its impact on the equilibria of the two contractual situations. We conclude in Section 6. All formal proofs are presented in the Appendix.

2 The Model

We consider a vertical industry where one monopoly upstream firm (or supplier) sells its product to two locally competitive retail markets, which are assumed to be symmetric. In each local market there are 2 downstream firms (or retailers) which use the upstream firm's product as an input to produce their retail goods, where the downstream production is one output for one input.[15] Competing retailers sell imperfect substitutes.

The supplier's cost of producing q units is $C(q)$, which is assumed to be twice continuously differentiable, strictly increasing: $C'(q) > 0$, and strictly convex: $C''(q) > 0$. Retailers are assumed to be symmetric in their costs of retailing (or distribution) and their retailing costs are normalized to zero.

The contract between the supplier and retailer i is a two-part tariff of form $T_i(q_i) = F_i + w_i q_i$, where F_i is the fixed fee paid by retailer i to the supplier at the signature of the contract and w_i is the unit price of each input to be purchased by retailer i. The timing of contracting between the upstream firm and retailers is the following:

Stage 1. Retailers simultaneously make take-it-or-leave-it contract offers to the upstream firm. The upstream firm decides which offer(s) to accept.

Stage 2. All acceptance and rejection decisions become public knowledge. The retailers which have a contract with the supplier choose their instruments: retail prices or output levels, and purchase the necessary amounts of the input from the supplier.

The demand for retailer i's product is defined as $q_i \equiv q(p_i, p_j)$ where p_j refers to the price of retailer i's rival. We make the following assumptions on demand functions: for $\forall i = 1, 2, 3, 4,$

A1. $\partial_{p_i} q_i < 0$: Each retailer's demand is decreasing in its own price.

A2. $\partial_{p_j} q_i > 0$: Each retailer's demand is increasing in its rival's price, i.e., competing retailers are selling substitutes.

A3. $|\partial_{p_i} q_i| > \partial_{p_j} q_i$: The own price effect dominates the cross price effect, i.e., the substitution between competing retailers is imperfect.

[15] Note that our qualitative results could easily be extended to a more general setup where there are $m \geq 2$ locally competitive retail markets and in each local market there are $n \geq 2$ competing retailers.

A4. The function q_i is twice continuously differentiable in its first argument and satisfies

$$\partial_{p_i} q_i + p_i \partial^2_{p_i} q_i < 0,$$

to ensure that the profit of each retailer is concave in its instrument (price or quantity), so attains its maximum at a unique price (or quantity).

Consider retailer i which has a contract with the supplier. If retailer i's rival, retailer j, does not have a contract with the manufacturer, retailer i will be the local monopoly. In this case, we define retailer i's demand as $q_i^m \equiv q\left(p_i, p_j^0\right)$, where p_j^0 is the virtual price of retailer j that makes the demand for retailer j equal to zero: $q\left(p_j^0, p_i\right) = 0$, and its inverse demand is defined as $p_i^m \equiv p\left(q_i, 0\right)$.

If the upstream firm has contracts with all retailers, the flow profit of the upstream firm is

$$\Pi_U = \sum_{i=1}^{4} w_i q_i - C\left(\sum_{i=1}^{4} q_i\right),$$

and its net profit is given by $\sum_{i=1}^{4} F_i + \Pi_U$. Let Π_U^{-i} denote the flow profit of the upstream firm if it rejected only retailer i's contract:

$$\Pi_U^{-i} = w_j q_j^m + \sum_{k \neq i,j} w_k q_k - C\left(q_j^m + \sum_{k \neq i,j} q_k\right),$$

in which case the net profit of the upstream firm is $\sum_{k \neq i} F_k + \Pi_U^{-i}$. If a retailer, say retailer i, has a supply contract, its gross profit is defined as

$$\Pi_i = \left(p_i - w_i\right) q_i,$$

and its net profit is given $\Pi_i - F_i$.

Hart and Tirole (1990), O'Brien and Shaffer (1992), McAfee and Schwartz (1994) consider vertical contracting where the manufacturer has all bargaining power and show that when supply offers made by the manufacturer are secret, the manufacturer sets its wholesale price at its marginal cost because it is not able to commit not to give secret discounts to any retailer. In our setup, like in Martimort and Stole (2003), Marx and Shaffer (2004), and Miklos-Thal, Rey, and Vergé (2008), retailers make the offers to a common manufacturer, so there is no possibility of opportunism by the manufacturer, but instead retailers have incentives to free-ride on the margin of their rival by lowering their wholesale price below the level that would induce the vertically integrated monopoly prices.

3 Secret Contracts

In this section we suppose that retailers never observe the terms of other retailers' supply contracts, but only observe which retailers have contracts with the supplier. Retailers which have contracts set their prices taking their rival's price as given.[16] Retailer i's problem is

$$\max_{p_i} \left[\Pi_i - F_i\right]. \tag{1}$$

A4 ensures the concavity of the problem, so the first-order condition characterizes retailer i's equilibrium price as a function of its wholesale price, $p_i(w_i)$, taking its rival's price as given:

$$FOC_{p_i} : \frac{\partial \Pi_i}{\partial p_i} = q_i + (p_i - w_i)\, \partial_{p_i} q_i = 0. \tag{2}$$

The solution to (2) for $\forall i = 1, 2, 3, 4$, characterizes the Nash equilibrium of retail competition when all retailers have contracts: $\{p_i^* \equiv p(w_i, w_j) \ for\ \forall i = 1, 2, 3, 4\}$. If the rival of retailer i, that is retailer j, has no contract with the supplier, in the problem we replace retailer i's demand by q_i^m, which is the monopolistic demand for retailer i (see the previous section for its definition).

In Stage I, retailers simultaneously determine their contract offer to the upstream firm without observing their rival's supply contract. Retailer i chooses contract (F_i, w_i) to maximize its profit providing the supplier with at least its outside option, which is the profit of the supplier if it is not dealing with retailer i:

$$\max_{F_i, w_i} \left[\Pi_i - F_i\right] \qquad s.t. \qquad F_i + \sum_{k \neq i} F_k + \Pi_U \geq \sum_{k \neq i} F_k + \Pi_U^{-i}. \tag{3}$$

Since the retailer's profit is decreasing in its fixed fee, the constraint is binding in equilibrium. After plugging the binding constraint into the problem, retailer i's problem is re-written as

$$\max_{w_i} \left[\Pi_i + \Pi_U - \Pi_U^{-i}\right],$$

or

$$\max_{w_i} \left[p_i q_i - C\left(q_i + q_j + \sum_{k \neq i,j} q_k\right) + w_j q_j - \left(w_j q_j^m - C\left(q_j^m + \sum_{k \neq i,j} q_k\right)\right)\right], \tag{4}$$

where price p_i, and therefore quantity q_i are functions of w_i, but neither price p_j nor quantity q_j does depend on w_i. Since retailer j does not observe w_i, it does not change its price (or quantity) as response to changes in w_i. Obviously non-rival retailers' demands, $\{q_k\}_{k \neq i,j}$,

[16] We present our results for price competition and note only the differences for quantity competition when it is necessary.

do not depend on w_i. The objective function in (4) clearly shows that in every equilibrium retailer i chooses w_i to maximize its bilateral profit with the supplier keeping other supply contracts fixed.[17] Intuitively, when setting its wholesale price, a retailer does not internalize the effect of its wholesale price on the profit of its rival. Starting from the wholesale price which induces the maximum industry profit, each retailer has an incentive to free-ride on its rival's margin by lowering its wholesale price.[18] Using the optimality condition (2) and the Envelope theorem, we therefore show that in equilibrium each retailer sets its wholesale price at the marginal cost of the upstream firm[19]:

$$w_i^* = w^* = C'\left(\sum_{i=1}^{4} q_i^*\right) \qquad for \quad i = 1, 2, 3, 4. \tag{5}$$

Since the upstream firm would be ready to sell any unit at its marginal cost, in equilibrium it accepts all contract offers to collect positive fixed fees. The equilibrium conditions (2) and (5) yield the optimal prices:

$$p_i^* = C'\left(\sum_{i=1}^{4} q_i^*\right) - \frac{q_i^*}{\partial_{p_i} q_i^*}, \tag{6}$$

where $q_i^* = q\left(p_i^*, p_j^*\right)$. The following lemma summarizes the results so far:

Lemma 1. When retailers make secret two-part tariff supply offers to the manufacturer, equilibrium contracts are bilaterally *efficient*, i.e., the marginal price of the input is equal to the marginal cost of the manufacturer.

Note that the bilateral efficiency result is very general. In particular, it is robust to assuming Cournot competition in each retail market and/or asymmetric retailers and/or different degree of competition in each retail market.

In equilibrium, we have $p_i^* = p_j^* = p^*$ and $q_i^* = q^*$ for $\forall i = 1, 2, 3, 4$. Each retailer then pays the fixed fee equal to

$$F^* = C\left(4q^*\right) - C\left(2q^* + q^{m*}\right) - C'\left(4q^*\right)\left[2q^* - q^{m*}\right], \tag{7}$$

where q^{m*} refers to the equilibrium quantity of a retailer when its rival has no contract with the supplier.

[17] Retailers use their wholesale prices to achieve their optimal retail price. Since wholesale prices are unobservable, we could simply combine two control variables, wholesale price and retail price, into one, retail price, and simplify the analysis of unobservable contracts by assuming that each supply contract consists only of a fixed fee.

[18] See Marx and Shaffer (2004).

[19] The second-order condition holds by A4.

Each retailer's equilibrium payoff is

$$\pi^* = p^* q^* - [C(4q^*) - C(2q^* + q^{m*})] + C'(4q^*)(q^* - q^{m*}), \tag{8}$$

4 Ex-post Observable Contracts

Suppose now that retailers observe their rival's wholesale price before choosing their price in Stage II. Retailer i sets its price by solving problem (1), $\max_{p_i} [\Pi_i - F_i]$, where the only difference is that each retail price reacts to its rival's wholesale price, not only to its own wholesale price as in the secret contracts analysis. Solving the optimality condition (2) for $i = 1, 2, 3, 4$, we get the Nash equilibrium of retail competition when all retailers have a contract with the supplier: $\{p_i(w_i, w_j) \; for \; \forall i = 1, 2, 3, 4\}$. If retailer j has no contract with the supplier, we replace retailer i's demand by $q_i^m(p_i)$, which is the monopolistic demand for retailer i (see Section 3 for its definition). In Stage I, each retailer determines its contract offer to the upstream firm taking into account that its rival's price and quantity will react to its wholesale price in the following stage. Recall that retailer i's problem in Stage I is

$$\max_{w_i} \left[p_i q_i - C\left(q_i + q_j + \sum_{k \neq i,j} q_k \right) + w_j q_j - \left(w_j q_j^m - C\left(q_j^m + \sum_{k \neq i,j} q_k \right) \right) \right].$$

Retailer i chooses w_i to maximize its bilateral profit with the supplier taking into account the fact that its rival reacts to changes in w_i. Using the optimality condition of retail competition, (2), and the Envelope theorem, we derive the first-order condition for retailer i as:

$$\sum_{t=i,j} \left[w_t - C'\left(\sum_{i=1}^{4} q_i \right) \right] \partial_{p_i} q_t \partial_{w_i} p_i + \left[w_j - C'\left(\sum_{i=1}^{4} q_i \right) \right] \partial_{p_j} q_j \partial_{w_i} p_j \tag{9}$$
$$+ \left[p_i - C'\left(\sum_{i=1}^{4} q_i \right) \right] \partial_{p_j} q_i \partial_{w_i} p_j = 0.$$

It is straightforward to see that in any symmetric equilibrium each retailer sets its wholesale price different than the marginal cost of the upstream firm. We denote the equilibrium of ex-post observable contracts by superscript **. When downstream instruments are strategic complements, which is the case when retailers compete in prices, retail prices increase in the rival's wholesale price, $\partial_{w_i} p_j > 0$. In this case, the equilibrium wholesale prices are above the marginal cost of the supplier, $w_i^{**} > C'\left(\sum_{i=1}^{4} q_i^{**}\right)$. Symmetrically, when downstream instruments are strategic substitutes, which is the case when retailers compete in quantities, retail prices decrease in the rival's wholesale price, $\partial_{w_i} p_j < 0$. In this case, the equilibrium wholesale prices are going to be below the marginal cost of the supplier, $w_i^{**} < C'\left(\sum_{i=1}^{4} q_i^{**}\right)$.

Lemma 2. When competing retailers make ex-post observable two-part tariff supply offers to the manufacturer, equilibrium contracts are bilaterally *inefficient*, i.e., the marginal price of the input is different than the marginal cost of the manufacturer. If retailers compete à la Bertrand, the unit price is above the upstream marginal cost. If retailers compete à la Cournot, the unit price is below the upstream marginal cost.

The bilateral inefficiency is originated from the observability of the rival's wholesale price before retail competition. By setting a wholesale price, each retailer alters its rival's reaction in the way to raise its profits. If retail competition is à la Bertrand, in symmetric equilibrium, each retailer sets a wholesale price above the marginal cost of the supplier in order to signal its rival that it is going to be a less fierce competitor, and thereby to raise its rival's retail price. If retailers compete à la Cournot, in symmetric equilibrium, each retailer sets a wholesale price below the marginal cost of the supplier in order to signal its rival that it is going to be a tough competitor, and thereby to contract its rival's output. McAfee and Schwartz (1994) show that a similar bilateral inefficiency occurs when one monopoly manufacturer makes take-it-or-leave-it two-part tariff offers to its competing retailers and offers are ex-post observable. By choosing a wholesale price, the manufacturer can change retailers' downstream choices in order to increase each retailer's expected profit, and thus its fixed fee.[20]

In equilibrium, $w_i^{**} = w^{**}$, $p_i^{**} = p^{**}$ and $q_i^{**} = q^{**}$ such that these values satisfy equilibrium conditions: (9) and (2) for $\forall i = 1, 2, 3, 4$. Each retailer then pays the fixed fee equal to

$$F^{**} = C\left(4q^{**}\right) - C\left(2q^{**} + q^{m**}\right) - w^{**}\left(2q^{**} - q^{m**}\right), \tag{10}$$

where q^{m**} refers to the equilibrium quantity of a retailer when its rival has no contract with the supplier.

Each retailer's equilibrium payoff is given by

$$\pi^{**} = p^{**}q^{**} - \left[C\left(4q^{**}\right) - C\left(2q^{**} + q^{m**}\right)\right] + w^{**}\left(q^{**} - q^{m**}\right), \tag{11}$$

Comparing the total equilibrium quantity in the case of ex-post observable contracts versus in the case of secret contracts, we conclude that when retailers compete in price, in the equilibrium of ex-post observable contracts, the total quantity is smaller. However, when retailers compete in quantity, in the equilibrium of ex-post observable contracts the total quantity is larger.

[20] In the case of strategic substitutes, as in McAfee and Schwartz, we face equilibrium inexistence problem since the input prices could be so below the manufacturer's marginal cost that the resulting retail price would be below combined costs and thus result in negative overall profit.

5 Buyer Merger and Size Discounts

We extend the model by introducing a single large retailer l as a result of a merger between 2 outlets which are active in different markets. Such a merger does not raise any horizontal concerns, so we could easily isolate its effects on vertical contracts. We call other retailers which run only one outlet as *small retailers.* The timing and the nature of contracting is the same as before, the only difference is that in the last stage each outlet of the large retailer competes against one small retailer. We denote the wholesale price and the fixed fee of the large retailer respectively by w_l and F_l. Retailer l pays F_l once it signs its contract with the supplier and pays w_l for each unit quantity it sells at its outlets.

Since the two markets are symmetric, retailer l sets the same price, denoted by p_l, at each of its outlets and each small retailer sets the same price, denoted by p_s. We therefore denote the demand for each outlet of the large retailer by $q_l \equiv q(p_l, p_s)$ and the demand for each small retailer by $q_s \equiv q(p_s, p_l)$. Demand functions q_l and q_s are assumed to satisfy assumptions A1-A4.

In Stage II, if all retailers have a contract with the supplier, retailer l chooses p_l by maximizing its profit taking as given the price of small retailers

$$\max_{p_l} (2\Pi_l - F_l) = [2(p_l - w_l) q_l - F_l]. \tag{12}$$

A small retailer chooses p_s by $\max_{p_s} (\Pi_s - F_s) = [(p_s - w_s) q_s - F_s]$. The first-order conditions of these problems are symmetric and the same as the equilibrium condition pre-merger, equation (2), for $i = l, s$

$$FOC_{p_i} : \frac{\partial \Pi_i}{\partial p_i} = q_i + (p_i - w_i) \partial_{p_i} q_i = 0, \tag{13}$$

which characterizes the Nash equilibrium of retail competition when all retailers have a contract with the supplier:$\{p_l(w_l, w_s), p_s(w_s, w_l)\}$. Retailer i's equilibrium price reacts only to its wholesale price when contracts are secret and reacts both to its wholesale price and its rival's wholesale price when contracts are ex-post observable. If the rival of retailer i has no contract with the supplier, we replace retailer i's demand by q_i^m, which is the monopolistic demand for retailer i (see Section 3 for its definition)

In Stage I, retailer s's problem is the same as before the merger, which is given in equation (4) for $i = s$, whereas retailer l chooses (w_l, F_l) by

$$\max_{F_l, w_l} [2\Pi_l - F_l] \qquad s.t. \qquad F_l + \sum_{k \neq l} F_k + \Pi_U \geq \sum_{k \neq l} F_k + \Pi_U^{-l}. \tag{14}$$

After plugging the binding constraint into the problem, retailer l's problem is re-written as

$$\max_{w_l} \left[2\Pi_l + \Pi_U - \Pi_U^{-l}\right],$$

or

$$\max_{w_l} \left[2p_l q_l - C\left(2q_l + 2q_s\right) + 2w_s q_s - \left(2w_s q_s^m - C\left(2q_s^m\right)\right)\right], \tag{15}$$

Price p_i and quantity q_i are functions of w_i for $i = l, s$. When contracts are secret, neither the rival's price, p_j, nor its quantity q_j depend on w_i since retailer j does not observe w_i. In this case, retailer i chooses w_i to maximize its bilateral profit with the supplier taking other supply contracts as given, and thus sets, for $i = l, s$,

$$w_i^* = w^* = C'\left(\sum_{i=1}^{4} q_i^*\right). \tag{16}$$

Using the equilibrium condition,(13), we therefore show that equilibrium prices are the same as before the merger:

$$p_i^* = C'\left(\sum_{i=1}^{4} q_i^*\right) - \frac{q_i^*}{\partial_{p_i} q_i^*}, \tag{17}$$

where $q_i^* = q\left(p_i^*, p_j^*\right)$. In equilibrium, we have $p_i^* = p_j^* = p^*$ and $q_i^* = q^*$ for $\forall i = 1, 2, 3, 4$, and retailer l pays a fixed fee equal to

$$F_l^* = C\left(4q^*\right) - C\left(2q^{m*}\right) - 2C'\left(4q^*\right)\left[2q^* - q^{m*}\right]. \tag{18}$$

where q^{m*} refers to the quantity sold by a retailer when it is local monopolist. It is straightforward to show that the total quantity sold in a market is higher when there is retail competition, $2q^* > q^{m*}$.

Given that the upstream cost function is convex and $2q^* > q^{m*}$, the merging parties pay a lower fixed fee than the sum of the fixed fees they were paying before the merger,

$$F_l^* < 2F^* = 2C\left(4q^*\right) - 2C\left(2q^* + q^{m*}\right) - 2C'\left(4q^*\right)\left[2q^* - q^{m*}\right].$$

Intuitively, the large retailer negotiates a larger quantity with the supplier which has a convex cost function, and thus has a higher incremental contribution to the industry profit than the small retailers. As a result, the large retailer pays a lower average tariff, i.e., gets size discounts. The merger is therefore profitable:

$$\pi_l^* = 2p^* q^* - \left[C\left(4q^*\right) - C\left(2q^{m*}\right)\right] + 2C'\left(4q^*\right)\left(q^* - q^{m*}\right) > 2\pi^*, \tag{19}$$

On the other hand, small retailers pay the same fixed fee, and thus earn the same profit as pre-merger, for $s \in S$,

$$F_s^* = F^* \qquad \pi_s^* = \pi^*. \tag{20}$$

To sum up, when supply contracts are secret, the large retailer gets size discounts from the supplier, however size discounts for the large retailer do not alter either equilibrium prices or the supply terms of the small retailers.

When contracts are ex-post observable, the rival's price, p_j, and its quantity q_j do depend on w_i since each retailer observes the contract of its rival before setting its instrument. In this case, the solution is again the same as the solution pre-merger, equation (9) for $i = l, s$.

For Bertrand (respectively Cournot) retail competition, the equilibrium wholesale prices are above (respectively below) the marginal cost of the supplier, and they are the same as pre-merger. Hence, the buyer merger does not affect the retail prices. In equilibrium, $p_i^{**} = p^{**}$ and $q_i^{**} = q^{**}$ for $i = l, s$, and the merging parties pay a fixed fee lower than pre-merger:

$$F_l^{**} = C\left(4q^{**}\right) - C\left(2q^{m**}\right) - 2w^{**}\left[2q^{**} - q^{m**}\right] < 2F^{**}. \tag{21}$$

The merger is therefore profitable:

$$\pi_l^{**} = 2p^{**}q^{**} - \left[C\left(4q^{**}\right) - C\left(2q^{m**}\right)\right] + 2w^{**}\left(q^{**} - q^{m**}\right) > 2\pi^{**}, \tag{22}$$

On the other hand, small retailers pay the same fixed fee, and thus earn the same profit as before the merger, for $s \in S$,

$$F_s^{**} = F^{**} \qquad \pi_s^{**} = \pi^{**}. \tag{23}$$

These results are summarized in Proposition 1.

Proposition 1 *A buyer merger is always profitable since it brings size discounts. However, size discounts for the large retailer do not alter equilibrium prices, i.e., there is no pass through of size discounts. Moreover, size discounts to the large retailer have no impact on the tariffs of the small retailers. These results are valid when two-part tariff supply contracts are secret or ex-post observable.*

The parties always want to merge to increase their size and negotiate a better deal with the supplier. This effect, presented in details by Chipty and Snyder (1999), comes from the convexity of the supplier' cost function. When the supplier has strictly increasing incremental costs of production, a small buyer negotiates "at the margin", where incremental costs are high. In contrast, if some small buyers merged, they would account for a larger fraction of the supplier's total sales, and thus negotiate less at the margin, thereby pay a lower price per unit. We show that this *size effect* of a buyer merger extends from a setup of locally monopolist stores to our model with downstream competition in each local market.

Size discounts to the large retailer do not change equilibrium prices, i.e., are not passed on to final consumers and do not change small retailers' profits.[21] The Competition Commission's report (2008) states that with the use of contracts with multi-part tariffs, discounts to powerful retailers would less likely have an impact on smaller retailers' profits.[22] Our results therefore support formally this prediction.

We show that a buyer merger results in a transfer of profits from the supplier to the large retailer without affecting retail prices or the small retailers' tariffs when supply contracts are secret or observable only before retail competition. When supply contracts are secret, each supply contract is bilaterally optimal holding others' contracts fixed, and thus the wholesale prices are set at the marginal cost of the upstream firm. A buyer merger does not change the optimal wholesale prices, since both before and after the merger, there is free-riding on the rival's margin as retailers do not take into account the effects of their wholesale price on their rival. The neutrality of buyer merger on retail prices is more surprising when the equilibrium wholesale prices are not at the marginal cost of the upstream firm pre-merger. This is the case when supply contracts are ex-post observable, where wholesale prices are set different than the marginal cost of the manufacturer to induce less fierce reactions from the rival retailer. It is not straightforward that a better bargaining position of the large retailer reduces its fixed fee, but does not affect the strategic deviation of the wholesale prices from the upstream marginal cost.

Compared to the Literature The literature on buyer power mostly considers linear wholesale prices. Dobson and Waterson (1997) analyze the implications of a merger between two competing retailers where wholesale prices are uniform, i.e. the same for all retailers. They show that when retailers are very differentiated, the horizontal merger increases consumer prices.[23] Our paper instead analyzes mergers between independent retailers, i.e., buyer mergers, like Majumdar (2006), Inderst (2007) and Inderst and Valetti (2008). These papers explain different reasons for size discounts, which make buyer mergers profitable. Majumdar (2006) shows that the large retailer wants to own more stores because this increases its rivals' costs (the spot price for smaller retailers) as there are fewer small stores over which the upstream fixed cost can be spread. Following Katz (1987). Inderst (2007), and Inderst and Valetti (2008) show that larger buyers get discounts from the supplier because they have the leverage to reduce the average cost of their outside option by dispersing a fixed cost of

[21] Our companion paper, Bedre and Caprice (2009), obtains the same results under a different contracting environment, that is when the manufacturer and retailers negotiate simultaneously and bilaterally quantity-forcing supply contracts.

[22] See appendix 5.4, paragraph 42.

[23] The horizontal merger improves the buyer power of all retailers through reducing alternative retail channels for the supplier. When retailers are sufficiently differentiated, the negative impact of the merger on retail competition dominates its positive impact through improving buyer power.

an alternative supplier over a larger volume of sales. Different from our results, focusing on linear supply contracts, they show that the exercise of buyer power of a larger retailer lowers its wholesale price at the expense of higher wholesale prices for smaller retailers, so called waterbed effects. Whether consumers would be adversely affected depends on how much input cost reductions are passed on to consumer prices by larger retailers and how much smaller retailers pass their cost increases to consumers. For instance, Inderst and Valetti show that in the Hotelling model, consumer prices would increase as a result of the waterbed effect. With linear demand, Majumdar shows that waterbed effects decrease the total welfare.

Chen (2003) considers non-linear supply contracts and obtains very different results than ours; mainly that the exercise of buyer power by a dominant retailer lowers the retail price. This is due to the differences between his and our setups. He measures bargaining power by an exogenous variable, that is the buyer's exogenous share over the gains from trade with the supplier, and does not model downstream competition as oligopoly, but instead considers a price-setter dominant firm competing against price-taker fringe firms. In his setup, the supplier strategically sets a lower marginal price (list price) to small buyers in order to improve its bargaining power vis-à-vis the dominant retailer in the following contract negotiation.

Our results that the buyer merger and size discounts to the large retailer are neutral for consumer prices and for the profits of smaller retailers hinge on the assumption that retail markets are symmetric. Due to the symmetry of the markets, the large retailer sells the same quantity at each market. If we assumed instead that retail markets were asymmetric in their degree of competition, the large retailer would sell different quantities at each market, and thus the buyer merger would affect the equilibrium retail prices. We analyze this asymmetric case in the next section.

6 Asymmetric retail markets and ex-post observability

In this section, we consider asymmetric retail markets in the setup of ex-post observable contracts. The objective is to see whether a buyer merger benefits to consumers and whether it results in waterbed effects when the merger is between two outlets active in asymmetric retail markets. We consider the simplest case of asymmetric markets; in one retail market, say market 1, there are two retailers, which are so differentiated that they do not compete, whereas in market 2 the two retailers are competing. We denote a market by subscript $m \in \{1, 2\}$, and a retailer by subscript $i \in \{A, B\}$. Subscript mi refers to retailer i active in market m and subscript mj, for $j \neq i \in \{A, B\}$, refers to retailer i's rival in market m. Supply tariff of retailer mi is thus denoted by $T_{mi}(q_{mi}) = w_{mi}q_{mi} + F_{mi}$. The demand for retailer mi is defined as $q_{mi} \equiv q_m(p_{mi}, p_{mj})$ and the inverse demand is $p_{mi} \equiv p_m(q_{mi}, q_{mj})$.

As an illustrative example, consider linear demands of form[24]

$$q_{mi} = \frac{1}{1+\gamma_m} - \frac{1}{1-\gamma_m^2} p_{mi} + \frac{\gamma_m}{1-\gamma_m^2} p_{mj}, \qquad for\ m = 1,2,\ i \neq j \in \{A, B\}.$$

We assume that there is no competition in market 1, $\gamma_1 = 0$, and some competition in market 2, $\gamma_2 \in]0,1]$, and thereby obtain the following monopolistic demand functions for the retailers in market 1:

$$q_{1i} = 1 - p_{1i}, \qquad for\ i \in \{A, B\}, \tag{24}$$

and competitive demands for the retailers in market 2 :

$$q_{2i} = \frac{1}{1+\gamma_2} - \frac{1}{1-\gamma_2^2} p_{2i} + \frac{\gamma_2}{1-\gamma_2^2} p_{2j}, \qquad for\ i \neq j \in \{A, B\}. \tag{25}$$

The respective inverse demands are given by

$$p_{1i} = 1 - q_{1i}, \qquad p_{2i} = 1 - q_{2i} - \gamma_2 q_{2j}, \qquad for\ i \neq j \in \{A, B\}. \tag{26}$$

In this setup, we consider a buyer merger between two outlets active in different markets, say $1A$ merges with $2A$. Depending on the nature of retail competition, we obtain different equilibrium prices and quantities for each market. We first characterize the equilibrium for price competition and the equilibrium for quantity competition before the merger, and then compare the respective pre-merger equilibrium quantities with the post-merger ones. Different from the case of symmetric retail markets, we show that the buyer merger, and thus size discounts modify the equilibrium quantities. The changes of the equilibrium quantities due to the buyer merger have different signs and magnitudes depending on the nature of competition, price vs quantity competition, in market 2, even if the intuition behind these changes is similar.

6.1 Pre-merger Equilibrium

Here, we characterize the equilibrium prices and quantities for each market before the merger takes place. When the competition in market 2 is à la Bertrand, we denote the equilibrium by superscript B, and when the competition in market 2 is à la Cournot, we denote the equilibrium by superscript C.

[24]Linear symmetric demands of this form are driven from the utility maximization problem of a representative consumer in each market: for market $m = 1, 2$,

$$\max_{q_{mA}, q_{mB}} U_m(q_{mA}, q_{mB}) = q_{mA} + q_{mB} - \gamma_m q_{mA} q_{mB} - \frac{1}{2}\left(q_{mA}^2 + q_{mB}^2\right)$$
$$s.t.\ p_{mA} q_{mA} + p_{mB} q_{mB} \leq I.$$

Since the retailers active in the same market are assumed to be symmetric, we are looking for a symmetric equilibrium for each market, that is for $m = 1, 2$ and $\forall i \in \{A, B\}$, in Bertrand equilibrium $w_{mi}^B = w_m^B$, $p_{mi}^B = p_m^B$ and $q_{mi}^B = q_m^B$, and in Cournot equilibrium $w_{mi}^C = w_m^C$, $p_{mi}^C = p_m^C$ and $q_{mi}^C = q_m^C$.

Lemma 3. Suppose that two retailers are local monopolies in market 1 with linear demands given in (24) and that two retailers in market 2 compete à la Bertrand with linear demands given in (25). The equilibrium prices and quantities are given by

$$\begin{aligned} w_1^B &= C'\left(q^B\right), \qquad w_2^B = C'\left(q^B\right) + \left(p_2^B - w_2^B\right) \frac{\gamma_2^2}{(1-\gamma_2)(2+\gamma_2)}; \\ q_1^B &= \frac{1-w_1^B}{2}, \qquad q_2^B = \frac{1-w_2^B}{(1+\gamma_2)(2-\gamma_2)}, \qquad q^B = \sum_{m=1,2} 2q_m^B; \\ p_1^B &= \frac{1+w_1^B}{2}, \qquad p_2^B = \frac{1+w_2^B-\gamma_2}{2-\gamma_2}. \end{aligned}$$

For quadratic cost function $C(q) = \frac{1}{2}q^2$, after replacing the value of $C'(q^B) = q^B$ into the above equations, the equilibrium wholesale prices and the total equilibrium quantity are found as

$$w_1^B = \frac{4+3\gamma_2}{6+5\gamma_2}, \qquad w_2^B = \frac{8+6\gamma_2+\gamma_2^2+\gamma_2^3}{12+10\gamma_2}, \qquad q^B = \frac{4+3\gamma_2}{6+5\gamma_2}.$$

In market 1, the retailers do not compete, and thus set their wholesale prices at the marginal cost of the manufacturer to maximize their chain profits. Whereas the retailers in market 2 compete in price, and thus each retailer sets its wholesale price greater than the marginal cost of the manufacturer in order to signal its rival that it is going to be a less fierce competitor, and thereby to raise its rival's retail price. Compared to the case of secret contracts, where the wholesale prices are always set at the marginal cost of the manufacturer, the total quantity in market 2 is lower when contracts are ex-post observable and retail competition is in price. This reduction of the total quantity in market 2 make the quantities produced for market 1 less costly since the manufacturer's cost function is convex. The retailers in market 1 therefore sell more than the case of secret contracts. As a result the total quantity sold in market 2, $2q_2^B$, is lower than the total quantity sold in market 1, $2q_1^B$.

We get different results if the retailers in market 2 compete in quantity:

Lemma 4. Suppose that two retailers are local monopolies in market 1 with linear demands given in (24) and that two retailers in market 2 compete à la Cournot with linear demands given in (25). The equilibrium prices and quantities are given by

$$\begin{aligned}
w_1^C &= C'\left(q^C\right), \qquad w_2^C = C'\left(q^C\right) - q_2^C \frac{\gamma_2^2}{2-\gamma_2}; \\
q_1^C &= \frac{1-w_1^C}{2}; \qquad q_2^C = \frac{1-w_2^C}{2+\gamma_2}, \qquad q^C = \sum_{m=1,2} 2q_m^C; \\
p_1^C &= \frac{1+w_1^C}{2}, \qquad p_2^C = \frac{1+(1+\gamma_2)\,w_2^C}{2+\gamma_2}.
\end{aligned}$$

For quadratic cost function $C(q) = \frac{1}{2}q^2$, after replacing the value of $C'(q^C) = q^C$ into the above equations, the equilibrium wholesale prices and the total equilibrium quantity are found as:

$$w_1^C = \frac{4-\gamma_2-\gamma_2^2}{6-\gamma_2-2\gamma_2^2}, \qquad w_2^C = \frac{4-3\gamma_2}{6-4\gamma_2}, \qquad q^C = \frac{4-\gamma_2-\gamma_2^2}{6-\gamma_2-2\gamma_2^2}.$$

As in price competition, the local monopoly retailers in market 1 set their wholesale prices at the marginal cost of the manufacturer. Each retailer in market 2 sets its wholesale price lower than the marginal cost of the manufacturer in order to signal a fierce competitor behavior in the following retail competition, and thus contract the quantity of its rival. Compared to the case of secret contracts, where the wholesale prices are always set at the marginal cost of the manufacturer, the total quantity in market 2 is higher when contracts are ex-post observable and retail competition is in quantity. This increase of the total quantity sold in market 2 makes the quantities produced for market 1 more costly since the manufacturer's cost function is convex. The retailers in market 1 therefore sell less than the case of secret contracts. As a result the total quantity sold in market 2, $2q_2^C$, is higher than the total quantity sold in market 1, $2q_1^C$.

To fix the ideas, hereafter we illustrate our results for quadratic cost function $C(q) = \frac{1}{2}q^2$ to simplify the algebra, though we believe that the intuition behind the results applies for more general convex costs.

6.2 Post-merger Equilibrium

Suppose that retailer $1A$ and retailer $2A$ merge. We call the merged entity as retailer A. We calculate the post-merger equilibrium for each market when the outlets in market 2 compete à la Bertrand and when they compete à la Cournot. Let w_A^B be the equilibrium wholesale price set by the merged entity and, w_{1B}^B and w_{2B}^B be the equilibrium wholesale prices set by respectively retailers $1B$ and $2B$ when the outlets in market 2 compete à la Bertrand. Similarly, w_A^C, w_{1B}^C and w_{2B}^C denote respectively equilibrium wholesale prices of retailer $A, 1B$, and $2B$ when the outlets in market 2 compete à la Cournot. Compare post-merger equilibria with pre-merger equilibria, we get the following proposition:

Proposition 2 *Assuming no competition in market* 1 *and price competition in market* 2*, after a merger between one outlet from market* 1*, say* $1A$*, and one outlet from market* 2*, say* $2A$*, the merged entity has a wholesale price higher than the pre-merger wholesale price of the monopolistic market and lower than the pre-merger wholesale price of the competitive market, i.e.,* $w_1^B < w_A^B < w_2^B$*. Moreover, the rival of the merged entity in market* 2 *has a lower wholesale price post-merger, i.e.,* $w_{2B}^B < w_2^B$*.*

Before the merger, the retailers in market 1 set their wholesale prices at the marginal cost of the manufacturer (since they do not compete), whereas the retailers in market 2 compete in price, and thus each retailer sets its wholesale price greater than the marginal cost of the manufacturer (see Lemma 3). After the merger, the merged entity sets its wholesale price between the pre-merger wholesale price of market 1 and the pre-merger wholesale price of market 2. This means that the outlet of the merged entity in market 2 has a lower wholesale price post-merger. Retailer $2B$ therefore competes against a more efficient rival, and thus it also sets a lower wholesale price post-merger. The total quantity in market 2 is therefore higher than before the merger. In market 1, the outlet of the merged entity sells less since its wholesale price is higher post-merger. We furthermore show that the total quantity increase in market 2 is lower than the total quantity decrease in market 1. Intuitively, when the outlets compete in prices, which is the case in market 2, a change in the marginal cost (or wholesale price) of an outlet affects its sales less significantly than the case of market 1 where the outlet is local monopoly. Following a change in the marginal cost of a retailer, it reflects this change on its price and its rival reacts by modifying its price in the same way. As a result, the change in the marginal cost affects the retailer's demand less than the case where it is a local monopoly. In other words, the strategic complementarity of prices lessens the impact of the change in the marginal cost of a firm on its own sales.

We obtain the following results when the outlets in market 2 compete in quantity.

Proposition 3 *Assuming no competition in market* 1 *and quantity competition in market* 2*, after the merger between outlets* $1A$ *and* $2A$*, the merged entity has a wholesale price lower than the pre-merger wholesale price of the monopolistic market and higher than the pre-merger wholesale price of the competitive market, i.e.,* $w_2^C < w_A^C < w_1^C$*. Moreover, the rival of the merged entity in market* 2 *has a higher wholesale price post-merger, i.e.,* $w_{2B}^C > w_2^C$*.*

Before the merger, the retailers in market 1 set their wholesale prices at the marginal cost of the manufacturer, whereas each retailer in market 2 sets its wholesale price lower than the marginal cost of the manufacturer (see Lemma 4). After the merger, the merged entity sets its wholesale price between the pre-merger wholesale price of market 1 and the pre-merger wholesale price of market 2. This means that the outlet of the merged entity in market 2 has a higher wholesale price post-merger. Retailer $2B$ therefore competes against a less efficient rival, and thus it also sets a higher wholesale price post-merger. The intuition behind retailer $2B$'s reaction is slightly different than price competition: when the retailers compete in quantity, the need to signal a more fierce competitor behavior, by lowering its wholesale price below the marginal cost of the manufacturer, is less significant when the rival is less efficient. The total quantity in market 2 is therefore lower than before. In market 1, the outlet of the merged entity sells more since its wholesale price is lower than before. More interestingly, the quantity decrease in market 2 is higher than the quantity increase in market 1. This is due to the nature of quantity competition: when the outlets compete à la Cournot, which is the case in market 2, a change in the marginal cost (or wholesale price) of an outlet affects its sales more significantly than the case of market 1 where the outlet is local monopoly. This is because strategic substitutability of quantities reinforces the impact of a change in the marginal cost on own sales.

Summing up the first-order effects described above, we conclude that the merger results in a reduction in the total quantity regardless of the type of competition in market 2.

Proposition 4 *Assuming no competition in market* 1 *and price or quantity competition in market* 2*, the merger between outlets* $1A$ *and* $2A$ *results in a smaller total quantity.*

This reduction in the total quantity reduces the cost of producing marginal units (due to the convex costs of production), and therefore lowers each retailer's wholesale price as a second-order effect. As a result, retailer $1B$ sets a lower wholesale price post-merger.

Corollary 1. Retailer $1B$ has a lower wholesale price post-merger, i.e., $w_{1B}^B < w_1^B$ and $w_{1B}^C < w_1^C$.

For retailer A and $2B$, the first-order effect dominates the second-order effect and the net effects are as described in Proposition 2 and Proposition 3.

Note that the results of this section are indeed more general than our simple setup of asymmetric retail markets. We believe that it can be extended (in spite of heavy algebra) to the case where there is some retail competition in market 1 such that its degree of competition is different than market 2.

6.3 Incentives to Merge, Waterbed Effects and Consumer Surplus

In the previous section, we documented the effects of a merger between $1A$ and $2A$ on the equilibrium prices and quantities of each market. Here, we first show that such a merger is indeed profitable and moreover modifies the equilibrium profits of other retailers, $1B$ and $2B$:

Proposition 5 *Assuming no competition in market* 1 *and price or quantity competition in market* 2*, the merger between outlets* $1A$ *and* $2A$ *is profitable and changes the other retailers'* *profits as the following:*

	Price Competition (Quantity competition)
Eqb. Profit of $1B$	$+$ $(+)$
Eqb. Profit of $2B$	$-$ $(+)$

The EC Guidelines argue that lower purchasing costs for powerful buyers are at the expense of higher costs for other buyers, since "the supplier would try to recover price reductions for one group of customers by increasing prices for other customers ..."[25] This mechanism, which is also known as the waterbed effect, has recently received some theoretical foundations in Inderst and Valetti (2008) and Majumdar (2006), where the authors consider linear supply tariffs and define waterbed effects in terms of changes in wholesale prices: There is waterbed effect if the wholesale price of the larger retailer (or the merged entity) decreases at the expense of an increase in the wholesale prices of smaller retailers. Different from this literature we consider two-part tariff supply contracts. When the supply contracts are non-linear, the definition of waterbed effects gets complicated and there is no well accepted definition in this case.[26] Following a buyer merger between outlets $1A$ and $2A$, we define waterbed effects in terms of changes in the equilibrium profits of the retailers:

Definition: ***Waterbed Effect*** There is a waterbed effect when lower purchasing costs of a large retailer (the merged entity) lead to lower equilibrium profits for a small retailer.

Proposition 5 shows that the equilibrium profits of retailer $1B$ increases post-merger regardless of the type of competition in market 2 since the wholesale price of retailer $1B$ is lower post-merger (see Corollary 1). We therefore show that there are anti-waterbed effects in market 1 where the outlets are local monopolies. When the outlets in market 2 compete à la Bertrand, we show that retailer $2B$ earns less after the merger even if its wholesale price is lower post-merger. Symmetrically, when the outlets in market 2 compete à la Cournot, we show that retailer $2B$ earns more after the merger even if its wholesale price is higher post-merger. These interesting results justify our definition of waterbed effects in terms of changes in equilibrium profits since the standard definition of waterbed effects, which is in terms of changes in wholesale prices, would be misleading as we consider non-linear supply contracts. When competing in price, retailer $2B$'s profits decrease after the merger because it competes against a more efficient rival, i.e., $w_A^B < w_2^B$. Symmetrically, when competing

[25] Guidelines in the applicability of Article 81 of the EC Treaty to horizontal cooperation agreements (2001/C3/02), paragraph 126.

[26] When supply contracts are non-linear, defining waterbed effects in terms of changes in wholesale prices of retailers might be misleading. For instance, suppose that one retailer gets bigger and receives size discounts from the supplier. A following increase in the wholesale price of a smaller retailer does not necessarily imply that the small retailer's profits are lower, since its average supply tariff could be lower even if its marginal tariff is higher.

in quantity, retailer $2B$'s profits increase after the merger because it competes against a less efficient rival, i.e., $w_A^C > w_2^C$. To sum up, we show that in market 2, there is a waterbed effect under price competition, but there is anti-waterbed effect if the outlets compete in quantity.

Finally, we compare the pre-merger and post-merger consumer surpluses and show the following results:

Proposition 6 *Assuming no competition in market* 1 *and price or quantity competition in market* 2*, the merger between outlets* $1A$ *and* $2A$ *results in*

	Price Competition (Quantity competition)
Consumer Utility (M1)	$-$ $(+)$
Consumer Utility (M2)	$+$ $(-)$

Proposition 6 shows that consumers in market 1, where the outlets are local monopolies, lose due to the merger if competition in market 2 is in price, whereas they benefit from the merger if competition in market 2 is in quantity. Intuitively, when the outlets in market 2 compete à la Bertrand, the merger between outlets $1A$ and $2A$, raises the wholesale price of outlet $1A$ as a first-order effect (see Proposition 2 and its discussion above), whereas the merger lowers the wholesale price of outlet $1B$ as a second-order effect since the manufacturer has convex costs and the total quantity produced for the other retailers is lower post-merger (see Corollary 1). Since the first-order effect dominates the second-order effect, the total quantity, and thus the consumer utility, in market 1 is lower post-merger. On the other hand, when the outlets in market 2 compete à la Cournot, the merger lowers the wholesale price of both outlets in market 1, i.e., both the first-order and second-order effects increase the quantity sold in market 1 (see Proposition 3 and Corollary 1). The merger therefore increases the consumer utility in market 1. Symmetrically, consumers in market 2, where the outlets are competing, benefit from the merger if competition in market 2 is in price since the merger lowers the wholesale prices of both outlets in market 2 (see Proposition 2 and its discussion above), and thus raises the total quantity sold in market 2. However, under Cournot competition, consumers in market 2 lose due to the merger because the merger raises the wholesale prices of both outlets in market 2 (see Proposition 3 and its discussion above)..

7 Conclusions

This paper analyzes the welfare implications of retailers' buyer power vis-à-vis their suppliers. Following Chipty and Synder (1999), we show that a larger retailer has more buyer power, and thus gets size discounts from its supplier which has decreasing returns to scale technology, i.e., convex costs. We focus on endogenous source of buyer power, that is to say we introduce a larger retailer through a merger between retailers from different retail markets, i.e., a buyer merger, which is indeed profitable since it brings size discounts to the merging parties. Such a merger does not raise any horizontal anti-competitive concerns, but could affect retail prices through changing terms of supply contracts. When the buyer merger is between outlets from symmetric retail markets, we show that although the larger retailer (or the merged entity) gets size discounts from its supplier, it does not pass such discounts on to retail prices. In other words, the buyer power of the larger retailer is neutral for consumer prices. This is because size discounts do not alter the retailer's marginal purchasing cost, but reduces its average supply price, when supply contracts are non-linear. Moreover, size discounts to the larger retailer do not influence the profits of smaller retailers, i.e., there are no waterbed effects. We obtain these results in a setup where locally competitive retailers make simultaneous two-part tariff supply offers to one monopoly manufacturer, and then compete in prices or quantities in the retail market. We show that these results are robust whether supply contracts are secret or observable before retail competition. Indeed, our companion paper, Bedre and Caprice (2009), obtains the same results under a different contracting environment, that is when the manufacturer and retailers negotiate simultaneously and bilaterally quantity-forcing supply contracts.

The literature on buyer power has focused mostly on linear wholesale prices even though non-linear supply contracts are more widely used type of contracts in practice. We contribute to the existing literature by considering non-linear supply contracts and obtaining quite different results from the literature. Although Chen (2003) considers non-linear supply contracts, he obtains different results than ours: the exercise of buyer power by a dominant retailer lowers the retail price. The main differences between his and our setups are that he measures bargaining power by an exogenous variable and does not model downstream competition as oligopoly, but instead considers a price-setter dominant firm competing against price-taker fringe firms.

We go further beyond the literature and analyze the implications of a buyer merger between two outlets active in different retail markets which are asymmetric in their degree of competition. When supply contracts are secret, we show that our previous results are valid also in this setup. However, when supply contracts are ex-post observable, our previous results change considerably. In this case, the size discounts to the larger retailer change retail prices. When retail competition is in price, the retail price of the merged entity's outlet in the more competitive market decreases post-merger, whereas the retail price of its outlet in the less competitive market increases. Symmetrically, when retail competition is in quantity, the retail price of the merged entity's outlet in the more competitive market increases, while the price of its outlet in the less competitive market decreases post-merger. Overall, the merger decreases the total quantity sold in the retail markets regardless of the type of competition. Regarding the profits of smaller retailers, when retail competition is in price, we show that only the rival of the merged entity in the more competitive market earns less, so we say that there is a waterbed effect in this market, whereas there is an anti-waterbed effect on the smaller retailer in the less competitive market, i.e., it earns more post-merger. When retail competition is in quantity, there are anti-waterbed effects on all smaller retailers.

Our results provide clear policy implications for anti-trust reactions towards buyer mergers between independent retailers and towards the exercise of buyer power. We show that whether the merging outlets are from symmetric retail markets, and if not the type of retail competition, determine(s) how the buyer merger affects consumer prices and smaller retailers. We show that in the case of symmetric retail markets, countervailing-power hypothesis[27] does not hold if supply contracts are non-linear. We furthermore illustrate situations when the exercise of buyer power of a larger retailer results in higher consumer prices and lower profits for smaller retailers. This work hence provides a useful guideline to analyze whether a buyer merger might harm consumers or smaller retailers when supply contracts are assumed to be non-linear, as it is mostly the case in practice.

There are two main limitations of our work. First, by focusing on a monopoly supplier, we ignore the implications of upstream competition on the consequences of buyer power. Considering upstream and downstream competition under the assumption of non-linear supply contracts would pose some technical problems, like inexistence of equilibria (see Rey and Vergé (2002)). Taking the existence of an equilibrium as given, we conjecture that when supply contracts are secret, our results would be robust to introducing upstream competition, since each supply contract would again be bilaterally efficient taking others' contracts as given. However, when supply contracts are ex-post observable, it is not straightforward to see how upstream competition affects the strategic incentives to set wholesale prices different than the upstream marginal cost. Moreover, the impact of a buyer merger on these strategic considerations is not obvious without a thorough analysis. We leave this interesting topic for future research. Second, we analyze only short-run welfare implications of buyer power. As it is shown by the literature, suppliers' incentives to invest in cost reducing innovation might be improved (Inderst and Wey (2007a, 2007b)) or dampened (Chen (2004), and Battigalli et al. (2006)) by the exercise of buyer power. Using these insights of the literature, our work could be extended to analyze also long-run implications of buyer power.

[27] By exercising buyer power, retailers are able to lower the prices they pay to their suppliers and pass on these savings to their customers. See Galbraith (1952) and Chen (2003).

APPENDIX

Proof of Lemma 3.

Taking the signed supply contracts as given, retailer mi sets a price to maximize its profit:

$$\max_{p_{mi}} (p_{mi} - w_{mi})\, q_{mi} - F_{mi}.$$

The solution to the previous problem determines the optimality conditions for retail competition, for $m \in \{1, 2\}$ and $i \neq j \in \{A, B\}$:

$$q_{mi} + (p_{mi} - w_{mi})\partial_{p_{mi}} q_{mi} = 0. \tag{27}$$

After replacing the linear demand function given in (25) and its derivative in its own price, the retail equilibrium conditions for market 2 are given by, for $i \neq j \in \{A, B\}$,

$$\frac{1}{1+\gamma_2} - \frac{1}{1-\gamma_2^2} p_{2i} + \frac{\gamma_2}{1-\gamma_2^2} p_{2j} - \frac{1}{1-\gamma_2^2}(p_{2i} - w_{2i}) = 0.$$

By solving the latter equation for the two retailers, we obtain the Nash equilibrium of downstream price competition for market 2:

$$p_{2i} = \frac{1}{4-\gamma_2^2}\left(2w_{2i} + \gamma_2 w_{2j} + 2 - \gamma_2 - \gamma_2^2\right). \tag{28}$$

Since the retailers do not compete in market 1, they set their monopoly prices, for $i \in \{A, B\}$:

$$p_{1i} = \frac{1 + w_{1i}}{2}. \tag{29}$$

In Stage I, retailer mi sets (F_{mi}, w_{mi}) by maximizing its profit subject to the participation constraint of the upstream firm:

$$\max_{F_{mi}, w_{mi}} [\Pi_{mi} - F_{mi}] \qquad s.t. \qquad F_{mi} + \sum_{k \neq mi} F_k + \Pi_U \geq \sum_{k \neq mi} F_k + \Pi_U^{-mi}. \tag{30}$$

Since the retailer's profit is decreasing in its fixed fee, the constraint is binding in equilibrium. After plugging the binding constraint into the problem, retailer mi's problem is re-written as

$$\max_{w_{mi}} \left[\Pi_{mi} + \Pi_U - \Pi_U^{-mi}\right],$$

or

$$\max_{w_{mi}} \left[p_{mi}q_{mi} - C\left(q_{mi} + q_{mj} + \sum_{k\neq mi,mj} q_k\right) + w_{mj}q_{mj} - \left(w_{mj}q_{mj}^m - C\left(q_{mj}^m + \sum_{k\neq mi,mj} q_k\right)\right)\right]. \tag{31}$$

Using the optimality condition of retail competition, (27), and the Envelope theorem, we derive the equilibrium condition for w_{mi}:

$$\left[w_{mi} - C'(\sum_{m=1,2}(q_{mA}+q_{mB}))\right]\frac{dq_{mi}}{dw_{mi}} + (p_{mi} - w_{mi})\,\partial_{p_{mj}}q_{mi}\partial_{w_{mi}}p_{mj} \tag{32}$$
$$+\left[w_{mj} - C'(\sum_{m=1,2}(q_{mA}+q_{mB}))\right]\frac{dq_{mj}}{dw_{mi}} = 0.$$

Since there is no competition in market 1, we have

$$\partial_{p_{1j}}q_{1i} = \partial_{w_{1i}}p_{1j} = \frac{dq_{1j}}{dw_{1i}} = 0,$$

and thus obtain the equilibrium wholesale price for market 1:

$$w_1^B = C'\left(\sum_{m=1,2} 2q_m^B\right),$$

where the corresponding equilibrium price and quantity are given respectively by

$$p_1^B = \frac{1+w_1^B}{2}, \qquad q_1^B = \frac{1-w_1^B}{2}.$$

Using the definition of linear demand functions given in (25) and the retail competition equilibrium given in (28), we derive

$$\frac{dq_{2i}}{dw_{2i}} = -\frac{2-\gamma_2^2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)}, \quad \frac{dq_{2j}}{dw_{2i}} = \frac{\gamma_2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)}, \quad \partial_{p_{2j}}q_{2i} = \frac{\gamma_2}{1-\gamma_2^2}, \quad \partial_{w_{2i}}p_{2j} = \frac{\gamma_2}{4-\gamma_2^2},$$

and thereby we re-write the equilibrium conditions for market 2, for $i \neq j \in \{A, B\}$,

$$-\left(2-\gamma_2^2\right)\left[w_{2i} - C'(.)\right] + \gamma_2^2\left(p_{2i} - w_{2i}\right) + \gamma_2\left[w_{2j} - C'(.)\right] = 0.$$

By solving the equilibrium conditions for the two retailers, we get the equilibrium wholesale price for market 2:

$$w_2^B = C'\left(\sum_{m=1,2} 2q_m^B\right) + \left(p_2^B - w_2^B\right)\frac{\gamma_2^2}{(1-\gamma_2)(2+\gamma_2)} > C'\left(\sum_{m=1,2} 2q_m^B\right),$$

where the corresponding equilibrium price and quantity are given respectively by

$$p_2^B = \frac{1+w_2^B-\gamma_2}{2-\gamma_2}, \qquad q_2^B = \frac{1-w_2^B}{(1+\gamma_2)(2-\gamma_2)}.$$

We finally calculate the total equilibrium quantity as a function of the equilibrium wholesale prices:

$$q^B = \sum_{m=1,2} 2q_m^B = 1 - w_1^B + \frac{2\left(1-w_2^B\right)}{(1+\gamma_2)(2-\gamma_2)}.$$

Proof of Lemma 4.

Taking the signed supply contracts as given, retailer mi sets its quantity to maximize its profit:

$$\max_{q_{mi}} (p_i - w_{mi})\, q_{mi} - F_{mi}.$$

The solution to the previous problem determines the optimality conditions for retail competition, for $m \in \{1,2\}$ and $i \neq j \in \{A,B\}$:

$$q_{mi}\partial_{q_{mi}} p_{mi} + p_{mi} - w_{mi} = 0. \tag{33}$$

After replacing the inverse demand function given in (26) and its derivative in its own quantity, the retail equilibrium conditions for market 2 are given by, for $i \neq j \in \{A,B\}$,

$$1 - 2q_{2i} - \gamma_2 q_{2j} - w_{2i} = 0.$$

Solving the latter equation for the two retailers, we obtain the Nash equilibrium of downstream quantity competition for market 2:

$$q_{2i} = \frac{1}{4-\gamma_2^2}\left(-2w_{2i} + \gamma_2 w_{2j} + 2 - \gamma_2\right). \tag{34}$$

Since the retailers do not compete in market 1, they set their monopoly prices, *for* $i \in \{A,B\}$:

$$q_{1i} = \frac{1-w_{1i}}{2}. \tag{35}$$

In Stage I, retailer mi chooses w_{mi} to maximize its bilateral profit with the supplier taking into account the fact that its rival, retailer mj, reacts to changes in w_{mi} (see (30) and (31) in the previous proof) Using the optimality condition of retail competition, (33), and the Envelope theorem, we derive the optimality condition for w_{mi}:

$$\left[w_{2i} - C'\left(\sum_{m=1,2}(q_{mA}+q_{mB})\right)\right]\partial_{w_{2i}}q_{2i} + \left[w_{2j} - C'\left(\sum_{m=1,2}(q_{mA}+q_{mB})\right)\right]\partial_{w_{2i}}q_{2j} \quad (36)$$
$$+q_{2i}\partial_{q_{2j}}p_{2i}\partial_{w_{2i}}q_{2j} = 0.$$

Since there is no competition in market 1, we have $\partial_{w_{2i}}q_{2j} = 0$, and thus obtain the equilibrium wholesale price for market 1:

$$w_1^C = C'\left(\sum_{m=1,2} 2q_m^C\right).$$

Using the definition of linear inverse demand functions given in (26) and the retail competition equilibrium given in (34), we derive

$$\partial_{w_{2i}}q_{2i} = -\frac{2}{4-\gamma_2^2}, \quad \partial_{w_{2i}}q_{2j} = \frac{\gamma_2}{4-\gamma_2^2}, \quad \partial_{q_{2j}}p_{2i} = -\gamma_2,$$

and thereby we re-write the equilibrium conditions for market 2, for $i \neq j \in \{A, B\}$,

$$-2\left[w_{2i} - C'(.)\right] + \gamma_2\left[w_{2j} - C'(.)\right] - \gamma_2^2 q_{2i} = 0.$$

By solving the equilibrium conditions for the two retailers, we get the equilibrium wholesale price for market 2:

$$w_2^C = C'\left(\sum_{m=1,2} 2q_m^C\right) - q_2^C\frac{\gamma_2^2}{2-\gamma_2} < C'\left(\sum_{m=1,2} 2q_m^C\right),$$

where the corresponding equilibrium quantity and price are given respectively by

$$q_2^C = \frac{1-w_2^C}{2+\gamma_2}, \qquad p_2^C = \frac{1+(1+\gamma_2)\,w_2^C}{2+\gamma_2}.$$

We finally calculate the total equilibrium quantity as a function of the equilibrium wholesale prices:

$$q^C = \sum_{m=1,2} 2q_m^C = 1 - w_1^C + \frac{2\left(1-w_2^C\right)}{2+\gamma_2}.$$

Proof of Proposition 2.

Pre-merger Bertrand Equilibrium:

The pre-merger equilibrium of price competition is the solution to (we derive the following equilibrium conditions in the proof of Lemma 3)

$$- \left[w_2^B - C'(q^B)\right](1-\gamma_2)(2+\gamma_2) + \left(\frac{1+w_2^B-\gamma_2}{2-\gamma_2} - w_2^B\right)\gamma_2^2 = 0,$$
$$C'(q^B) = w_1^B,$$
$$q^B = 1 - w_1^B + \frac{2\left(1-w_2^B\right)}{(1+\gamma_2)(2-\gamma_2)}.$$

For quadratic cost function $C(q) = \frac{1}{2}q^2$, after replacing $C'(q^B) = q^B$ into the above equations, the equilibrium wholesale prices and the total equilibrium quantity are found as

$$w_1^B = \frac{4+3\gamma_2}{6+5\gamma_2}, \quad w_2^B = \frac{8+6\gamma_2+\gamma_2^2+\gamma_2^3}{12+10\gamma_2}, \quad q^B = \frac{4+3\gamma_2}{6+5\gamma_2}.$$

Post-merger Bertrand Equilibrium:

Taking the signed supply contracts as given, the merged entity, retailer A, sets the prices of its outlets, p_{1A} and p_{2A}, by maximizing its profits from the two outlets:

$$\max_{p_{1A},p_{2A}} \left[(p_{1A}-w_A)\,q_{1A} + (p_{2A}-w_A)\,q_{2A}\right] - F_A.$$

The optimality conditions for retailer A are

$$\begin{aligned} q_{1A} + (p_{1A}-w_A)\partial_{p_{1A}}q_{1A} &= 0, \\ q_{2A} + (p_{2A}-w_A)\partial_{p_{2A}}q_{2A} &= 0. \end{aligned}$$

Similarly, after solving the respective problems of retailer $1B$ and $2B$, we get their optimality conditions respectively as

$$\begin{aligned} q_{1B} + (p_{1B}-w_{1B})\partial_{p_{1B}}q_{1B} &= 0, \\ q_{2B} + (p_{2B}-w_{2B})\partial_{p_{2B}}q_{2B} &= 0. \end{aligned}$$

For linear demands given in (24) and (25), the solution of these optimality conditions gives the retail equilibrium:

$$p_{1i} = \frac{1+w_i}{2}, \qquad p_{2i} = \frac{1}{4-\gamma_2^2}\left(2w_i + \gamma_2 w_{2j} + 2 - \gamma_2 - \gamma_2^2\right). \tag{37}$$

Similar to the pre-merger case, retailer $1B$ is a local monopoly, and thus sets its wholesale price at the marginal cost of the manufacturer to maximize its chain profit:

$$w_{1B}^{B} = C'\left(\sum_{m=1,2}\left(q_{mA}^{B} + q_{mA}^{B}\right)\right).$$

Using the retail equilibrium condition for market 1, (37), we derive the price and quantity of retailer $1B$ as functions of its wholesale price

$$p_{1B}^{B} = \frac{1 + w_{1B}^{B}}{2}, \qquad q_{1B}^{B} = \frac{1 - w_{1B}^{B}}{2}.$$

Retailer A sets its wholesale price to maximize its bilateral profit with the supplier taking into account the fact that its rival in market 2, retailer $2B$, reacts to changes in w_A:

$$\max_{w_A}\left[p_{1A}q_{1A} + p_{2A}q_{2A} - C\left(\sum_{m=1,2}\left(q_{mA} + q_{mB}\right)\right) + w_{1B}q_{1B} + w_{2B}q_{2B} - (w_{1B} + w_{2B})q_B^m + C\left(2q_B^m\right)\right],$$

which leads to the optimality condition for w_A:

$$\left[w_A - C'\left(.\right)\right]\left(\frac{dq_{1A}}{dw_A} + \frac{dq_{2A}}{dw_A}\right) + \left(p_{2A} - w_A\right)\partial_{p_{2B}}q_{2A}\partial_{w_A}p_{2B} + \left[w_{2B} - C'\left(.\right)\right]\frac{dq_{2B}}{dw_A} = 0.$$

Similarly, the problem of retailer $2B$ gives

$$\left[w_{2B} - C'(.)\right]\frac{dq_{2B}}{dw_{2B}} + \left(p_{2B} - w_{2B}\right)\partial_{p_{2A}}q_{2B}\partial_{w_{2B}}p_{2A} + \left[w_A - C'(.)\right]\frac{dq_{2A}}{dw_{2B}} = 0.$$

Using the definition of linear demand functions given in (24), (25), and the retail equilibrium conditions given in (37), we derive

$$\frac{dq_{1A}}{dw_A} = -\frac{1}{2},\ \frac{dq_{2A}}{dw_A} = -\frac{2-\gamma_2^2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)},\ \frac{dq_{2B}}{dw_A} = \frac{\gamma_2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)},\ \partial_{p_{2B}}q_{2A}\partial_{w_A}p_{2B} = \frac{\gamma_2^2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)},$$

and thus re-write the optimality condition for w_A as

$$-\left(8 - 7\gamma_2^2 + \gamma_2^4\right)\left[w_A^B - C'\left(\sum_{m=1,2} q_{mA}^B + q_{mA}^B\right)\right] + 2\gamma_2^2\left[p_{2A}^B - w_A^B\right] + 2\gamma_2\left[w_{2B}^B - C'\left(\sum_{m=1,2} q_{mA}^B + q_{mA}^B\right)\right] = 0.$$

Similarly we derive

$$\frac{dq_{2B}}{dw_{2B}} = -\frac{2-\gamma_2^2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)}, \quad \frac{dq_{2A}}{dw_{2B}} = \frac{\gamma_2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)}, \quad \partial_{p_{2A}}q_{2B}\partial_{w_{2B}}p_{2A} = \frac{\gamma_2^2}{\left(1-\gamma_2^2\right)\left(4-\gamma_2^2\right)},$$

and re-write the optimality condition for retailer $2B$ as

$$-\left(2-\gamma_2^2\right)\left[w_{2B}^B - C'\left(\sum_{m=1,2} q_{mA}^B + q_{mA}^B\right)\right] + \gamma_2^2\left(p_{2B}^B - w_{2B}^B\right) + \gamma_2\left[w_A^B - C'\left(\sum_{m=1,2} q_{mA}^B + q_{mA}^B\right)\right] = 0.$$

We calculate the total equilibrium quantity as a function of the equilibrium wholesale prices:

$$\begin{aligned} q^{Bmerger} &= \sum_{m=1,2}\left(q_{mA}^B + q_{mB}^B\right) \\ &= 1 + \frac{2}{1+\gamma_2} - \frac{w_A^B + w_{1B}^B}{2} - \frac{1}{(1+\gamma_2)(2-\gamma_2)}\left[w_A^B + w_{2B}^B + 2(1-\gamma_2)\right]. \end{aligned}$$

The post-merger equilibrium of price competition is the solution to

$$\begin{gathered} -\left(8 - 7\gamma_2^2 + \gamma_2^4\right)\left[w_A^B - C'\left(q^{Bmerger}\right)\right] + 2\gamma_2^2\left[p_{2A}^B - w_A^B\right] + 2\gamma_2\left[w_{2B}^B - C'\left(q^{Bmerger}\right)\right] = 0, \\ -\left(2-\gamma_2^2\right)\left[w_{2B}^B - C'\left(q^{Bmerger}\right)\right] + \gamma_2^2\left(p_{2B}^B - w_{2B}^B\right) + \gamma_2\left[w_A^B - C'\left(q^{Bmerger}\right)\right] = 0, \\ C'\left(q^{Bmerger}\right) = w_{1B}^B, \\ q^{Bmerger} = 1 + \frac{2}{1+\gamma_2} - \frac{w_A^B + w_{1B}^B}{2} - \frac{1}{(1+\gamma_2)(2-\gamma_2)}\left[w_A^B + w_{2B}^B + 2(1-\gamma_2)\right]. \end{gathered}$$

For quadratic cost function $C(q) = \frac{1}{2}q^2$, after replacing the values of $C'\left(q^{Bmerger}\right)$, p_{2A}^B, and p_{2B}^B into the above equations, the equilibrium wholesale prices are found as:

$$w_A^B = \frac{128 + 96\gamma_2 - 40\gamma_2^2 - 28\gamma_2^3 + 7\gamma_2^4 + 5\gamma_2^5}{192 + 160\gamma_2 - 72\gamma_2^2 - 60\gamma_2^3 + 11\gamma_2^4 + 9\gamma_2^5},$$

$$w_{1B}^B = \frac{128 + 96\gamma_2 - 48\gamma_2^2 - 36\gamma_2^3 + 7\gamma_2^4 + 5\gamma_2^5}{192 + 160\gamma_2 - 72\gamma_2^2 - 60\gamma_2^3 + 11\gamma_2^4 + 9\gamma_2^5},$$

$$w_{2B}^B = \frac{128 + 96\gamma_2 - 32\gamma_2^2 - 24\gamma_2^3 - 3\gamma_2^4 + 2\gamma_2^6 + \gamma_2^7}{192 + 160\gamma_2 - 72\gamma_2^2 - 60\gamma_2^3 + 11\gamma_2^4 + 9\gamma_2^5},$$

whereas the pre-merger equilibrium wholesale prices were

$$w_1^B = \frac{4 + 3\gamma_2}{6 + 5\gamma_2}, \qquad w_2^B = \frac{8 + 6\gamma_2 + \gamma_2^2 + \gamma_2^3}{12 + 10\gamma_2}.$$

Figures 1,2, and 3 compare pre-merger and post-merger wholesale prices as functions of the substitution parameter of market 2, γ_2. Figure 1 shows that the merger between outlets $1A$ and $2A$ increases the wholesale price of outlet $1A$, but decreases the wholesale price of outlet $2A$, i.e., $w_1^B < w_A^B < w_2^B$:

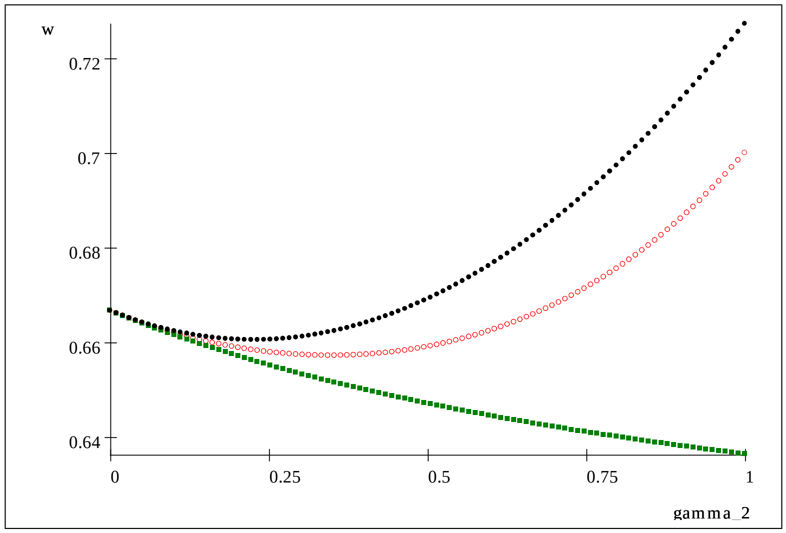

Figure 1. w_1^B : green crosses, w_2^B : black dots, w_A^B : red circles.

Figure 2 shows that the merger reduces the wholesale price of retailer $2B$, i.e., $w_{2B}^B < w_2^B$:

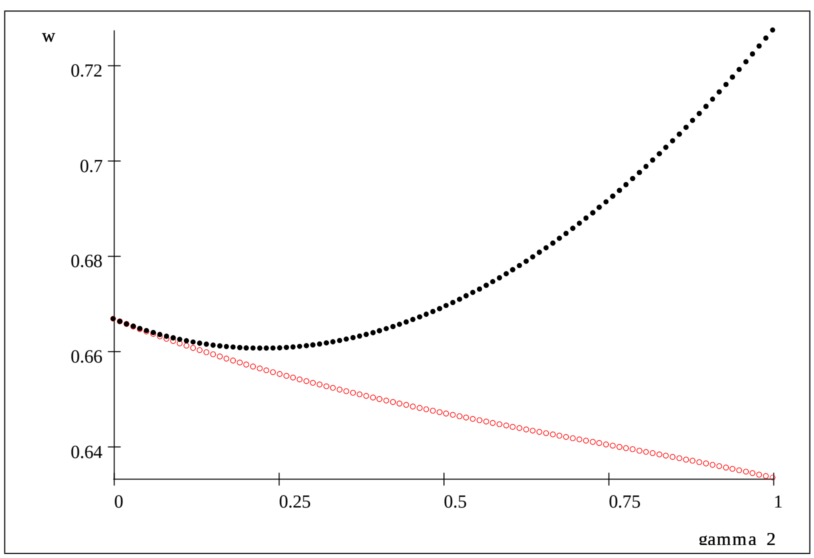

Figure 2. w_2^B : black dots, w_{2B}^B : red circles.

Figure 3 shows that the merger reduces the wholesale price of retailer $1B$, i.e., $w_{1B}^B < w_1^B$:

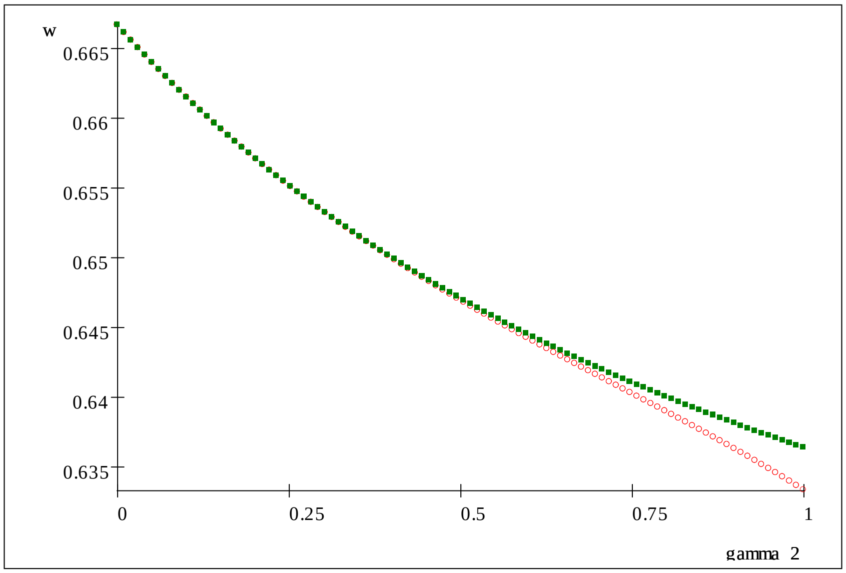

Figure 3. w_1^B : green crosses, w_{1B}^B : red circles.

Proof of Proposition 3.

Pre-merger Cournot Equilibrium:

The pre-merger equilibrium of quantity competition is the solution to (we derive the following equilibrium conditions in the proof of Lemma 4)

$$(2-\gamma_2)\left[w_2^C - C'(q^C)\right] + \gamma_2^2 \frac{1-w_2^C}{2+\gamma_2} = 0,$$
$$C'(q^C) = w_1^C,$$
$$q^C = 1 - w_1^C + \frac{2\left(1-w_2^C\right)}{2+\gamma_2}.$$

For quadratic cost function $C(q) = \frac{1}{2}q^2$, after replacing $C'(q^C) = q^C$ into the above equations, the equilibrium wholesale prices and the total equilibrium quantity are found as:

$$w_1^C = \frac{4-\gamma_2-\gamma_2^2}{6-\gamma_2-2\gamma_2^2}, \quad w_2^C = \frac{4-3\gamma_2}{6-4\gamma_2}, \quad q^C = \frac{4-\gamma_2-\gamma_2^2}{6-\gamma_2-2\gamma_2^2}.$$

Post-merger Cournot Equilibrium:

Stage II: The problem of the merged entity, A, is

$$\max_{q_{1A},q_{2A}} (p_{1A} - w_A)\, q_{1A} + (p_{2A} - w_A)\, q_{2A} - F_A,$$

which leads to the optimality conditions:

$$\begin{aligned} q_{1A} &= \frac{1-w_A}{2}, \\ 1 - 2q_{2A} - \gamma_2 q_{2B} - w_A &= 0. \end{aligned}$$

Similarly the problems of retailer $1B$ and $2B$ give respectively

$$\begin{aligned} q_{1B} &= \frac{1-w_{1B}}{2}, \\ 1 - 2q_{2B} - \gamma_2 q_{2A} - w_{2B} &= 0. \end{aligned}$$

Solving these equations together, we get the retail equilibrium:

$$q_{2A} = \frac{1}{4-\gamma_2^2}\left(-2w_A + \gamma_2 w_{2B} + 2 - \gamma_2\right), \; q_{2B} = \frac{1}{4-\gamma_2^2}\left(-2w_{2B} + \gamma_2 w_A + 2 - \gamma_2\right). \quad (38)$$

Stage I: At optimum retailer $1B$ sets (similar to the pre-merger equilibrium)

$$w_{1B}^C = C'\left(\sum_{m=1,2} q_{mA}^C + q_{mA}^C\right),$$

where

$$p_{1B}^C = \frac{1+w_{1B}^C}{2}, \qquad q_{1B}^C = \frac{1-w_{1B}^C}{2}.$$

Retailer A sets its wholesale price to maximize its bilateral profit with the supplier taking into account the fact that retailer $2B$ reacts to changes in w_A:

$$\max_{w_A}\left[p_{1A}q_{1A} + p_{2A}q_{2A} - C\left(\sum_{m=1,2}(q_{mA}+q_{mB})\right) + w_{1B}q_{1B} + w_{2B}q_{2B} - (w_{1B}+w_{2B})q_B^m + C\left(2q_B^m\right)\right],$$

which leads to the optimality condition for w_A:

$$\left[w_A - C'\left(.\right)\right]\left(\partial_{w_A}q_{1A} + \partial_{w_A}q_{2A}\right) + q_{2A}\partial_{q_{2B}}p_{2A}\partial_{w_A}q_{2B} + \left[w_{2B} - C'\left(.\right)\right]\partial_{w_A}q_{2B} = 0.$$

Similarly, the problem of retailer $2B$ gives us its optimality condition:

$$\left[w_{2B} - C'(.)\right]\partial_{w_{2B}}q_{2B} + q_{2B}\partial_{q_{2A}}p_{2B}\partial_{w_{2B}}q_{2A} + \left[w_A - C'(.)\right]\partial_{w_{2B}}q_{2A} = 0.$$

Using the definition of linear demand functions and the retail equilibrium conditions given in (38), we derive

$$\partial_{w_A} q_{1A} + \partial_{w_A} q_{2A} = -\frac{8-\gamma_2^2}{2\left(4-\gamma_2^2\right)}, \quad \partial_{q_{2B}} p_{2A} = -\gamma_2, \quad \partial_{w_A} q_{2B} = \frac{\gamma_2}{4-\gamma_2^2},$$

and thus re-write the optimality condition for w_A:

$$-\left(8-\gamma_2^2\right)\left[w_A^C - C'\left(\sum_{m=1,2}\left(q_{mA}^C + q_{mB}^C\right)\right)\right] - 2\gamma_2^2 q_{2A}^C + 2\gamma_2\left[w_{2B}^C - C'\left(\sum_{m=1,2}\left(q_{mA}^C + q_{mB}^C\right)\right)\right] = 0.$$

Similarly, we derive

$$\partial_{q_{2A}} p_{2B} \partial_{w_{2B}} q_{2A} = -\frac{\gamma_2^2}{4-\gamma_2^2}, \quad \partial_{w_{2B}} q_{2B} = -\frac{2}{4-\gamma_2^2}, \quad \partial_{w_{2B}} q_{2A} = \frac{\gamma_2^2}{4-\gamma_2^2},$$

and re-write the optimality condition for w_{2B}:

$$-2\left[w_{2B}^C - C'\left(\sum_{m=1,2}\left(q_{mA}^C + q_{mB}^C\right)\right)\right] - \gamma_2^2 q_{2B}^C + \gamma_2\left[w_A^C - C'\left(\sum_{m=1,2}\left(q_{mA}^C + q_{mB}^C\right)\right)\right] = 0.$$

Finally, we calculate the total equilibrium quantity as a function of the equilibrium wholesale prices:

$$\begin{aligned} q^{Cmerger} &= \sum_{m=1,2}\left(q_{mA}^C + q_{mB}^C\right) \\ &= 1 + \frac{2}{2+\gamma_2} - \frac{w_A^C + w_{1B}^C}{2} - \frac{w_A^C + w_{2B}^C}{2+\gamma_2}. \end{aligned}$$

The post-merger equilibrium of quantity competition is the solution to

$$\begin{gathered} -\left(8-\gamma_2^2\right)\left[w_A^C - C'\left(q^{Cmerger}\right)\right] - 2\gamma_2^2 q_{2A}^C + 2\gamma_2\left[w_{2B}^C - C'\left(q^{Cmerger}\right)\right] = 0, \\ -2\left[w_{2B}^C - C'\left(q^{Cmerger}\right)\right] - \gamma_2^2 q_{2B}^C + \gamma_2\left[w_A^C - C'\left(q^{Cmerger}\right)\right] = 0, \\ C'\left(q^{Cmerger}\right) = w_{1B}^C, \\ q^{Cmerger} = 1 + \frac{2}{2+\gamma_2} - \frac{w_A^C + w_{1B}^C}{2} - \frac{w_A^C + w_{2B}^C}{2+\gamma_2}. \end{gathered}$$

For quadratic cost function $C(q) = \frac{1}{2}q^2$, after replacing the values of $C'\left(q^{Cmerger}\right)$, q_{2A}^C, and q_{2B}^C into the above equations, the equilibrium wholesale prices are found as:

$$w_A^C = \frac{128 - 32\gamma_2 - 88\gamma_2^2 + 12\gamma_2^3 + 15\gamma_2^4}{192 - 32\gamma_2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4},$$

$$w_{1B}^C = \frac{128 - 32\gamma_2 - 80\gamma_2^2 + 12\gamma_2^3 + 11\gamma_2^4}{192 - 32\gamma_2^2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4},$$

$$w_{2B}^C = \frac{128 - 32\gamma_2 - 96\gamma_2^2 + 16\gamma_2^3 + 17\gamma_2^4 - \gamma_2^5}{192 - 32\gamma_2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4},$$

whereas the pre-merger equilibrium wholesale prices were

$$w_1^C = \frac{-4 + \gamma_2 + \gamma_2^2}{-6 + \gamma_2 + 2\gamma_2^2}, \qquad w_2^C = \frac{4 - 3\gamma_2}{6 - 4\gamma_2}.$$

Figures 4,5, and 6 compare pre-merger and post-merger wholesale prices as functions of the substitution parameter of market 2, γ_2. Figure 4 shows that the merger between outlets $1A$ and $2A$ decreases the wholesale price of outlet $1A$, but increases the wholesale price of outlet $2A$, i.e., $w_2^B < w_A^B < w_1^B$:

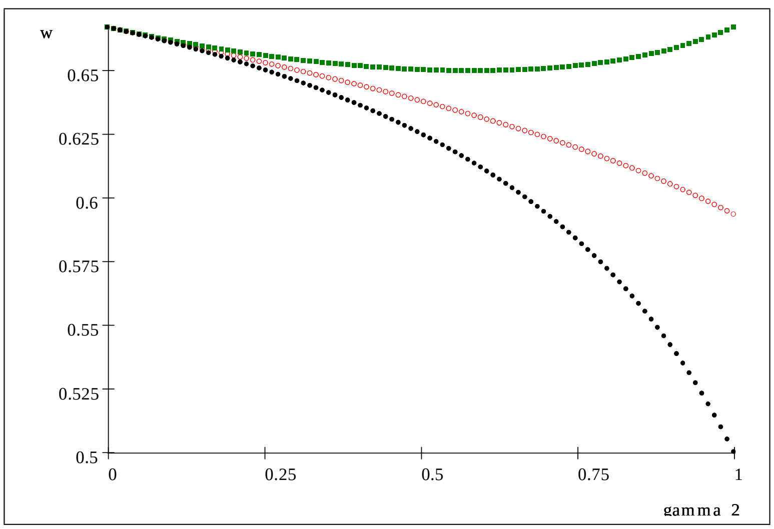

Figure 4. w_1^B : green crosses, w_2^B : black dots, w_A^B : red circles.

Figure 5 shows that the merger increases the wholesale price of retailer $2B$, i.e., $w_{2B}^{B} > w_{2}^{B}$:

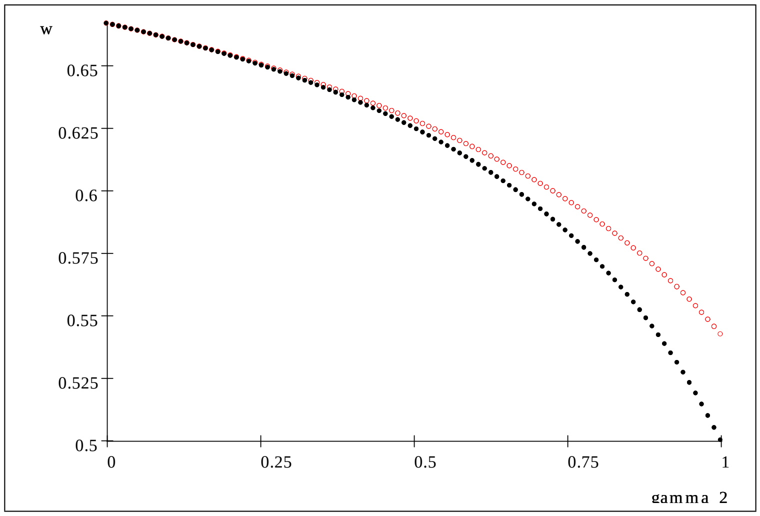

Figure 5. w_{2}^{B} : black dots, w_{2B}^{B} : red circles.

Figure 6 shows that the merger reduces the wholesale price of retailer $1B$, i.e., $w_{1B}^{B} < w_{1}^{B}$:

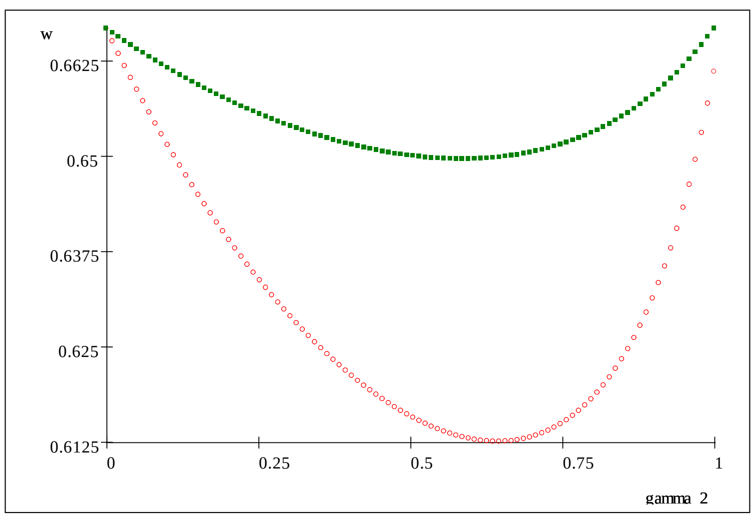

Figure 6. w_{1}^{B} : green crosses, w_{1B}^{B} : red circles.

Proof of Proposition 4.

When the outlets in market 2 compete à la Bertrand, the total pre-merger equilibrium quantity is (see the proof of Proposition 2)

$$q^B = \frac{4 + 3\gamma_2}{6 + 5\gamma_2},$$

and the total post-merger equilibrium quantity is

$$q^{Bmerger} = \frac{128 + 96\gamma_2 - 48\gamma_2^2 - 36\gamma_2^3 + 7\gamma_2^4 + 5\gamma_2^5}{192 + 160\gamma_2 - 72\gamma_2^2 - 60\gamma_2^3 + 11\gamma_2^4 + 9\gamma_2^5}.$$

When the outlets in market 2 compete à la Cournot, the total pre-merger equilibrium quantity is (see the proof of Proposition 3)

$$q^C = \frac{-4 + \gamma_2 + \gamma_2^2}{-6 + \gamma_2 + 2\gamma_2^2},$$

and the total post-merger equilibrium quantity is

$$q^{Cmerger} = \frac{128 - 32\gamma_2 - 80\gamma_2^2 + 12\gamma_2^3 + 11\gamma_2^4}{192 - 32\gamma_2^2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4}$$

Figures 7 and 8 compare pre-merger and post-merger total equilibrium quantities as functions of the substitution parameter of market 2, γ_2. Both figures show that the merger reduces the total equilibrium quantity regardless of the type of competition in market 2, i.e., $q^{Bmerger} < q^B$ and $q^{Cmerger} < q^C$:

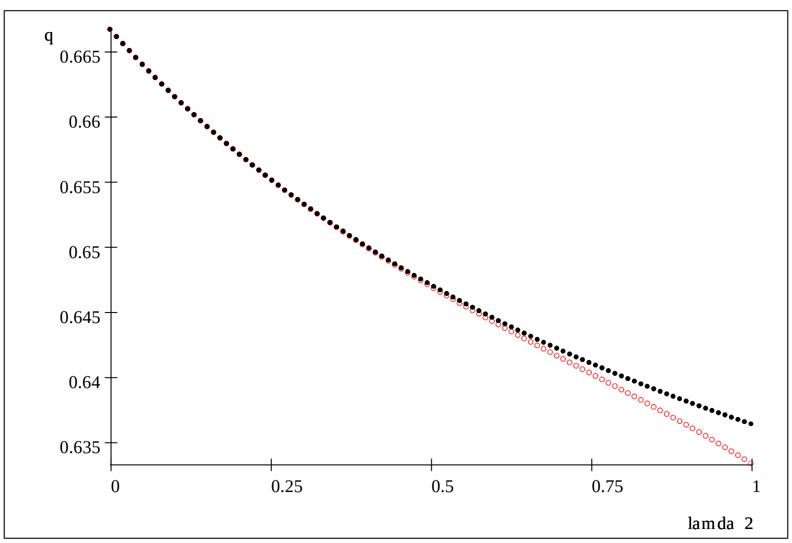

Figure 7. q^B : black dots, $q^{Bmerger}$: red circles.

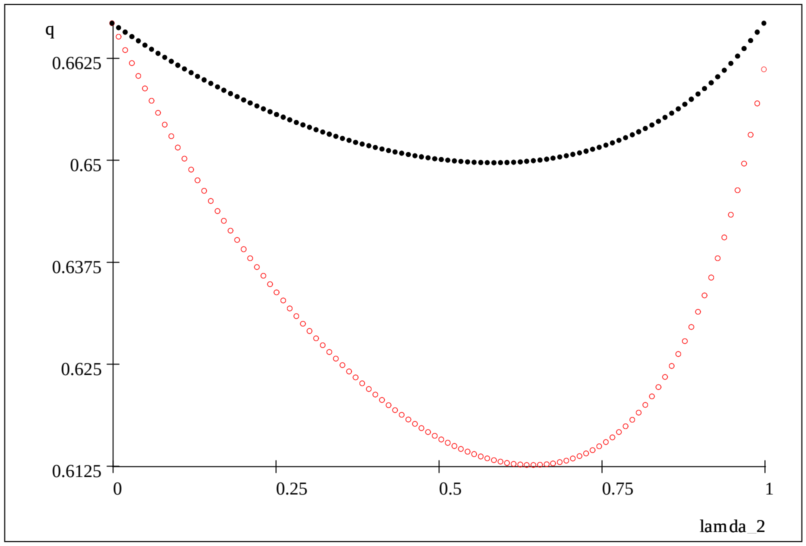

Figure 8. q^C : black dots, $q^{Cmerger}$: red circles.

Observe that the reduction in the total quantity due to the merger is more significant when there is quantity competition in market 2 than when there is price competition.

Proof of Proposition 5.

The profit of retailer mi is given by

$$\pi_{mi} = (p_{mi} - w_{mi})\, q_{mi} - F_{mi},$$

where F_{mi} is its optimal fixed fee satisfying the participation constraint of the upstream firm (see (30)):

$$\begin{aligned} F_{mi} &= \Pi_U^{-mi} - \Pi_U \\ &= C(q) - C(q_{mj} + \sum_{k \neq mi,mj} q_k) - w_{mi}q_{mi} - w_{mj}q_{mj} + w_{mj}q_{mj}^m. \end{aligned}$$

Recall that q_{mj}^m refers to the quantity of retailer mj when its rival, retailer mi, has no contract with the upstream firm. For linear demand

$$q_{mi} = \frac{1}{1+\gamma_m} - \frac{1}{1-\gamma_m^2} p_{mi} + \frac{\gamma_m}{1-\gamma_m^2} p_{mj},$$

we have

$$q_{mi}^m = \frac{1}{1+\gamma_m} - \frac{1}{1-\gamma_m^2} p_{mi} + \frac{\gamma_m}{1-\gamma_m^2} p_{mj}^0,$$

where p_{mj}^0 is the virtual price of retailer mj which makes its demand equal to zero for any

p_{mi}, that is

$$q_{mj} = \frac{1}{1+\gamma_m} - \frac{1}{1-\gamma_m^2} p_{mj}^0 + \frac{\gamma_m}{1-\gamma_m^2} p_{mi} = 0,$$

We therefore get $q_{mi}^m = 1 - p_{mi}$ for $m \in \{1, 2\}$ and $i \in \{A, B\}$. Since there is no competition in market 1, we have $q_{1i}^m = q_{1i} = 1 - p_{1i}$.

Profits before the merger:

Using the symmetry of retailers, the profit of a retailer active in market 1 is given by

$$\pi_{1A} = \pi_{1B} = \pi_1 = (p_1 - w_1)\, q_1 - F_1,$$

where

$$F_1 = C(q) - C(2q_2 + q_1^m) - w_1 q_1.$$

Similarly, the profit of a retailer active in market 2 is

$$\pi_{2A} = \pi_{2B} = \pi_2 = (p_2 - w_2)\, q_2 - F_2,$$

where

$$F_2 = C(q) - C(2q_1 + q_2^m) + w_2 (q^m - 2q_2).$$

Profits after the merger:

The profit of the merged entity, retailer A, is given by

$$\pi_A = (p_{1A} - w_A)\, q_{1A} + (p_{2A} - w_A)\, q_{2A} - F_A,$$

where

$$F_A = C\left(q^{Emerger}\right) - C(q_{1B} + q_{2B}) - w_A (q_{1A} + q_{2A}) + w_{2B} (q_{2B}^m - q_{2B}).$$

Similarly, the profits of retailer $1B$ and retailer $2B$ are respectively given by

$$\pi_{1B} = (p_{1B} - w_{1B})\, q_{1B} - F_{1B}, \quad \pi_{2B} = (p_{2B} - w_{2B})\, q_{2B} - F_{2B},$$

where

$$\begin{aligned} F_{1B} &= C\left(q^{Emerger}\right) - C(q_{1A}^m + q_{2A} + q_{2B}) - w_{1B} q_{1B}, \\ F_{2B}^E &= C\left(q^{Emerger}\right) - C\left(q_{2A}^m + q_{1A}^E + q_{1B}^E\right) - w_{2B} q_{2B} + w_A (q_{2A}^m - q_{2A}). \end{aligned}$$

Profits under Price Competition:

Before the merger, for quadratic cost function $C(q) = \frac{1}{2} q^2$, we have (from the proof of

Proposition 2)

$$w_1^B = \frac{4+3\gamma_2}{6+5\gamma_2}, \quad w_2^B = \frac{8+6\gamma_2+\gamma_2^2+\gamma_2^3}{12+10\gamma_2}, \text{ and } q^B = \frac{4+3\gamma_2}{6+5\gamma_2}.$$

Using these together with the equilibrium conditions of Lemma 3, we moreover calculate

$$q_1^B = \frac{1+\gamma_2}{6+5\gamma_2}, \quad q_2^B = \frac{2+\gamma_2}{2\left(6+5\gamma_2\right)}, \quad q_2^{mB} = \frac{4\gamma_2-\gamma_2^2-\gamma_2^3+4}{20\gamma_2+24},$$

$$p_1^B = \frac{4\gamma_2+5}{5\gamma_2+6}, \quad p_2^B = \frac{7\gamma_2-\gamma_2^2+10}{10\gamma_2+12},$$

and obtain the pre-merger Bertrand profits:

$$\pi_1^B = \frac{3\left(1+\gamma_2\right)^2}{2\left(6+5\gamma_2\right)^2}, \quad \pi_2^B = \frac{48+32\gamma_2-8\gamma_2^3-3\gamma_2^4+10\gamma_2^5+5\gamma_2^6}{32\left(6+5\gamma_2\right)^2}.$$

The pre-merger profit of the merging parties, retailer $1A$ and $2A$, is equal to $\pi_1^B+\pi_2^B$.

Similarly, using the equilibrium wholesale prices and conditions derived in the proof of Proposition 2, we calculate

$$\begin{aligned}
p_{1B}^B &= \frac{96\gamma_2-48\gamma_2^2-36\gamma_2^3+7\gamma_2^4+5\gamma_2^5+128}{320\gamma_2-144\gamma_2^2-120\gamma_2^3+22\gamma_2^4+18\gamma_2^5+384}+\frac{1}{2}, \\
q_{1B}^B &= \frac{48\gamma_2^2-96\gamma_2+36\gamma_2^3-7\gamma_2^4-5\gamma_2^5-128}{320\gamma_2-144\gamma_2^2-120\gamma_2^3+22\gamma_2^4+18\gamma_2^5+384}+\frac{1}{2}, \\
p_{1A}^B &= \frac{96\gamma_2-40\gamma_2^2-28\gamma_2^3+7\gamma_2^4+5\gamma_2^5+128}{320\gamma_2-144\gamma_2^2-120\gamma_2^3+22\gamma_2^4+18\gamma_2^5+384}+\frac{1}{2}, \\
q_{1A}^B &= \frac{40\gamma_2^2-96\gamma_2+28\gamma_2^3-7\gamma_2^4-5\gamma_2^5-128}{320\gamma_2-144\gamma_2^2-120\gamma_2^3+22\gamma_2^4+18\gamma_2^5+384}+\frac{1}{2}, \\
p_{2A}^B &= \frac{112\gamma_2-80\gamma_2^2-46\gamma_2^3+16\gamma_2^4+7\gamma_2^5-\gamma_2^6+160}{160\gamma_2-72\gamma_2^2-60\gamma_2^3+11\gamma_2^4+9\gamma_2^5+192}, \\
q_{2A}^B &= \frac{1}{\gamma_2+1}+\frac{30\gamma_2^3-192\gamma_2^2-48\gamma_2+62\gamma_2^4-4\gamma_2^5-8\gamma_2^6+160}{264\gamma_2^2-160\gamma_2+220\gamma_2^3-83\gamma_2^4-69\gamma_2^5+11\gamma_2^6+9\gamma_2^7-192}, \\
p_{2B}^B &= \frac{112\gamma_2-76\gamma_2^2-46\gamma_2^3+11\gamma_2^4+7\gamma_2^5+160}{160\gamma_2-72\gamma_2^2-60\gamma_2^3+11\gamma_2^4+9\gamma_2^5+192}, \\
q_{2B}^B &= \frac{1}{\gamma_2+1}+\frac{34\gamma_2^3-188\gamma_2^2-48\gamma_2+57\gamma_2^4-9\gamma_2^5-7\gamma_2^6+\gamma_2^7+160}{264\gamma_2^2-160\gamma_2+220\gamma_2^3-83\gamma_2^4-69\gamma_2^5+11\gamma_2^6+9\gamma_2^7-192},
\end{aligned}$$

and obtain the post-merger Bertrand profits:

$$\pi_{1B}^{B} = \frac{6\left(16+16\gamma_2-6\gamma_2^2-6\gamma_2^3+\gamma_2^4+\gamma_2^5\right)^2}{\left(192+160\gamma_2-72\gamma_2^2-60\gamma_2^3+11\gamma_2^4+9\gamma_2^5\right)^2},$$

$$\pi_{2B}^{B} = \frac{(2+\gamma_2)^2\left(768-256\gamma_2-512\gamma_2^2+64\gamma_2^3+188\gamma_2^4+92\gamma_2^5-71\gamma_2^6-6\gamma_2^7+5\gamma_2^8\right)}{\left(192+160\gamma_2-72\gamma_2^2-60\gamma_2^3+11\gamma_2^4+9\gamma_2^5\right)^2},$$

$$\pi_{A}^{B} = \frac{(2+\gamma_2)^2\left(\begin{array}{c} 8192+2048\gamma_2-6656\gamma_2^2-1280\gamma_2^3+2176\gamma_2^4 \\ +672\gamma_2^5-708\gamma_2^6-188\gamma_2^7+253\gamma_2^8+20\gamma_2^9-54\gamma_2^{10}+5\gamma_2^{12} \end{array}\right)}{8\left(192+160\gamma_2-72\gamma_2^2-60\gamma_2^3+11\gamma_2^4+9\gamma_2^5\right)^2}.$$

In Figures 9, 10, 11, we compare the profits of the retailers before and after the merger as functions of the degree of competition in market 2, γ_2. Figure 9 shows that the merger between retailers $1A$ and $2A$ is profitable, i.e., $\pi_A^B > \pi_1^B + \pi_2^B$:

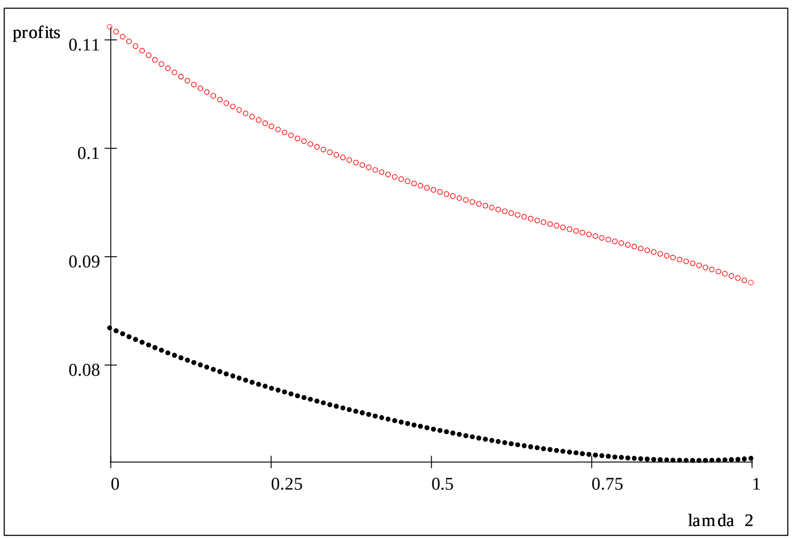

Figure 9. $\pi_1^B + \pi_2^B$: black dots, π_A^B : red circles.

Figure 10 shows that retailer $1B$ earns slightly more profits post-merger, i.e., $\pi_{1B}^B > \pi_1^B$:

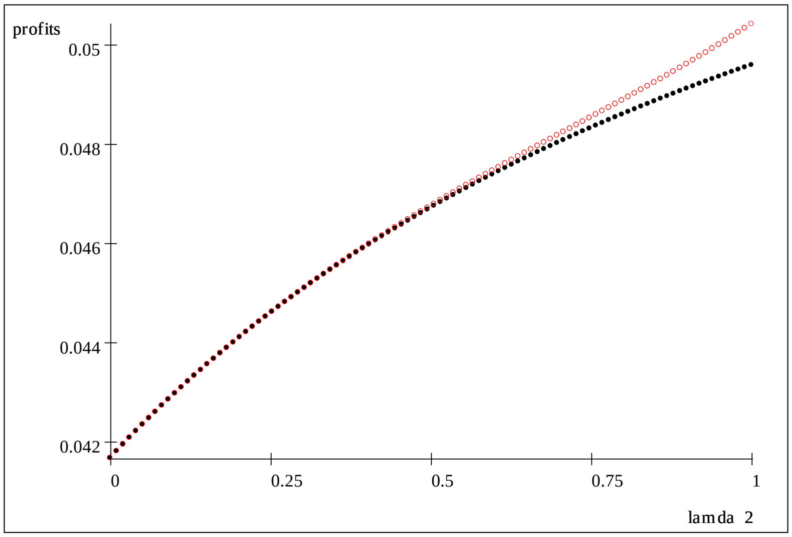

Figure 10. π_1^B : black dots, π_{1B}^B : red circles.

Figure 11 shows that retailer $2B$ earns higher profits after the merger, i.e., $\pi_{2B}^B > \pi_2^B$:

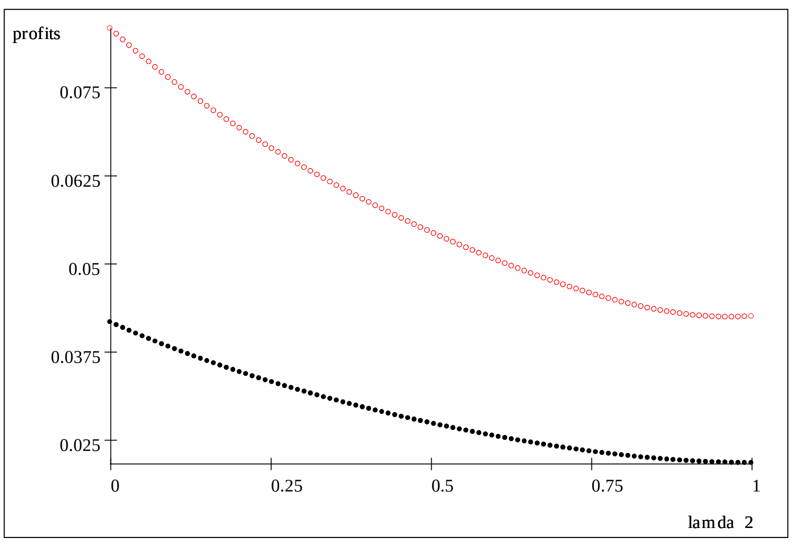

Figure 11. π_2^B : black dots, π_{2B}^B : red circles.

Profits under Quantity Competition:

For quadratic cost function $C(q)=\frac{1}{2}q^2$, we have (from the proof of Proposition 3)

$$w_1^C=\frac{-4+\gamma_2+\gamma_2^2}{-6+\gamma_2+2\gamma_2^2},\ w_2^C=\frac{4-3\gamma_2}{6-4\gamma_2},\text{ and } q^C=\frac{-4+\gamma_2+\gamma_2^2}{-6+\gamma_2+2\gamma_2^2}.$$

Using these together with the equilibrium conditions of Lemma 4, we moreover calculate

$$q_1^C=\frac{-2+\gamma_2^2}{2\left(-6+\gamma_2+2\gamma_2^2\right)},\quad q_2^C=\frac{-2+\gamma_2}{2\left(-6+\gamma_2+2\gamma_2^2\right)},\quad q_2^{mC}=\frac{2-\gamma_2}{12-8\gamma_2},$$

$$p_1^C=\frac{2\gamma_2+3\gamma_2^2-10}{2\gamma_2+4\gamma_2^2-12},\quad p_2^C=\frac{3\gamma_2+3\gamma_2^2-10}{2\gamma_2+4\gamma_2^2-12},$$

and obtain the pre-merger Cournot profits:

$$\pi_1^C=\frac{3\left(-2+\gamma_2^2\right)^2}{8\left(-6+\gamma_2+2\gamma_2^2\right)^2},\ \pi_2^C=\frac{\left(-2+\gamma_2^2\right)^2\left(12-4\gamma_2-3\gamma_2^2\right)}{32\left(-6+\gamma_2+2\gamma_2^2\right)^2}.$$

Similarly, using the equilibrium wholesale prices and conditions derived in the proof of Proposition 3, we calculate

$$\begin{aligned}
p_{1B}^C &= \frac{12\gamma_2^3-80\gamma_2^2-32\gamma_2+11\gamma_2^4+128}{24\gamma_2^3-336\gamma_2^2+46\gamma_2^4+384}+\frac{1}{2},\\
q_{1B}^C &= \frac{32\gamma_2+80\gamma_2^2-12\gamma_2^3-11\gamma_2^4-128}{24\gamma_2^3-336\gamma_2^2+46\gamma_2^4+384}+\frac{1}{2},\\
p_{1A}^C &= \frac{12\gamma_2^3-88\gamma_2^2-32\gamma_2+15\gamma_2^4+128}{24\gamma_2^3-272\gamma_2^2-64\gamma_2+46\gamma_2^4+384}+\frac{1}{2},\\
q_{1A}^C &= \frac{32\gamma_2+88\gamma_2^2-12\gamma_2^3-15\gamma_2^4-128}{24\gamma_2^3-272\gamma_2^2-64\gamma_2+46\gamma_2^4+384}+\frac{1}{2},\\
p_{2A}^C &= \frac{32\gamma_2^2-16\gamma_2+6\gamma_2^3-7\gamma_2^4-32}{12\gamma_2^3-136\gamma_2^2-32\gamma_2+23\gamma_2^4+192}+1,\\
q_{2A}^C &= \frac{6\gamma_2^3-16\gamma_2^2-16\gamma_2+\gamma_2^4+32}{12\gamma_2^3-136\gamma_2^2-32\gamma_2+23\gamma_2^4+192},\\
p_{2B}^C &= \frac{-16\gamma_2+28\gamma_2^2+10\gamma_2^3-6\gamma_2^4-\gamma_2^5-32}{12\gamma_2^3-136\gamma_2^2-32\gamma_2+23\gamma_2^4+192}+1,\\
q_{2B}^C &= \frac{6\gamma_2^3-12\gamma_2^2-16\gamma_2+32}{12\gamma_2^3-136\gamma_2^2-32\gamma_2+23\gamma_2^4+192},
\end{aligned}$$

and obtain the post-merger Cournot profits:

$$\pi_{1B}^C=\frac{6\left(16-14\gamma_2^2+3\gamma_2^4\right)^2}{\left(192-32\gamma_2-136\gamma_2^2+12\gamma_2^3+23\gamma_2^4\right)^2},$$

$$\pi_{2B}^{C} = \frac{\left(12 - 4\gamma_2 - 3\gamma_2^2\right)\left(16 - 8\gamma_2 - 6\gamma_2^2 + 3\gamma_2^3\right)^2}{2\left(192 - 32\gamma_2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4\right)^2},$$

$$\pi_{A}^{C} = \frac{\left(32768 - 24576\gamma_2 - 34816\gamma_2^2 + 25600\gamma_2^3 + 12288\gamma_2^4 - 8576\gamma_2^5 - 1552\gamma_2^6 + 928\gamma_2^7 + 32\gamma_2^8 - 8\gamma_2^9 + 5\gamma_2^{10}\right)}{8\left(192 - 32\gamma_2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4\right)^2}.$$

In Figures 12, 13, and 14, we compare the profits of the retailers before and after the merger as functions of the degree of competition in market 2, γ_2. Figure 12 shows that the merger between retailers $1A$ and $2A$ is profitable, i.e., $\pi_A^C > \pi_1^C + \pi_2^C$:

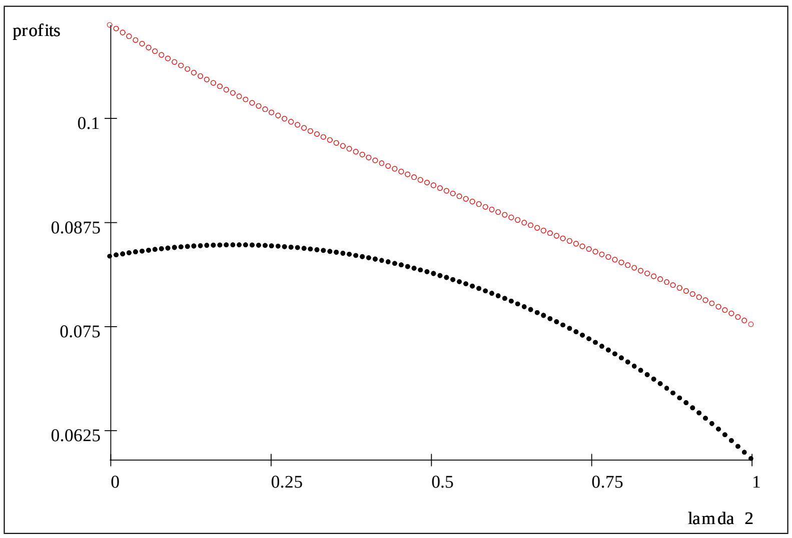

Figure 12. $\pi_1^C + \pi_2^C$: black dots, π_A^C : red circles.

Figure 13 shows that retailer $1B$ earns slightly more profits post-merger, i.e., $\pi_{1B}^C > \pi_1^C$:

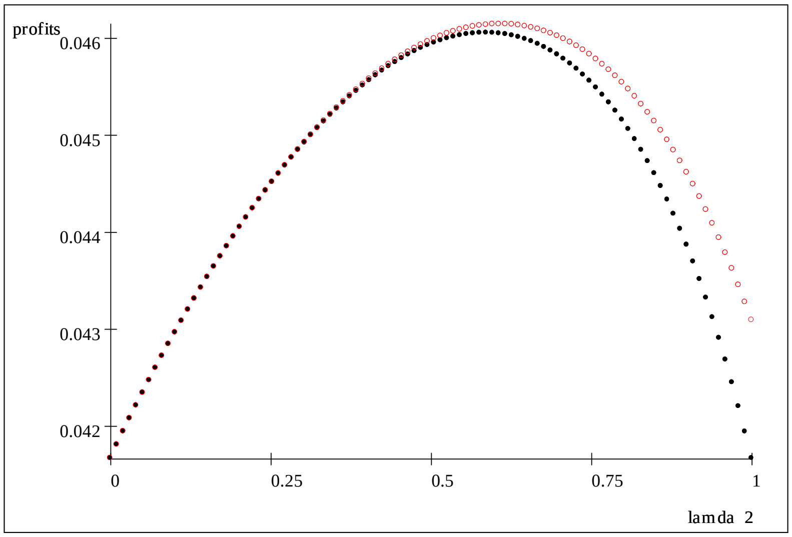

Figure 13. π_1^C : black dots, π_{1B}^C : red circles.

Figure 14 shows that retailer $2B$ earns less after the merger, i.e., $\pi_{2B}^C < \pi_2^C$:

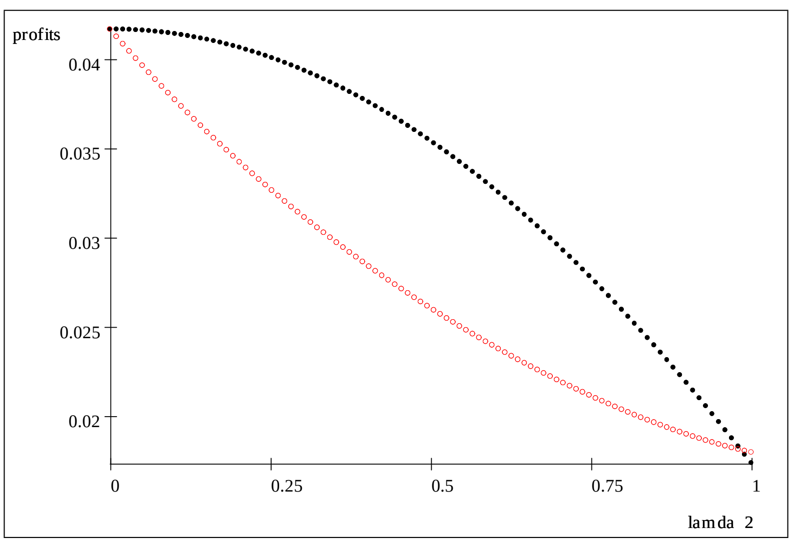

Figure 14. π_2^C : black dots, π_{2B}^C : red circles.

Proof of Proposition 6.

Recall that we derive the linear demand function $q_{mi} \equiv q_m(p_{mi}, p_{mj})$ (given in (24) and

(25)) from the utility maximization problem of a representative consumer in market m:

$$\max_{q_{mA},q_{mB}} U_m = q_{mA} + q_{mB} - \gamma_m q_{mA} q_{mB} - \frac{1}{2}\left(q_{mA}^2 + q_{mB}^2\right)$$
$$s.t. \quad p_{mA} q_{mA} + p_{mB} q_{mB} \leq I.$$

Since $\gamma_1 = 1$, the surplus of consumers in market 1 is given by

$$V_1 = q_{1A} + q_{1B} - \frac{1}{2}\left(q_{1A}^2 + q_{1B}^2\right),$$

whereas the surplus of consumers in market 2 is given by

$$V_2 = q_{2A} + q_{2B} - \gamma_2 q_{2A} q_{2B} - \frac{1}{2}\left(q_{2A}^2 + q_{2B}^2\right).$$

Consumer Surplus under Bertrand Competition:

Using the equilibrium quantities for cost function $C(q) = \frac{1}{2}q^2$, which we derive in the proof of Proposition 2, we calculate the surplus of consumers before the merger:

$$V_1^B = \frac{(1+\gamma_2)(11+9\gamma_2)}{(6+5\gamma_2)^2}, \quad V_2^B = \frac{(2+\gamma_2)\left(22+17\gamma_2-\gamma_2^2\right)}{4(6+5\gamma_2)^2},$$

and after the merger:

$$V_1^{Bmerger} = \frac{4\left(2816+5120\gamma_2+32\gamma_2^2-4128\gamma_2^3-1066\gamma_2^4+1432\gamma_2^5+507\gamma_2^6-244\gamma_2^7-99\gamma_2^8+18\gamma_2^9+8\gamma_2^{10}\right)}{\left(160\gamma_2-72\gamma_2^2-60\gamma_2^3+11\gamma_2^4+9\gamma_2^5+192\right)^2},$$

$$V_2^{Bmerger} = \frac{(2+\gamma_2)^2\left(5632+1536\gamma_2-4928\gamma_2^2-416\gamma_2^3+1660\gamma_2^4+16\gamma_2^5-263\gamma_2^6+12\gamma_2^7+15\gamma_2^8\right)}{2\left(160\gamma_2-72\gamma_2^2-60\gamma_2^3+11\gamma_2^4+9\gamma_2^5+192\right)^2}.$$

Figures 15 and 16 compare the consumer surpluses before and after the merger as functions of the degree of competition in market 2, γ_2. Figure 15 shows that the consumer surplus of market 1 reduces as a result of the merger, and this reduction is more significant for high degrees of competition in market 2:

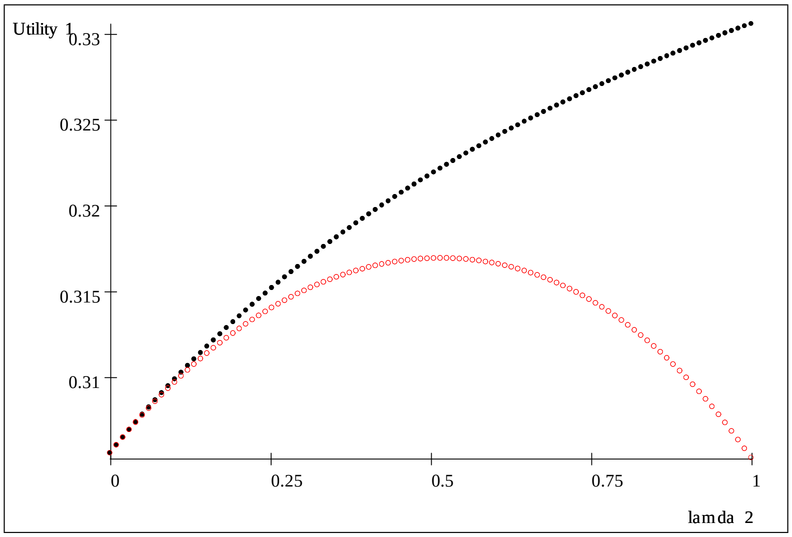

Figure 15. V_1^B : black dots, $V_1^{Bmerger}$: red circles.

Figure 16 shows that the consumer surplus of market 2 increases as a result of the merger, and this increase is more significant for high degrees of competition in market 2:

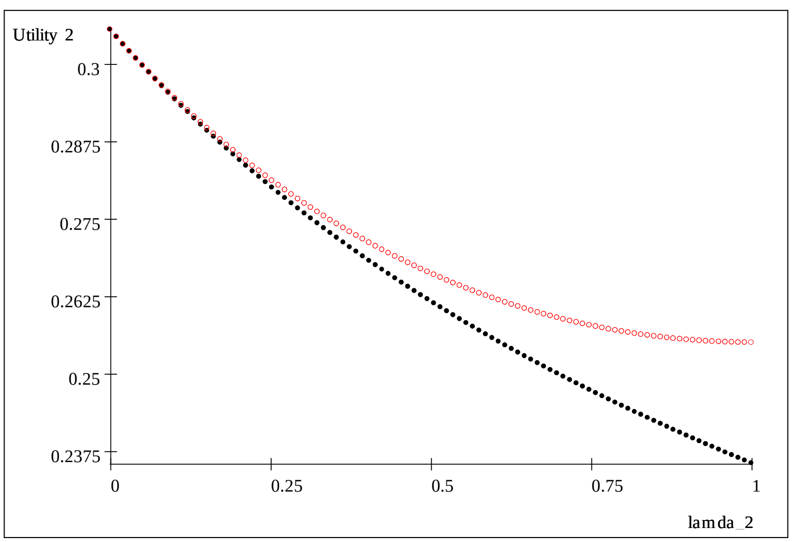

Figure 16. V_2^B : black dots, $V_2^{Bmerger}$: red circles.

Consumer Surplus under Cournot Competition:

Using the equilibrium quantities for cost function $C(q) = \frac{1}{2}q^2$, which we derive in the proof of Proposition 3, we calculate the surplus of consumers before the merger:

$$V_1^C = \frac{44 - 8\gamma_2 - 36\gamma_2^2 + 4\gamma_2^3 + 7\gamma_2^4}{4\left(-6 + \gamma_2 + 2\gamma_2^2\right)^2}, \quad V_2^C = \frac{44 - 32\gamma_2 - 9\gamma_2^2 + 7\gamma_2^3}{4\left(-6 + \gamma_2 + 2\gamma_2^2\right)^2},$$

and after the merger:

$$V_1^{Cmerger} = \frac{4\left(2816 - 512\gamma_2 - 4256\gamma_2^2 + 608\gamma_2^3 + 2366\gamma_2^4 - 236\gamma_2^5 - 573\gamma_2^6 + 30\gamma_2^7 + 51\gamma_2^8\right)}{\left(192 - 32\gamma_2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4\right)^2},$$

$$V_2^{Cmerger} = \frac{\left(22528 - 16384\gamma_2 - 22784\gamma_2^2 + 16256\gamma_2^3 + 7664\gamma_2^4 - 5168\gamma_2^5 - 944\gamma_2^6 + 516\gamma_2^7 + 33\gamma_2^8\right)}{2\left(192 - 32\gamma_2 - 136\gamma_2^2 + 12\gamma_2^3 + 23\gamma_2^4\right)^2}.$$

Figures 17 and 18 compare the consumer surpluses before and after the merger as functions of the degree of competition in market 2, γ_2. Figure 17 shows that the consumer surplus of market 1 is higher after the merger, and it increases more for higher degrees of competition in market 2:

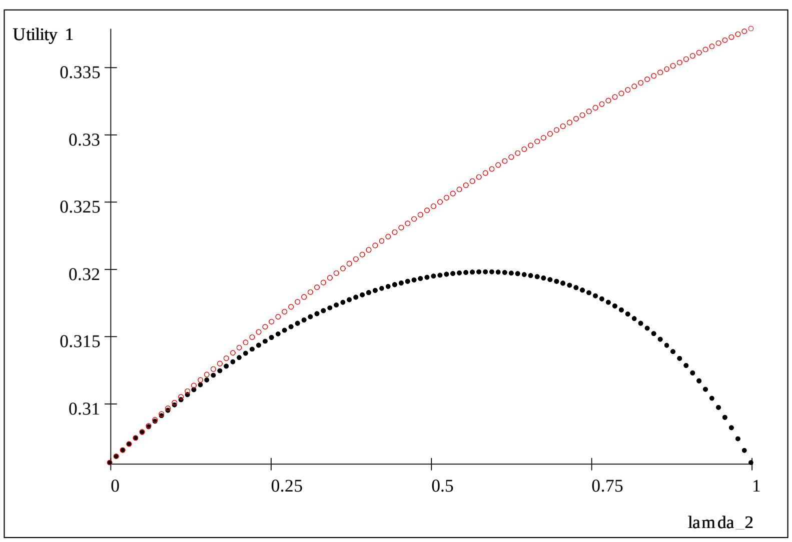

Figure 17. V_1^C : black dots, $V_1^{Cmerger}$: red circles.

Figure 18 shows that the consumer surplus of market 2 is lower post-merger, and it decreases more for higher degrees of competition in market 2:

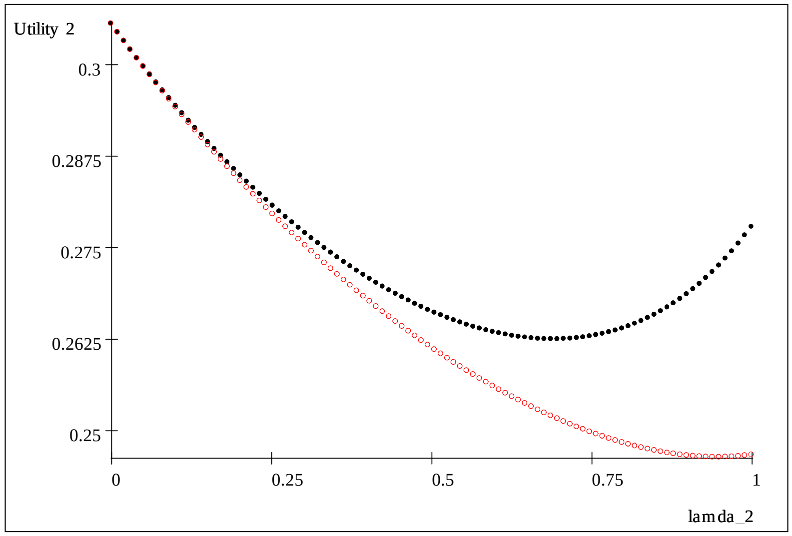

Figure 18. V_2^C : black dots, $V_2^{Cmerger}$: red circles.

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