Dominant Retailers' Incentives for Product Quality

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ABSTRACT

This paper investigates the diverging incentives for product quality in a channel with two asymmetric retailers and a common supplier. When retailers differ in terms of service provision and channel power, changes in manufactured quality cause channel conflicts. In particular, our results show that if the low service retailer becomes dominant in the channel, it may induce a low level of quality that is detrimental for the other members of the channel. The low service retailer benefits from quality reduction first by improving its competitive standing against its rival retailer by lessening the importance of quality for consumer choice and second by strengthening its relative bargaining position vis-à-vis its supplier. Our results also show that consumer surplus may increase as a result of quality reduction.

Keywords: Product Quality; Channels of Distribution; Retailing; Dominant Retailer

1. Introduction

One of the controversial issues surrounding large-scale discount retailers is a concern over product quality.[1] Critics of Wal-Mart, in particular, complain not only that it sells low quality products but, perhaps more importantly, that its size and influence may actually have detrimental effects on quality, which go beyond the products sold within its stores.[2] This paper examines the connection between the influence on quality by certain retailers and the quality of products sold elsewhere.

Traditionally, quality was determined exclusively by consumer product manufacturers. Such a determination was based on market needs and manufacturer profitability. Now, however, as has been well-documented, several large-scale retailers have acquired significant influence over their suppliers. This influence may even extend to product specifications (Dobson and Waterson 1999, Luo et al. 2007).[3] For example, Wal-Mart is known for its influence with manufacturers to lower product quality.[4] A fundamental question this paper addresses is: why and under what conditions does a powerful retailer try to reduce manufactured quality?

An important aspect of our research is the fact that manufacturers sell their products through multiple retailers. Lower quality, as induced by a single powerful retailer, may therefore

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[1] A *Consumer Reports* (2002) survey of shoppers found that Wal-Mart was among the lowest in perceived quality among major retailers in the US. See also *The Mirror* (October 15, 2005) for criticisms of Tesco's quality standards.
[2] See anecdotal discussions of Wal-Mart's influence on manufactured quality and the impact of this influence on its suppliers and rival retailers in Charles Fishman's (2006) book: "The Wal-Mart Effect". See also *The Scotsman* (August 26, 2005) for concerns that Tesco's use of foreign sourced, low quality beef, which is labeled to appear locally sourced, adversely affects consumer's general perceptions of British produced beef.
[3] Fishman (2006) reports the CEO of an instantly recognizable consumer products company in an interview saying, "You know they (Wal-Mart) have a tremendous impact on innovation, on the development of new products. You know they are enormously damaging in that arena." For instance, according his interviews with an ex-design engineer electronics manufacturer, Philips, faced with pressure from Wal-Mart, made its TV cabinets thinner and took away extra features Wal-Mart did not want (Fishman 2006).
[4] According to *Business Week*, Wal-Mart heavily influences product specifications and is criticized by suppliers that it forces down quality standards (Bianco 2003). For example, Snapper Lawn Mowers were sold in both Wal-Mart and in specialty lawn care retailers. According to an interview with its CEO, continuing to supply Wal-Mart meant gradual but irresistible corrosion of the very qualities for which Snapper was known (Fishman 2006).

have an impact at other retailers supplied by the same manufacturer. If reduced quality benefits the powerful retailer then how does it affect the other members of the channel, the manufacturer and competing retailers? This is a second question we ask in this paper. A third and final question asked in this research is: What are the implications for consumers when a powerful retailer exerts its influence on quality? This question is particularly important since large discounters are often criticized on reducing manufacturers' quality which may become detrimental to consumers (Fishman 2006).

The motivating premise behind our inquiry is the fact that manufacturers of nationally branded goods typically distribute their products through competing retailers which may differ in, among other things, the level of their service or their ability to accentuate quality features of products. For instance, the department store chain, Sears, sells many of the same products as Wal-Mart, yet has emphasized better product quality and better customer service than Wal-Mart (*Journal Record* 1991). Similarly, retailers in the grocery industry, such as H-E-B and Wegmans, are acclaimed for introducing lavish displays in order to highlight quality attributes of many national brands, which are also sold at large discounters.[5] Furthermore, while discounters are subject to complaints about customer service,[6] these smaller, regional retailers emphasize their commitment to customer service.[7]

It is perhaps not surprising that smaller retailers are differentiated from their larger rivals. What is not so obvious is the implication of these differences for the channel relationships vis-à-vis their common suppliers. The examples above illustrate the asymmetric nature of retail competition, which is crucial for understanding the diverging incentives for product quality.

[5] See, for example HBS Case, H-E-B Own Brands and *Fortune* article "The Wegmans Way" (Boyle et al. 2005).
[6] See, for example, consumeraffairs.com (http://www.consumeraffairs.com/retail/walmart.htm).
[7] See, again, HBS Case, H-E-B Own Brands and *Fortune* article "The Wegmans Way (Boyle et al. 2005).

And, depending on the power structure of the channel, these differences have implications for the level of quality produced, prices paid, and the corresponding welfare of consumers.

Our analysis is based on a game-theoretical model in which two asymmetric retailers compete for the sale of a single product supplied by a common manufacturer. Under the premise that the retailers differ with respect to their channel power and level of service, we first show that if the low service retailer (e.g. a discounter) has more channel power over the manufacturer (dominant) than the high service retailer (weak), then the dominant retailer benefits from a reduction in manufactured quality.

There are two benefits accruing to the influential retailer. One benefit is that a quality reduction improves the dominant retailer's competitive standing against the other retailer by lessening the importance of quality for consumer choice. Specifically, when quality is reduced, the distinction between retailers becomes muted, leaving the higher service retailer with less of a competitive advantage. We call this the "competitive position effect". As a second benefit, a quality reduction improves the dominant retailer's bargaining position vis-à-vis the manufacturer by reducing the manufacturer's outside option of selling exclusively through the high service retailer. This has a downward effect on the negotiated wholesale price. We call this the "bargaining position effect". Therefore, given some authority over quality, a dominant retailer will influence it downward in order to profit from these two benefits.

Because lower quality products are usually cheaper to produce, it is often argued that discount retailers induce lower quality in order to drive down manufacturer costs and, consequently, wholesale prices. Our model suggests, however, that the competitive and bargaining position effects provide incentives to induce lower quality regardless of changes in production costs. Our theory, therefore, identifies new motivations for certain retailers to influence quality downward.

These motivations exist whenever a manufacturer sells the same product to competing retailers. Some manufacturers, however, may develop channel specific products. For example, a manufacturer can sell the lower quality version of its product to discount retailers and its higher quality version to other retailers. In an extension of the basic model, we show that even when the manufacturer has retailer-specific quality levels,[8] the dominant retailer can still have a strategic incentive for quality reduction. This can occur if a manufacturer's overall brand equity depends on the quality of each the products it sells (Randall et al. 1998). If this dependence is significant, our results indicate that the dominant, low service retailer profits by exerting its influence to lower the quality of the low-end version.

Our results also show that the dominant retailer's benefit from lower quality comes at the loss of the manufacturer and the competing retailer in the form of lower profits. This implies that the manufacturer and weak retailer have a joint incentive to improve quality attributes that are specific to the weak retailer. For example, investments in retail sales staff training, exclusive warrantees, or in-store product displays that improve consumers' appreciation of quality at the weaker retailer may work to restore the manufacturer's bargaining position vis-à-vis the dominant retailer.

Lastly, our model permits an assessment of the impact of lower quality on consumer welfare. Lower quality has a direct effect on consumer utility, but it also means a release of upstream market power and therefore more competitive retail prices. The results indicate that for quality intensive products, quality reduction by a dominant retailer decreases consumer surplus.

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[8] For instance, Levi's developed its *Signature* series of clothing specifically for sale through Wal-Mart, making its original *Red Tab* line available only at selected retailers (Cuneo 2003).

This result is consistent with claims of some critics that suggest Wal-Mart's influence on quality is detrimental to consumers.[9] Our analysis also suggests, however, that when the quality component of a product is low, quality reduction may actually benefit consumers. It is possible, therefore, that the reduction of manufacturers' market power outweighs the direct impact of lower quality.[10]

Jueland and Shugan (1983) is perhaps the first work to point out that members of the distribution channel can have different preferences for quality. Jueland and Shugan (1983), however, deal with a single retailer, and thus do not assess the competitive role that quality plays across retailers in the same market. More importantly, in Jueland and Shugan (1983) as well as in many subsequent studies (e.g., McGuire and Staelin 1983; Moorthy 1987; Lal 1990; Choi 1991; Gerstner and Hess 1995; Ingene and Parry 1995; Purohit 1997; Trivedi 1998; Desai et al 2004), the focus is on channel coordination. In contrast, channel coordination are intentionally absent in our study, which lets us isolate changes in the distribution of economic rents across channel members and consumers due to changes in quality.

While the literature cited above focused on the manufacturer or overall channel objectives, recent attention has been placed on understanding retailers' objectives and their increased power within the channel. For example, Chen (2003), Dobson and Waterson (1997), Dukes et al. (2006) evaluate prices, consumer surplus, and the distribution of profits, as implied by retailers' increased buying power. Raju and Zhang (2005) examine the impact of pricing

[9] See, for example, www.walmartwatch.com/consumer_rights
[10] It is noteworthy that gains in consumer surplus are purely a result of a shift in rents away from the manufacturer and weak retailer rather than from efficiency gains due to, for example, market expansion.

contracts on channel efficiencies in the presence of a dominant retailer. Dukes et al. (2009) and Geylani et al. (2007) investigate the implication of retailer dominance on the decisions of upstream manufacturer who supplies a competing retailer. In addition, Jerath et al. (2008) study how a retailer pursues its dominance. None of the above mentioned studies, however, examines the impact of this buying power on the incentives for quality.

The rest of the paper is organized as follows. In the next section, we set up the model in which a manufacturer sells through two asymmetric retailers, which we use to investigate the diverging preferences for quality across channel members. In Section 3, we evaluate the implications of the quality decision on consumer surplus. In Section 4, we examine the setting when the manufacturer uses retailer-specific qualities. Finally, in Section 5, we summarize the results, discuss their managerial implications, and suggest directions for further research. In an Appendix at the end of the paper, we provide the omitted technical details of our analysis.

2. The Channel Model

Consider a manufacturer selling a common product to end-consumers through two independent retailers – a dominant retailer (1) and a weak retailer (2). The dominant retailer, unlike the weaker one, possesses some degree of influence with the manufacturer's decisions. Retailers are differentiated both horizontally and vertically. Horizontal differentiation is represented spatially using a Hotelling (1929) line with a retailer located at each end. Consumers, located uniformly along the line, incur transportation costs when traveling from their locations to a retailer at a cost of $t > 0$ times distance traveled. Each consumer enjoys a base utility from product consumption, denoted by v, plus a retailer specific component, $Q_i \geq 0$, $i = 1,2$, which we interpret as the product's "delivered" quality when purchased from retailer *i*.

The product's delivered quality $Q_i \geq 0$ affects consumer's utility positively, but not uniformly, across retailers, thus capturing vertical differentiation between retailers. Specifically, we assume that consumers' appreciation of the product's quality at retailer i is $Q_i = s_i + h_i q$ where q represents the product's inherent, or manufactured, quality as produced by the manufacturer. Parameters s_i and h_i are exogenous and represent retailers i's contribution to the delivered quality. We assume that one retailer is more "service" oriented with $s_1 < s_2$ and $h_1 < h_2$. The costs of providing s_i and h_i are assumed to be zero without changing the main results qualitatively.

This service orientation is two dimensional and includes not only the ability of the retailer to contribute to delivered quality through better customer service, but also in its ability to highlight the product's quality attributes. In particular, we interpret this formulation as follows. The parameter s_i represents the ability of the retailer to supplement manufactured quality by, among other things, providing product repairs, guarantees, and a more enjoyable shopping experience. The other parameter, h_i, captures a retailer's ability to highlight the product's quality attributes through, for example, better displays, lighting, design, ambiance, or through its sales staff's ability to describe the product's manufactured quality, q. In this sense, h_i is retailer i's ability to accentuate manufacturer's quality, while s_i is its "extras". [11]

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[11] Note that our formulation of $Q_i = s_i + h_i q$ is not limited to interpretations of service that are either s_i or h_i. Rather, Q_i permits general notions of retail service, which are combinations of s_i and h_i. To illustrate, suppose store lighting can make the quality of the product more salient (an *h* part) and can also make the purchase experience better (an *s* part). Then store *i*'s lighting is represented by the vector (s_i, h_i).

In this one-product model, we normalize the service parameters by defining $s \equiv s_2 > s_1 = 0$ and $h \equiv h_2 > h_1 = 0$.[12] Under this normalization, we specify the utility of a consumer, located at x and facing retail prices p_1 and p_2, when purchasing the product from retailer i by:

$$U_i(x) = \begin{cases} v - tx - p_1 & \text{if } i = 1; \\ v + s + hq - t(1-x) - p_2 & \text{if } i = 2; \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

Given any pair of retail prices, consumers maximize their utility in (1). To ensure meaningful results, we require that v is sufficiently high so that all consumers make a purchase in equilibrium and that retailer 2's service advantage is not too large that it attracts all the consumers in the market. Formally we impose the following:

ASSUMPTION 1: $v > \dfrac{15(s+qh)^2 + 1107t^2 - 162t(s+qh)}{36(5t-qh-s)}$ *and* $s + qh < 5t$,

which is maintained throughout the analyses of the one-product model and guarantees that, in equilibrium, both retailers are in *bona fida* competition with each other. Under Assumption 1, the market shares for two retailers implied by (1) are given by:

$$D_1 = \frac{1}{2} - \frac{s+hq}{2t} + \frac{p_2 - p_1}{2t} \quad \text{and} \quad D_2 = \frac{1}{2} + \frac{s+hq}{2t} - \frac{p_2 - p_1}{2t}. \tag{2}$$

Given this consumer choice framework, we first analyze a two-stage pricing game in which quality q is an exogenous parameter. Later, in section 2.2 we discuss the decision of quality. In the first stage, wholesale prices are simultaneously determined. We assume that the wholesale price w_1 is determined through bilateral negotiations between the manufacturer and

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[12] This comes without loss of generality when there is only one product. If the market is fully covered, then only the differences $s_2 - s_1$ and $h_2 - h_1$ drive consumer choice. Later, in section 4, we depart from this normalization to investigate the situation when the manufacturer sells two products of differing quality.

retailer 1. This reflects the notion that certain retailers use their influence with their suppliers regarding the wholesale price they pay.[13] Concurrent with negotiations, the manufacturer offers a take-it-or-leave-it price w_2 to retailer 2.[14] In the second stage, after observing w_1 and w_2 retailers choose their prices p_1 and p_2.

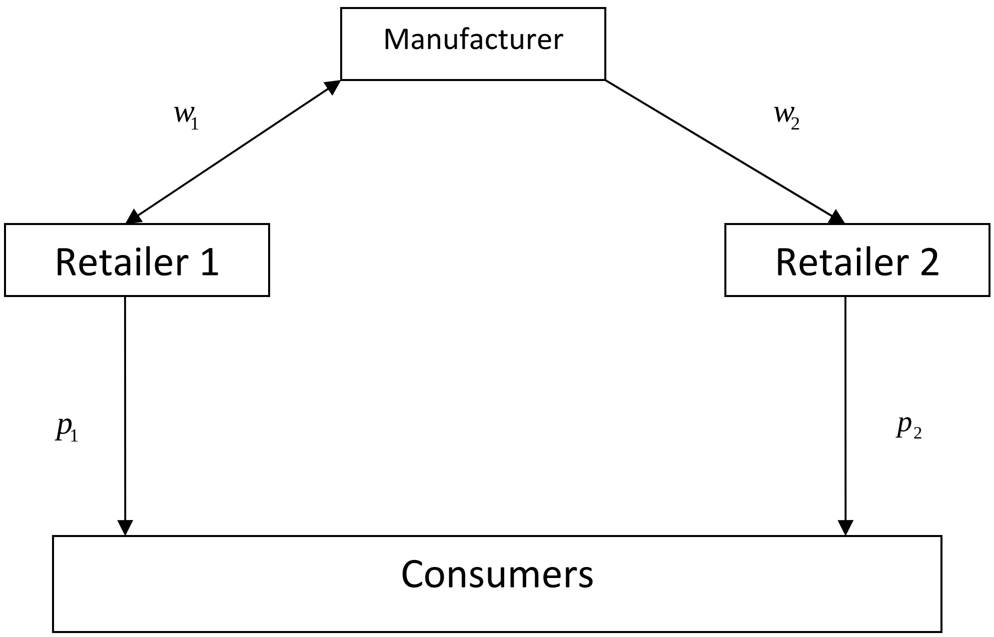

Figure 1: The Channel Structure with Asymmetric Retailers

To summarize, retailer 1 represents a low service dominant retailer, which uses its channel power with manufacturers to bargain over wholesale prices. Retailer 2, on the other

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[13]Influential retailers are known for insisting on price concessions from their supplier. For instance, according to *Fortune* Wal-Mart is famous for its hard negotiations on wholesale price (Useem et al. 2003).

[14] The assumption that retailer 2 is not able to negotiate wholesale terms reflects that retailer 1 has some degree of dominance in the channel relative to retailer 2. This is consistent with previous literature (Chen 2003) which also assumes dominant retailer has more influence on the manufacturer through negotiations, but other retailers get take-it-or leave-it offers.

hand, is a high service but weaker retailer and is subject to a take-it-or- leave-it offer from the manufacturer. The relationships between the manufacturer and retailers are illustrated in Figure 1.

To solve for the equilibrium, we start at the second stage in which given the wholesale prices w_1 and w_2, the retailers choose their prices simultaneously to maximize their profits:

$$\Pi_i = (p_i - w_i)D_i;\ i = 1,2 \tag{3}$$

where D_i is given in (2). In the first stage, the wholesale prices w_1 and w_2 are simultaneously determined by taking into account the pricing reactions (given in the Appendix). Now, consider the negotiation between retailer 1 and the manufacturer, which we model as Nash bargaining. If the negotiation results in agreement, retailer 1 and the manufacturer earn

$$\Pi_1 = (p_1 - w_1)D_1 \tag{4}$$

$$\Pi_M = w_1 D_1 + w_2 D_2 - K(q) \tag{5}$$

where $K(q)$ is cost of quality and is an increasing function of q. While we assume that higher quality imparts higher fixed costs for the manufacturer, marginal costs are always zero. The assumption on zero marginal cost is made to demonstrate the strategic role of quality in the channel. Including a marginal cost component of quality would not qualitatively change the results.

To determine the negotiated wholesale price w_1, we compute disagreement payoffs to the negotiating parties:

$$\Pi_1^{-M} = 0 \tag{6}$$

$$\Pi_M^{-1} = w_2 D_2^{-1} - K(q) \tag{7}$$

where D_2^{-1} denotes sales through retailer 2 when retailer 1 does not sell *M*'s product because of this breakdown. The marginal contributions of each negotiating party are:

$$\Pi_1 - \Pi_1^{-M} = (p_1 - w_1)D_1; \tag{8}$$

$$\Pi_M - \Pi_M^{-1} = w_1 D_1 + w_2(D_2 - D_2^{-1}). \tag{9}$$

Using the model described above, we are able to decompose the motive for quality reduction in to two parts. A *competitive position effect*, illustrated in the next section, shows how a reduction in quality improves the dominant retailer's competitive standing against its retail rival. This effect is demonstrated by restricting the manufacturer's disagreement point in the bargaining solution. The restriction removes issues related to channel bargaining positions and pinpoints the impact of quality changes on retailers' competitive rivalry. Next, we relax this restriction to demonstrate a second motive for quality reduction: a *bargaining position effect*, which shows how quality reduction improves the dominant retailer's relative bargaining position vis-à-vis the manufacturer.

2.1 Competitive Position and Bargaining Position Effects

To decompose the incentives for quality reduction by the dominant retailer, we first impose the restriction that, in the event negotiations between the dominant retailer and the manufacturer break down, the manufacturer experiences no gain in sales through the other retail channel. This directly implies that changes in quality do not affect the relative bargaining positions of either the manufacturer or the dominant retailer. Mathematically, this restriction takes the form $D_2^{-1} = D_2$. The Nash bargaining solution defines a wholesale price, w_1, which maximizes the product:

$$F = (\Pi_1 - \Pi_1^{-M})(\Pi_M - \Pi_M^{-1}). \tag{10}$$

The maximization of (10) determines the negotiated wholesale price w_1' and the maximization of (5) determines the manufacturer's optimal take-it-or-leave-it price w_2' to retailer 2. The following lemma characterizes the equilibrium in this restricted case.

LEMMA 1: *If retailer 2 experiences no additional sales as a result of a breakdown in negotiations between retailer 1 and the manufacturer ($D_2^{-1} = D_2$) then the equilibrium is characterized as follows.*

1) *Wholesale prices:* $w_1' = \dfrac{9t - s - qh}{6}$ and $w_2' = \dfrac{9t + s + qh}{3}$

2) *Retail prices:* $p_1' = \dfrac{9t - s - qh}{3}$ *and* $p_2' = \dfrac{7t + s + qh}{2}$

3) *Retailer and manufacturer profits:* $\Pi_1' = \dfrac{(9t - s - qh)^2}{72t}$, $\Pi_2' = \dfrac{(s + qh + 3t)^2}{72t}$,

and $\Pi_M' = \dfrac{s^2 + q^2h^2 + 2st + 2qh(s+t) + 45t^2}{24t} - K(q)$.

Given the results in Lemma 1, we can easily investigate the effect of quality on the channel members. If the manufacturer has full control of the quality decision, then it invests in *q* up to the optimality condition: $\partial\Pi_M'(q)/\partial q = 0$.

However, for all levels of $q > 0$ retailer 1 would prefer lower quality ($\partial\Pi_1'(q)/\partial q < 0$). With full control of quality it would dictate $q' = 0$. Retailer 1's desire, in this case, is to offset its rival's competitive advantage. As long as $s + qh > 0$, consumers have a preference for retailer 2, gross of price. By lowering *q*, the distinction between retailer 1 and retailer 2 is reduced. Thus, retailer 1 can improve its competitive standing against retailer 2 by lessening the importance of quality for consumer choice. We call this the "competitive position effect".

It is also interesting to point out how wholesale prices are affected by the quality change. A reduction in quality causes retailer 1 to pay *higher* wholesale prices ($\partial w_1' / \partial q < 0$). This is due to the fact that, as retailer 2's quality advantage is reduced (as q becomes lower), retailer 1 gains sales from retailer 2. In the bargaining relationship, the manufacturer negotiates a portion of the surplus acquired from these added sales via a higher wholesale price w_1'. Conversely, w_2' decreases with decreasing quality q ($\partial w_2' / \partial q > 0$) as it loses sales from shrinking quality advantage.

By ignoring any potential gain in manufacturer sales through the retailer during negotiation breakdown, we identified a strategic motivation for quality reduction vis-à-vis retail competition. However, ignoring this possibility implies that quality does not affect relative bargaining positions in the low-service channel. Next, we illustrate how quality reduction by the dominant retailer has a second benefit beyond the competitive effect. We will show, that quality reduction improves its relative bargaining position vis-à-vis the manufacturer and thereby induces lower wholesale prices.

Suppose now that, in the event of breakdown in negotiations between the manufacturer and retailer 1, the sales of retailer 2 increase ($D_2^{-1} > D_2$). Specifically, suppose that some consumers, who would have bought from retailer 1, switch to retailer 2 in the event that the product is not available at retailer 1. The demand at retailer 2 is determined by using (1) without the option of buying at retailer 1:

$$D_2^{-1} = \frac{v + s + hq - p_2^{-1}}{t}. \qquad (11)$$

Given retailer 1's and the manufacturer's incremental payoffs in (8) and (9), the Nash bargaining solution defines the wholesale price for retailer 1 as:[15]

$$w_1^* = \arg\max_{w_1} \left[w_1 D_1 + w_2 (D_2 - D_2^{-1}) \right] \left[(p_1 - w_1) D_1 \right]. \tag{12}$$

It is the increase in sales $D_2^{-1} - D_2$ that the manufacturer can sustain without retailer 1 that governs his bargaining position. (See Figure 2.)

Solving (12) and maximizing (5) with respect to w_2 simultaneously, we get the wholesale prices in equilibrium presented in the following lemma. We relegate the details of the solution procedure to the Appendix and present the equilibrium variables which are denoted with the notation *:

LEMMA 2: *In equilibrium:*

1) *Wholesale prices are*

$$w_1^* = \frac{3v - 15t + \sqrt{3}\alpha}{6} \qquad \textit{and} \qquad w_2^* = \frac{3v - 6t + 3(s + qh) + \sqrt{3}\alpha}{6};$$

2) *Retail prices are*

$$p_1^* = \frac{3v - 6t - s - qh + \sqrt{3}\alpha}{6} \qquad \textit{and} \qquad p_2^* = \frac{3v - 3t + 4s + 4qh + \sqrt{3}\alpha}{6};$$

[15] Note that in the first stage the wholesale prices are set simultaneously, and the manufacturer sets its price for retailer 2, w_2, assuming that its negotiations with retailer 1 are successful. The simultaneous determination of wholesale prices is a simplifying assumption, which has been made in the marketing literature on channel bargaining with multiple retailers (Dukes et al. 2006 and Draganska et al. 2009). During the negotiations, the manufacturer and retailer 1 take into account the fact that retailer 2 is aware of this and therefore in the case of a disagreement it uses the same w_2 when calculating its price p_2. However, both the manufacturer and retailer 1 also know that in the second stage retailer 2 can observe the outcome of the first stage bargaining and set its pricing reaction $p_2(w_2)$ accordingly. Therefore, p_2 in the case of a disagreement between the manufacturer and retailer 1, is different than the p_2 in the case of an agreement. (See the Appendix for details.)

3) Retailer and manufacturer profits are:

$$\Pi_1^* = \frac{(9t - s - qh)^2}{72t}\,, \qquad \Pi_2^* = \frac{(3t + s + qh)^2}{72t} \quad \textit{and}$$

$$\Pi_M^* = \frac{12tv + s^2 + q^2h^2 + 6st + 2qh(s+3t) - 51t^2 + 4t\sqrt{3}\alpha}{24t} - K(q)$$

$$\textit{where } \alpha \equiv \sqrt{2q^2h^2 + 2s^2 + 6s(v-2t) + 2qh(3v+2s-6t) + 3(31t^2 - 4tv + v^2)}\,.$$

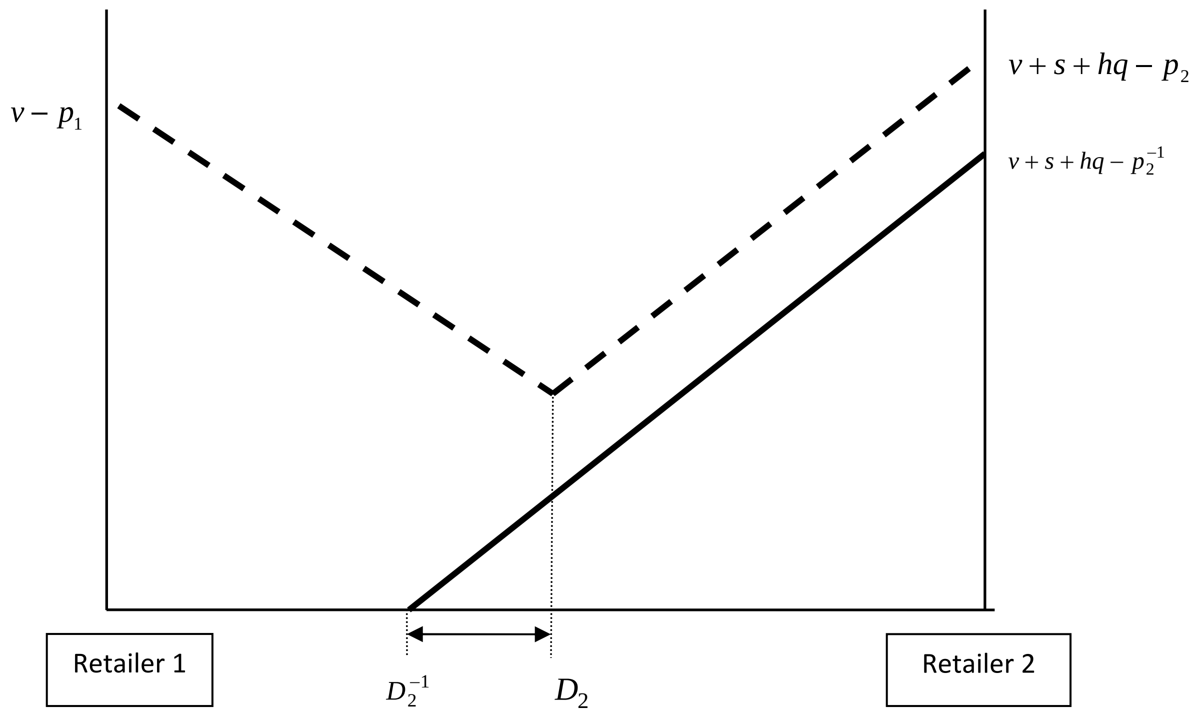

Figure 2: The Bargaining Position of the Manufacturer when Negotiating with Retailer 1

Comparing the wholesale prices for retailer 1 in Lemmas 1 and 2, we decompose the wholesale price paid by retailer 1 into two parts.

PROPOSITION 1: *The equilibrium wholesale price can be decomposed as follows:* $w_1^* = w_1' + \Delta$, $\Delta > 0$ *for* $v > 8t$ *; and* $\partial\Delta / \partial q > 0$.

Proposition 1 decomposes the wholesale price w_1^* where Δ represents a premium accruing to the manufacturer because of retailer 2's gains in sales when, due to disagreement, retailer 1 is foreclosed from the sale of the manufacturer's product. These gains ($D_2^{-1} - D_2 > 0$) provide the manufacturer a better disagreement point when negotiating with retailer 1. Therefore, relative to the case when $D_2^{-1} = D_2$ the manufacturer can negotiate a higher wholesale price ($w_1^* > w_1'$). Moreover, the premium Δ increases with quality q because the manufacturer can extract more surplus from the consumers the higher the quality of the product is ($\partial w_2^* / \partial q > 0$). Conversely, a quality reduction improves retailer 1's relative bargaining position vis-à-vis the manufacturer, which has a downward effect on the negotiated wholesale price. We call this the "bargaining position effect" of quality reduction.

2.2 Firms' Profits and the Quality Decision

Next we examine the effect of product quality on firms' profits and evaluate the impact of the distribution of decision rights for quality. We first establish the opposing preferences for quality through the channel as implied by the equilibrium results of Lemma 2 in the following proposition.

PROPOSITION 2: *An increase in quality reduces the dominant retailer's profits and increases the weak retailer's profits:*

$$\frac{\partial \Pi_1^*}{\partial q} < 0 ; \qquad \frac{\partial \Pi_2^*}{\partial q} > 0 .$$

The manufacturer's revenue (profit net of quality costs) is also increasing in quality:

$$\frac{\partial [\Pi_M^* + K(q)]}{\partial q} > 0 .$$

This proposition illustrates the tension across the channel members with respect to quality. When competing retailers differ in their level of service provision, they have opposing incentives for the level of quality provided by a common supplier. While retailer 1 would prefer lower quality, retailer 2 would prefer higher quality. As discussed above, retailer 1 benefits from lower quality due to improved competitive and bargaining positions. Figure 3 graphically represents profit functions of all three channel members as suggested in Proposition 2.

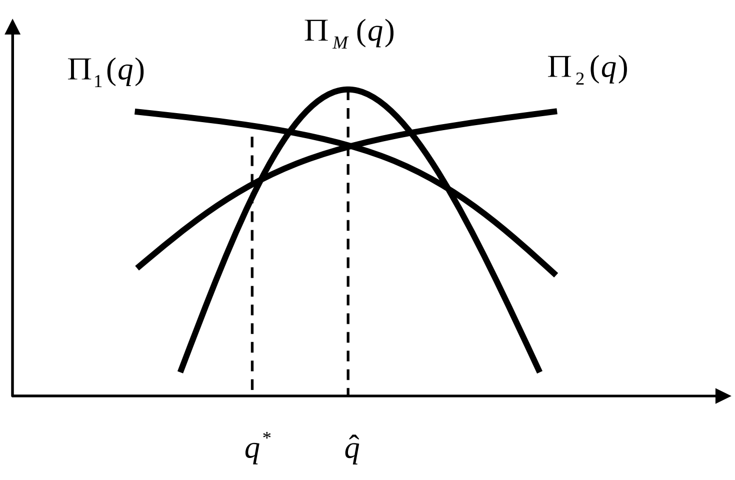

Figure 3: The Diverging Incentives for Quality Among Channel Members

The equilibrium level of quality in this asymmetric channel depends on who controls this decision. If the manufacturer has full control of quality, it will invest in q up to the optimality condition:[16] $\partial\Pi_M^* / \partial q = 0$. Denote this level of quality as $\hat{q}$. However, if retailer 1 has influence over the level of quality, then it would always induce lower quality $q < \hat{q}$.

To illustrate suppose that the manufacturer and retailer 1 negotiate on the level of quality before the wholesale prices are set. In this case, the Nash bargaining solution defines a level of quality q which maximizes the product $\Pi_1^*(\Pi_M^* - \tilde{\Pi}_M)$, where $\tilde{\Pi}_M$ is the manufacturer's profit in the case of a breakdown in the quality negotiations.[17] Denote this negotiated level of quality as q^*. Proposition 3 demonstrates the relationship between q^* and $\hat{q}$.

PROPOSITION 3: *Let the manufacturer's cost of quality be $K(q)$ be sufficiently convex to guarantee a unique (finite) level of quality $\hat{q}$ that maximizes manufacturer's profit Π_M^*. If q^* is the jointly decided level of quality determined through negotiations between the manufacturer and retailer 1, then $q^* < \hat{q}$.*

The proposition guarantees that any negotiated level of quality will be less than the manufacturer prefers. In light of shifting channel power, a discount retailer will exert influence on the quality decision in the direction it prefers, which is downward (Proposition 2). Proposition

[16] An interior $\hat{q}$ that maximizes Π_M^* is finite if $K(q)$ is sufficiently convex.

[17] We assume that the disagreement payoff to retailer 1 is zero and that the manufacturer can still sell its product through the weak retailer and make a positive profit. For example, with the specification $K(q) = cq^2$, c sufficiently large, the manufacturer sets $\tilde{q} = h(s+v)/(8ct - h^2)$, yielding the optimal profit $\tilde{\Pi}_M = c(s+v)^2/(8ct - h^2)$.

3 confirms that retailer 1 would exert its influence toward lower quality. Furthermore, the dominant retailer's influence is to the annoyance of the manufacturer and the rival retailer.[18]

The model, however, also points to strategies for the weak retailer and the manufacturer to react against this influence. We interpret these strategies as investments in a service advantage, which is exclusive to the weak retailer. Specifically, the retailer and manufacturer may want to engage in joint programs that simultaneously help restore the manufacturer's bargaining position and the weak retailer's competitive advantage.

The model parameters *s* and *h* represent the service advantage of retailer 2. As its service advantage increases, retailer 2 becomes more competitive while this hurts retailer 1 ($\frac{\partial \Pi_1^*}{\partial s}, \frac{\partial \Pi_1^*}{\partial h} < 0 < \frac{\partial \Pi_2^*}{\partial s}, \frac{\partial \Pi_2^*}{\partial h}$). However, it is instructive to discuss the effect of these service parameters on the manufacturer profits. It is clear from the discussion in the previous section that the manufacturer benefits from strengthening its bargaining position in its negotiations with retailer 1.

A means by which the manufacturer strengthens its bargaining position is by helping the rival retailer so that it can provide better service to its customers (Note that $\partial \Pi_M^* / \partial s, \partial \Pi_M^* / \partial h > 0$). For example, the manufacturer can offer in-store fixturing and training of the store personnel so that they know how to position and sell the products.[19] Improving store service and design can

[18] One can evaluate the impact of the manufacturer's disagreement payoff $\tilde{\Pi}_M$ on the negotiated level of quality. All else equal, an increase in $\tilde{\Pi}_M$ gives the manufacturer a stronger say in negotiations over quality and leads to higher q^*. (Formally, $q^* \to \hat{q}$ as $\tilde{\Pi}_M \uparrow \Pi_M^*$.)

[19] An illustration of this practice can be found in the cookware industry, in which manufacturers seek out exclusive partnerships with independent specialty retailers (Gorman 2001).

increase the manufacturer's profits through retailer 2, and therefore, strengthen its bargaining position vis-à-vis the dominant retailer.

The manufacturer gains because she can negotiate a higher wholesale price w_1. This bestows an indirect benefit to the weak retailer by relaxing the competitive pressure in retail prices. The manufacturer gets some additional benefit of relaxed price competition via a higher wholesale price w_2. Although this raises retailer 2's costs, the increased demand due to its service advantage more than compensates its loss due to the higher wholesale price.

3. Implications for Consumers

In this section we investigate the impact of quality reduction on consumer surplus. As mentioned in the introduction, there are expressed concerns that dominant retailers' influence on quality may have detrimental effects on consumers. But our model suggests that the implications of this influence are not obvious. On one hand, as the quality level of the products sold decreases, the direct utility that consumers derive from these products should decrease. On the other hand, prices may fall with lower quality, giving consumers potentially more value. Determining the net consequence of these two opposing effects is the objective of this section.

Note that one reason prices can fall with lower quality is that lower quality is cheaper to produce. Benefits to consumers, net of lower utility from quality in this case, would come from market expansion facilitated by lower prices. However, by construction, in our model marginal costs and market size are fixed. This permits us to isolate changes to consumer surplus stemming solely from shifts in rents, rather than from efficiency gains or lower production costs. This is an important distinction because we are thus able to pinpoint the role that quality plays in the distribution of market power.

Consumer surplus is computed, as a function of quality q and the other variables associated with quality, s and h, as

$$CS = \int_0^{D_1} (v - tx - p_1)dx + \int_{D_1}^{1} (v + s + hq - t(1-x) - p_2)dx \,. \qquad (13)$$

To assess the impact of quality changes on consumer surplus, we evaluate the sign of the partial derivatives of equilibrium CS^* in the following proposition.

PROPOSITION 4: *Let* $\bar{v}$ *be as defined in the Appendix.*

1) *If* $v < \bar{v}$ *, then consumer surplus is increasing in q,* $\partial CS^* / \partial q > 0$;

2) *If* $v > \bar{v}$ *, then consumer surplus is decreasing in q,* $\partial CS^* / \partial q < 0$.

To understand the results of Proposition 4, recall that quality reduction has two opposing effects on consumer surplus. There is a direct negative effect on consumer utility (See (1)). But there is also an indirect positive effect through its effect on negotiations and subsequent retail prices.

To assess which of these two effects is stronger, it is helpful to interpret the conditions for v that distinguish the two cases. When $v < \bar{v}$, quality is an important factor in consumers' utility. The direct effect on utility from a quality change is stronger than the indirect effect on paid prices. Therefore, any reduction in manufactured quality q lowers consumer surplus overall.

When v is large, on the other hand, the direct role that quality plays in a consumer's utility from consumption is relatively small. Therefore, it is the indirect effect of quality on prices that is the most important for consumer surplus. Specifically, when quality is reduced, the manufacturers' bargaining position is weakened, ensuring a lower wholesale price for retailer 1 and causing a downward effect on both retail prices. Since product quality is less important for consumers, reducing the quality increases consumer surplus.

The above result is noteworthy in light of the popular discussion on retail dominance. It says that when a discount retailer, retailer 1 in our model, has influence on quality, it may actually benefit consumers in some cases. Consider products with relatively large *v*, which one might interpret as ordinary commodity goods, for example. Retailers who exert their influence on manufacturer's production quality serve to reduce retail differentiation and lower the manufacturer's market power. This process benefits consumers. We emphasize, however, that this is not always the case. Indeed, for products with small *v*, our model suggests the opposite impact: retailer influence on quality is harmful to consumers.

4. Two Products

While manufacturers often sell the same product to all retailers, there are many instances in which this is not the case. A manufacturer's high quality product may be found only at high service retailers while its lower quality product only at discounters or low service retailers. In this section we show that the dominant retailer may have an incentive to reduce quality even if the manufacturer uses a two product strategy.

To see this suppose that products *L* and *H* are sold to the end consumers through retailers 1 and 2, respectively. Let $q_H > q_L$ denote the qualities of the two products offered by the manufacturer. Accordingly, we modify the consumers' utility function (1) to:

$$U_i(x) = \begin{cases} v + s_1 + h_1 q_L - tx - p_1 & \text{if } i = 1; \\ v + s_2 + h_2 q_H - t(1-x) - p_2 & \text{if } i = 2; \\ 0 & \text{otherwise.} \end{cases} \qquad (14)$$

In order to guarantee that, in the equilibrium of this two product model, the entire market is covered and each retailer's demand is positive, we require the following assumption, which is the two-product analog of Assumption 1.

ASSUMPTION 2: $v > \hat{v}$ *($\hat{v}$ defined in the Appendix) and* $(s_2 + h_2 q_H) - (s_1 + h_1 q_L) < 5t$.

We now identify a sufficient condition for which the dominant retailer has the incentive to exert its influence for lower quality even if the manufacturer has the ability to separate its products by selling different qualities through the different retailers. The condition requires that two different quality products manufactured under the same brand are not entirely independent. Such dependence is implied by the notion that a manufacturer's brand equity may be negatively affected if it extends its product line with a lower quality product while retaining the brand name (Randall et al. 1998). Assuming that brand equity plays a role in consumer's perception of product quality, then the perceived quality of the high-end product at the high service retailer may be adversely affected by the declining quality of the product at the low-service retailer.

To make this precise, suppose that these qualities are represented by an objective quality component q_j^o, $j = L, H$ and a common brand quality component q^b, so that $q_j = q_j^o + q^b$. The objective component represents all aspects of the product that can be measured, such as durability, product dimensions, or quantifiable performance measures. The brand component captures the non-objective aspects of quality associated with the brand, such as reputation or image. Further, assume that this brand component depends on the objective qualities of the two products: $q^b(q_L^o, q_H^o)$ with $\partial q^b(q_L^o, q_H^o) / \partial q_j^o > 0$, for *j* = *L*,*H*. The derivative indicates the degree to which objective quality affects the brand quality. For instance, if this derivative is large, it means that reducing the quality of the "low end" of the product line can hurt the "high end". Under this scenario, a low-service retailer pursuing quality reduction of the product sold in its store creates a spillover reduction across the remainder of the product line. This opens up the possibility of restoring the incentive of quality reduction by a low-service retailer even with retailer-specific products. The following proposition states exactly how large this spillover must be for retailer 1 to benefit from quality reduction.

PROPOSITION 5: *If* $\frac{\partial q^b}{\partial q_L^o} > \frac{h_1}{h_2 - h_1}$*, then incentive for quality reduction exists,* $\frac{\partial \Pi_1^{**}}{\partial q_L^o} < 0$; *otherwise* $\frac{\partial \Pi_1^{**}}{\partial q_L^o} \geq 0$.

According to the proposition, if retailer 1's relative ability in highlighting of quality, $h_1/(h_2 - h_1)$, is low, it benefits from sacrificing its own quality q_L^o. With inferior highlighting skills, quality does not help retailer 1 much in extracting surplus from the consumers. Therefore, a reduction in its quality through its effect on brand reputation helps retailer 1 by reducing retailer 2's competitive advantage over retailer 1 (i.e. competitive position effect) and by improving its relative bargaining position vis-à-vis the manufacturer (i.e. bargaining position effect).

5. Summary & Conclusion

An important trend in the retailing industry and distribution channel management is the emergence of dominant retailers such as Wal-Mart. These retailers use their channel power to influence not only the manufacturers' wholesale pricing decision but also their choice of product quality. As a reaction to the growth of the dominant retailers, other retailers try to remain competitive by improving the design of their stores to highlight their products' quality attributes and by their attention to customers.

In this paper we use a model that captures these aspects of the current retailing environment. Specifically, in our model there are two asymmetric retailers that compete for the sale of a single product supplied by a common manufacturer. The retailers are asymmetric with respect to the level of their service and their influence on the manufacturer's choice of quality and price.

Using such a model, we are able to identify two benefits that accrue to the low service retailer from a reduction in product quality. First, a quality reduction improves the dominant retailer's competitive standing against the other retailer by lessening the importance of quality for consumer choice. Second, it weakens the manufacturer's outside option, and therefore improves the low service retailer's relative bargaining position.

These benefits come at the expense of the other channel members however. Quality reduction hurts the high service retailer because it loses demand to the rival retailer. It hurts the manufacturer because it not only weakens the manufacturer's relative bargaining position vis-à-vis the low service retailer but also with a low quality product the manufacturer extracts less surplus from the consumers. Thus, the channel members have diverging incentives for product quality. If the low service retailer becomes dominant it may induce a level of quality that is detrimental for the other members of the channel.

There are also concerns that the dominant retailers' influence in lowering product quality is detrimental to consumers. However, we show that this is not necessarily the case because the price that consumers pay decreases when the manufacturer is weakened in negotiations. As emphasized, prices will decline with lower quality even though the marginal cost and market size are constant in quality. Thus, our results show the possibility of a surplus transfer from the firms to the consumers as a result of a quality reduction.

But what can a manufacturer do when faced with a dominant retailer that uses its channel power to influence product quality? We show that when faced with such a threat, the manufacturer can improve its position in the negotiations by helping the rival retailer to improve its service to the customers. With a better outside option, the manufacturer can charge a higher wholesale price to the dominant retailer.

In addition, the manufacturer may develop channel specific products to mitigate the spillover effects of quality, for example by selling its lower quality product at the low service retailer and the high quality product at the high service retailer. Our results show that despite having retailer specific products, a dominant low-service retailer may still benefit from lower quality whenever there is a strong common brand component across the manufacturer's product line.

Our results may suggest long term product and distribution strategies for manufacturers which are not modeled here. For example, if manufacturers see quality eroding due to dominant retailers, then they can consider producing private labels of high quality for traditional retailers. The advantage of these private labels is that the dominant retailers cannot influence their quality. Alternatively, the manufacturers may consider withdrawing their high quality brands from the dominant retailers and distribute only through high service retailers.

The effects of dominant retailers on product specifications and quality are important in current retailing practices. Further research can study related issues such as how dominant retailers affect the product line decisions by manufacturers and the implications of supplier competition on the incentives identified in this paper. We hope our research inspires further interest in this topic.

Appendix

This Appendix contains the proofs of Lemmas 1-2 and Propositions 1-5.

Proof of Lemma 1: Pricing reactions in the second stage, derived from the first order conditions of the maximization in (3), are given by:

$$p_1(w_1, w_2) = \tfrac{1}{3}(3t + 2w_1 + w_2 - s - qh) \qquad \text{(A1)}$$

$$p_2(w_1, w_2) = \tfrac{1}{3}(3t + w_1 + 2w_2 + s + qh).$$

The second order conditions for the maximizations of (3) are satisfied because

$$\frac{\partial^2 \Pi_i}{\partial (p_i)^2} = -\frac{1}{t} < 0, \quad i = 1,2$$

Pricing reactions in (A1) are used in the maximizations of (5) and (10) given the demands in (2) and our assumption that $D_2^{-1} = D_2$. The first order conditions for the maximizations of (5) and (10) are:

$$qh + s + 3t + 2(w_1 - w_2) = 0 \qquad \text{(A2)}$$

$$(qh + s - 3t + w_1 - w_2)^2 (w_2 - 4w_1 + 3t - qh - s) = 0 \qquad \text{(A3)}$$

respectively. Simultaneous solution of (A2) and (A3) provides w_1' and w_2' in the lemma. The second order condition for the maximization of (5) is satisfied since $\frac{\partial^2 \Pi_M}{\partial (w_2)^2} = -\frac{1}{3t} < 0$. The second order condition for the maximization of the Nash bargaining product (10) evaluated at w_1' and w_2' $\frac{\partial^2 F}{\partial (w_1')^2} = -\frac{(9t - s - qh)^2}{108t}$ is negative as well.

Note that equilibrium retail prices are found by using (w_1', w_2') in (A1) and the optimal profits by using (p_1', p_2') and (w_1', w_2') in (3) and (5) and that the market is covered since for the threshold customer $U_1'(D_1) = 2v + hq - s - p_1' - p_2' = \frac{1}{6}[12v - 45t + 6(s + qh)]$ is positive if $v > 15t/4$, which holds under Assumption 1. Q.E.D.

Proof of Lemma 2: Note that in the maximization (12), the retailers reactions in (A1) are used in D_1 and D_2. However, since both the manufacturer and retailer 1 take into account the fact that once the negotiations are over, retailer 2 knows whether or not they are successful, the p_2 used in D_2^{-1} is different. In the case of a disagreement between the manufacturer and retailer 1, retailer 2 maximizes its profits $\Pi_2^{-1} = D_2^{-1} p_2^{-1}$. This maximization implies

$$p_2^{-1} = \frac{v + s + hq + w_2}{2} \,. \tag{A4}$$

Using (A4) in (12) implies the following first order condition

$$(3t - qh - s + w_2 - w_1)\begin{Bmatrix} (s + q - 3t)^2 + 4w_1^2 \\ + w_1[5(s + qh - 3t) - 8w_2] + w_2(s + qh + 3t + 6v) - 2w_2^2 \end{Bmatrix} = 0 \tag{A5}$$

Solving (A2) and (A5) simultaneously we get the wholesale prices given in the proposition.[20] As mentioned above, second order condition for the maximization of (5) is satisfied since: $\frac{\partial^2 \Pi_M}{\partial (w_2)^2} = -\frac{1}{3t} < 0.$ Denoting the Nash product in (12) by F, we also verify the second order condition for the maximization at (w_1^*, w_2^*): $\frac{\partial^2 F}{\partial (w_1)^2} = -\frac{(s+qh)^2 + (243t - 36s - 36qh)t}{216t^2} < 0$.

[20] Notice that the α used in w_1^* and w_2^* is real since $2q^2h^2 + 2s^2 + 6s(v-2t) + 2qh(3v + 2s - 6t) + 3(31t^2 - 4tv + v^2) >$ $(qh - 3t)^2 + (s - 3t)^2 + (v - 3t)^2 > 0$.

Equilibrium retail prices are found by using (w_1^*, w_2^*) in (A1) and the optimal profits by using (p_1^*, p_2^*) and (w_1^*, w_2^*) in (3) and (5).

Note that the market is covered when the negotiations are successful since under Assumption 1: $U_1\,(D_1) = \frac{1}{2}(2v + s + qh - p_2 - p_1 - t) = \frac{1}{12}(6v + 3s + 3qh + 3t - 2\sqrt{3}\alpha) > 0$. And retailer 2 does not sell to the entire market in the case of a breakdown in negotiations since for the consumer at $x = 0$ under Assumption1: $U_2^{-1}(0) = v + s + qh - p_2^{-1} - t$ $= \frac{1}{12}(3v + 3s + 3qh - 6t - \sqrt{3}\alpha) < 0$. This justifies our demand specifications in (2) and (11).

Q.E.D.

Proof of Proposition 1: Using w_1^* from Lemma 2 and w_1' from Lemma 1 we get

$$w_1^* - w_1' = \tfrac{1}{6}(3v + s + qh - 24t + \sqrt{3}\alpha) = \Delta\,. \qquad \text{(A6)}$$

Thus, Δ is positive for $v > 8t$.

Taking the derivative of (A6) with respect to q we get

$$\frac{\partial \Delta}{\partial q} = h + \frac{\sqrt{3}h(3v + 2s + 2qh - 6t)}{\alpha} > 0\,. \qquad \text{(A7)}$$

The derivative in (A7) is positive if $v > 2t$, which holds under the threshold given for v in Assumption 1. Q.E.D.

Proof of Proposition 2: Using the equilibrium values in Lemma 2: $\frac{\partial \Pi_1^*}{\partial q} = -\frac{h(9t - s - qh)}{36t} < 0$,

$$\frac{\partial \Pi_2^*}{\partial q} = \frac{h(9t + s + qh)}{36t} > 0 \quad \text{and} \quad \frac{\partial [\Pi_M^* + K(q)]}{\partial q} = \frac{h}{12t\alpha}\left[4\sqrt{3}t(s + qh - 3t) + 6\sqrt{3}tv + \alpha(s + qh + 3t)\right] > 0$$

for $v > 2t$, which is implied by the threshold given for v in Assumption 1. Q.E.D.

Proof of Proposition 3: Let q^* be a maximizer of $G(q) \equiv \Pi_1^*(\Pi_M^* - \tilde{\Pi}_M)$, which uniquely exists for $K(q)$ sufficiently convex. Then q^* must satisfy the first order condition of this maximization:

$$\left.\frac{\partial G}{\partial q}\right|_{q=q^*} = \left.\frac{\partial \Pi_1^*}{\partial q}\right|_{q=q^*}\left[\Pi_M^*(q^*) - \tilde{\Pi}_M\right] + \Pi_1^*(q^*)\left.\frac{\partial\left(\Pi_M^* - \tilde{\Pi}_M\right)}{\partial q}\right|_{q=q^*} = 0.$$

By Proposition 2 and the fact that $\Pi_M^*(q^*) - \tilde{\Pi}_M > 0$, the first additive term above is negative. Therefore, the second term is positive. Also observe that

$$\operatorname{sgn}\left\{\left.\frac{\partial \Pi_M^*}{\partial q}\right|_{q=q^*}\right\} = \operatorname{sgn}\left\{\Pi_1^*(q^*)\left.\frac{\partial\left(\Pi_M^* - \tilde{\Pi}_M\right)}{\partial q}\right|_{q=q^*}\right\}$$

since $\Pi_1^*(q^*) > 0$ and $\tilde{\Pi}_M$ does not depend on *q*. Hence, $\Pi_M^*(q)$ is increasing in *q* at q^*. Finally, since $\partial^2\Pi_M^* / \partial q^2 < 0$ for $K(q)$ sufficiently convex, we can conclude that *M*'s optimal quality $\hat{q}$ must exceed the negotiated quality q^*. Q.E.D.

Proof of Proposition 4: Computing the consumer surplus in equilibrium as defined in (13) gives the expression: $CS^* = \dfrac{72tv + s^2 + q^2h^2 + 30t + 81t^2 + 2qh(s+15t) - 24\sqrt{3}t\alpha}{144t}$. Thus,

$$\frac{\partial CS^*}{\partial q} = hz, \frac{\partial CS^*}{\partial s} = z, \text{ and } \frac{\partial CS^*}{\partial h} = qz \tag{A8}$$

where $z = [-24\sqrt{3}t(s + qh - 3t) - 36\sqrt{3}tv + \alpha(qh + s + 15t)]/(72t\alpha)$.

Note that $\dfrac{\partial^2 CS^*}{\partial v \partial q} = hy$, $\dfrac{\partial^2 CS^*}{\partial v \partial s} = y$, and $\dfrac{\partial^2 CS^*}{\partial v \partial h} = qy$ with $y = [\sqrt{3}(2st - 81t^2 + qh(2t - v) - sv]/(2\alpha^3)$

and that $y < 0$ if $v > 2t$, which holds under Assumption 1. Therefore, the partial derivatives in

(A8) are monotonic and decreasing in v. Solving $z=0$ for v we get

$$\bar{v} = \frac{1}{3(1071t^2 - q^2h^2 - s^2 - 30st - 2qh(s+15t))}\{\sqrt{3}[(qh+s+15t)^2(q^4h^4 + s^4 + 30s^3t - 720s^2t^2 \\ - 2430st^3 + 86751t^4 + 2q^3h^3(2s+15t) + 6q^2h^2(s^2+15st-120t^2) + 2qh(2s^3+45s^2t-720st^2-1215t^3))]^{0.5} \\ + [3q^3h^3 + 3s^3 + 84s^2t - 2097st^2 + 6426t^3 + 3q^2h^2(3s+28t) + 3qh(3s^2+56st-699t^2)]\}$$

Hence, the expressed signs of the derivatives in the proposition depend on the relative order of v and $\bar{v}$. To see that $\bar{v}$ is real observe that the term within the square root in $\bar{v}$

$$m \equiv (qh+s+15t)^2[q^4h^4 + s^4 + 30s^3t - 720s^2t^2 \\ - 2430st^3 + 86751t^4 + 2q^3h^3(2s+15t) + 6q^2h^2(s^2+15st-120t^2) + 2qh(2s^3+45s^2t-720st^2-1215t^3)]$$

is positive when $t=0$ (i.e., $m_{t=0} = (qh+s)^5 > 0$). Notice also that $\frac{\partial m}{\partial t}\Big|_{t=0} = 60(qh+s)^2 > 0$

and $\partial(\partial m/\partial t)/\partial t = 36(28917t^2 - 40(qh+s)^2 - 405t(s+qh)) > 0$ under Assumption 1. Therefore $\partial m/\partial t > 0$ for all $t \geq 0$. This implies that $m > 0$ and ensures that $\bar{v} \in \Re$. Furthermore, if $s + hq < 3t$ then $\bar{v} > 0$. Q.E.D.

Proof of Proposition 5: Given any pair of retail prices, consumers maximize their utility in (14), from which we get the following demand functions:

$$D_1 = \frac{1}{2} - \frac{(s_2+h_2q_H)-(s_1+h_1q_L)}{2t} + \frac{p_2-p_1}{2t},\ D_2 = \frac{1}{2} - \frac{(s_1+h_1q_L)-(s_2+h_2q_H)}{2t} - \frac{p_2-p_1}{2t}. \qquad \text{(A9)}$$

In the second stage, the maximization of (3) yields the pricing reactions:

$$p_1(w_1,w_2) = \tfrac{1}{3}(3t + 2w_1 + w_2 - (s_2+h_2q_H) + (s_1+h_1q_L)) \\ p_2(w_1,w_2) = \tfrac{1}{3}(3t + w_1 + 2w_2 + (s_2+h_2q_H) - (s_1+h_1q_L)). \qquad \text{(A10)}$$

Second order conditions for this maximization are satisfied because: $\frac{\partial^2 \Pi_i}{\partial (p_i)^2} = -\frac{1}{t} < 0.$

In the first stage, using agreement demands (A9), pricing reactions (A10), and disagreement demand

$$D_2^{-1} = \frac{v + s_2 + h_2 q_H - p_2^{-1}}{t} \tag{A11}$$

where $p_2^{-1} = \frac{v + s_2 + h_2 q_H + w_2}{2}$, maximization of (5) with respect to w_2 and maximization of (12) with respect to w_1 yield the following equilibrium wholesale prices:

$$w_1^{**} = \frac{3(v + q_1 h_L + s_1 - 5t) + \sqrt{3}\sigma}{6} \text{ and } w_2^{**} = \frac{3(v + q_2 h_H + s_2 - 2t) + \sqrt{3}\sigma}{6} \tag{A12}$$

$$\sigma \equiv \sqrt{93t^2 - 12tv + 3v^2 - q_L^2 h_1^2 + 2q_H^2 h_2^2 - s_1^2 - 12ts_2 + 6vs_2 + 2s_1 s_2 + 2s_2^2 + 2q_L h_1(q_H h_2 + s_2 - s_1) + 2q_H h_2(3v + 2s_2 + s_1 - 6t)}.$$

Note that σ is real since the term within the square root is greater than $(v - 2t)^2 + (s_2 - 6t)^2 + (q_H h_2 - 6t)^2$, which is positive.

Second order condition for the maximization of (5) is satisfied since:

$\frac{\partial^2 \Pi_M}{\partial (w_2)^2} = -\frac{1}{3t} < 0.$ Denoting the Nash product in (12) by *F*, we verify the second order condition for the maximization of (12) at the solution at (w_1^{**}, w_2^{**}):

$$\frac{\partial^2 F}{\partial (w_1)^2} = -\frac{[(s_2 + h_2 q_H) - (s_1 + h_1 q_L)]^2 + 36t\{\frac{27}{4}t - [(s_2 + h_2 q_H) - (s_1 + h_1 q_L)]\}}{216t^2} < 0$$

Note that the market is covered if:

$$U_1(D_1) = \frac{1}{2}(2v + s_2 + h_2 q_H + s_1 + h_1 q_L - p_2 - p_1 - t) = \frac{3(2v + s_1 + s_2 + q_L h_1 + q_H h_2 + t) - 2\sqrt{3}\sigma}{12} > 0$$

which implies:

$$v > \hat{v} \equiv \frac{369t^2 - 7q_L^2 h_1^2 + 5q_H^2 h_2^2 - 6ts_1 - 7s_1^2 - 54ts_2 + 2s_1 s_2 + 5s_2^2 + 2q_L h_1(q_H h_2 + s_2 - 3t - 7s_1) + 2q_H h_2(5s_2 + s_1 - 27t)}{5t - [(s_2 + h_2 q_H) - (s_1 + h_1 q_L)]}$$

And retailer 2 does not sell to the entire market in the case of a breakdown in negotiations since for the consumer at $x = 0 : U_2^{-1}(0) = v + s_2 + q_H h_2 - p_2^{-1} - t = \frac{3v + 3s_2 + 3q_H h_2 - 6t - \sqrt{3}\sigma}{12} < 0$.

This justifies the demand specifications (A9) and (A11).

Equilibrium retail prices are found by using (A12) in (A10) and the optimal profits by using (p_1^{**}, p_2^{**}) and (w_1^{**}, w_2^{**}) in (3) and (5) with demands defined as in (A9) which yield:

$$\Pi_1^{**} = \frac{(9t - s_2 - h_2 q_H + s_1 + h_1 q_L)^2}{72t}.$$

Using $q_j = q_j^o + q^b,\ j = L, H$ in Π_1^{**} we get:

$$\Pi_1^{**} = \frac{(9t + q_L^o h_1 + q^b (h_1 - h_2) - q_H^o h_2 + s_1 - s_2)^2}{72t}.$$

Then:

$$\frac{\partial \Pi_1^{**}}{\partial q_1^o} = \frac{9t + q_L^o h_1 + q^b (h_1 - h_2) - q_H^o h_2 + s_1 - s_2}{36t}\left[h_1 + (h_1 - h_2)\frac{\partial q^b}{\partial q_L^o}\right]$$

Notice that $9t + q_L^o h_1 + q^b (h_1 - h_2) - q_H^o h_2 + s_1 - s_2$ is positive under Assumption 2,

which implies if $\dfrac{\partial q^b}{\partial q_1^o} > \dfrac{h_1}{h_2 - h_1}$ then $\dfrac{\partial \Pi_1^{**}}{\partial q_L^o} < 0$ otherwise $\dfrac{\partial \Pi_1^{**}}{\partial q_L^o} \geq 0.$ Q.E.D.

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