Buyer Power and Vertically Differentiated Retailers

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January 2011

Abstract

We consider a model of vertical competition where retailers purchase an upstream input from a monopolist and are able to differentiate from each other in terms of quality. Our primary focus is to study the effects of introducing a large retailer, such as a Wal-Mart Supercenter, that is able to lower wholesale prices (i.e., countervailing buyer power). We obtain two main results. First, the store with no buyer power responds to the presence of the large retailer by increasing its quality, a finding that is consistent with recent efforts by traditional retailers to enhance shoppers' buying experience. Second, the presence of a large retailer causes consumer welfare to increase. There are, however, two reasons for the increase in consumer welfare: consumers gain from the large retailer's low price because the upstream discount is partially passed on to the retail price and from the high quality offered by the traditional retailer. Contrary to the conventional wisdom, most of the consumer welfare gains seem due to the latter. The intuition for this result is that price competition softens substantially as a result of firms' quality differentiation. We also investigate the effects of buyer power on retail and wholesale prices as well as on producer welfare.

Keywords: buyer power, vertical differentiation, Wal-Mart

JEL Code: D43, L13, L81, M31, Q13

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1. Introduction

For decades, researchers and policy makers have been concerned with the negative effects of imperfect markets in the food industry. Most of the attention has focused on *seller* concentration and its association with higher prices, reduced consumer surplus, and larger profits. Under this "unidirectional" market power approach, downstream agents (buyers) play a passive role by accepting the price set by upstream firms. However, recent concentration trends in food processing, manufacturing and retailing require a closer look at the existence and effects of both *seller* and *buyer* power. Ignoring bidirectional market power can produce biased results when analyzing important policy questions, such as how welfare is affected by mergers or by the presence of large retail chains. Specifically, the ubiquitous negative connotation that market power is given may need to be reconsidered by antitrust legislators and policy makers as buyer power may, for example, help consumers buy at lower prices (Dobson et al., 2001, Wilke, 2004).

The rise in manufacturing concentration in recent years is attributable to the many mergers and acquisitions. Consolidation has been particularly noteworthy in the beer industry, the confectionary industry, and the meat processing industry.[1] Furthermore, a large fraction of fresh produce output is channeled through large and increasingly dominant retail chains: in 2005 food sales by the four largest retailers at the *national* level was 35.5% while food sales by the four largest retailers in a *local* metropolitan area was, on average, 72.3% (ERS, 2000; 2007).[2] Importantly, mass merchandisers (e.g. Wal-Mart, Target and Kmart) and warehouse clubs (e.g. Costco and Sam's) are capturing an ever larger share of all food retail sales in the United States. Wal-Mart, for example, has been the largest food retailer in the United States since 2000

[1] In 2008, the beer industry saw InBev buy Anheuser-Bush Cos. to form the world's largest beer company (Anheuser-Busch InBev). This was followed by a merger of the U.S. no.2 and 3 brands, i.e., SABMiller PLC and Molson Coors Brewing Co. (now MillerCoors). In the confectionary industry, Mars Inc. bought Wm. Wrigley Jr. Co. and meat processor JBS S.A. acquired Smithfield Beef Group.

[2] The second figure (72.3%) corresponds to 1998.

(Martinez, 2007). Given its size, Wal-Mart can be a pivotal buyer to food manufacturers. Notable examples in the food industry are Procter & Gamble, Dean Foods, General Mills, Kellogg, Kraft, Campbell Soup, Tyson Foods and Pepsico, who earned between 11 and 17 percent of their annual revenue from sales to Wal-Mart in 2004 (Martinez, 2007).

Wal-Mart is known for its low prices: 8-27% lower than conventional retailers (Hausman and Leibtag, 2007). With the introduction of Supercenters, Wal-Mart is changing the food retailing landscape. Volpe and Lavoie (2008) show that in response to a Wal-Mart Supercenter, competing supermarkets in the New England region of the United States lower their prices by 6% to 7% for national brands and by 3% to 8% for private labels.[3] Basker and Noel (2009), with a U.S.-wide dataset and a different methodology, find that low-end grocery stores, which compete more directly with Wal-Mart, cut their prices by 1 to 1.2 percent. The decrease in price is more than twice as much as higher-end stores, like Albertson's, Safeway, and Kroger.

A question that has been raised in the recent popular press (Wilke, 2004) and in the academic literature, starting with Galbraith (1952), is whether the countervailing power of large retailers, such as Wal-Mart, can benefit society if the associated savings are passed on to consumers. Chen (2003) examined this question by modeling the retailing sector as a dominant firm with a competitive fringe. In this context, countervailing power results in a lower price to consumers and an increase in consumer surplus, but not always an increase in total surplus due to efficiency losses in retailing.

The above studies have looked at the short-run impact of entry of non-traditional food retailers, i.e., the effect on prices and welfare. However, none have considered the long-run strategic non-price response of traditional grocery chains, such as product differentiation. In fact, after years of decline brought on by fighting Wal-Mart on price, supermarkets appear to be

[3] Other effects of Wal-Mart's presence are discussed by Basker (2007) and references therein.

winning shoppers back by "sharpening their difference with Wal-Mart's price-obsessed supercenters, stressing less-hectic stores with exotic or difficult-to-match products and greater convenience" (McWilliams, 2007). Martinez (2007) provides a comprehensive description of product differentiation strategies used by traditional food retailers to ward off the inroads made by non-traditional retailers such as supercenters, drugstores, and by the food-service segment. The strategies used by supermarkets include expanded product offerings (e.g., expanding organic and private labels selection, adding fuel pumps), new store layouts (adding delis, on-site bakeries, coffee shops, banks, pharmacies, redesigning stores sections to give them a more upscale and sophisticated feel), innovative in-store technology (e.g., self-checkout lanes), image enhancement (e.g., reporting voluntary activities that demonstrate social responsibility), and new product labels (e.g., using more upscale terms such as "premium" and "gourmet"). Thus, supermarkets have improved the quality of the shopping experience and increased the quality (real or perceived) of their products. According to an empirical study by Bonanno and Lopez (2009), such strategies have been successful in attracting less price-sensitive consumers.

In this article, we develop a model to study the price and non-price effects of a large retailer with countervailing buyer power and the resulting welfare implications. The application we have in mind is the entry of Wal-Mart Supercenters, which, with their full line of grocery products, compete with traditional supermarkets. More specifically, we consider a simple wholesaler-retailer relationship where retailers buy a good from a monopolist wholesaler and then sell it (without processing) to final consumers.[4] For tractability purposes we focus on duopoly competition downstream, namely there is one conventional retailer (i.e., with no

[4] In the remainder of the paper the terms "wholesaler", "manufacturer" and "upstream firm" are used interchangeably, as well as the terms "retailer", "supermarket", "store" and "downstream firm."

countervailing buyer power) and another with countervailing power (e.g., Wal-Mart).[5] Buyer power is measured by a discount negotiated between the manufacturer and the retailer, and assumed to be exogenous in our model.[6] As opposed to earlier work, a key component of our model is to allow downstream firms to compete not only in prices but also in quality: retailers can choose a different level of "service" (i.e., quality of the product and/or shopping experience).

We compare our equilibrium results to two "no Wal-Mart" retail configurations: monopoly and duopoly. This allows us to evaluate the effect of Wal-Mart's entry (either by addition or substitution of a retailer) on 1) consumer and producer welfare, and 2) the price and quality equilibrium levels.

In the absence of a large retailer, the two conventional retailers set their quality at the same level and compete with each other in a standard Bertrand fashion. Though the profits for both retailers are zero, the wholesaler (as well as consumers) benefit from the intense price competition between retailers. In the presence of a large retailer, conversely, the degree of quality differentiation depends on the size of the discount (i.e., market power, ability to negotiate) obtained by the retailer. As the discount gets larger, the large retailer has a higher incentive to lower prices and a decreased incentive to increase quality. On the other hand, the conventional retailer responds by offering a high-quality/high-priced product.

We find that consumer welfare increases because some consumers with a strong preference for quality benefit from the high-quality/high-price combination offered by the conventional retailer, while some consumers with weaker preference for quality benefit from low-quality/low-price combination offered by the large retailer. However, the first effect is much

[5] Given the common association of Wal-Mart with low-prices, the "large retailer" that can negotiate lower prices with suppliers in our theoretical model will be often referred to as "Wal-Mart."

[6] This assumption contrasts sharply with the model developed by Snyder (1996) where the discount factor is determined endogenously. In order to construct a tractable model where both price and quality are strategic variables, we decide to depart from Snyder's oligopoly competition assumption upstream.

larger, suggesting that increases in consumer welfare stemming from lower prices might be smaller than usually claimed. A second finding is that producer welfare (i.e., the joint profits of upstream and downstream firms) also increases in the presence of a large retailer. The main reason for this result is that the presence of a large retailer allows the wholesaler to reap the benefits of price discrimination between the two retailers. Importantly, producer welfare gains are larger than consumer welfare gains.

The paper is organized as follows. We briefly discuss prior work related to our research in section 2. The model and the main results are presented in section 3. Section 4 presents robustness checks of our model and section 5 provides concluding remarks, limitations and suggestions for further research.

2. Related Studies

There are several prior studies on buyer power, with different focus (i.e., empirical vs. theoretical) as well as with different research scopes. However, there have been very few attempts to incorporate product differentiation in the analysis.

A related issue is whether increased buyer power by a downstream firm that countervails upstream seller power translates into a lower price for the final good. The canonical model considers bilateral market power with a single manufacturer bargaining with competing retailers over the price of a homogeneous good. Dobson and Waterson (1997) and von Ungern-Sternberg (1996) show that, contrary to conventional wisdom, retail prices can sometimes increase (and welfare decrease) with retailer concentration. Chen (2003) assumes a dominant firm structure in the retail market and shows that as the bargaining power of the retailer increases, consumers face lower retail prices.

Erutku (2005) relaxes the assumption of a homogeneous product sold by retailers by assuming a degree of substitutability between a national retailer's good and the same good sold by a local retailer. Results of the model are ambiguous as retail prices may increase or decrease with the degree of buyer power by the national retailers. Brekke and Straume (2004) also study horizontal product differentiation in the context of bilateral monopoly. Their approach, however, is to study how bargaining affects the degree of product differentiation downstream and find that downstream firms increase product heterogeneity as the supplier's bargaining power increases.

Related studies, such as Dobson and Inderst (2007, 2008) and Dobson and Chakraborty (2008), Inderst and Valletti (2009), examine the so-called "waterbed effect." That is, whether other downstream firms have to pay more for inputs if one firm can obtain cheaper input prices. Inderst and Valletti (2009) present a model of buyer power in the upstream market, where the asymmetric exercise of buyer power leads to a loss in consumer welfare. The loss is due to the increase in wholesale price to buyers not receiving the discount. In our model, even the downstream firm that does not receive a discount experiences higher profits and consumers that purchase from the high-quality firm enjoy surplus through vertical product differentiation.

Inderst and Shaffer (2009) consider a model of two-part tariff contracts offered by an upstream monopolistic supplier to asymmetric downstream firms, where larger firms obtain a lower wholesale price than their competitors.[7] The authors show that it is optimal for the supplier to set discriminatory wholesale prices. While their model allows for downstream firms to have different marginal costs, our article acknowledges the possibility of quality improvement downstream. However, both articles show that consumer surplus, industry profits, and welfare increase with differential pricing by the wholesaler.

[7] Contrast to DeGraba (1990) and Yoshida (2000).

The buyer power literature has investigated various other issues that are beyond the scope of this paper. Some recent papers explore the long-run implications of upstream buyer power in capacity constraint, technology choice, and mergers. For example, see Inderst and Wey (2003, 2007), and Vieira-Montez (2007). For a broader perspective, the interested reader is referred to Dobson et al. (2001) and Snyder (2008). Dobson et al. (and references therein) offer an empirical and practical overview of buyer power. The authors focus on the increased concentration of the retail sector in Europe and discuss the implications of the resulting buyer power on several competition and policy issues. Snyder provides a concise overview of theoretical work.

3. Model

In this section we model the wholesaler-retailer relationship where retailers buy a product from a wholesaler and sell it to consumers. Three scenarios are analyzed. In the first scenario (B1), there is a single conventional retailer. The second scenario (B2) consists of two conventional retailers with no buyer power. The third scenario (WM), which nests the second scenario, has a large retailer (e.g., Wal-Mart) with countervailing buyer power. The first two scenarios are compared against the last one to study the effect of entry of a large retailer without displacing the local retailer (i.e., case B1 to WM), and the effect of entry with displacement of one local retailer (i.e., case B2 to WM).

3.1 Setup

Consider one manufacturer – a monopolist – offering an identical product to two retailers who compete in prices. Retailers are differentiated in the level of service they provide to consumers, i.e., quality of the shopping experience. We model this vertical differentiation à la Mussa and Rosen (1978). Consumers are heterogeneous in their valuation of quality given by θ. The conditional indirect utility of a consumer with a marginal willingness to pay θ for quality k

and income y is given by $y+\theta k-p$ if one unit of the product of quality k is purchased at price p, and by y if the product is not purchased. We assume a continuum of consumers with total mass of one distributed uniformly over a unit interval (i.e., $\theta \in U[0,1]$).

Let θ_L denote the consumer who is indifferent between buying the low-quality product and not buying at all, where the subscript L denotes the low-quality product.[8] Thus, θ_L is the value of θ that solves $y+\theta k_L-p_L=y$. Similarly, θ_H is the consumer that is indifferent between buying the low- or high-quality product, i.e., θ_H is the value of θ that solves $y+\theta k_H-p_H=y+\theta k_L-p_L$, where the subscript H denotes the high-quality product. Thus, consumers with $\theta \in [0,\theta_L)$ will not buy the product, those with $\theta \in [\theta_L,\theta_H]$ will buy the low-quality product and the others $\theta \in (\theta_H,1]$ will buy the high-quality product. Accordingly, the demand for each quality is the length of the consumer interval buying the given quality multiplied by the density of consumers along that interval times the total number of consumers, N=1, for illustrative convenience. Thus, the demands for the low- and high-quality products are:

$$D_L\left(p_H,p_L,k_H,k_L\right)=\theta_H-\theta_L=\frac{p_H k_L-p_L k_H}{k_L\left(k_H-k_L\right)}, \quad (1)$$

$$D_H\left(p_H,p_L,k_H,k_L\right)=1-\theta_H=1-\frac{p_H-p_L}{k_H-k_L}. \quad (2)$$

We consider a three-stage game. In stage 1, retailers select k_H and k_L, the levels of service (quality) to provide. In stage 2, the wholesale price (w) to each retailer is determined either through a manufacturer's (or wholesaler's) take-it-or-leave-it offer if the retailer has no buyer power or through bargaining between the manufacturer and retailer. In stage 3, retailers

[8] Low- (high-) quality product refers to a good purchased at a retailer with low- (high-) quality shopping experience and/or quality (real or perceived) of products as mentioned previously. By shopping experience we mean product display, store lighting, the presence of deli, bakery, and butcher shop, etc.

simultaneously set p_H and p_L. The subgame perfect equilibrium is solved by backward induction. Quality is selected first because most of the changes in quality described in the introduction (e.g., adding a deli, renovating store aisles, self-checkout lanes, expanded private label selections, etc.) are longer term decisions than price setting.

In this model, Wal-Mart (i.e., the large retailer) has buyer power and can obtain a discount $\gamma \in (0,1)$ on the wholesale price, w. The size of the discount is determined through bargaining, which is assumed to be exogenous to the problem. The larger is γ, the larger is the bargaining (i.e., buyer) power of Wal-Mart. This formulation allows us to nest a "no-Wal-Mart" case ($\gamma = 0$) and a Wal-Mart case into a single specification. The maximization problem of the retailers (stage 3) can be expressed as

$$\max_{p_H} \pi_H = (p_H - w) D_H(p_H, p_L, k_H, k_L) - C_H(k_H),$$
$$\max_{p_L} \pi_L = (p_L - (1-\gamma) w) D_L(p_H, p_L, k_H, k_L) - C_L(k_L),$$

where π denotes profit and $C(\bullet)$ is the cost of quality improvement. $\gamma = 0$ when the low-quality retailer is a conventional supermarket, and $\gamma > 0$ when the low-quality retailer is Wal-Mart. This formulation assumes that the retailer incurs only the costs of buying the product from the manufacturer and its quality improvement. The quality improvement cost function is assumed to be cubic and does not vary with the quantity of products being sold.[9] It is represented by $c_i(k_i - k_0)^3/3$, i=L, H, where k_0 is the minimum quality level and the coefficient $c_L \geq c_H$ captures the efficiency of quality improvement. That is, the high-quality retailer is more efficient at improving quality than the low-quality retailer. To facilitate the derivation of our

[9] We employ a cubic cost function because alternatives (such as a quadratic setting) involve too many corner solutions. The cubic cost function also provides the necessary convexity. The cost functional form plays an important role in determining the equilibrium; however, the qualitative properties of our conclusions, discussed in section 4, are robust to other cost specifications.

model, we further assume that the coefficient of the quality improvement cost for the high-quality retailer, c_H, and minimum quality level k_0 are normalized to 1.[10] After substituting the demand and cost expressions into the profit functions, taking the first-order condition with respect to price for each retailer, and solving for the retail prices we obtain:

$$p_H\left(w,k_H,k_L;\gamma\right)=\frac{k_H\left(2k_H-2k_L+w(3-\gamma)\right)}{4k_H-k_L},\; p_L\left(w,k_H,k_L;\gamma\right)=\frac{k_H(k_L+2w(1-\gamma))-k_L(k_L-w)}{4k_H-k_L}.$$

These prices can be substituted into the retailers' demands (equations 1 and 2) to find the aggregate demand for the manufacturer. That is,

$$D_H\left(w,k_H,k_L;\gamma\right)=\frac{2k_H(k_H-k_L)-w(k_H+\gamma k_H-k_L)}{(k_H-k_L)(4k_H-k_L)},$$
$$D_L\left(w,k_H,k_L;\gamma\right)=\frac{k_Hk_L(k_H-k_L)-wk_H(2k_H-2k_L-2\gamma k_H+\gamma k_L)}{(k_H-k_L)(4k_H-k_L)k_L}.$$

The manufacturer maximizes profits from sales to the low-quality retailer (at a discount or not) and from sales to the high-quality retailer by choosing w (stage 2). This maximization problem can be expressed as:

$$\max_w \pi_M=\left(1-\gamma\right)w\frac{2k_H(k_H-k_L)-w(k_H+\gamma k_H-k_L)}{(k_H-k_L)(4k_H-k_L)}+w\frac{k_Hk_L(k_H-k_L)-wk_H(2k_H-2k_L-2\gamma k_H+\gamma k_L)}{(k_H-k_L)(4k_H-k_L)k_L}.$$

This formulation assumes that the manufacturer does not incur costs. It is straightforward to relax this assumption later. From this maximization problem we obtain the manufacturer's price:

$$w\left(k_H,k_L;\gamma\right)=\frac{k_Hk_L(k_H-k_L)(3-\gamma)}{4k_H{}^2(1-\gamma)^2-2k_Hk_L(1-4\gamma+\gamma^2)-2k_L{}^2}, \qquad (3)$$

[10] In principle, the parameter k_0 may vary by firm (i.e., could have an i subscript) and may be different from 1. Our simplified version allows an easier comparison between the $\gamma=0$ and $\gamma>0$ cases, and it makes the computation of k_L and k_H more tractable.

which can be substituted back into the retail demands and prices to solve for the optimal quality choices by both retailers. The maximization problem of retailers in stage 1 corresponds to

$$\max_{k_H} \pi_H = \left[\frac{k_H\left(2k_H - 2k_L + w(3-\gamma)\right)}{4k_H - k_L} - w\right]\left[\frac{2k_H(k_H - k_L) - w(k_H + \gamma k_H - k_L)}{(k_H - k_L)(4k_H - k_L)}\right] - \frac{(k_H - 1)^3}{3}, \qquad (4)$$

$$\begin{aligned}\max_{k_L} \pi_L = &\left[\frac{k_H(k_L + 2w(1-\gamma)) - k_L(k_L - w)}{4k_H - k_L} - (1-\gamma)w\right] \\ &\bullet\left[\frac{k_H k_L(k_H - k_L) - w k_H(2k_H - 2k_L - 2\gamma k_H + \gamma k_L)}{(k_H - k_L)(4k_H - k_L)k_L}\right] - \frac{c_L(k_L - 1)^3}{3},\end{aligned} \qquad (5)$$

where w is defined in equation (3). From (4) and (5) we obtain the equilibrium quality, and thus equilibrium prices and quantities. This stage of the model is solved with numerical methods given the non-linearity of the expressions.

Solving equations (4) and (5) tells us that the optimal levels of k_L and k_H are functions of γ and c_L. That is, in addition to the low-quality retailer's coefficient of quality improvement cost (c_L), the optimal quality levels also depend on the discount γ, which is the measure of buyer power. Therefore, varying γ from 0 (a conventional supermarket with no bargaining power) to a positive number (Wal-Mart, with a superior bargaining position against a manufacturer) allows us to evaluate the effect of countervailing power on prices, quality levels, and welfare.

In the simulation, we first assume the low-quality retailer's coefficient of quality improvement cost is equal to one ($c_L = 1$) and vary the discount γ from 0 to 1 by 0.1 increments. For comparison purposes, we consider two base-case scenarios. In the first one, there is only one conventional retailer in the market. We call this "base case 1" (B1). In the second scenario, there are two conventional retailers with $\gamma = 0$. This scenario is labeled "base case 2" (B2). We compare these two scenarios with a third one, "Wal-Mart" case (WM), which consists of one conventional retailer ($\gamma = 0$) and one retailer (Wal-Mart) with $\gamma \in [0.1,1]$. We compare scenario

B1 with WM, to study the effect of the entry of Wal-Mart without the exit of a local retailer. Scenarios B2 and WM are compared to study the entry effects of Wal-Mart when it causes the exit of a local retailer. Table 1 shows the corresponding results of B1 (2^{nd} row), B2 (4^{th} row) and WM (5^{th} row onwards).

3.2 Base Case 1 (B1): One Conventional Store

When there is one conventional retailer in the market, the maximization problems of the retailer and the manufacturer can be written, respectively, as:

$$\pi_{B1} = \left(p_{B1} - w\right)\left(1-\theta_{B1}\right) - \frac{(k_{B1}-1)^3}{3} = \left(p_{B1} - w\right)\left(1-\frac{p_{B1}}{k_{B1}}\right) - \frac{(k_{B1}-1)^3}{3},$$

$$\pi_{M(B1)} = w\left(1-\theta_{B1}\right) = w\left(1-\frac{p_{B1}}{k_{B1}}\right),$$

where the subscript *B1* stands for "base case 1" and the coefficient of quality improvement cost (c) is assumed to be 1. The corresponding equilibrium is given by:

$$k_{B1} = \frac{5}{4},\ w = \frac{k_{B1}}{2} = \frac{5}{8},\ p_{B1} = \frac{k_{B1}+w}{2} = \frac{3k_{B1}}{4} = \frac{15}{16},$$

$$\theta_{B1} = \frac{p_{B1}}{k_{B1}} = \frac{3}{4},\ D_{B1} = 1-\theta_{B1} = \frac{1}{4},\ \pi_{B1} = \frac{7}{96},\ \pi_{M(B1)} = \frac{5}{32}.$$

The second row of table 1 displays these results. Note that, quality is above the minimum level (k_{B1}=1.25 > k_0=1),[11] whereas the retail price is 50% larger than the wholesale price (0.9375 vs. 0.625). Only 25% of the market and most of society's welfare is captured by firms (0.2292 out of 0.2682), given that the double-marginalization problem is not mitigated with any countervailing power. Most of firms' surplus is going to the manufacturer (0.1563 out of 0.2292).

[11] Increasing quality above the minimum level is profitable for this monopolistic conventional retailer (π_{B1} = 7/96 when k_{B1} = 5/4 vs. π_{B1} = 1/16 when k_{B1} = 1). Note that the quantity demanded remains unchanged with different quality levels. Both retail profits and consumer surplus increase due to quality improvement.

3.3 Base Case 2 (B2): Two Conventional Retailers: $\gamma = 0$

With two conventional stores, we assume that no retailer receives a discount from the manufacturer, i.e., they have no buying power ($\gamma = 0$). Table 1 (row 4) shows that both conventional retailers set their quality at the same level ($k_H = k_L = k^* = 1.0004$) and compete with each other in a standard Bertrand fashion ($w = k^* / 2 \approx p_H = p_L$).[12] Both retailers operate at the same quality level, but we still refer to them as L and H for notational convenience. Market demand is 0.5, which is split equally between two retailers.

Note that both retailers set their quality level higher than 1 even though they receive zero profits. To understand why retailers want to improve their quality, let us look at figure 1 – a payoff matrix of strategies in stage 1. Given that the competitor chooses not to improve quality, the retailer's best response is to improve its own quality. Conversely, if the competitor decides to improve quality, the retailer is indifferent between improving and not improving quality. Therefore, ($k_L > 1$, $k_H > 1$) are weakly dominant strategies, implying that both retailers slightly improve their quality (from 1 to 1.0004) in stage 1.

With competition at the retail level, the results obtained when comparing B2 with B1 are as expected. In other words, we find that the quality levels as well as the wholesale and retail prices decrease; meanwhile, the market demand doubles (from 0.25 to 0.5). In addition, consumer surplus and wholesaler profits increase while total retailer profits decreases. The total welfare gains stem entirely from increased retailer competition on prices. This comparison suggests that the entry of a conventional retailer to a market currently being served by a similar (conventional) store will trigger intense price competition (and virtually no quality competition) thereby unambiguously benefiting consumers.

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[12] The retailers' prices (p_L and p_H) are actually slightly above the wholesale price (w) so that retailers can cover the small quality improvement cost. The difference between w and p_i is very small and thus can not be seen in Table 1.

3.4 Wal-Mart case (WM): One Conventional Store and One "Wal-Mart" Store: $\gamma > 0$

In this case, we have one conventional retailer with no buyer power and Wal-Mart ($\gamma > 0$). Wal-Mart, or the large retailer, is the low-quality retailer given its emphasis on low prices and a no-frills shopping experience. In table 1 (rows 5 through 14) we report results for $\gamma \in [0.1, 1]$ in 0.1 intervals.[13] Results in table 1 lead to several important observations.

The quality level set by the low-quality retailer (i.e., Wal-Mart) has an interesting pattern (figure 2). When the discount obtained from the wholesaler is small ($\gamma = 0.1$), Wal-Mart has an incentive to set its quality slightly higher than firms in B2 ($k_L = 1.0441 > 1.0004$) and to charge a higher price (p_L=0.5823 > 0.5002). As the discount gets larger, Wal-Mart finds it more effective to attract customers through a lower price (for $\gamma > 0.3$ Wal-Mart's price is lower than in B2, see figure 3) rather than by improving its quality ($k_L = 1$ for all $\gamma \in [0.2,1]$). Intuitively, for a large enough discount (i.e., $\gamma > 0.1$) the profitability incentive to offer low prices overcomes the profitability incentive to attract customers via high quality.

In response to Wal-Mart's low-price policy, the high-quality retailer chooses to differentiate its product/service by significantly improving the quality level above that observed in B2 ($k_H > 1.2$ for all $\gamma \in [0.1,1]$, see figure 2), although not always above the quality level of 1.25 observed in B1. Because of its inability to obtain a discount, the conventional retailer is at a disadvantage when trying to compete in prices with Wal-Mart. Instead, it chooses to augment profits by increasing its quality.

All prices (wholesale, w, as well as retail, p_L and p_H) exhibit a non-monotonic relationship with the discount γ (see figure 3). The price increases at low levels of discount are

[13] In reality, a portion of the [0.1, 1] interval is likely to be more relevant than the rest for a specific retail chain. In this section, we describe the results for the whole range to provide readers with a broad picture of our model's results. Section 3.5 analyzes the reasonable discount range that Wal-Mart is likely to obtain and discusses the results for that range.

due to the intense quality competition that retailers engage in: a relatively small bargaining power by the low-quality retailer makes both firms focus their competition on quality, which results in higher equilibrium prices. Conversely, as a larger discount is achieved, prices tend to fall because: a) the quality level offered by the conventional retailer tends to decrease (figure 2),[14] and b) all prices inevitably experience intense downward pressure by Wal-Mart's low-price policy. Importantly, for $\gamma > 0.3$ consumers shopping at the low-quality retailer pay lower prices than in B2, whereas for $\gamma > 0.5$ *all* consumers pay a lower price than in B2.

Interestingly, a portion of the purchase discount for the low-quality retailer is always passed on to consumers. To see this, recall that Wal-Mart pays $(1-\gamma)w$ and sells at p_L, where $(1-\gamma)w < p_L < w$ (figure 3). Thus, the fraction $(w - p_L)/\gamma w$ of the discount γw is passed on to consumers (figure 4). The pass-through rate, $(w - p_L)/\gamma w$, is decreasing in γ, which implies that more buyer power allows the low-quality retailer to retain a larger fraction of the discount (and therefore enjoy more profits). Consistently, the markup of the low-quality retailer, $p_L - (1-\gamma)w$, is increasing in γ.

A mechanism by which Wal-Mart contributes to an increase in consumer welfare is by allowing more consumers (those with lower willingness to pay for quality) to join the market as prices decrease. Market demand is $D_L + D_H = 1 - \theta_L$ and increasing in the discount when $\gamma \in [0.2,1]$ (figure 5).[15] However, it is not until $\gamma = 0.4$ that more consumers than in B2 join the market. In other words, when Wal-Mart replaces a conventional retailer, more customers with lower valuations for quality are able to join the market only if Wal-Mart is able to get a

[14] Except for k_H in the $\gamma \in [0.8,1]$ range. In general, our model implies that lower equilibrium quality levels need to be associated with lower price levels.

[15] Note that when $\gamma \in [0.1, 0.2]$, θ_L increases initially in γ, due to Wal-Mart's quality improvement.

sufficiently high discount from the supplier. When Wal-Mart enters a market without displacing a conventional store, more consumers join the market and consumer welfare improves for any size discount to Wal-Mart.

In general, all consumers (low-quality as well as high-quality purchasers) tend to gain with larger discounts, especially for $\gamma > 0.4$ (figure 6). Importantly, total consumer surplus (figure 8) is, with one exception ($\gamma = 0.3$), always larger in WM than in B2. For low discounts ($\gamma \in [0.1, 0.2]$), low-quality purchasers do not gain much from Wal-Mart displacing a conventional retailer. But, as γ grows, prices decrease resulting in new consumers joining the market and some consumers switching from being high-quality to low-quality buyers. For large enough discounts, those low-quality buyers enjoy a larger surplus when Wal-Mart replaces a conventional retailer. Conversely, high-quality consumers always gain from the entry of Wal-Mart, i.e., whether it brings competition to a monopolist (WM vs. B1) or whether it replaces a conventional retailer in a duopoly (WM vs. B2).

Relative to the profit earned under B2, when Wal-Mart is present, the manufacturer prefers a relatively low discount, i.e., in the [0.1, 0.4] range (see figure 7). It is in this range that product differentiation is maximal (see figure 2) and therefore more profitable for a monopolistic manufacturer to engage in price discrimination.[16] The low-quality retailer enjoys greater profits at higher discounts (as its ability to gain additional customers is enhanced) whereas the high-quality retailer prefers a low discount, which translates in higher prices (figure 3) and larger demand (figure 5).

[16] The term price discrimination is not fully accurate here because the discount to Wal-Mart is bargained rather than chosen by the manufacturer to maximize profits. As a result of the countervailing power of Wal-Mart and its ability to obtain a lower price, to maximize profits the manufacturer, raises prices to the retailer that does not have buyer power (for low discount to Wal-Mart). This is similar to the "waterbed effect" described by Dobson and Inderst (2007, 2008) and Dobson and Chakraborty (2008), although in our model the retailer not receiving the discount experiences higher profit due to product differentiation.

For low levels of discount to Wal-Mart, the manufacturer's profits are higher under the retail configuration with Wal-Mart (WM) than when conventional retailers compete (B2). However, when Wal-Mart's countervailing power is such that large discounts are obtained, the manufacturer prefers a retail configuration characterized by double marginalization (B1). Because price competition softens in WM, retailers' profits are larger (greater than zero) than in B2 and, for $\gamma > 0.7$, joint retailers' profits are greater than in B1.

From a social planner point of view, the optimal discount for maximizing consumer surplus and social welfare is 1 whereas producers' surplus is maximized at $\gamma = 0.1$ (see figure 8). If, on the other hand, one wants to maximize joint profits between the manufacturer and the discount retailer the optimal discount is about 0.3 (see figure 9). Finally, total welfare is always higher in WM than in either B1 or B2.

3.5. Reasonable Discount for Wal-Mart

In the previous section, we present how the discount obtained by Wal-Mart affects prices, quality, and welfare. In this section, we indirectly infer a reasonable range for the discount obtained by Wal-Mart using slotting fee information as, to the best of our knowledge, there is no such published information available.

As opposed to supermarkets, Wal-Mart does not have any slotting fees or hidden allowances (Walton, 2005). Instead it receives lower wholesale price partly as a compensation for shelf space (Klein and Wright, 2007).[17] We use this differential treatment in slotting allowances to obtain a rough estimate of the plausible discount bargained by Wal-Mart.

[17] In an article written by the editor of *Baking Management*, Seiz (2005), one finds the following quote "When you deal with a supermarket retailer, they negotiate with you once, then they negotiate with you about 15 times after that (…) You get your prices, and then there are slotting fees, advertising allowances, display allowances and tickets to the golf tournament."

To focus on our main point, we ignore other costs in the following analysis. A manufacturer's profit when selling to a conventional retailer is $\pi = wD_H - S$, where S is the slotting allowance. Conversely, the profit when selling to Wal-Mart is $\pi = (1-\gamma)wD_L$, where γwD_L represents the discount to Wal-Mart. Given the size of Wal-Mart and evidence of its bargaining power, a reasonable assumption is that the discount obtained by Wal-Mart is no less than *S*, i.e., $\gamma wD_L \geq S$.[18] Thus, if we have a measure of slotting fees, we can find a crude lower bound for Wal-Mart's discount.

Table 3 in FTC (2003) has a ratio of slotting fee payments to new product revenues. In terms of our model, the ratio is computed by $S/(pD)$, where the subscript is omitted to simplify notation. Though the range of slotting fee values is large, on average the slotting fee (for all retailers/divisions) is 18%, it is 16% for ice cream, and 20% for salad dressing (products for which slotting fees are most often applied).[19] To compare these values with Wal-Mart's discount, we can rewrite the above inequality as:

$$\frac{S}{p_L D_L} \leq \frac{\gamma w D_L}{p_L D_L} = \frac{\gamma w}{p_L}$$

That is, the left hand side is a lower bound on Wal-Mart's discount to price ratio. We compute the right hand side of this formula for our simulation results (for $\gamma \in [0.1, 1]$) reported in table 1. The second column of table 2 contains the results of this calculation. We deem discounts above 0.4 unlikely as they would imply equivalent slotting fees greater than 73%, an unlikely event. Similarly, a discount of 0.1 is equivalent to a slotting fee of 11.03%, which is unlikely given that

[18] The significant pressure Wal-Mart places on upstream prices is illustrated by Rubbermaid's merger with Newell, which was triggered by Rubbermaid's loss of Wal-Mart's business to lower price competitors.
[19] Not incorporating the 443% for ice cream for retailer 7 division 2.

slotting allowances are typically greater. Using this reasoning, we conclude that a reasonable range for Wal-Mart's discount is [0.2, 0.4].

Using this range, the results of the WM case can be better contrasted with those of the B1 case. First, the high-quality retailer provides significantly higher quality products/services to differentiate itself in response to Wal-Mart's entry (figure 2). Second, retail prices decrease due to competition while wholesale price increases due to the waterbed effect (figure 3). Third, because of competition and quality improvement, joint consumer surplus and joint producer surplus are higher (figure 8).

We now turn to the comparison of the WM case with respect to the B2 case. First, we find that quality differentiation arises in the presence of Wal-Mart. Second, wholesale price increases due to the waterbed effect while quality differentiation (and the resulting softening of competition) pushes retail prices up, except when $\gamma = 0.4$ for p_L. On the basis of previous studies, we expect Wal-Mart prices to be lower than those in a market characterized by two conventional retailers. However, this may be a short-run phenomenon. In the short-run, when firms cannot change the quality level, the entry of Wal-Mart would surely decrease prices. However, in the long-run, when firms are able to adjust quality, it is possible that Wal-Mart would choose to raise prices. Gregory (2009) reports that Wal-Mart is currently in the beginning stages of a strategy remodeling effort, called "Project Impact." The Project is aimed at building up "cleaner, less cluttered stores that will improve the shopping experience, friendlier customer service, and focus on categories where the competition can be killed." The other reason for a relatively high Wal-Mart price is that our model does not consider Wal-Mart's economies of scale. While this is a drawback of our model, our finding that Wal-Mart's presence represents an improvement on consumer and society makes our results conservative.

Third, in terms of welfare, consumer surplus and producer surplus are higher than in B2 except for consumer surplus when $\gamma = 0.3$. A closer look at the components of consumer surplus reveals that the high-quality consumers get a larger portion of the increase in consumer surplus, a result of quality improvement. Our results suggest that when the discount is relatively small, the increase in welfare by low-quality consumers may not be as high as usually expected or claimed.

Our overall interpretation of the model indicates that Wal-Mart's entry into a market whether by replacing a traditional retailer (WM vs. B2) or as a new entrant (WM vs. B1) is likely to positively affect total welfare (figure 8). We next turn our attention to several robustness checks of our findings.

4. Robustness

To make our model tractable we made two important assumptions (1) consumer's price sensitivity (x) is assumed to be equal to 1 in $y + \theta k - xp$, and (2) the coefficient of quality improvement cost for Wal-Mart (c_L) is equal to 1. In this section we vary x and c_L to investigate whether and how our main findings remain.

First, we assume a price sensitivity parameter of $x = 2$. The results for $\gamma \in [0, 0.3]$ are presented in table 3. When consumers are more sensitive to price, we observe that a) the quality of service for the high-quality retailer is lower (although still higher than Wal-Mart's for $\gamma \in [0.1, 0.3]$), b) the wholesale and retail prices are all lower (B1, B2 and WM cases), c) Wal-Mart's price falls below that observed in B2 when $\gamma = 0.3$ (as opposed to 0.4 when $x = 1$); and d) the low- (high-) quality demand increases (decreases). Therefore, compared with results obtained for $x = 1$, low-quality consumers' welfare is higher (due to lower prices) whereas high-quality customers' welfare is smaller due to a smaller quality improvement. Total consumer surplus may be higher or smaller, but both producer surplus and total welfare are smaller.

The intuition for these results is as follows. When faced with more price sensitive consumers, the high-quality retailer's incentives to improve quality erode. Instead it has an added incentive to compete with the low-quality retailer via more aggressive pricing. Low-quality consumers gain at expense of the high-quality ones. The important finding is that, our main results remain (qualitatively) unchanged when we allow for more price sensitive consumers. Nevertheless, these results indicate that price sensitivity is an important factor in the model.

Next we explore the effect of different quality improvement costs for Wal-Mart (c_L). Consistent with our assumption that $c_L \geq c_H = 1$, we vary c_L from 1 to 2 by 0.1 increments, and investigate its effects on the equilibrium quality levels. Because the optimal k_L for all $\gamma \in [0.2,1]$ is equal to 1 when $c_L = 1$, increases in Wal-Mart's quality improvement costs do not change Wal-Mart's quality level; i.e., $k_L = 1$ for all $\gamma \in [0.2,1]$ for any $c_L \geq 1$. As a consequence, k_L and k_H are the same as what we got in table 1 for all $\gamma \in [0.2,1]$ and $c_L \in [1, \infty)$. On the other hand, it is reasonable to expect some impacts of changes in c_L on equilibrium k_L for $\gamma = 0.1$ as the optimal k_L is greater than 1 in this case (see tables 1 and 3).[20] These results are reported in table 4.

The last two columns of table 4 show as c_L increases from 1 to 2, k_L monotonically decreases from 1.0441 to 1.0249; conversely, k_H increases slightly from 1.4674 to 1.4678. It is reasonable that Wal-Mart responds more to the increase in its quality improvement cost than the high-quality retailer. In the case of prohibitive quality improvement cost, i.e., $c_L \to \infty$, Wal-Mart chooses not to improve its quality for $\gamma = 0.1$ whereas the high-quality retailer sets the quality at the highest level 1.4683. As with our previous robustness check, results in table 4 increase our confidence in our findings.

[20] Assuming that $c_L > 1$ in the $\gamma = 0$ case is not relevant as B2 (the case of two conventional retailers) captures the essence of two identical retailers.

5. Concluding Remarks

In this paper we develop a simple model to study wholesaler-retailer relationships that accommodate for two key features of retail markets: buyer power and quality differentiation. Motivated by Wal-Mart's increasingly pivotal role in food the retail industry, we study the countervailing effects of a large retail chain's buyer power when it competes with conventional retailers. To make our model computationally tractable we make some heroic assumptions about the industry: upstream supply is provided by a monopolist, there is a single product, product differentiation is vertical (i.e., in the quality dimension), and there is no transformation of the product downstream. Despite this simplistic representation of the industry, our model does a reasonably good job at predicting several observed patterns.

The occurrence of quality differentiation in our model is quite robust (i.e., for any discount and different assumptions). This is consistent with McWilliams (2007), Martinez (2007), and Volpe and Lavoie (2008) who highlight how competitive pressure from Wal-Mart has driven traditional supermarkets to enhance the quality of the shopping experience by adding features like high-end private-label brands, deli, coffee shop, gourmet section, and gas station.

Our framework also sheds light on a much debated issue of cost savings pass-through. The usual argument used by Wal-Mart advocates is that consumers are better off because they can purchase at lower prices. We find that indeed this effect can be present, but when firms have the option of being "different" from Wal-Mart they choose to do so thereby undermining otherwise more aggressive price competition (and therefore lower equilibrium prices). This prediction is consistent with recent findings. Basker and Noel (2009) report that Wal-Mart's entry triggers different price responses from incumbent grocery stores: high-end grocery stores' (such as Kroger) price reductions are less than half the size of those reported at low-end grocery stores. Put differently, Wal-Mart's price effect will be larger in markets where low-quality stores already exist.

In general, we find that total welfare increases with the presence of buyer power. However, while consumers gain, most of the welfare increases are realized at the firm level. In particular, the biggest winner is the wholesaler who can profitably engage in price discrimination between the low-quality and the high-quality retailers.[21] Further, consumers' gain is unevenly distributed, with the more high-quality concerned consumers earning a larger share of the gain.

As consolidation of retailers continues to increase, so does their seller power. A valid concern is that the welfare loss due to the consolidation may dominate the gains associated with buyer power. Although our model focuses on concentrated retail markets (with 1 or 2 firms), it indirectly addresses this concern. Because the case of two identical conventional retailers yields a perfectly competitive outcome, we can interpret it as a case of minimal concentration. Our results suggest that even an extreme move from this case to a duopoly where Wal-Mart operates, the buyer power gains outweigh the potential losses due to seller power.

There are some caveats, however. Our model considers a monopoly upstream. With several sellers of a differentiated good upstream (e.g., some large, some small), buyer power could foreclose smaller competitors thereby reducing varieties or the spectrum of qualities for the end consumers.

Moreover, Wal-Mart's impacts on welfare are more complex than what the current model is able to capture. Our approach is silent about the effects on the labor market, the local economy, traffic, pollution, etc. However, our welfare results show that despite the criticisms and protests generated by Wal-Mart's entry in town, it provides significant benefits to consumers either

[21] We should interpret this result with caution as it may be specific to our assumption of a monopolistic upstream market structure.

directly or indirectly. In the short-run, consumers benefit from the lower prices of Wal-Mart and the lower prices at rivals supermarkets brought on by the competition from Wal-Mart (Volpe and Lavoie, 2008 and Basker and Noel, 2009). When the long-run product differentiation effects are considered, this article also shows that consumers also benefit from an increase in quality at Wal-Mart's rivals.

In 2003, R. Hewitt Pate, the Justice Department's antitrust chief, told a Senate Judiciary Committee hearing that: "…price fixing and other forms of collusion are just as unlawful when the victims are sellers rather than buyers," when referring to cases of large downstream firms forcing upstream suppliers to lower their prices (Wilke, 2004). While there are several important aspects of the real world that our model does not capture, our generally positive assessment of buyer power suggests that the antitrust authorities' view may need to be carefully rethought. Specifically, when analyzing the impact of countervailing buyer power, not only must the impact on retail prices be considered, but also the resulting impact on product and service quality.

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Table 1: Simulation Results

	γ	k_{B1}		w_{B1}	p_{B1}		θ_{B1}		D_{B1}		CS_{B1}		$\pi_{M(B1)}$	π_{B1}		CS_{B1}	PS_{B1}	TW_{B1}
*B1**	0.0000	1.2500		0.6250	0.9375		0.7500		0.2500		0.0391		0.1563	0.0729		0.0391	0.2292	0.2682
	γ	k_L	k_H	w	p_L	p_H	θ_L	θ_H	D_L	D_H	CS_L	CS_H	π_M	π_L	π_H	CS	PS	TW
*B2***	0.0000	1.0004	1.0004	0.5002	0.5002	0.5002	0.5000	0.5000	*0.2500*	*0.2500*	*0.0625*	*0.0625*	0.2501	0.0000	0.0000	0.1251	0.2501	0.3752
WM***	0.1000	1.0441	1.4674	0.6425	0.5823	0.8241	0.5577	0.5711	0.0134	0.4289	0.0001	0.1410	0.2833	0.0001	0.0438	0.1410	0.3272	0.4682
	0.2000	1.0000	1.4410	0.6781	0.5631	0.8411	0.5631	0.6304	0.0673	0.3696	0.0023	0.1233	0.2871	0.0014	0.0317	0.1256	0.3202	0.4458
	0.3000	1.0000	1.3934	0.7008	0.5381	0.8162	0.5381	0.7067	0.1686	0.2933	0.0142	0.1094	0.2882	0.0080	0.0135	0.1236	0.3098	0.4334
	0.4000	1.0000	1.3190	0.6566	0.4712	0.7234	0.4712	0.7906	0.3194	0.2094	0.0510	0.0958	0.2633	0.0247	0.0032	0.1468	0.2912	0.4379
	0.5000	1.0000	1.2319	0.5230	0.3563	0.5556	0.3563	0.8596	0.5033	0.1404	0.1267	0.0828	0.2051	0.0477	0.0004	0.2095	0.2532	0.4627
	0.6000	1.0000	1.2005	0.4070	0.2626	0.4351	0.2626	0.8601	0.5975	0.1399	0.1785	0.0953	0.1542	0.0596	0.0012	0.2738	0.2151	0.4889
	0.7000	1.0000	1.2106	0.3451	0.2099	0.3828	0.2099	0.8210	0.6112	0.1790	0.1868	0.1288	0.1250	0.0650	0.0036	0.3155	0.1937	0.5092
	0.8000	1.0000	1.2330	0.3024	0.1741	0.3547	0.1741	0.7753	0.6012	0.2247	0.1807	0.1662	0.1043	0.0683	0.0075	0.3469	0.1802	0.5271
	0.9000	1.0000	1.2613	0.2684	0.1477	0.3387	0.1477	0.7309	0.5832	0.2691	0.1701	0.2026	0.0879	0.0705	0.0130	0.3727	0.1713	0.5440
	1.0000	1.0000	1.2926	0.2386	0.1274	0.3293	0.1274	0.6901	0.5627	0.3099	0.1583	0.2365	0.0740	0.0717	0.0198	0.3948	0.1654	0.5602

Notes: * This row represents base case 1 (*B1*), where there is only one conventional retailer in the market (variables are denoted by *B1* with either a superscript or in parentheses).

** This row represents base case 2 (*B2*), where there are two conventional retailers in the market.

*** These rows denote the Wal-Mart case (WM), where one of the two retailers is able to get a positive discount from the manufacturer.

γ : discount rate (buyer power measure) offered to the low-quality retailer.

k_L and k_H : low- and high -quality retail quality levels, respectively.

w : wholesale price.

p_L and p_H : low- and high -quality retail prices, respectively.

$D_L = \theta_H - \theta_L$: low-quality demand; $D_H = 1-\theta_H$: high-quality demand.

CS_L and CS_H: consumer surplus for low- and high-quality groups, respectively.

π_M, π_L, and π_H: profits for wholesaler, low- and high-quality retailers, respectively

$CS = CS_L + CS_H$: total consumer surplus.

$PS = \pi_M + \pi_L + \pi_H$: total producer surplus.

$TW = CS + PS$: total welfare.

Table 2: Wal-Mart's Received Unit Discount to Price Ratio

γ	$\frac{\gamma w}{p_L}100\%$
0.1	11.03
0.2	24.09
0.3	39.07
0.4	55.74
0.5	73.41
0.6	93.00
0.7	115.11
0.8	138.95
0.9	163.56
1.0	187.32

Note: Ratios (second column) are derived using the wholesale prices (w) and low-quality retailer prices (p_L) reported in table 1.

Table 3: Simulation Results for x =2

	γ	k_{B1}		w_{B1}	p_{B1}		θ_{B1}		D_{B1}		CS_{B1}		$\pi_{M(B1)}$	π_{B1}		CS_{B1}	PS_{B1}	TW_{B1}
B1	0.0000*	1.1768		0.2942	0.4413		0.7500		0.2500		0.0368		0.0735	0.0349		0.0368	0.1085	0.1453
	γ	k_L	k_H	w	p_L	p_H	θ_L	θ_H	D_L	D_H	CS_L	CS_H	π_M	π_L	π_H	CS	PS	TW
B2	0.0000	1.0000	1.0000	0.2500	0.2500	0.2500	0.5000	0.5000	*0.2500*	*0.2500*	*0.0625*	*0.0625*	0.1250	0.0000	0.0000	0.1250	0.1250	0.2500
WM	0.1000	1.0684	1.3282	0.3142	0.2887	0.3664	0.5405	0.5979	0.0573	0.4021	0.0018	0.1320	0.1426	0.0002	0.0092	0.1338	0.1520	0.2858
	0.2000	1.0000	1.3037	0.3213	0.2713	0.3722	0.5425	0.6647	0.1222	0.3353	0.0075	0.1143	0.1391	0.0017	0.0077	0.1217	0.1486	0.2703
	0.3000	1.0000	1.2534	0.3165	0.2488	0.3460	0.4975	0.7671	0.2696	0.2329	0.0363	0.0968	0.1334	0.0073	0.0014	0.1331	0.1422	0.2753

Note: See Table 1 for explanation of notation. x is consumer's price sensitivity measure.

Table 4: Robustness of Model to Different Values of c_L, WM case

	$\gamma = 0.1$	
c_L	k_L	k_H
1.0	1.0441	1.4674
1.1	1.0406	1.4675
1.2	1.0376	1.4676
1.3	1.0352	1.4676
1.4	1.0331	1.4677
1.5	1.0313	1.4677
1.6	1.0297	1.4677
1.7	1.0283	1.4677
1.8	1.0270	1.4678
1.9	1.0259	1.4678
2.0	1.0249	1.4678
∞	1.0000	1.4683

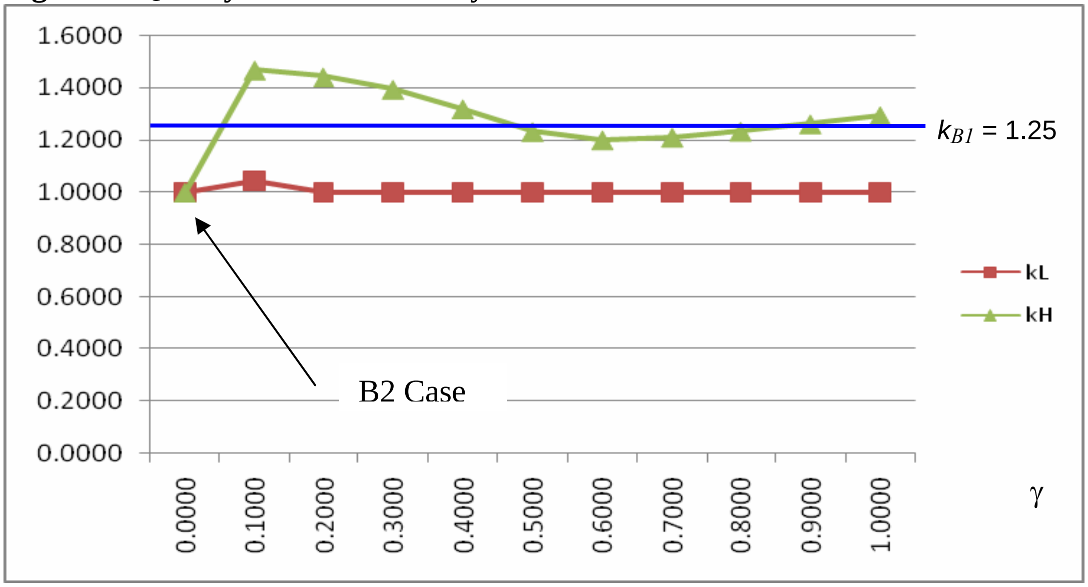
Note: c_L: coefficient of quality improvement cost for Wal-Mart.
k_L and k_H : low- and high -quality retail quality levels, respectively.
WM case: one conventional retailer and one Wal-Mart store.

Figure 1: Payoff Matrix for Two Conventional Retailers When $\gamma = 0$, B2 case

		Retailer *H*	
		$k_H = 1$	$k_H > 1$
Retailer *L*	$k_L = 1$	(0 , 0)	(0, 7/96)
	$k_L > 1$	(7/96, 0)	(0 , 0)

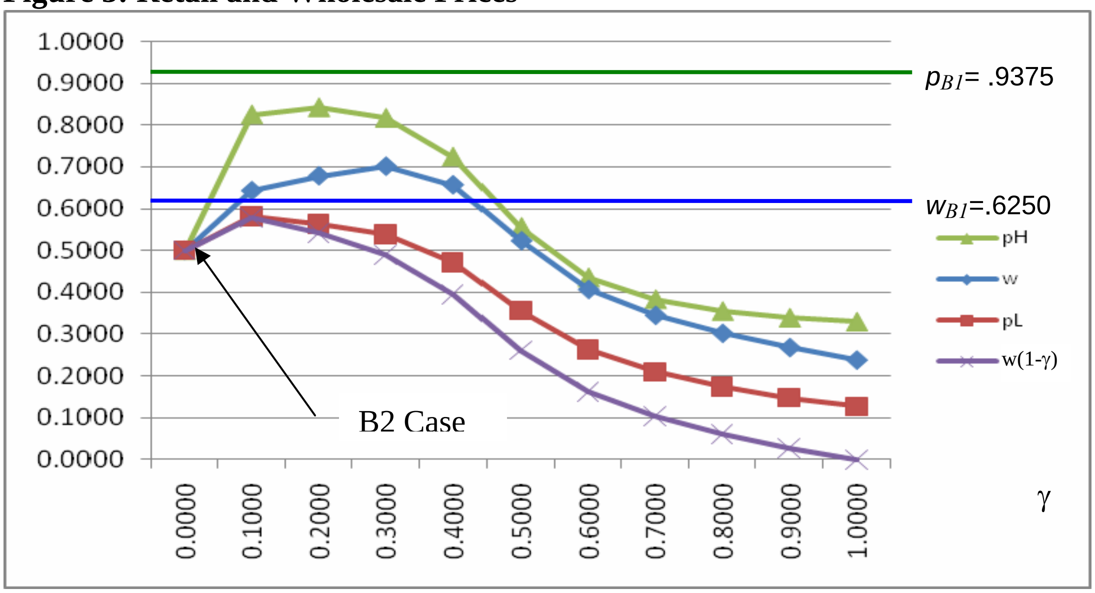
Note: k_L and k_H : quality levels for retailers *L* and *H*, respectively.
B2 case: two conventional retailers in the market.

Figure 2: Quality Levels Chosen by the Retailers



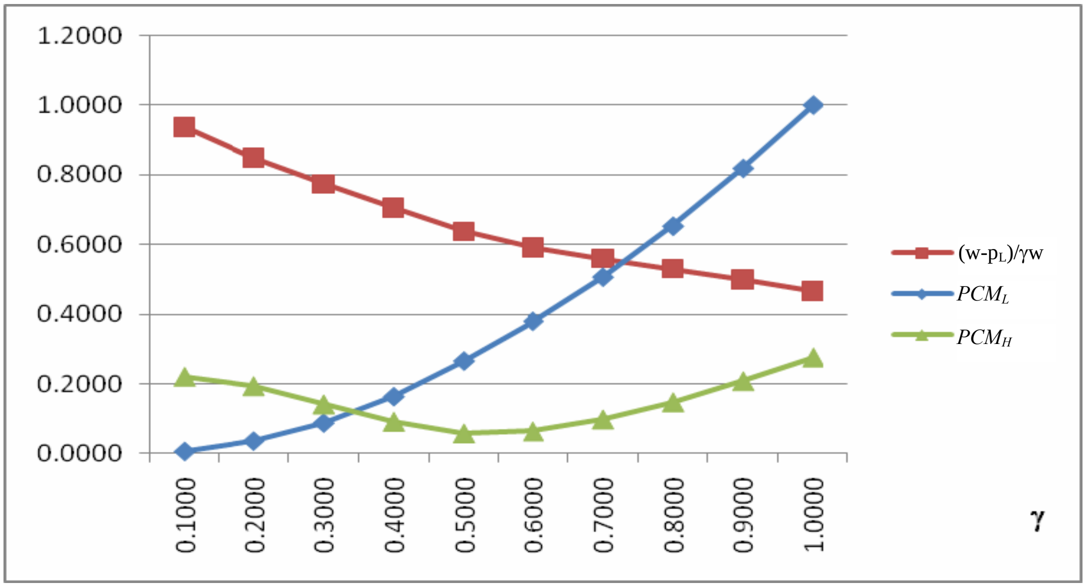
Note: k_L and k_H : low- and high -quality retail quality levels, respectively;
k_{B1} : retail quality level in the B1 case.
B1 case: only one conventional retailer in the market (i.e. with no buyer power)
B2 case: two conventional retailers in the market.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).

Figure 3: Retail and Wholesale Prices



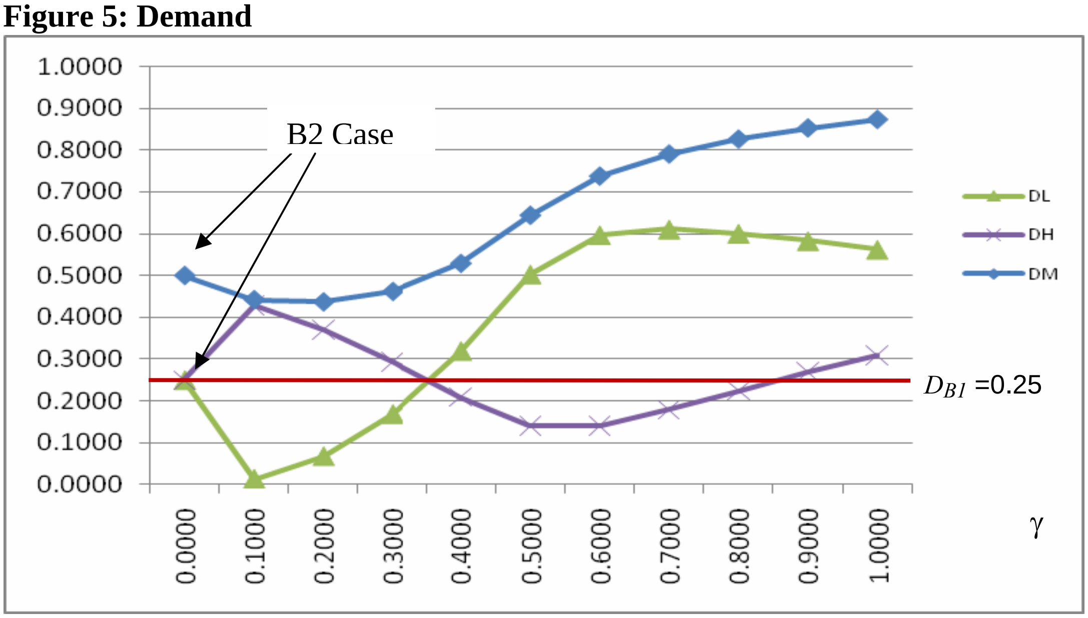
Note: p_H and p_L : high- and low-quality retail prices, respectively;
w and (1- γ) w: wholesale price for high-quality retailer and discounted wholesale price for low-quality retailer, respectively;
p_{B1} and w_{B1} : retail and wholesale prices, respectively, in the B1 case.
B1 case: only one conventional retailer in the market (i.e. with no buyer power)
B2 case: two conventional retailers in the market.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).

Figure 4: Retailer Price-Cost Margins and Pass-Through Rate for the Low-Quality Retailer



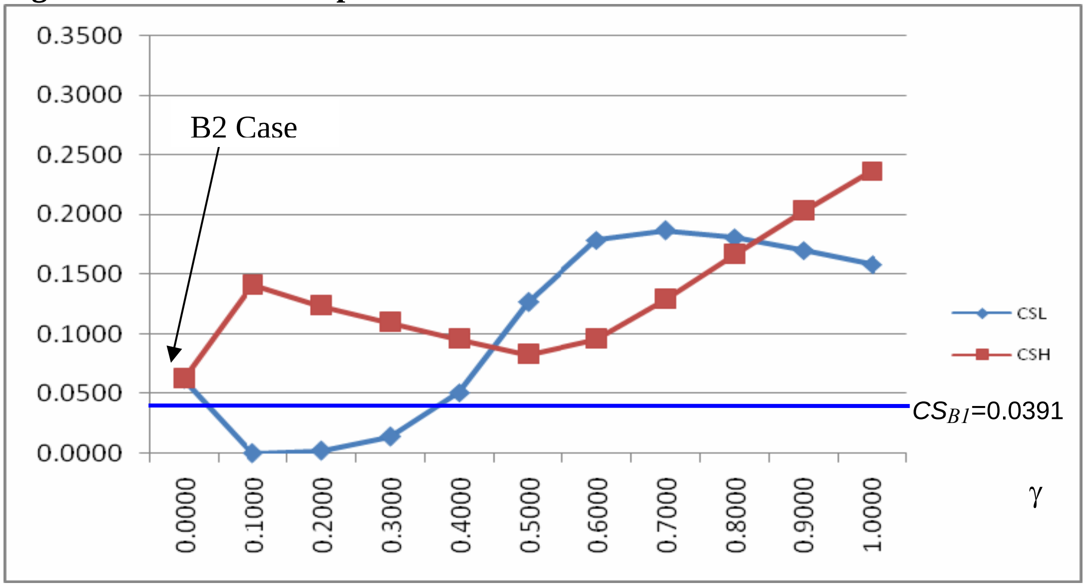
Note: w : wholesale price; p_L: low-quality retail price.
γ : discount offered to the low-quality retailer.
$PCM_L=(p_L-(1-\gamma)w)/p_L$: price-cost margin for the low-quality retailer.
$PCM_H=(p_H-w)/p_H$: price-cost margin for the high-quality retailer.
$(w - p_L)/\gamma w$: pass-through rate for the low-quality retailer.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).

Figure 5: Demand



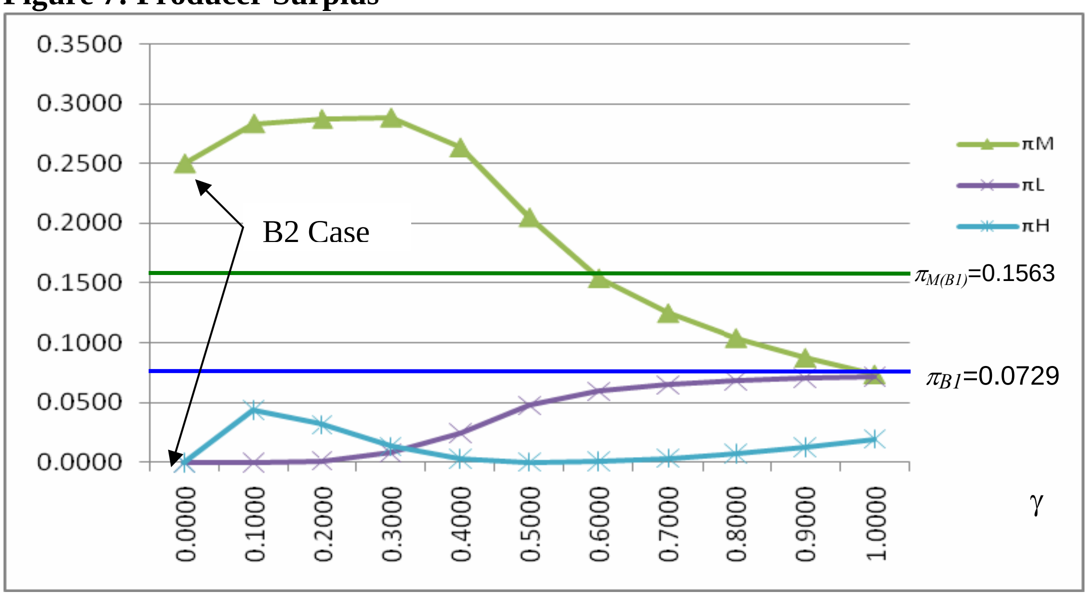
Note: High-quality demand: $D_H = 1\text{-}\theta_H$; Low-quality demand: $D_L = \theta_H - \theta_L$;
Market Demand: $D_M = 1\text{-}\theta_L$; demand in the B1 case: $D_{B1} = 1\text{-}\theta_{B1}$.
B1 case: only one conventional retailer in the market (i.e. with no buyer power)
B2 case: two conventional retailers in the market.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).

Figure 6: Consumer Surplus



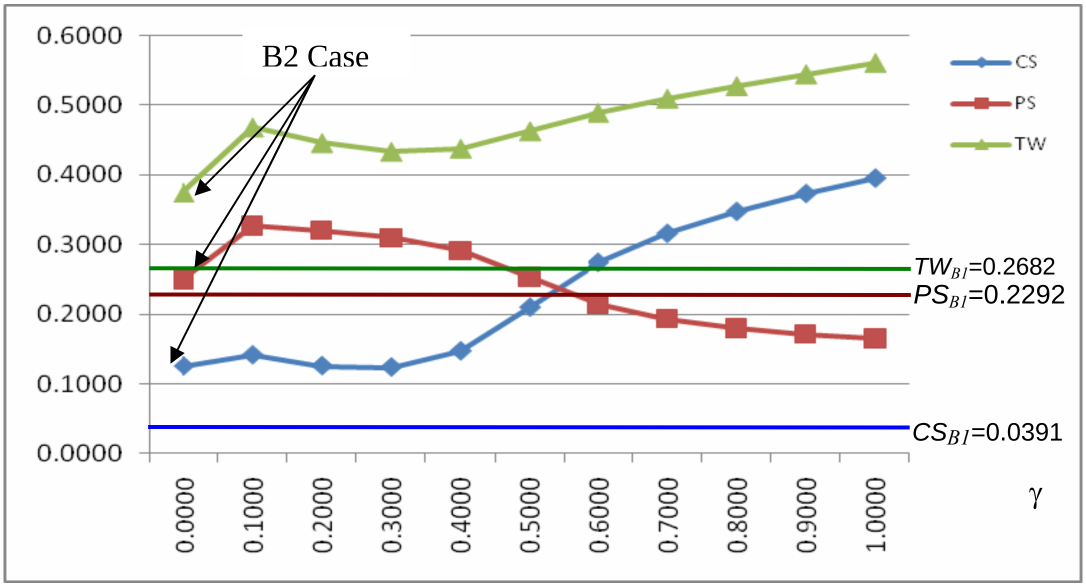
Note: CS_H and CS_L: consumer surplus for high- and low-quality groups, respectively;
CS_{B1} : consumer surplus in the B1 case
B1 case: only one conventional retailer in the market (i.e. with no buyer power)
B2 case: two conventional retailers in the market.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).

Figure 7: Producer Surplus



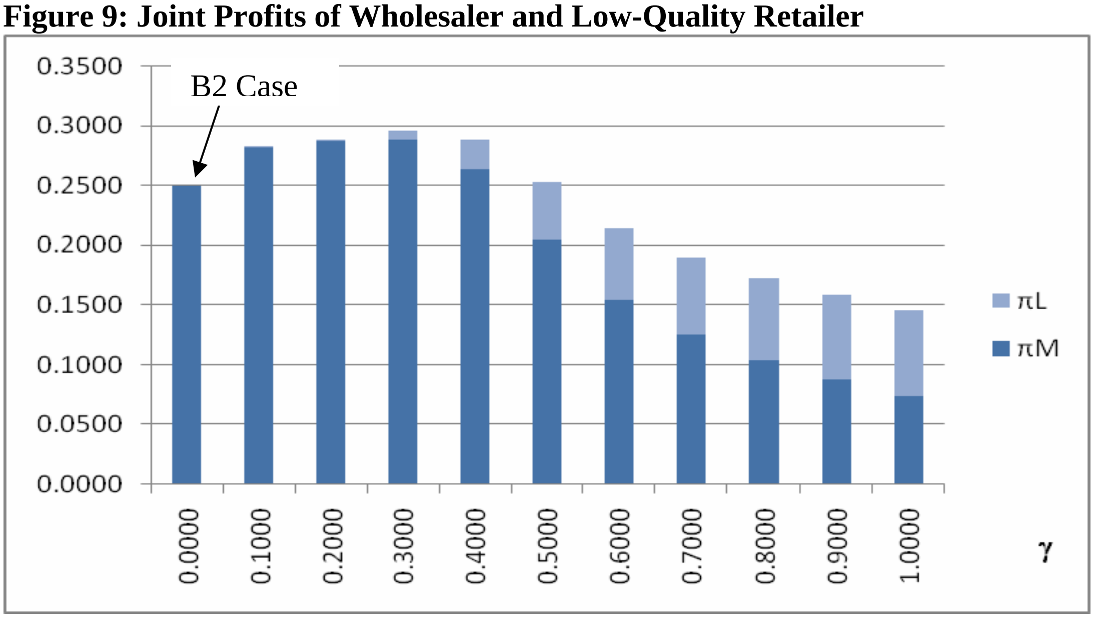
Note: π_M, π_H, and π_L: profits for wholesaler, high- and low-quality retailers, respectively;
$\pi_{M(B1)}$ and π_{B1}: profits for wholesaler and retailer, respectively, in the B1 case.
B1 case: only one conventional retailer in the market (i.e. with no buyer power)
B2 case: two conventional retailers in the market.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).

Figure 8: Total Consumer Surplus, Producer Surplus, and Welfare



Note: Total consumer surplus $CS = CS_H + CS_L$; Total producer surplus $PS = \pi_L + \pi_H + \pi_L$;
Total welfare $TW = CS + PS$.
CS_{B1}, PS_{B1}, and TW_{B1}: consumer surplus, producer surplus, and total welfare, respectively, in the B1 case.
B1 case: only one conventional retailer in the market (i.e. with no buyer power)
B2 case: two conventional retailers in the market.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).

Figure 9: Joint Profits of Wholesaler and Low-Quality Retailer



Note: π_M and π_L: profits for wholesaler and low-quality retailer, respectively.
B2 case: two conventional retailers in the market.
$\gamma > 0$ corresponds to the WM case (one conventional retailer and one Wal-Mart store).