Buyer Power and Vertically Differentiated Retailers

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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 price, quality and welfare effects of introducing a large retailer, such as Costco or a Wal-Mart Supercenter, that is able to obtain lower wholesale prices (i.e., countervailing buyer power). We obtain two main results. First, the store with no buyer power (a "traditional retailer") 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 consumers' shopping experience. Second, the presence of a large retailer causes consumer welfare to increase through two different channels: a) the upstream discount obtained by the large retailer is partially passed on to the retail price, and b) a greater quality offered by the traditional retailer. Contrary to conventional wisdom, most of the consumer welfare gains in our model are, at low levels of countervailing power, due to the latter channel.

Keywords: buyer power, vertical differentiation, Wal-Mart, waterbed effect

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, allow consumers to enjoy lower prices (Dobson et al., 2001, Wilke, 2004).

The rise in manufacturing concentration in recent years is attributable to 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). Importantly, mass merchandisers (e.g. Wal-Mart, Target and Kmart) and warehouse clubs (e.g. Costco and Sam's Club) are capturing an ever larger share of all food retail sales in the United

[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 beer manufacturers, 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.

States. Wal-Mart, for example, has been the largest food retailer in the United States since 2000 (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.[2] 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 two times larger than that observed at higher-end stores (such as 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 or warehouse clubs, can benefit society if the associated savings are passed on to consumers. In this context, countervailing power may result 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 (Chen, 2003).

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,

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

after years of decline brought on by fighting Wal-Mart on price, supermarkets appear to be 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, warehouses, drugstores, and by the food-service segment. These strategies include expanded product offerings (e.g., expanding organic and private labels selection, adding fuel pumps), improved 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, in many ways supermarkets have improved the quality of the shopping experience and increased the quality (real or perceived) of their products.

In this article, we develop a model to study the price, quality and welfare effects of a large retailer with countervailing buyer power. The application we have in mind is the entry of Wal-Mart Supercenters or warehouse clubs such as Costco or Sam's Club, 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.[3]

[3] 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."

This study contributes to a recent and growing empirical literature on the effects of competition on the provision of quality in grocery retailing. A notable example is Ellickson (2006), who shows that the U.S. retail food industry is characterized by a two-tier structure with low-quality firms in one tier and high-quality firms in another. Bonanno and Lopez (2009), find that retailers have been successful in attracting less price-sensitive consumers by adding new in-store services. More recently, Courtemanche and Carden (2011) find that the introduction of a Costco in a metropolitan area raises prices of other incumbent retailers; this and other evidence leads the authors to conclude that higher product quality and an enhanced shopping experience is a strategy that Costco's rivals use to compete more effectively. Finally, Matsa (2011) examines the connection between competition and quality in the supermarket industry. He finds that entry of Wal-Mart increases the quality of competing food retailers, as measured by reduced incidence of "stockouts."[4]

In line with the above cited empirical studies, we define quality as an enhancement of customers' shopping experience through, for example, higher levels of in-store services, better store layout and aesthetics, and a wider selection of product varieties.[5] As such, one can think of the quality differentiation in our model as an 'add-on' to the product that enhances the consumer's valuation for the good. Following this definition of quality and previous literature (including Basker (2011)), big-box retailers market "low quality" whereas traditional retailers

[4] See also Matsa (2011) for related literature on the connection between quality provision and market concentration in the context of other industries.

[5] Big-box retailers carry a limited assortment of brand and varieties relative to traditional retailers (e.g., Singh, Hansen, and Blattberg, 2006; Basker, 2007; Senauer and Seltzer, 2010; Matsa, 2011). We make the same argument as Ellickson (2006) that at the same price, consumers prefer more choice to less. Thus, big-box retailers provide a lower "quality" in our model. This interpretation ignores the horizontal differentiation brought about by a "variety" effect (e.g., offering a gourmet or organic variant of a product).

market "high quality."[6] Our study is novel in that we examine the distribution of welfare effects of the entry of big-box retailers with buying power while also considering the impact on quality provision.

For tractability purposes we focus our model on a single good rather than an array of products and on duopoly competition downstream, namely there are two retailers: a conventional retailer and a large retailer (e.g., Wal-Mart, Costco). The difference is that the "conventional" retailer has no countervailing buyer power whereas the "large" retailer does.[7] Buyer power is measured by a discount negotiated between the manufacturer and the retailer, and assumed to be exogenous.[8] As opposed to earlier work, we allow downstream firms to compete in quality: retailers can choose a different level of "service" (i.e., the 'add-on' that enhances the shopping experience).

We compare our equilibrium results to two "no Wal-Mart" retail configurations: monopoly and duopoly. These benchmark configurations allow us to evaluate the effect of entry by the large store on: a) consumer and producer welfare, and b) the price and quality equilibrium levels. Moreover, by comparing the "Wal-Mart" configuration to the two benchmark scenarios we can separate the effect of two types of entry: a) entry of a large retailer without displacing the conventional retailer (i.e., conventional monopolistic retailer vs. Wal-Mart configuration), and b)

[6] In the model presented below, we assume that the large retailer offers low quality. In an expanded version of our model where quality choice is endogeneized, we found two Nash equilibria (none of which Pareto-dominates the other) whereby retailers prefer to be vertically differentiated rather than market the same quality.

[7] 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."

[8] This assumption contrasts sharply with the model developed by Snyder (1996), for example, 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.

entry by displacement of one conventional retailers (i.e., conventional duopolistic retailers vs. Wal-Mart configuration).[9]

We find that in the presence of a large retailer, it is profit-maximizing for the conventional retailer to raise its quality beyond what is observed in both benchmark retail configurations, at least for low enough values of the discount. 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 larger for low values of the discount, suggesting that increases in consumer welfare may be even larger than previously claimed as consumers not only benefit from low prices. 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 largest winner depends on the size of the discount. At low discount values it is the manufacturer that benefits because the large retailer allows the wholesaler to reap the benefits of price discrimination between the two retailers. At higher discount levels, the big-box retailer benefits the most because its lower price allows an increase in market share.

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

[9] This second type of entry can also be regarded as a merger between the two conventional retailers that is triggered by Wal-Mart's entry. According to Martinez (2007), over the last two decades, the growth of Wal-Mart and other large retailers such as Costco has contributed to a wave of consolidation in the retail sector.

2. Related Studies

While there have been several prior studies on buyer power, there have been few attempts to incorporate product differentiation in the analysis. Past work is extensive and has had various foci (i.e., empirical vs. theoretical) and scopes (i.e., type of industry). In this section we review studies (beyond those mentioned in the introduction) that are most closely connected with our work.

A central issue in this literature is whether 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 decrease (and welfare increase) 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.

A number of studies, Dobson and Inderst (2007, 2008), Dobson and Chakraborty (2008), Inderst and Valletti (2009), and Inderst and Valletti (2011), examine the so-called "waterbed

effect." This effect arises when an upstream firm increases its price to some downstream firms as a way to compensate the low price that it needed to concede to another (strong) downstream firm. Inderst and Valletti (2011) present a model of buyer power in the upstream market where the asymmetric exercise of buyer power can lead, in some cases, to a loss in consumer welfare. The loss is due to the transmission of higher wholesale prices (for those downstream firms lacking buyer power) to retail prices.

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. The authors show that it is optimal for the supplier to set discriminatory wholesale prices. Consistent with our findings below, the authors find that consumer surplus, industry profits, and welfare increase with differential pricing by the wholesaler.

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 the presence of capacity constraints, technological choices, and mergers. For examples of this literature 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 in the European retail sector and its implications for competition policy. Snyder provides a concise overview of theoretical work.

3. Model

The setup of the model is given by a wholesaler-retailer relationship in which retailers buy a product from a wholesaler and sell it to consumers. Specifically, we consider a monopolist

manufacturer offering an identical product to two retailers. As in Bolton and Bonanno (1988), retailers are differentiated in the level of service they provide to consumers (i.e., the quality of the shopping experience). We model this vertical differentiation à la Mussa and Rosen (1978).[10] 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.[11] 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:

[10] The vertical differentiation model of Mussa and Rosen (1978) has been extensively used in the agricultural and food economics literature over the last decade. Saitone and Sexton (2010) provide a review of this literature. See also Giannakas (2011) for a review of the vertical differentiation models in the context of consumer demand for food. In addition, Mussa-Rosen preferences have been used to model manufacturers and retailers' brand competition, e.g., Mills (1995), Bontems, Monier-Dilhan, and Réquillart (1999), Bergès-Sennou and Waterson (2005), Bazoche, Giraud-Héraud, and Soler (2005).

[11] Low- (high-) quality product refers to a good purchased at a retailer with low- (high-) quality shopping experience as mentioned previously.

$D_L(p_H, p_L, k_H, k_L) = \theta_H - \theta_L = \frac{p_H k_L - p_L k_H}{k_L(k_H - k_L)}$, $D_H(p_H, p_L, k_H, k_L) = 1 - \theta_H = 1 - \frac{p_H - p_L}{k_H - k_L}$. To avoid a perfectly competitive solution when the two retailers sell the same quality, we assume that retailers compete in quantities. For this reason, we need to work with the inverse demands:

$$p_L(q_H, q_L, k_H, k_L) = k_L(1 - q_H - q_L), \tag{1}$$

$$p_H(q_H, q_L, k_H, k_L) = k_H(1 - q_H) - k_L q_L. \tag{2}$$

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 simultaneously set q_H and q_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, the large retailer (henceforth 'Wal-Mart') 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. A larger γ implies a greater bargaining/buyer power by Wal-Mart. The maximization problem of the retailers (stage 3) can be expressed as

$$\max_{q_L} \pi_L = \left[p_L(q_H, q_L, k_H, k_L) - (1-\gamma)w \right] q_L - C_L(k_L), \tag{3}$$

$$\max_{q_H} \pi_H = \left[p_H(q_H, q_L, k_H, k_L) - w \right] q_H - C_H(k_H), \tag{4}$$

where π denotes profit and $C(\cdot)$ is the cost of providing a certain quality of service (add-on cost). When the low-quality retailer is a conventional supermarket γ is equal to zero whereas

when the low-quality retailer is Wal-Mart $\gamma > 0$. Thus, the retailer has two costs: the price of buying the product from the manufacturer and a fixed cost associated with the "add-on" level of quality. The quality production function is represented by $0.5(k_i - k_0)^2$, $i=L, H$, where k_0 is the minimum quality level. Under this formulation, the cost of quality provision is greater for k_H than for k_L (since by assumption $k_H > k_L$) and so is the marginal cost of quality improvement.

To facilitate the numerical solutions in our model, we further normalize the minimum quality level k_0 to 1.[12] After substituting the demand and cost expressions into the profit functions, taking the first-order condition with respect to quantity for each retailer, and solving for quantities we obtain:

$$q_L\left(w, k_H, k_L; \gamma\right) = \frac{k_H k_L - w\left(2k_H\left(1-\gamma\right) - k_L\right)}{k_L\left(4k_H - k_L\right)}, \tag{5}$$

$$q_H\left(w, k_H, k_L; \gamma\right) = \frac{2k_H - k_L - w\left(1+\gamma\right)}{4k_H - k_L}. \tag{6}$$

These equations represent the demands facing the manufacturer. 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:

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

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:

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

[12] In principle, the parameter k_0 need not be equal to 1. However, we set k_0=1 as this allows us to find feasible numerical solutions (i.e., positive demands and profits) for the whole range of the discount (γ) considered.

which can be substituted back into the manufacturer's demand (equations 5 and 6), which are then substituted into the retail demands (equations 1 and 2), to solve for the optimal quality choices by both retailers. The maximization problem of retailers in stage 1 corresponds to

$$\max_{k_L} \pi_L = \frac{k_L}{16}\left[\frac{4k_H\left((1-\gamma)^2 k_H + \gamma k_L\right) - \left((3-\gamma)k_H - k_L\right)\left(2(1-\gamma)k_H - k_L\right)}{\left(4k_H - k_L\right)\left((1-\gamma)^2 k_H + \gamma k_L\right)}\right]^2 - \frac{\left(k_L - 1\right)^2}{2}, \tag{7}$$

$$\max_{k_H} \pi_H = \frac{k_H}{16}\left[\frac{4\left(2k_H - k_L\right)\left((1-\gamma)^2 k_H + \gamma k_L\right) - \left(1+\gamma\right)k_L\left((3-\gamma)k_H - k_L\right)}{4\left(4k_H - k_L\right)\left((1-\gamma)^2 k_H + \gamma k_L\right)}\right]^2 - \frac{\left(k_H - 1\right)^2}{2}. \tag{8}$$

From (7) and (8) 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.

The optimal quality levels k_L and k_H depend on the discount γ, which is the measure of buyer power. Therefore, varying γ allows us to evaluate the effect of countervailing power on prices, quantities, quality levels, and welfare.

4. Results

We study three scenarios. In the first scenario (B1), there is a single conventional retailer with quality k and no buyer power ($\gamma=0$). The second scenario (B2) consists of two conventional retailers with quality k competing in quantity and with no buyer power ($\gamma=0$). This second scenario nests the first. The third scenario (WM), has a large retailer (e.g., Wal-Mart) with countervailing buyer power ($\gamma>0$) together with a conventional retailer with no buyer power ($\gamma=0$). Firms always compete in quantities, as indicated earlier. The first two scenarios are compared against the third to study: a) the effect of entry of a large retailer without displacing the conventional retailer (i.e., case B1 to WM), and b) the effect of entry with either the

displacement of one conventional retailer or the merger of the two conventional retailers (i.e., case B2 to WM). We vary the discount γ from 0 to 1 by 0.025 increment in the WM scenario and compare each resulting equilibrium to that obtained under the B1 and B2 cases. Table 1 shows the results for 0.05 increments of γ; in the next subsections we describe each scenario and contrast their results.

4.1 M Conventional Stores

Cases B1 and B2 are nested in a general model with *m* identical retailers of quality *k* competing in quantities with Cournot conjectures. When there is more than one retailer, we assume that they are not vertically differentiated. This assumption simplifies the model and allows us to focus on the greater differentiation that exists between Wal-Mart and conventional retailers. The conjectural variation is expressed as $\xi = \frac{\partial Q}{\partial q_i}\frac{q_i}{Q} = \frac{1}{m}$, where Q is the total quantity and $q_i=Q/m$ is the quantity of retailer *i*. With only one quality, the indifferent consumer is located at $\overline{\theta} = p/k$ and the inverse demand facing the retailers is $p=k(1-Q)$. The profit equations of retailer *i* and the manufacturer can be written, respectively, as:

$$\pi_i = \left(p(Q;k) - w\right)q_i - \frac{(k-1)^2}{2},$$
$$\pi_M = wQ\left(w;k,m\right)$$

Solving the three stages by backward induction, the corresponding equilibrium prices, quantities, and quality as a function of *m* are given by:

$$k = 1 + \frac{1}{4\left(m+1\right)^2},\ w = \frac{k}{2},\ p = \frac{k\left(2+m\right)}{2\left(1+m\right)},\ Q = \frac{m}{2\left(1+m\right)}.$$

The first two rows of table 1 display the results for cases B1 and B2, where *m* takes the values of 1 and 2 respectively. Both the monopoly and Cournot duopoly raise quality above the minimum

level with quality of the monopoly being higher than that of the duopoly (k_{B1}=1.06 > k_{B2}=1.03 > 1). The increase in competition in the duopoly scenario results in lower retail prices and larger quantities, which benefit consumers and the manufacturer. The manufacturer gains because the decrease in manufacturer's price is more than offset by the increase in quantity sold. Society's welfare is improved with competition. Under the monopoly and duopoly structure, only 25% and 33.3% of the market respectively is served and most of society's welfare is captured by firms (85.6% and 79.9% respectively). Most of firms' surplus goes to the manufacturer who benefits from a reduction in the double-marginalization problem.

4.2 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 onwards) we report results for $\gamma \in [0, 1]$ in 0.05 intervals.[13] Results in table 1 lead to several important observations.

The quality level set by the low-quality retailer (i.e., Wal-Mart) is always set at the minimum (k_L = 1 for all $\gamma \in [0,1]$). A large retailer able to negotiate a discount finds it more effective to attract customers through a lower price rather than by improving its quality. Intuitively, the profitability incentive to offer low prices and capture a larger share of the market 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. For all values of the discount, the quality of the high-quality retailer is above the quality level of the Cournot duopolists. This quality is also above the quality

[13] Note that in reality, only a portion of the [0, 1] interval is likely to be more relevant for a specific retail chain. In this section, we describe the results for the whole range to provide a broad picture of our model's results. Section 4.3 analyzes the reasonable discount range that Wal-Mart is likely to obtain and discusses the results for that range.

level chosen by the monopolist (case B1) for sufficiently low levels of the discount, i.e., $\gamma<0.45$. 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. This result is consistent with recent empirical studies and case studies examining the impact of competition by big-box retailers on quality provisions by traditional supermarkets (Carré, Tilly, and Holgate, 2009; Courtemanche and Carden, 2011; Matsa, 2011).

The level of quality chosen by the conventional retailer (k_H) exhibits a non-monotonic relationship with the discount (γ). At low levels of discount, the price competition is intense and the conventional retailer benefits from differentiating its products with a high quality, despite the cost. As the discount increases, it is profit maximizing for the conventional retailer to decrease the level of quality (and decrease the level of product differentiation) in order to be more competitive with Wal-Mart in terms of the price-quality ratio offered. However, eventually (for $\gamma > 0.65$) the product differentiation becomes low enough that it becomes profit maximizing to raise the quality again because the benefits of product differentiation begin to outweigh the costs.

With a retailer able to negotiate a discount in the market, the wholesale price increases relative to B1 and B2, as long as the discount is not too large (i.e., $\gamma<0.55$) (figures 1 and 2). We interpret this findings as supportive of the "waterbed effect" (Dobson and Inderst, 2007, 2008; Dobson and Chakraborty, 2008). When the manufacturer faces two retailers with different levels of buyer power, the discount to Wal-Mart results in an increase in the wholesale price to the conventional retailer. In our simulations, the wholesale price exhibits a non-monotonic relationship with the discount γ. At low levels of discount, the wholesale price increases with the level of the discount. However, eventually the discount becomes high enough ($\gamma>0.25$) that it makes sense to decrease the wholesale price.

Retail prices (p_L and p_H) are lower than under the monopoly case (figure 1). Consumers shopping at Wal-Mart pay lower prices than in B2 (Cournot duopoly) for all values of the discount (figure 2). However, consumers shopping at the conventional retailer experience higher prices than in B2 for low enough values of the discount (i.e., $\gamma<0.4$). The divergent predictions on p_L and p_H are explained by the increase in quality by the conventional retailer (and the decrease in quality by Wal-Mart), as well as the increase in the wholesale price to the conventional retailer (i.e., waterbed effect). Note also that both p_L and p_H decrease as the discount increases. As larger discounts are achieved, prices tend to fall because: a) the quality level offered by the conventional retailer tends to decrease,[14] and b) all prices inevitably experience intense downward pressure by Wal-Mart's low-price policy.

A primary goal of this article is to determine the welfare impacts of Wal-Mart and other big-box retailers that have the ability to countervail the power of manufacturers. More specifically, do consumers benefit from the countervailing power of large retailers and from the resulting vertical differentiation? The answer to this question is not clear *a priori* because of the waterbed effect. While consumers may gain from the pass-through of a discount, the increase in wholesale price to the conventional retailer could offset this gain as consumers bear this increase through higher retail prices (despite an increase in quality).

In our setting, total consumer surplus increases with the entry of Wal-Mart, regardless of whether the entry occurs with or without the displacement of a conventional store. In addition, consumer surplus increases with the discount obtained by Wal-Mart. 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. Intuitively, this

[14] As long as the discount is not too large, i.e. $\gamma < 0.65$ range. In general, our model implies that lower equilibrium quality levels need to be associated with lower price levels.

Wal-Mart effect more than compensates the negative effect on D_H caused by the increasingly larger retail price of the conventional retailer (table 1).

To evaluate how the gain in consumer surplus is distributed, we calculate the change in consumer surplus for three groups of consumers: 1) consumers who continue to buy from the conventional retailer(s), i.e., ΔCS_{kH}, 2) consumers who were buying from the conventional retailer and switch to Wal-Mart, i.e., ΔCS_{kL}, 3) consumers who were buying nothing in the benchmark case and then buy from Wal-Mart, i.e., ΔCS_{0L}. The expressions for the change in consumer surplus are:

$$\Delta CS_{kH} = \int_{\theta_H}^{1} \left[\left(\theta k_{HWM} - p_{HWM} \right) - \left(\theta k_{Bi} - p_{Bi} \right) \right] d\theta = \frac{\left(k_{HWM} - k_{Bi} \right)}{2} \left(1 - \theta_H^2 \right) - \left(p_{HWM} - p_{Bi} \right) \left(1 - \theta_H \right),$$

$$\Delta CS_{kL} = \int_{\theta_{Bi}}^{\theta_H} \left[\left(\theta k_{LWM} - p_{LWM} \right) - \left(\theta k_{Bi} - p_{Bi} \right) \right] d\theta = \frac{\left(k_{LWM} - k_{Bi} \right)}{2} \left(\theta_H^2 - \theta_{Bi}^2 \right) - \left(p_{LWM} - p_{Bi} \right) \left(\theta_H - \theta_{Bi} \right),$$

and

$$\Delta CS_{0L} = \int_{\theta_L}^{\theta_{Bi}} \left(\theta k_{LWM} - p_{LWM} \right) d\theta = \frac{k_{LWM}}{2} \left(\theta_{Bi}^2 - \theta_L^2 \right) - p_{LWM} \left(\theta_{Bi} - \theta_L \right).$$

where $\theta_H = 1 - D_H$, $\theta_L = 1 - D_H - D_L$, and $\theta_{Bi} = 1 - D$ represent respectively the equilibrium values of the consumer that is indifferent between high- and low-quality in the WM case, the consumer indifferent between buying nothing and the low-quality in the WM case, and the consumer indifferent between buying nothing and quality k in the Bi (i=1,2) case. The equilibrium low- and high-quality values in the WM case are represented by k_{LWM} and k_{HWM} and the equilibrium value of quality is k_{Bi} for case Bi. Similarly, the equilibrium prices in each of these cases are p_{LWM}, p_{HWM}, and p_{Bi}. In table 2, we express the change in consumer surplus for each group as a percentage of the total change in consumer surplus.

Table 2 shows that all three groups of consumers gain from the entry of Wal-Mart either with or without the displacement of a conventional retailer. It is worth noting that consumers staying with the conventional retailer tend to capture the greatest share of the increase in consumer surplus for low values of γ ($\gamma<0.3$ in B1 vs. WM, and $\gamma<0.25$ in B2 vs. WM). This result occurs even though the quality-price ratio facing those consumers is worse than the quality-price ratio of consumers shopping at Wal-Mart. Consumers shopping at the conventional retailer benefit the most because they have the highest willingness to pay for quality, thus the value of the increase in quality more than offsets the increase in price. Consequently, as the quality of the conventional retailer decreases with the discount, the consumer surplus of those consumers decreases (as well as their share of the total consumer surplus gained with respect to B1 and B2). At low discount values, consumers who capture the smallest share of the total consumer surplus gain are those who join the market with Wal-Mart's entry; these consumers capture an increasing share of the total consumer surplus gain as the discount increases because more consumers join the market as prices decrease. As Wal-Mart is able to obtain greater discounts, it is the consumers who switch from the conventional retailer to Wal-Mart who tend to capture the largest share of the gain in consumer surplus; for these consumers, the value of the loss in quality is more than offset by the decrease in price associated with the discount obtained by Wal-Mart.

Overall, the countervailing power of a large retailer benefits consumers through lower prices from the large retailer as well as through higher quality from the conventional retailer. This occurs despite a waterbed effect that is in fact mitigated by product differentiation.

The manufacturer benefits from being able to price discriminate between two retailers.[15] The manufacturer is able to raise the price to the retailer that does not have buying power, while selling at a discount to Wal-Mart. This waterbed effect, benefits the manufacturer as long as γ is low enough under B2 (i.e., $\gamma<0.3$). Note that the retailer not receiving the discount experiences higher profit due to product differentiation for low values of the discount relative to B2 (i.e., $\gamma<0.15$). Recall that at low enough discounts the traditional retailer benefits from higher prices (figure 2) and larger demand than under B2. As such, our model shows that when the conventional retailer has the ability to raise its quality, the increase in the wholesale price through the waterbed effect does not necessarily lead to a lower profit for that retailer. Wal-Mart enjoys greater profits than a Cournot retailer under B2 at higher discounts ($\gamma>0.1$) as its ability to gain additional customers is enhanced.

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 ($\gamma>0.5$), the manufacturer prefers a retail configuration characterized by stronger double marginalization (B1).

Producer surplus increases relative to both B1 and B2 and with the size of the discount. The manufacturer captures more than half of the producer surplus for low values of the discount ($\gamma<0.60$), whereas it is Wal-Mart that captures the largest share of producer surplus when γ becomes large enough. From a social planner's point of view, the optimal discount for maximizing consumer surplus and social welfare is 1 whereas producers' surplus is maximized

[15] 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.

at γ=0 (see columns TW and PS in table 1). Finally, note that total welfare is always higher in WM than in either B1 or B2 due to the increase in share of consumers served.

4.3. 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, publicly available information on such discount does not exist.

As opposed to supermarkets, Wal-Mart does not have any slotting fees or hidden allowances (Walton, 2005). Instead it receives lower wholesale prices partly as a compensation for shelf space (Klein and Wright, 2007).[16] We use this differential treatment in slotting allowances to obtain a rough estimate of the plausible discount bargained by Wal-Mart.

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., $\gamma wD_L \geq S$.[17] Thus, if we have a measure of slotting fees at conventional retailers, we can find a crude lower bound for Wal-Mart's discount.

[16] 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."

[17] 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.

Table 3 in FTC (2003) has average ratios of slotting fee payments to new product revenues, for each retailer-division examined. In terms of our model, the ratio is computed as S/pD. Though the range of slotting fee values is large, on average the slotting fee to revenue ratio (for all retailers/divisions and products for which slotting fees are paid) is 19%: 16% for ice cream, [18] and 20% for salad dressing (products for which slotting fees are most often applied).[19]

Moreover, 90 percent of the ratios of slotting fee to revenue are less than 35%. To compare these values with Wal-Mart's discount, we can rewrite the above inequality as:

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

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 $\gamma \in [0,1]$) reported in table 1. The second column of table 3 contains the results of this calculation. A slotting fee to sales ratio of 35% percent corresponds to a discount value between 0.35 to 0.4 (table 3). Because 90 percent of the slotting fees to sale ratio reported by the FTC are less than 35%, we feel confident that a plausible range of discount for Wal-Mart is 0.00 to 0.4.

Using this range, the results of the WM case can be better contrasted with those of the B1 and B2 cases. First, the conventional retailer provides significantly higher quality products/services to differentiate itself in response to Wal-Mart's entry in both B1 and B2. Second, the manufacturer's price increases relative to both B1 and B2 due to the waterbed effect. Third, relative to the B2 case the price of the conventional retailer increases due to three effects 1) softening of the competition due to the product differentiation, 2) increase in quality, and 3) the increase in the manufacturer's price due to the waterbed effect (figures 1 and 2). Wal-Mart

[18] Not incorporating the 443% for ice cream for retailer 7 division 2.
[19] The overall average ratio including retailers that do not charge slotting fees for certain products is 11.3% and the median is 4.5%.

has a lower price than the conventional retailer in all scenarios. This is consistent with what has been found in previous studies (Hausman and Leibtag, 2007; Volpe and Lavoie, 2008) and is due to both the discount captured by Wal-Mart and the decrease in quality relative to both the B1 and B2 cases.

In terms of welfare, all welfare measures are higher than in B1 due to the increase in competition. We observe the same effect when the benchmark case is B2, even though there is a small increase in concentration as measured by the Herfindahl Hirschman Index (HHI). The HHI is 5000 under B2 and ranges from 5000 (γ=0.15) to 6043 (γ=0.40), with an average value of 5331 in the range $\gamma \in [0.00, 0.40]$, when Wal-Mart is present. 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.

Using the equations presented in section 4.1, we can also examine the effects on welfare when Wal-Mart is responsible for a larger increase in concentration in retailing. More specifically, we can examine the effects of the entry of Wal-Mart when it results in the displacement, through exit or merger, of two conventional retailers, i.e., a benchmark case of three retailers. Under that case, the consumer surplus corresponds to 0.07 and Wal-Mart would cause a decrease in consumer surplus throughout the relevant range of discount. Moreover, the entry of Wal-Mart would also cause a decrease in producer surplus largely because of a decrease in the manufacturer's profit. We characterize this case as extreme because of the large and likely unrealistic increase in concentration, i.e., the HHI would increase from 3333 to an average of 5331 in the range $\gamma \in [0.00, 0.40]$.

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 consumer surplus and total welfare.

5. Concluding Remarks

In this paper we develop a simple model to study wholesaler-retailer relationships that accommodates for two key features of retail markets: buyer power and quality differentiation. Motivated by the increasingly pivotal role of large chains in the food 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 stringent assumptions about the industry: upstream supply is provided by a monopolist, there is a single product, differentiation is vertical, 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), Volpe and Lavoie (2008), Carré, Tilly, and Holgate (2009), Courtemanche and Carden (2011), and Matsa (2011), who highlight how competitive pressure from Wal-Mart and/or Costco has driven traditional supermarkets to enhance the quality of the shopping experience by adding features like a coffee shop, a bank, or a deli.

Our framework also sheds light on the 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 a large retail store 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-end stores already exist.

We find that total welfare increases with the presence of buyer power. However, while consumers gain from the replacement of a conventional retailer by a big-box retailer with countervailing power, most of the welfare increases tend to be realized at the firm level. In particular, the wholesaler tends to be the biggest winner at low levels of discounts because it can profitably engage in price discrimination between the low-quality and the high-quality retailers.[20] However, when the countervailing power of the big-box retailer is large enough, the size of this retailer allows it to capture the largest share of the increase in producer surplus. Further, consumers' gain is unevenly distributed, with the more high-quality concerned consumers earning a larger share of the gain for low enough values of the discount.

Finally, our model suggests that the waterbed effect might be mitigated by the resulting vertical differentiation of the retailers: the downstream firm that does not receive a discount may experience higher profits while consumers that purchase from the high-quality retailer enjoy the boost in quality.

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, especially if the success of big-box retailers is the cause for further consolidation.

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

Our model shows that it takes a fairly large, and likely unrealistic, increase in concentration for consumers and society to lose welfare from the entry of a large firm with the ability to countervail the power of manufacturers when we consider the vertical differentiation that results at the downstream level.

There are some caveats. First, our model considers a monopolistic wholesaler. 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. Second, our model does not provide an analytical solution, which limits our ability to broadly generalize our findings; this is the cost of adding a quality dimension to the analysis. 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 directly or indirectly. In the short-run, consumers benefit from the lower prices of Wal-Mart and the lower prices at rival 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 stores competing with large chains.

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		w	p		D_i		CS		π_M	π_i		D	CS	PS	TW
*B1**	0.0000	1.0625		0.5313	0.7969		0.2500		0.0332		0.1300	0.0645		0.2500	0.0332	0.1973	0.2305
*B2**	0.0000	1.0278		0.5139	0.6852		0.1667		0.0571		0.1713	0.0282		0.3333	0.0571	0.2276	0.2847
	γ	k_L	k_H	w	p_L	p_H	D_L	D_H	CS_L	CS_H	π_M	π_L	π_H	D_H+D_L	CS	PS	TW
	0.00	1.0000	1.1801	0.5382	0.6586	0.7989	0.1204	0.2210	0.0114	0.0489	0.1837	0.0145	0.0414	0.3414	0.0627	0.2400	0.3023
	0.05	1.0000	1.1664	0.5534	0.6603	0.7926	0.1346	0.2051	0.0091	0.0521	0.1843	0.0181	0.0352	0.3397	0.0612	0.2376	0.2988
	0.10	1.0000	1.1514	0.5663	0.6605	0.7834	0.1509	0.1886	0.0114	0.0489	0.1837	0.0228	0.0295	0.3395	0.0603	0.2359	0.2962
	0.15	1.0000	1.1354	0.5761	0.6589	0.7711	0.1693	0.1718	0.0143	0.0458	0.1818	0.0287	0.0243	0.3411	0.0602	0.2348	0.2950
	0.20	1.0000	1.1191	0.5821	0.6552	0.7558	0.1895	0.1552	0.0180	0.0429	0.1786	0.0359	0.0199	0.3448	0.0609	0.2344	0.2953
	0.25	1.0000	1.103	0.5840	0.6492	0.7379	0.2112	0.1395	0.0223	0.0402	0.1740	0.0446	0.0162	0.3508	0.0625	0.2348	0.2973
	0.30	1.0000	1.0881	0.5815	0.6408	0.7179	0.2338	0.1254	0.0273	0.0379	0.1681	0.0547	0.0132	0.3592	0.0652	0.2359	0.3011
	0.35	1.0000	1.0751	0.5748	0.6301	0.6966	0.2565	0.1134	0.0329	0.0360	0.1610	0.0658	0.0110	0.3699	0.0689	0.2378	0.3067
	0.40	1.0000	1.0642	0.5640	0.6172	0.6747	0.2788	0.1040	0.0389	0.0347	0.1530	0.0777	0.0094	0.3828	0.0736	0.2402	0.3138
	0.45	1.0000	1.0556	0.5498	0.6025	0.6526	0.3001	0.0975	0.0450	0.0343	0.1443	0.0901	0.0085	0.3975	0.0793	0.2428	0.3221
WM**	0.50	1.0000	1.0493	0.5323	0.5862	0.6308	0.3200	0.0939	0.0512	0.0347	0.1351	0.1024	0.0080	0.4138	0.0859	0.2456	0.3314
	0.55	1.0000	1.0449	0.5121	0.5687	0.6094	0.3382	0.0931	0.0572	0.0360	0.1256	0.1144	0.0081	0.4313	0.0932	0.2481	0.3413
	0.60	1.0000	1.0423	0.4895	0.5504	0.5886	0.3546	0.0951	0.0629	0.0384	0.1160	0.1257	0.0085	0.4496	0.1013	0.2502	0.3515
	0.65	1.0000	1.0411	0.4651	0.5317	0.5686	0.3689	0.0995	0.0680	0.0418	0.1063	0.1361	0.0095	0.4683	0.1099	0.2518	0.3617
	0.70	1.0000	1.0412	0.4393	0.5129	0.5497	0.3811	0.1060	0.0726	0.0463	0.0968	0.1452	0.0109	0.4871	0.1189	0.2529	0.3718
	0.75	1.0000	1.0425	0.4127	0.4944	0.5320	0.3912	0.1144	0.0765	0.0516	0.0876	0.1530	0.0128	0.5056	0.1281	0.2534	0.3815
	0.80	1.0000	1.0449	0.3857	0.4764	0.5157	0.3992	0.1244	0.0797	0.0577	0.0788	0.1594	0.0152	0.5236	0.1374	0.2533	0.3908
	0.85	1.0000	1.0483	0.3588	0.4591	0.5009	0.4053	0.1355	0.0821	0.0646	0.0705	0.1643	0.0181	0.5409	0.1467	0.2528	0.3995
	0.90	1.0000	1.0529	0.3325	0.4428	0.4879	0.4096	0.1476	0.0839	0.0719	0.0627	0.1678	0.0215	0.5572	0.1558	0.2520	0.4078
	0.95	1.0000	1.0584	0.3069	0.4275	0.4766	0.4122	0.1603	0.0850	0.0796	0.0555	0.1699	0.0255	0.5725	0.1646	0.2509	0.4155
	1.00	1.0000	1.0648	0.2824	0.4134	0.4669	0.4134	0.1733	0.0854	0.0876	0.0489	0.1709	0.0299	0.5866	0.1730	0.2497	0.4227

Notes: * These rows represents case 1 (*B1*) and case 2 (B2), where there is one or 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.

Di = demand of Cournot firm i. $D_L = \theta_H - \theta_L$: 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_i: profit of Cournot firm i. 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. Change in consumer surplus

	From B1 to WM			From B2 to WM		
γ	$\%\Delta CS_{kH}$	$\%\Delta CS_{kL}$	$\%\Delta CS_{0L}$	$\%\Delta CS_{kH}$	$\%\Delta CS_{kL}$	$\%\Delta CS_{0L}$
0.00	76.92	8.90	14.17	86.31	13.11	0.58
0.05	71.47	14.17	14.37	85.21	14.30	0.49
0.10	65.40	19.84	14.76	80.87	18.55	0.58
0.15	58.90	25.72	15.38	70.09	28.93	0.97
0.20	52.31	31.46	16.23	55.91	42.35	1.73
0.25	46.01	36.67	17.32	44.51	52.69	2.80
0.30	40.36	41.01	18.63	36.93	58.95	4.12
0.35	35.60	44.26	20.14	31.85	62.48	5.67
0.40	31.85	46.33	21.82	28.33	64.27	7.41
0.45	29.12	47.26	23.62	25.92	64.79	9.29
0.50	27.36	47.15	25.50	24.44	64.29	11.27
0.55	26.49	46.12	27.39	23.75	62.96	13.29
0.60	26.39	44.34	29.27	23.75	60.94	15.31
0.65	26.97	41.95	31.09	24.34	58.39	17.27
0.70	28.09	39.09	32.81	25.43	55.43	19.14
0.75	29.66	35.91	34.43	26.92	52.17	20.90
0.80	31.58	32.50	35.91	28.73	48.74	22.54
0.85	33.76	28.97	37.27	30.77	45.20	24.03
0.90	36.12	25.39	38.48	32.98	41.64	25.38
0.95	38.60	21.83	39.57	35.29	38.11	26.59
1.00	41.15	18.33	40.52	37.67	34.66	27.67

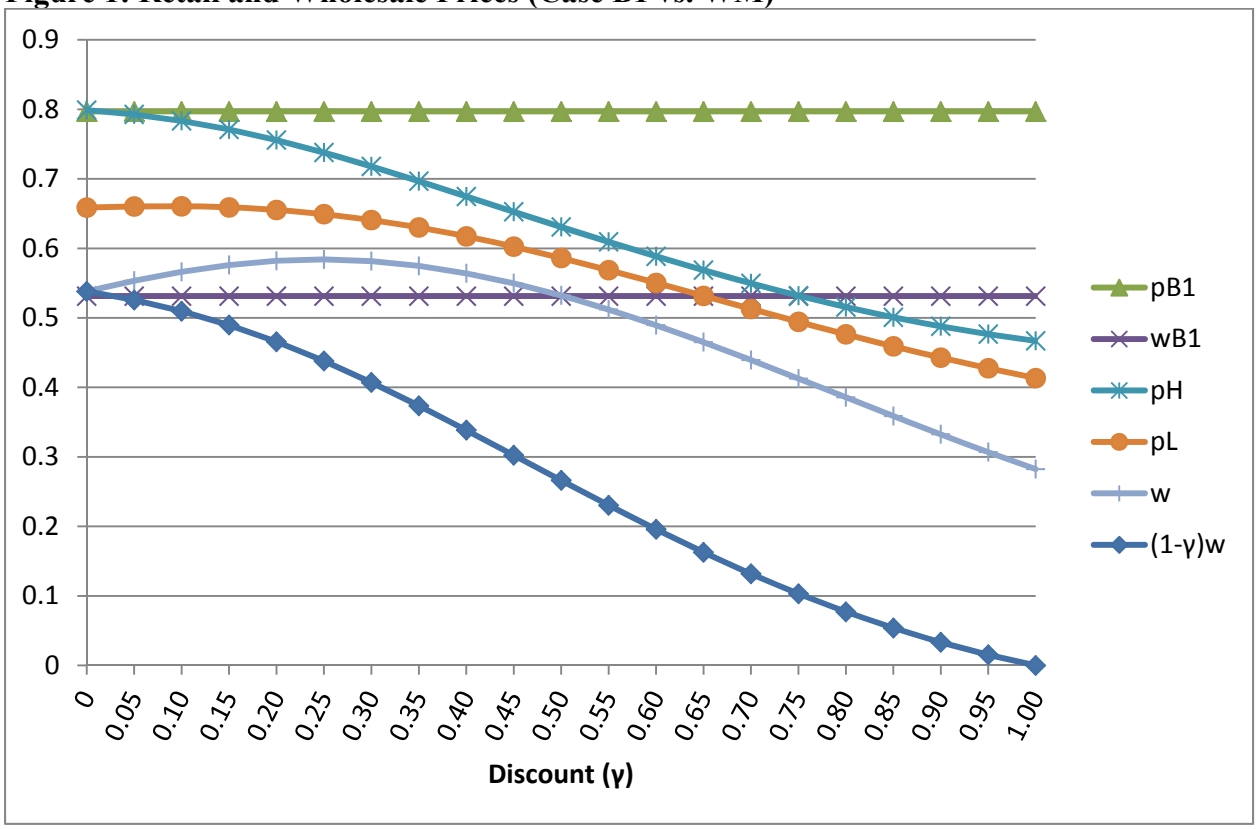
Notes:
$\%\Delta CS_{kH}$: the change in consumer surplus of consumers shopping at the conventional retailer before and after the entry of Wal-Mart, expressed as a percentage of the total change in consumer surplus.
$\%\Delta CS_{kL}$: the change in consumer surplus of consumers shopping at the conventional retailer and switching to Wal-Mart upon its entry, expressed as a percentage of the total change in consumer surplus.
$\%\Delta CS_{0L}$: the change in consumer surplus of consumers buying nothing in the benchmark case and shopping at Wal-Mart upon its entry, expressed as a percentage of the total change in consumer surplus.

Table 3: Wal-Mart's Received Unit Discount to Price Ratio

γ	$\frac{\gamma w}{p_L}100\%$
0.00	0.00
0.05	4.19
0.10	8.57
0.15	13.11
0.20	17.77
0.25	22.49
0.30	27.22
0.35	31.93
0.40	36.55
0.45	41.06
0.50	45.41
0.55	49.53
0.60	53.37
0.65	56.86
0.70	59.96
0.75	62.60
0.80	64.77
0.85	66.43
0.90	67.58
0.95	68.20
1.00	68.32

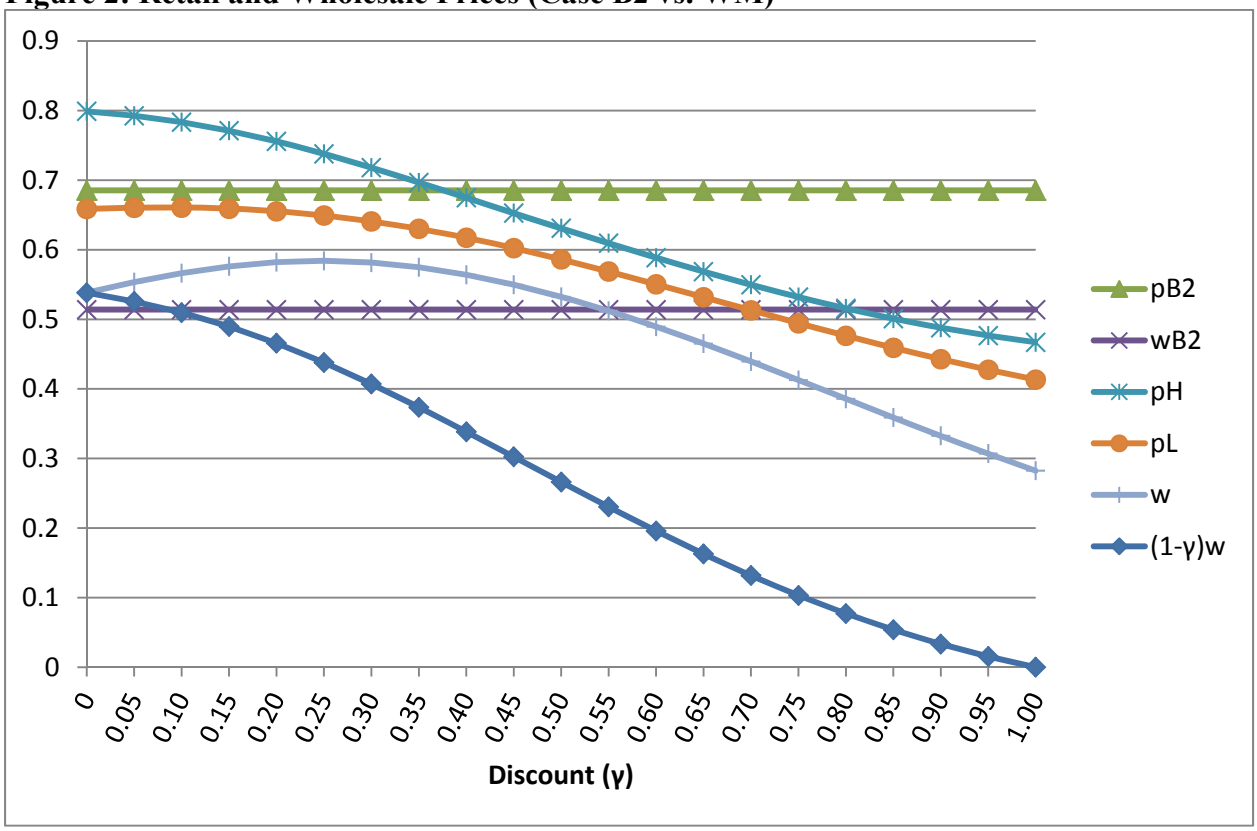
Note: Ratios (second column) are derived using the wholesale prices (w) and low-quality retailer prices (p_L) reported in table 1.

Figure 1: Retail and Wholesale Prices (Case B1 vs. WM)



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)

Figure 2: Retail and Wholesale Prices (Case B2 vs. WM)



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_{B2} and w_{B2} : retail and wholesale prices, respectively, in the B2 case.
B2 case: two conventional retailers in the market.