



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

Papers downloaded from AgEcon Search may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.



University of Massachusetts Amherst

Department of Resource Economics

Working Paper No. 2010-1

<http://www.umass.edu/resec/workingpapers>

Buyer Market Power and Vertically Differentiated Retailers

Shinn-Shyr Wang¹, Christian Rojas², and Nathalie Lavoie³

Abstract:

We consider a model of vertical competition where downstream firms (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. buyer market power). We obtain two main results. First, the store with no buyer market 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 (i.e. quality). 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) as well as from the high quality level 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 market power on retail and wholesale prices as well as on producer welfare.

Keywords: buyer market power, vertical differentiation, Wal-Mart

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

¹Shinn-Shyr Wang, Department of Resource Economics
University of Massachusetts, 212A Stockbridge Hall
80 Campus Center Way, Amherst, MA 01003-9246
E: wang@reseccon.umass.edu P: 413-545-5738 F: 413-545-5853

²Christian Rojas, Department of Resource Economics
University of Massachusetts, 219B Stockbridge Hall
80 Campus Center Way, Amherst, MA 01003-9246
E: rojas@reseccon.umass.edu P: 413-545-2496 F: 413-545-5853

³Nathalie Lavoie, Department of Resource Economics
University of Massachusetts, 212D Stockbridge Hall
80 Campus Center Way, Amherst, MA 01003-9246
E: lavoie@reseccon.umass.edu P: 413-545-5713 F: 413-545-5853

Buyer Market Power and Vertically Differentiated Retailers

Shinn-Shyr Wang Christian Rojas Nathalie Lavoie^{*}

January 2010

Abstract

We consider a model of vertical competition where downstream firms (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. buyer market power). We obtain two main results. First, the store with no buyer market 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 (i.e. quality). 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) as well as from the high quality level 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 market power on retail and wholesale prices as well as on producer welfare.

Keywords: buyer market power, vertical differentiation, Wal-Mart

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

^{*} Department of Resource Economics, University of Massachusetts Amherst. Contact email: Wang <wang@reseccon.umass.edu>. We gratefully acknowledge support from USDA-NRI grant 2008-35400-18700.

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 downstream markets (i.e. food processors and retailers) require a closer look at the existence and effects of *buyer* market 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.¹ More specifically, the ubiquitous negative connotation that market power is given may need to be reconsidered by antitrust legislators and policy makers as buyer market power may, for example, help consumers buy at lower prices (Dobson et al, 2001).

Unlike other inputs such as energy, oil or labor, agricultural products are either purchased in raw form by final consumers or are transformed (processed) in some way. These characteristics make buyer market power especially relevant in agricultural markets. For example, agricultural products are often sold to a handful of firms that specialize in processing it; this is notably reflected by the consolidation of food processors as buyers of farmers’ outputs. In addition, 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,

¹ The two most commonly used terms in the literature are *buyer market power* and *countervailing market power*. We employ the former as it is more intuitive when referring to a buyer’s ability to push upstream prices down (whether it emerges from lack of competition among buyers or simply because the seller has an inherent superior “negotiating” ability). In this paper we assume there is buyer market power, without seeking to explain its existence.

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. Among these merchandisers, Wal-Mart can be a particularly pivotal buyer to food manufacturers. Notable examples in the food industry are Procter & Gamble, Heinz, and Kraft, who earn at least 10 percent of their annual revenue from sales to Wal-Mart (Hopkins, 2003).

Being the largest retailer in the United States, Wal-Mart's 2008 revenues were more than the total combined revenues of the next six U.S. retailers (Kroger, Costco, Home Depot, Target, Walgreen, and CVS Caremark; Schultz, 2009). Among other things, Wal-Mart is known for its low prices: 8-27% lower than conventional retailers (Hausman and Leibtag, 2007). In addition, Volpe and Lavoie (2008) show that in response to a Wal-Mart Supercenter's presence, competing supermarkets lower their prices by 6% to 7% lower for national brands and by 3% to 8% for private labels.³ Moreover, competing supermarkets have tended to increase the quality of the shopping experience by including amenities such as delis, on-site bakeries, coffee shops, gas stations, banks, pharmacies etc. (Volpe and Lavoie, 2008) as well as introducing high-end private-label brands.⁴ After years of decline brought on by fighting Wal-Mart on price, supermarkets appear to be finding a way to win 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).

In this paper, we develop a model to study the effects of the presence of a large retailer with buyer market power. Specifically, we consider a simple wholesaler-retailer relationship

² The second Figure (72.3%) corresponds to 1998.

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

⁴ A recent study by Bonanno and Lopez (2009) also shows that retailers differentiate themselves from competitors and attract less price-sensitive consumers by service competition in fluid milk markets.

where retailers buy a good from a monopolist wholesaler and then sell it (without processing) to final consumers (in the remainder of the paper the terms “wholesaler”, “manufacturer” and “upstream firm” are used interchangeably). 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 (in the remainder of the paper the terms “retailer”, “supermarket”, “store” and “downstream firm” are used interchangeably). For tractability purposes we focus on duopoly competition downstream, namely there is one conventional retailer (i.e. with no buyer market power) and the other with buyer market power (e.g. Wal-Mart).⁵ Buyer market power is measured by a discount rate negotiated between the manufacturer and the retailer, and assumed to be exogenous in our model. As opposed to earlier work, a key component of our model is that it allows 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 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) obtained by the retailer: as the discount gets larger, the large retailer has a higher incentive to lower prices

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”.

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 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 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 market 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.

An issue related to our work that has been analyzed conceptually is whether increased buyer market power by a downstream firm that counteracts seller market power upstream 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 market 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.

The buyer market power literature has investigated a variety of other issues that are beyond the scope of this paper. 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 market power; the authors focus on the increased concentration of the retail sector in Europe and discuss the implications that the resulting buyer market power by retailers can have for several competition and policy issues. Snyder, on the other hand, provides a concise overview of theoretical work.

3. Model

We adopt a three-stage game: in stage 1, retailers select the level of service (quality) to provide. In stage 2, the wholesale price to each retailer is determined either through a manufacturer's take-it-or-leave-it offer if the retailer has no buyer market power or through bargaining between the manufacturer and retailer. As a result, the wholesale price depends on the degree of the retailer's buyer market power. In stage 3, retailers compete and simultaneously set retail prices to consumers.

3.1 Setup

In this section we model the wholesaler-retailer relationship where retailers buy a product from a wholesaler and sell it to consumers. Consider one manufacturer with (seller) market power 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.⁶ 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

⁶ Low- (high-) quality product refers to a good purchased at a retailer with low- (high-) quality shopping experience as mentioned previously. By shopping experience we mean product display, store lighting, the presence of deli, bakery, and butcher shop, etc.

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. As a result, the demands for the low- and high-quality products are:

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

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

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 market power or through bargaining between the manufacturer and retailer. In stage 3, retailers simultaneously set p_H and p_L . The subgame perfect equilibrium is solved by backward induction.

In this model, Wal-Mart (i.e. the large retailer) has buyer market 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.⁷ 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 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 1.⁸ Substituting the demand and cost expressions into the profit functions, we have

$$\pi_H = (p_H - w) \left[1 - \frac{p_H - p_L}{k_H - k_L} \right] - \frac{(k_H - 1)^3}{3},$$

$$\pi_L = (p_L - (1-\gamma)w) \left[\frac{p_H k_L - p_L k_H}{k_L (k_H - k_L)} \right] - \frac{c_L (k_L - 1)^3}{3}.$$

⁷ 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.

⁸ 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.

Taking the first-order condition on price for each retailer and solving for the retail prices we obtain

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

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

$$D_H(w, k_H, k_L; \gamma) = \frac{2k_H(k_H - k_L) - w(k_H + \gamma k_H - k_L)}{(k_H - k_L)(4k_H - k_L)},$$

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

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:

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

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 given by $w(k_H, k_L; \gamma)$,

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

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

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

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

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.

By solving equations (4) and (5), we can see 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 rate γ , which is the measure of buyer market power. Therefore, varying γ from 0 (a conventional supermarket with no bargaining power) to a positive number (Wal-Mart has a superior bargaining position against a manufacturer) allows us to evaluate the effect of buyer market 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 rate γ from 0 to 1 by 0.1 increments. For comparison purposes, we also consider the case in which there is only a conventional retailer in the market (next section, 3.2); we call this “base case 1” (B1). Section 3.3 discusses the two-retailer case with $\gamma = 0$, which is labeled as “base case 2” (B2). The two-retailer case with $\gamma \in [0.1, 1]$ is discussed in section 3.4; we label this the “Wal-Mart” case (WM). Table 1 shows the corresponding results of B1 (2nd row), B2 (4th row) and WM (5th 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:

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

where the subscript $B1$ stands for “base case 1” (in parentheses for manufacturer’s profits) and the coefficient of quality improvement cost (c) is assumed to be 1. The corresponding equilibrium is given by:

$$\begin{aligned}k_{B1} &= \frac{5}{4}, \quad w = \frac{k_{B1}}{2} = \frac{5}{8}, \quad p_{B1} = \frac{k_{B1} + w}{2} = \frac{3k_{B1}}{4} = \frac{15}{16}, \\ \theta_{B1} &= \frac{p_{B1}}{k_{B1}} = \frac{3}{4}, \quad D_{B1} = 1 - \theta_{B1} = \frac{1}{4}, \quad \pi_{B1} = \frac{7}{96}, \quad \pi_{M(B1)} = \frac{5}{32}.\end{aligned}$$

The second row of Table 1 displays these results. As it can be seen, quality is above the minimum level ($k_{B1}=1.25 > k_0=1$)⁹, 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) with most of firms’ surplus going to the manufacturer (0.1563 out of 0.2292).

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

⁹ Increasing quality above the minimum level is profitable for this monopolistic conventional retailer ($\pi_{B1} = 7/96$ when $k_{B1} = 5/4$ vs. $\pi_{B1} = 1/16$ 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.

with each other in a standard Bertrand fashion ($w = k^*/2 \approx p_H = p_L$).¹⁰ Since both retailers operate at the same quality level, we cannot label low- and high- quality retailers, 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. While profits are zero for retailers under both $(k_L = 1, k_H = 1)$ and $(k_L > 1, k_H > 1)$, the wholesaler and consumers benefit from this quality improvement. Specifically, when $k_L = k_H = 1.0004$ (instead of $k_L = k_H = 1$) wholesaler's profits are 0.2501 instead of 0.25 and consumer surplus is 0.1251 instead 0.125.

Comparing B2 with B1, we find that the quality level as well as 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. One can think of this result as an analogue to the standard double marginalization problem (without quality competition): a lower degree of market power in a stage of the supply chain (in this case the retail level) reduces the double marginalization problem thereby increasing overall profits and consumer surplus. This comparison suggests that the entry of a conventional retailer to a market

¹⁰ 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.

currently being served by a similar (conventional) store will trigger intense price competition (and virtually no quality competition) thereby unambiguously benefiting consumers.

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

In this case, one of the retailers in the B2 case above is replaced by a retailer that has access to a positive discount $\gamma > 0$ (e.g., Wal-Mart). In Table 1 (rows 5 through 14) we report results for $\gamma \in [0.1, 1]$ in 0.1 intervals.¹¹ 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 rate obtained from the wholesaler is small ($\gamma = 0.1$), compared to B2, Wal-Mart has an incentive to increase its quality ($k_L = 1.0441 > 1.0004$) and to charge higher prices ($p_L = 0.5823 > 0.5002$). As the discount rate 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 rate (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. Intuitively, 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 its profitability by increasing its quality level.

¹¹ 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 results. Section 3.5 analyzes the reasonable discount range that Wal-Mart is likely to have and discusses the results for that range.

All prices (wholesale, w , as well as retail, p_L and p_H) exhibit a non-monotonic relationship with the discount rate γ (see Figure 3). The initial price increases are due to the initial 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 larger discount rates are achieved prices tend to fall because: a) the quality levels offered by firms tends to drop (Figure 2)¹², 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. This can be seen in Figure 3: $p_L < w$, which implies that 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 market 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 .

Market demand is $D_L + D_H = 1 - \theta_L$ and increasing in the discount rate when $\gamma \in [0.2, 1]$ (Figure 5).¹³ However it is not until $\gamma = 0.4$ that more consumers join the market (compared to B2). 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 sufficiently

¹² 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.

¹³ Note that when $\gamma \in [0.1, 0.2]$, θ_L increases initially in γ , due to Wal-Mart's quality improvement.

high discount rate from the supplier. Accordingly, it is not until $\gamma = 0.4$ that the low-quality retailer sells more than the high-quality retailer.

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 (and, of course, always larger than in B1). Initially (for $\gamma \in [0.1, 0.2]$), low-quality purchasers do not gain much from the discount Wal-Mart gets, but as γ grows many new consumers (those below $\theta = 0.5$) as well as some “old” high-quality consumers start enjoying the lower prices. 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).

In terms of profits, the manufacturer prefers a relatively low discount rate, i.e. in the [0.1, 0.4] range, relative to B2 (see Figure 7). The intuition for this result is that it is in this range where product differentiation is maximal (see Figure 2) and therefore more profitable for a monopolistic manufacturer to engage in price discrimination. 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 rate as it enjoys higher prices (Figure 3) as well as larger demand (Figure 5).

Comparing profits with B2, a manufacturer prefers competition between quality differentiated retailers (WM) as long as the discount is not too large (i.e. when it can profitably engage in price discrimination). However, it may actually prefer double marginalization (B1) if the discount rate is too large. 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 the B1.

From a social planner point of view, the optimal discount rate 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 rate 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 Rate for Wal-Mart

In the previous section, we present how the discount rate 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 as a compensation for shelf space (Klein and Wright, 2007).¹⁴ We use this differential treatment in slotting allowances to obtain a rough estimate of the plausible discount Wal-Mart can get from manufacturers.

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

¹⁴ 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."

than S , i.e., $\gamma w D_L \geq S$.¹⁵ 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).¹⁶ 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 rate above 0.4 as 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 slotting allowances are typically greater. Using this reasoning, we assume 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 price discrimination (Figure 3). Third,

¹⁵ 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.

¹⁶ Not incorporating the 443% for ice cream for retailer 7 division 2.

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 price discrimination while quality differentiation (and the resulting softening of competition) pushes retail prices up (except for p_L when $\gamma = 0.4$). That is, Wal-Mart's lower price in the case of replacing an existing supermarket occurs as long as the discount rate is relatively large ($\gamma = 0.4$). Third, in terms of welfare, consumer surplus and producer surplus are higher 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 rate 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).¹⁷ 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's response to the raise of its quality improvement cost is more sensitive than the high-quality retailer. In the case of prohibitive quality improvement cost, i.e., $c_L \rightarrow \infty$, 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.

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 market power and quality differentiation. Motivated by Wal-Mart's increasingly pivotal role in food the retail industry, we study the effects of a large retail chain's buyer market 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 overly simplistic representation of the industry, our model does a remarkable job at predicting several observed patterns.

The occurrence of quality differentiation in our model is quite robust (i.e., for any discount rate and different assumptions). This is consistent with McWilliams (2007) and Volpe and Lavoie (2008) who highlight how competitive pressure from Wal-Mart has driven traditional

¹⁷ 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.

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) who 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 market 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.¹⁸ Further, consumers’ gain is unevenly distributed, with the more high-quality concerned consumers earning a larger share of the gain.

While not explicitly modeled, our framework captures the essence of other variants. A wholesaler-retailer relationship can be more efficient in the presence of a large, sophisticated retailer. For example, Wal-Mart’s size can guarantee economies of scale in shipping. Also, recent technology innovations (such as radio frequency identification) that can be implemented in large and stable wholesaler-retailer relations can reduce inventory management costs.

¹⁸ We should interpret this result with caution as it may be specific to our assumption of a monopolistic upstream market structure.

Theoretically, a more (or less) cost-effective supply chain relationship will be captured by our model by appropriately modifying the discount factor.

There are some caveats, however. Our comparison of price effects between B2 and WM indicates that when Wal-Mart replaces a conventional retailer, the price decreases for large discount values ($\gamma \geq 0.4$), which might 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.” Also, 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. Our model considers a monopoly upstream, but with several sellers of a differentiated good upstream (e.g. some large, some small) buyer market power can foreclose smaller competitors thereby reducing varieties for the end consumers.

As consolidation of retailers continues to increase, so does their seller market power. A valid concern is that the welfare loss due to the consolidation may dominate the gains associated with buyer market power. Although our model focuses on concentrated retail markets (with 1 or 2 firms), it indirectly addresses this concern. Since 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 market power gains outweigh the potential losses due to seller market power.

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 (as noted above), our generally positive assessment of buyer market power suggests that the antitrust authorities' view (as depicted in the statement above) may need to be carefully rethought.

Finally, several extensions to our model may be worth exploring. Our assumption of an exogenous discount rate can be relaxed by exploring the optimal discount rate between the wholesaler and the large retailer using a Nash bargaining approach. Alternatively, discounts can be endogenously determined by allowing the upstream market structure to be non-monopolistic (as in Snyder, 1996). Finally, in many rural areas of the U.S. there was no retailer before Wal-Mart came into town. A natural extension can study entry deterrence strategies by Wal-Mart.

References

Basker, E., 2007. "The Causes and Consequences of Wal-Mart's Growth." *Journal of Economic Perspectives*, 21(3):177-198.

Basker, E. and M. Noel. 2009. "The Evolving Food Chain: Competitive Effects of Wal-Mart's Entry into the Supermarket Industry," *Journal of Economics and Management Strategy*, 18(4): 977-1009.

Bonanno, A. and R. A. Lopez, 2009. "Competition Effects of Supermarket Services." *American Journal of Agricultural Economics*, 91(3):555-68.

Brekke, K.R. and O.R. Straume, 2004. "Bilateral Monopolies and Location Choice." *Regional Science and Urban Economics*, 34:275-288.

Chen, Z., 2003. "Dominant Retailers and the Countervailing-Power Hypothesis." *Rand Journal of Economics*, 34:612-625.

Dobson, P. and M. Waterson, 1997. "Countervailing Power and Consumer Prices." *Economic Journal*, 107:418-430.

Dobson, P., R. Clarke, S. Davies and M. Waterson, 2001. "Buyer Power and its Impact on Competition in the Food Retail Distribution Sector of the European Union." *Journal of Industry, Competition and Trade*, 1(3):247-281.

Economic Research Service, USDA, 2000. *Agricultural Outlook*, December. Available at <http://www.ers.usda.gov/publications/agoutlook/aug2000/ao273g.pdf>.

Economic Research Service, USDA, 2007, Briefing Room, Food Retailing, <http://www.ers.usda.gov/Briefing/FoodMarketingSystem/FoodRetailing.htm>, accessed August 18, 2009

Erutku, C., 2005. "Buying Power and Strategic Interactions." *Canadian Journal of Economics*, 38(4):1160-1172.

Federal Trade Commission, 2003. "Slotting Allowances in the Retail Grocery Industry: Selected Case Studies in Five Product Categories." Available at <http://www.ftc.gov/os/2003/11/slottingallowancerpt031114.pdf>.

Gregory, S., 2009. "Walmart's Latest Move to Crush the Competition." *Time*, Sep. 09, 2009. Available at <http://www.time.com/time/business/article/0,8599,1920698,00.html>

Hausman, J. and E. Leibtag, 2007. "Consumer Benefits from Increased Competition in Shopping Outlets: Measuring the Effect of Wal-Mart." *Journal of Applied Econometrics*, 22(7):1157-1177.

Hopkins, J., 2003. "Wal-Mart's Influence Grows." *USA TODAY*, available at: http://www.usatoday.com/money/industries/retail/2003-01-28-walmartnation_x.htm, accessed on April 10, 2009.

Klein, B. and J. D. Wright, 2007. "The Economics of Slotting Contracts." *Journal of Law and Economics*, 50(3):421-54.

McWilliams, G., 2007. "Grocers take bite out of Wal-Mart." *The Wall Street Journal*, June 9.

Mussa, M. and S. Rosen, 1978. "Monopoly and Product Quality." *Journal of Economic Theory*, 18:301-317.

Schulz, D. P., 2009. "The Nation's Retail Power Players 2008." *Stores Magazine*, July 2009. Available at: http://www.stores.org/Current_Issue/2009/07/cover.asp.

Seiz, K., 2005. "Wal-Mart: What do bakers really think?" *Baking Management*. Available at http://baking-management.com/news/bm_imp_8082/.

Snyder, C., 1996. "A dynamic theory of countervailing power." *Rand Journal of Economics*, 27(4): 747-769.

Snyder, C. 2008. "Countervailing Power," in Steven. N. Durlauf and Lawrence E. Blume, eds., *The New Palgrave Dictionary of Economics*, 2nd edition, Palgrave Macmillan.

Volpe, R.J. III and N. Lavoie, 2008. "The Effect of Wal-Mart Supercenters on Grocery Prices in New England." *Review of Agricultural Economics*, 30(1):4-26.

von Ungern-Sternberg, T., 1996. "Countervailing power revisited." *International Journal of Industrial Organization*, 14: 507-520.

Walton, S. R., 2005. "Wal-Mart, Supplier-Partners, and the Buyer Power Issue." *Antitrust Law Journal*, 72:509-27.

Wilke, J., 2004. "Bully Buyers: How Driving Prices Lower Can Violate Antitrust Statutes; 'Monopsony' Suits Mount As Companies Are Accused Of Squeezing Suppliers; Farmers vs. Cigarette Makers," *The Wall Street Journal*, January 27.

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 | | | |
| $B2^{**}$ | 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 market 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 | $\frac{\gamma w}{p_L} \times 100\%$ |
|----------|-------------------------------------|
| 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 |
| $B2$ | 0.0000 | 1.0000 | 1.0000 | 0.2500 | 0.2500 | 0.2500 | 0.5000 | 0.5000 | 0.2500 | 0.2500 | 0.0625 | 0.0625 |
| 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 |
| | 0.2000 | 1.0000 | 1.3037 | 0.3213 | 0.2713 | 0.3722 | 0.5425 | 0.6647 | 0.1222 | 0.3353 | 0.0075 | 0.1143 |
| | 0.3000 | 1.0000 | 1.2534 | 0.3165 | 0.2488 | 0.3460 | 0.4975 | 0.7671 | 0.2696 | 0.2329 | 0.0363 | 0.0968 |

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

| c_L | $\gamma = 0.1$ | |
|----------|----------------|--------|
| | 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.

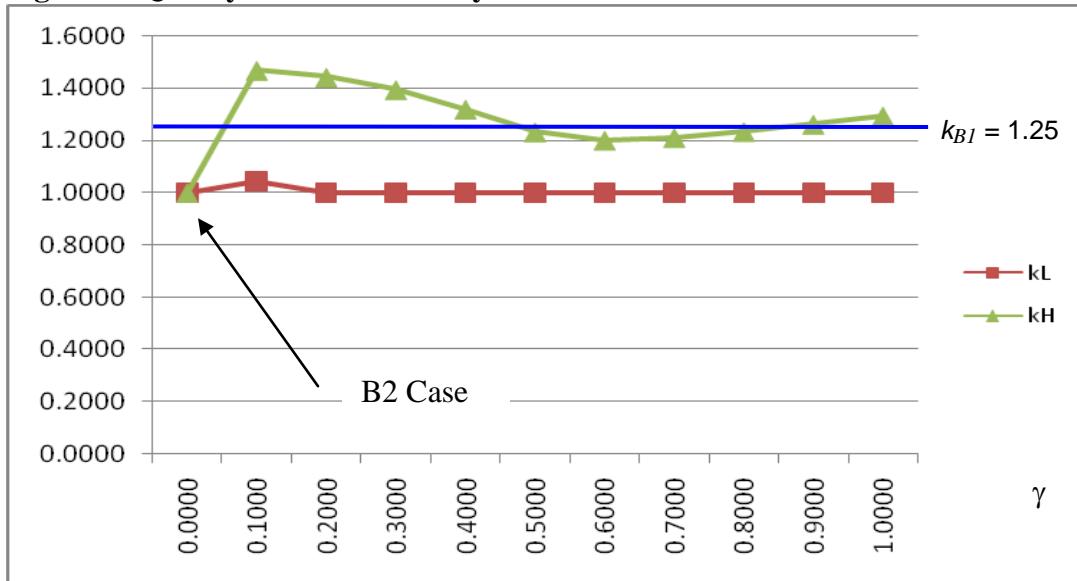
Figure 1: Payoff Matrix for Two Conventional Retailers When $\gamma = 0$, B2 case

| | | 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;

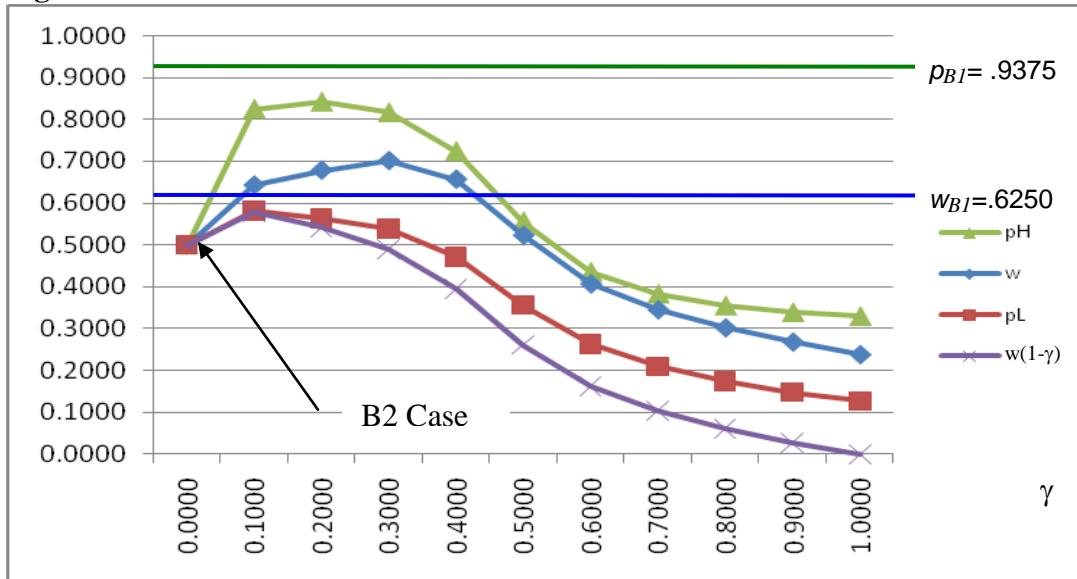
k_{B1} : retail quality level in the B1 case.

B1 case: only one conventional retailer in the market (i.e. with no buyer market 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 $(1-\gamma) w$: wholesale price for high-quality retailer and discounted wholesale price for low-quality retailer, respectively;

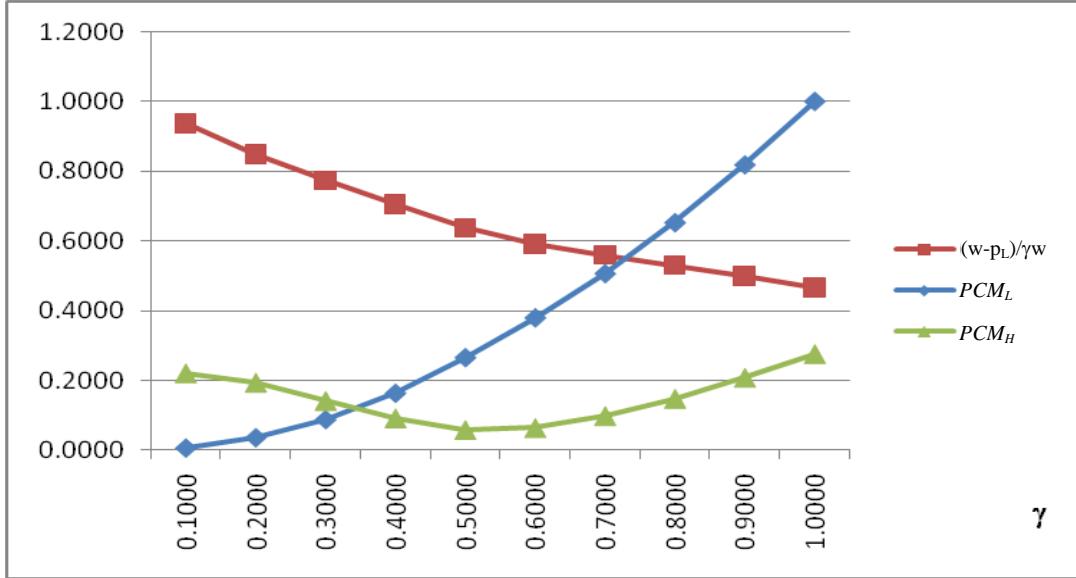
p_{B1} and w_{B1} : retail and wholesale prices, respectively, in the B1 case.

B1 case: only one conventional retailer in the market (i.e. with no buyer market 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 rate offered to the low-quality retailer.

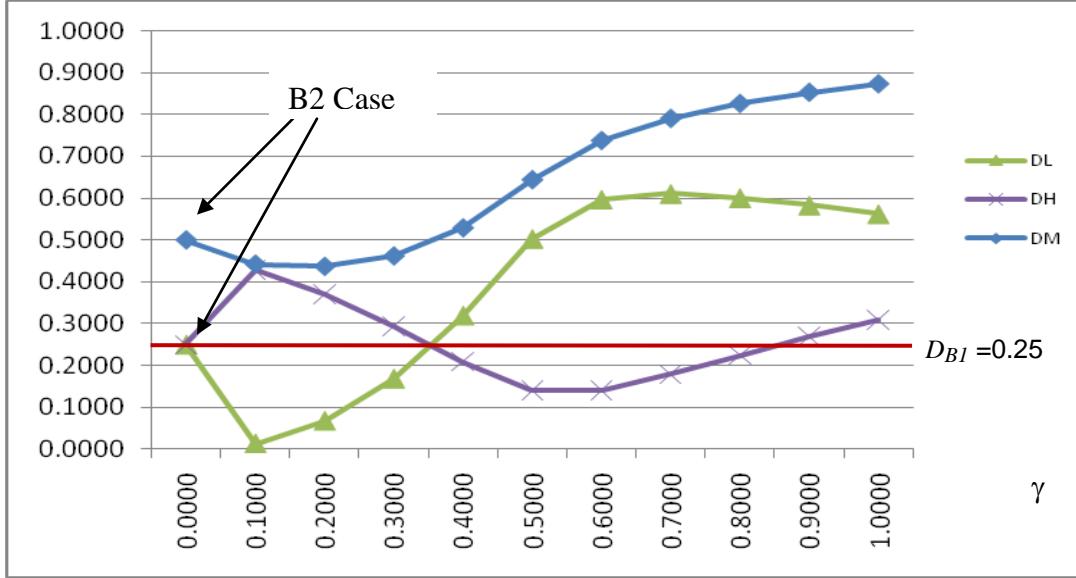
$PCM_L = (p_L - (1-\gamma)w)/p_L$: price-cost margin for the low-quality retailer.

$PCM_H = (p_H - w)/p_H$: 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



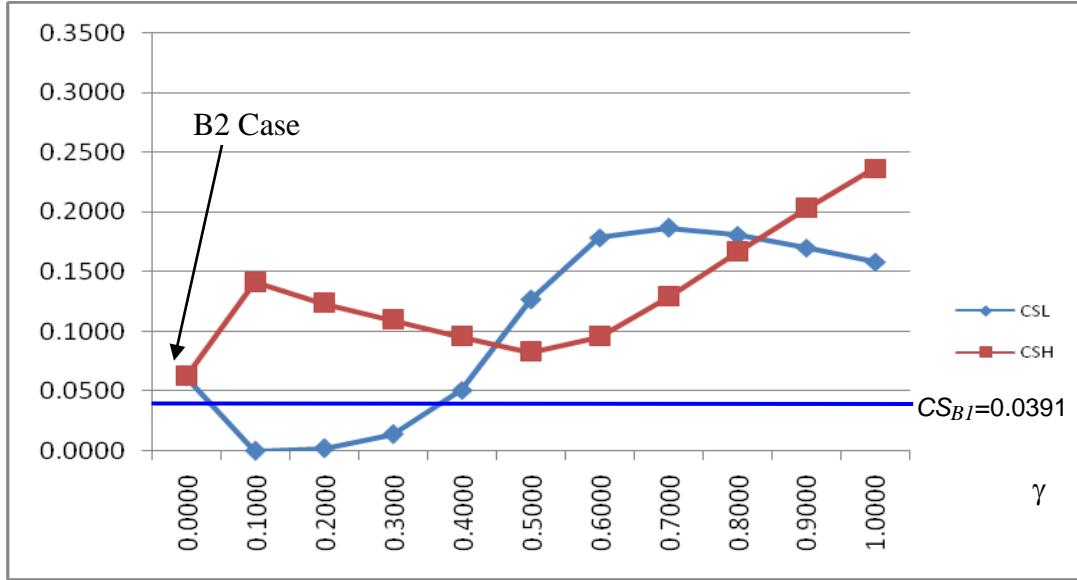
Note: High-quality demand: $D_H = 1 - \theta_H$; Low-quality demand: $D_L = \theta_H - \theta_L$;

Market Demand: $D_M = 1 - \theta_L$; demand in the B1 case: $D_{BI} = 1 - \theta_{BI}$.

B1 case: only one conventional retailer in the market (i.e. with no buyer market 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;

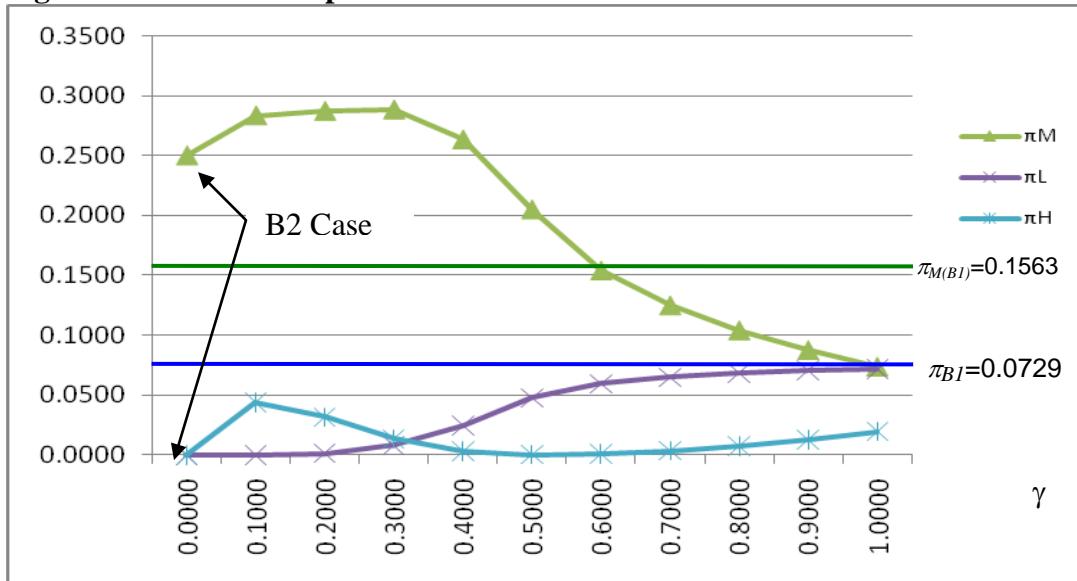
CS_{B1} : consumer surplus in the B1 case

B1 case: only one conventional retailer in the market (i.e. with no buyer market 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;

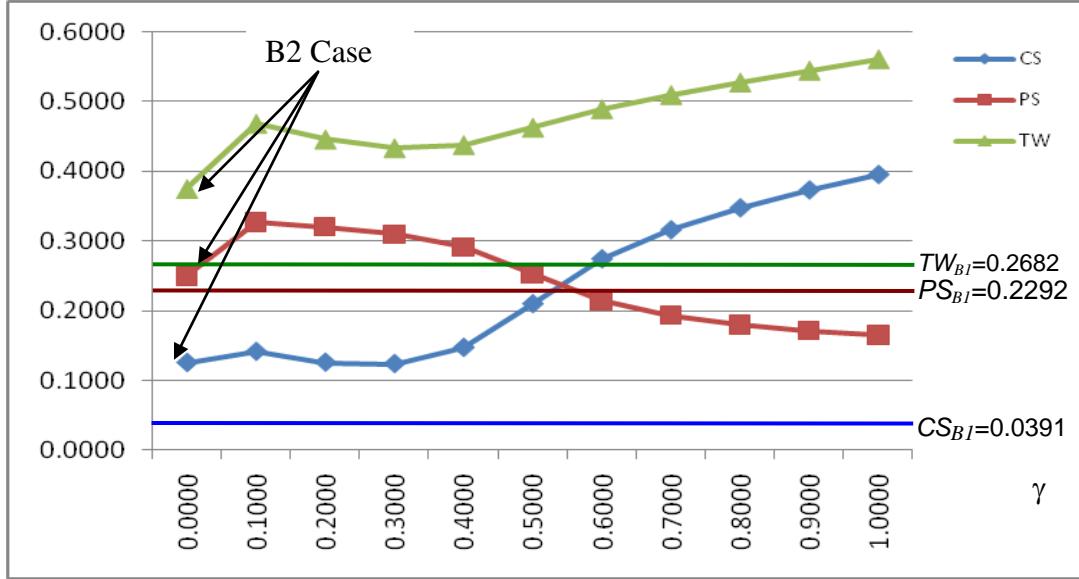
$\pi_{M(B1)}$ and π_{B1} : profits for wholesaler and retailer, respectively, in the B1 case.

B1 case: only one conventional retailer in the market (i.e. with no buyer market 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 $TW = CS + PS$.

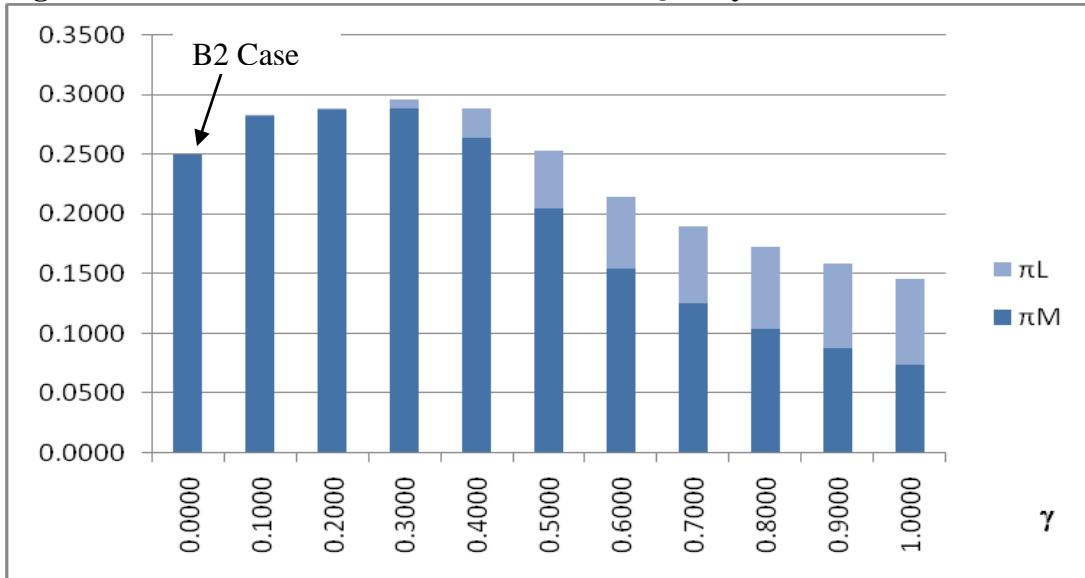
CS_{B1} , PS_{B1} , and TW_{B1} : consumer surplus, producer surplus, and total welfare, respectively, in the B1 case.

B1 case: only one conventional retailer in the market (i.e. with no buyer market 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).