Production Arrangements and Strategic Brand Level Competition

in a Vertically Linked Market

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ABSTRACT

This paper develops and tests different theoretical models of competition in a vertically linked market assuming different production arrangements for retailer private label brands (PL). We then empirical estimate retailer manufacturer competitive behavior based on best-fit games and determine the impact of PL production arrangements on pricing strategies for PLs and NBs.

Retailers are using different production arrangements to produce PL products. In fact, a retailer may own a production facility, a national brand manufacturer (NB) produces the PL product exclusively for the retailer or the retailer outsources PL production to a non-NB manufacturer. These possible, different production arrangements can have significant implications for the competitive interactions and market outcomes between retailers and NB manufacturers. Existing economic literature has identified a significant degree of variation in the type of competitive interactions across grocery product categories. However, the majority empirical studies in IO have typically imposed assumptions about the nature of vertical production arrangement without formally and explicitly investigating the nature of PL-NB competitive interaction under different production arrangements.

The analysis builds on the Non-Nested Model Comparison (NNMC) approach and employs weekly store-level retail scanner data, for a major North American retail chain. The findings from different theoretical models and their empirical application reveal that no consistent pattern of competitive interactions exists between PLs and NBs across different food product categories. Competitive patterns and outcomes vary depending on the nature of the PL production arrangement. Our study contributes to the IO literature by being the first to consistently derive and estimate the impact of PL production arrangement on brand-level competition.

Keywords: Competition, Bertrand Nash, Stackelberg leader follower, Non-Nested Model Comparison, Canadian retail level, Private label, National brand, Production arrangements

INTRODUCTION

For the last several decades, manufacturers have been the main producers of branded consumer packaged products. This leadership position has eroded over time as major grocery retail chains have introduced their own branded product lines - private label (PL) brands (Wu and Wang 2005; Kumar and Steenkamp 2007). PL products have shown significant increase in market across retail market, and in 1998 they were among the top three brands in 70 percent of all retail product categories (Wu and Wang 2005). In Canada, PL retail sales were $ 11.4 billion, roughly 25% market share in 2010 (Nielsen 2010). The rapid growth of retail brands (PLs) has created new and stiff competition for many established NB manufacturers, as retailers have been found to use PLs as strategic bargaining weapons in negotiations with NB producers (Gomez and Benito 2008). Moreover, Berges and Bouamra-Mechemache (2011) among others show that the introduction of a PL product affects both the horizontal and vertical competitive relationship between PLS and NBs.

Retailers are using three different production arrangements for PL products (Berges-Sennou 2006). Some own the production facility to gain more control on the production; in this regard, Doug Rauch, president of Trader Joe's (which carries about 80 percent PL products), said "we could put our destiny in our own hands" (Kumar and Steenkamp 2007). In 2011, one major retail chain in Canada owned about 14 percent of total sales production facilities (Safeway 2011). Retailers also outsource PL products from local markets. Kumar and Steenkamp (2007) stated that thousands of firms focus exclusively to produce PL products. Also, NB manufacturers produce PL products for retailers. For instance, Chen et al. (2010) reported that more than 50 percent of PL products are being supplied by the NB manufacturers. These different production arrangements (retailer owns the production facility for PL products, retailer outsources PL products, NB manufacturer produces PL products) raise concerns for retailers, NB manufacturers and policy makers regarding competitive behavior.

In a vertically linked market, the strategic competition between PLs and NBs is mutually dependent and the choice of marketing instruments is affected by the rival's competitive behavior under different production arrangements. The production arrangement assumptions of PL brand are critically important to the retailer's and manufacturer's optimal competitive strategy. Therefore, to understand the effect of the marketing mix on the profit of the producer (retailer/NB manufacturer), we need to understand the competitive interaction between a retailer and NB manufacturer under different production arrangements.

To assess the effectiveness of different marketing instruments (price and promotion), it is important to know the underlying production arrangements and competitive interactions between NB and PL. Previous economic studies empirically analyzed competition between NB and PL. These studies have typically made assumptions about underlying production arrangements and competitive interaction between PL and NB, but in reality the competitive interaction may differ for different product categories and under alternative PL production arrangements. So the wrong assumptions regarding PL and NB competitive interaction may result in false conclusions. It is important to determine the type of competitive interaction between PL and NB under different PL production arrangements instead of assuming a particular type of competitive interaction.

Based on the literature review conducted in this subject area, there is no study that tested the nature of competitive interactions under different production arrangements. Thus, the main objective of this study is to see the type of competition between PL and NB in a vertically linked market when there are different PL production arrangements. We extend the theoretical model of competition, assuming different production arrangements of PL products. Furthermore, we estimate the model empirically by using Canadian retail data and identifying the competitive interaction between PL and NB that actually exists in the market. The empirical analysis helps us to identify how NB and PL prices influence the demand for these products in the Canadian context. In this regard, we use retail scanner data for the period 2004 to 2007. The dataset contains retail sales information (price, applicable discount, sales quantity, retail margin) for 200 Universal Product Code (UPC) product categories available at a major North American retail chain with stores in Canada.

The fast growth of PLs plays an important role in both intra- and inter-store retail competitions. As PL products are often less expensive than their NB substitutes, they often produce higher retail margins, making PL products an important source of retailer revenue and profit (Hoch and Banerji 1993). There is sufficient evidence that availability/introduction of PL reduces or avoids double marginalization problem which has positive impact on the social welfare (Berges-Sennou et al. 2004). Mills (1995) argues that a retailer gains from PL marketing at the expense of decrease in sales of NB and the retailer's gain exceeds the NB loss. Retailers are using PL marketing as an instrument to overcome the problem of double marginalization. The net effect of PL marketing results in an improvement in the performance of distribution channel. Narasimhan and Wilcox (1998) found that PL products are often used as strategic weapons by retail chains in their competition against NB food manufacturers. To date, evidence from the economic literature suggests that retailers may be effectively using PL brand lines to exert market power against many NB manufacturers (Narasimhan and Wilcox 1998; Sayman, et al. 2002; Meza and Sudhir 2010). The complex nature of the competitive interactions between PLs and NBs has become a concern (to set the price of NB and PL, to increase profit, share etc.) not only to marketing managers in food industries, but also economists and policy makers responsible for competition policy and fair practices along vertical food marketing channels (Cotterill et al. 2000).

Volpe (2010) and other researchers (Corstjens and Lal 2000; Cotterill and Putsis 2000) note that increasing levels of product quality have significantly contributed to the penetration of PLs in many retail product categories. The quality of PLs is also documented by a large number of publications in the retail press (e.g., Progressive Grocer) that show a rise in PL popularity and retailer efforts to promote higher quality PLs to consumers in order to maximize sales and increase category market shares. The shift to and focus on PL quality over time has intensified brand competition (Volpe 2010). Behind this development stands the observation that consumers in many markets, including Canada, increasingly recognize the quality of PL products and have developed preferences for many PL brand lines (e.g. Loblaws' President's Choice). New and increasingly differentiated PL product lines are used to attract additional consumer demand and, therefore, intensify competition between PLs and NBs. Several large retail chains have developed differentiated PL "good for you" product lines and labeling schemes around their healthy product options. For example, Canadian Loblaws developed "President's Choice Blue Menu" and Safeway developed "Eating Right" healthy product lines. These healthy product lines focus on reducing or removing unfavourable ingredients (e.g., fat, sodium, sugar, salt, etc.) (Anders and Moeser 2010). In the present study, regular and vertically differentiated bacon (low salt bacon) products are considered to see how the competitive interaction varies between NB and PL.

The remainder of this paper is divided into five sections. The first reviews the economic literature, the second deals with the model development, the third and fourth are concerned with the data issues and empirical estimation respectively, and the last discusses the study's conclusions.

REVIEW OF LITERATURE

Very few studies in economic literature discuss different issues relating to the production of store brands (Quelch and Harding 1996; Verhoef et al. 2002; Berges-Sennou 2006; Berges and Bouamra-Mechemache 2011). Verhoef et al. (2002) and Wu and Wang (2005) discuss advantages and disadvantages to the NB manufacturer producing PL products. Verhoef et al. (2002) identified various factors (e.g., brand strength, image, product variety, ability to create technological product differentiation) that NB manufacturers consider before taking on PL production. The study concludes that NB manufacturers do not directly compete with PL by reducing the price of the product; rather, they mainly focus on increasing the distance from PL products.

Berges and Bouamra-Mechemache (2011) studied various factors affecting the PL production process. The study shows that if production cost is low, the retailer prefers to buy its product from independent firms, and if production cost is high then it is beneficial for the retailer to get its products from NB manufacturers. The study also observes that when the NB manufacturer's bargaining power goes up, there are fewer chances for the retailer to buy PL products from the NB manufacturer. The authors further conclude that if the quality of the NB is low or high then the retailer prefers to sell only PL, while for intermediate quality it is beneficial for the retailer to sell both NB and PL. Berges-Sennou (2006) studied the impact of different production arrangements of PLs on the retailer's bargaining and customer loyalty. The results of the study indicate that the retailer entrusts the NB manufacturer when either the retailer has lower bargaining power or numerous consumers are loyal to the NB. The author further explains this behavior as if consumers are loyal to the NB and the PL is less attractive to the consumers; then, there are more chances for the retailer to assign PL production to the NB manufacturers. If the consumers are less loyal to the NB and the retailer has stronger bargaining power, there is a greater chance that the retailer will buy the PL product from the competitive market.

A number of economic studies assume a particular production arrangement (Narasimhan and Wilcox 1998; Raju et al. 1995; Wu and Wang 2005; Karray and Herran 2009). For example, Narasimhan and Wilcox (1998) and Raju et al. (1995) assume that retailers outsource PL products. Raju et al. (1995) further assume that retailers buy PL products at a fixed per unit price. They conclude that introducing PLs in a product category with a large number of competing NBs would increase the retailer's profit in the respective product category. Narasimhan and Wilcox (1998) show that the penetration of PL products across categories is associated with overall higher margins for the retailers. Wu and Wang (2005) assume the NB manufacturer produces both NB and PL products. They discuss the economic benefits for the NB manufacturer to produce PL products. For this purpose, they develop a theoretical model that considers the interaction of two NBs and one store brand. The study concludes that if the NB manufacturer supplies PL products to the retailer, it benefits the NB manufacturer as it decreases its promotional expenditures. Karray and Herran (2009) assume that the retailer owns the production facility for PL products. They analyze the impact of advertising on product sales over time. The authors conclude that the effect of advertising on brand sales depends on whether the manufacturer and retailer's advertising are competitive or complementary in nature. In the case of competitive advertising from the manufacturer, the advertising expenditure has a negative relationship with the retail price of both NB and PL brands.

A significant amount of literature exists on the question of how PL products are competing with NBs at the retail level. A number of studies have assumed a particular competitive behavior (Stackelberg leader follower) and developed theoretical models (Raju et al. 1995; Narasimhan and Wilcox 1998; Wu and Wang 2005; Karray and Herran 2009; Meza and Sudhir 2010). Most of the studies conclude that introducing PL products benefits retailers. Some studies, however, focus explicitly on testing different game specifications assuming a particular production arrangement on the dataset (Putsis and Dhar 1998; and Cotterill and Putsis 2001). These studies conclude that the nature of games played differs across product categories. Putsis and Dhar (1998) use the conjectural variation approach and test the presence of leader follower games between PLs and NBs. The study shows that the most common behavior is that NB behaves as a leader, while for some product categories (milk, frozen vegetables and fresh bread), the PL behaves as the leader. Cotterill and Putsis (2001) apply a non-nested model comparison approach on US data. The study assumes that retailers outsource their products from the manufacturer. The results show that vertical Nash is most common type of competition between the PL and NB, while only 2 out of 12 product categories show the manufacturer as a Stackelberg leader.

Previous theoretical literature either assumes a particular competitive interaction between PL and NB or tests different competitive interaction games. However, these articles do not take into account the variation in how PL products are produced. In reality, retailers are using three different production arrangements for PL products and these arrangements have serious implications for NB retailers and manufacturers. Despite a large number of studies on the PL-NB competition in retailing, the literature has provided no insight on the nature of the PL-NB competitive relationship with varying PL production arrangements in the Canadian retail sector. The present study makes a significant contribution in filling the knowledge gap by developing theoretical models under various production arrangements of PL brands and shows how the different production arrangements of PL have an impact on both the retailer's profit and the NB manufacturer's profit. Another contribution is empirical testing of the nature and extent of pricing competition across different food product categories and between PLs and NBs in the Canadian retail market. This study also contributes to the literature by testing the nature and extent of pricing competition under various production arrangements of PL products by using retail scanner data. Finally, it helps to draw conclusions regarding pricing strategies between PLs and NBs in different product categories under different production arrangements.

MODEL DEVELOPMENT

Historically, before the introduction of PL products, manufacturers were considered to be the main producers of consumer products. Manufacturers produced and supplied branded products to retailers, who supplied these products to consumers in the marketplace (as shown in figure 1).

Figure 1: NB Manufacturer Produces Only NB and Retailer Does not has PL Product

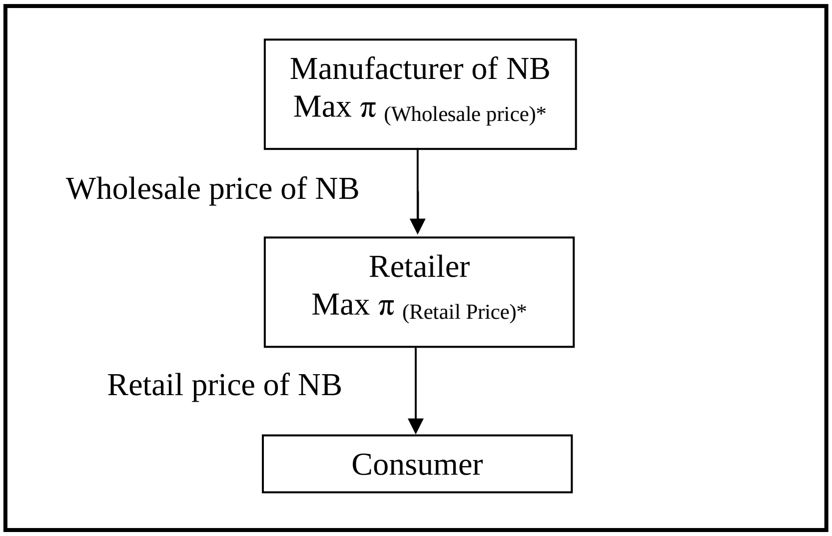


Figure 2 describes the changes in the marketing organization after PL products are introduced in the marketplace. In this case, the NB manufacturer produces PL products for the retailer (Chen et al. 2010). The manufacturer's maximizes profit not only with the production of NBs, but also with PLs. As in Figure 2, the manufacturer produces and supplies both products to the retailer and the retailer sells these products to the consumers.

Figure 2: NB Manufacturer Produces both NB and PL Products

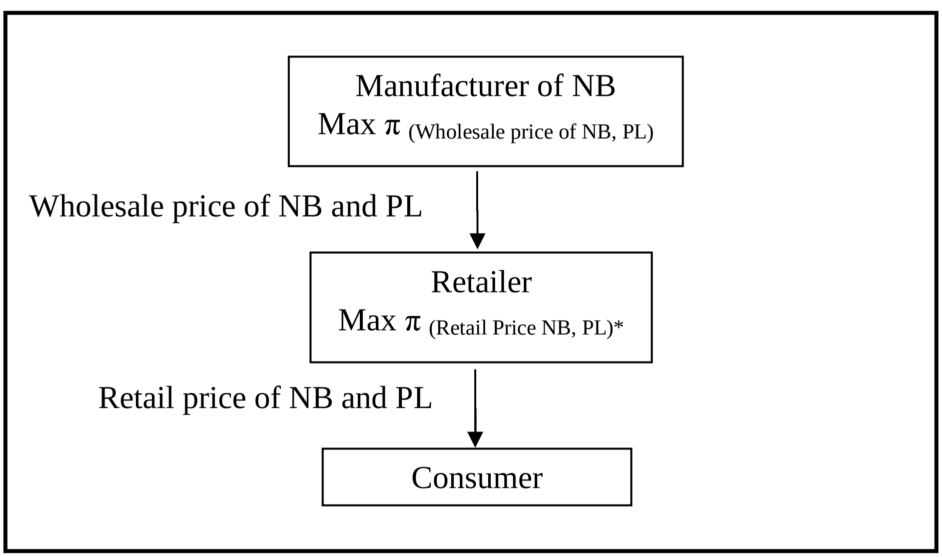
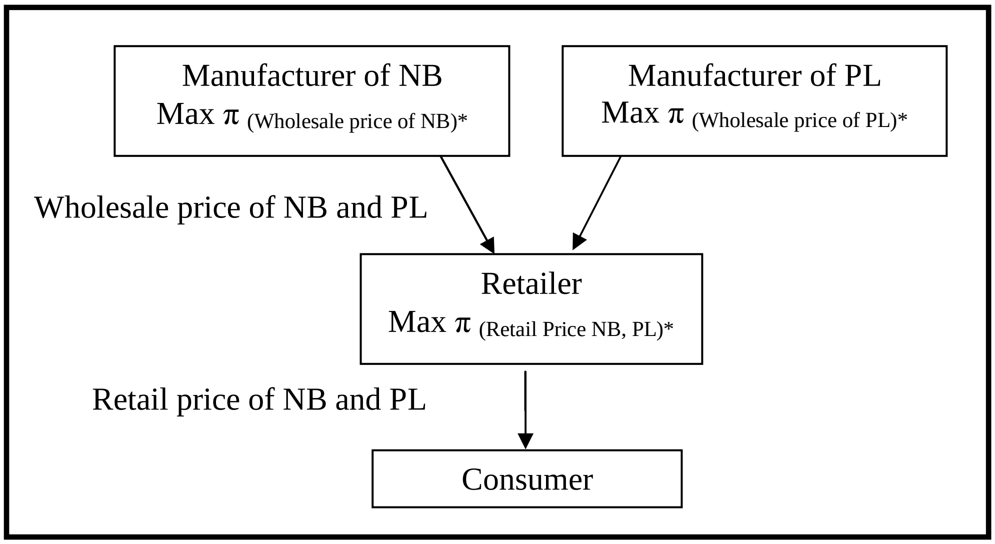


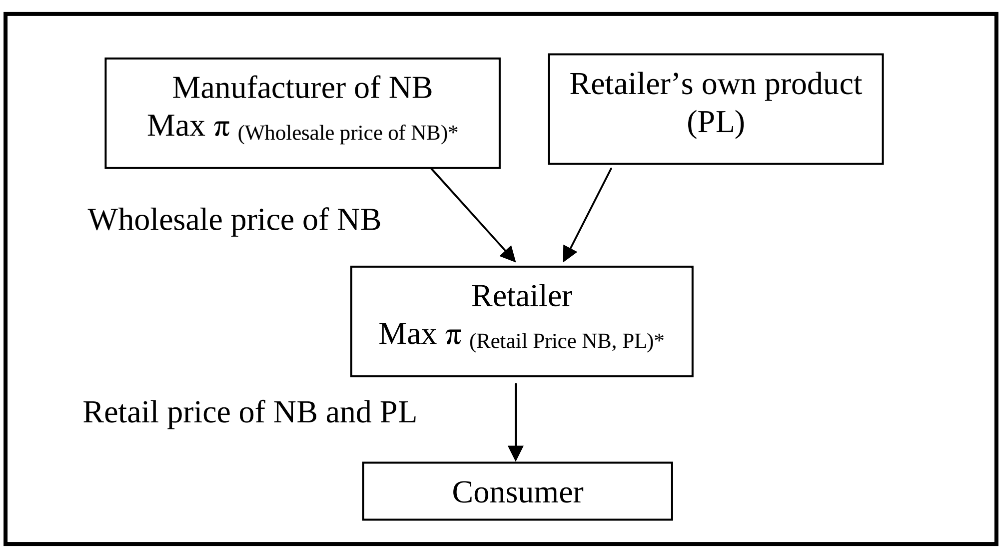
Figure 3 shows the case where the retailer outsources PL products. In this scenario, different manufacturers produce PL and NB separately and supplies the products to the retailer who sells them to the consumers.

Figure 3: Retailer Outsources PL Product and NB Manufacturer Produces NB Brand



In figure 4, we assume that the retailer owns the production facility. In this case, the retailer's function is to produce and sell PL products to the consumers, whereas the NB manufacturer also supplies its products to the retailer, who then sells both products (NB and PL) to the consumers.

Figure 4: Retailer Owns the Production Facility and NB Manufacturer Produces NB Brand



Estimation strategy

The method used in the present study is based on the new empirical industrial organization (NEIO) approach used by Cotterill and Putsis (2000). Kadiyali et al. (2001) stated that the NEIO approach is based on the development and estimation of structural, strategic, econometric models and firms' competitive behavior. This approach has three basic characteristics: demand specification (linear, logit etc.), cost specification (constant marginal cost or linear, log linear specification of cost) and the interaction of competitive behavior (Kadiyali, et al. 2001). To identify the competitive behavior, two kinds of approaches are commonly used: the conjectural variation (CV) approach and the menu approach (or Non-Nested Model Comparison (NNMC)) (Roy et al. 2006).

Iwata (1974) developed a method to measure the numerical value of CV. In this approach, each firm's strategic variable effect and its reaction can be captured using one parameter. There can, however, be severe biases in this single coefficient. There are also some problems interpreting this parameter; for example, a positive value of CV shows that there is cooperation in the market. On the other hand, CV also shows the positive value if a decrease (increase) in the price of one firm is accompanied by similar behavior in a rival firm. This price change could be the strategic response to the competitor. In other words, the positive value of CV does not show cooperative or non-cooperative behavior (Roy et al. 2006).

The NNMC approach develops alternative competitive behavior models, such as Bertrand or Stackelberg leader-follower. These strategic models are applied on the dataset and whichever model best fits the data is considered the most appropriate description of the market (Putsis and Dhar, 1998; Kadiyali et al. 2001). This approach also has certain disadvantages as it cannot be implemented if the estimation is not done simultaneously. It therefore requires large degrees of freedom and enough exogenous instruments so it is possible to identify each equation in the system (Roy et al. 2006). The other disadvantage to this approach is that as the number of firms or number of brands increases to more than two, it becomes difficult to apply, because the number of possible competitive behaviors increases very rapidly (Vilcassim et al. 1999).

Roy et al. (2006) compared different estimation approaches (e.g., CV and NNMC) and concluded that the NNMC approach performs better than the CV approach. Since the present study deals with two brands and uses retail scanner data, it is easy to use the NNMC approach to understand different competitive behaviors in a vertically linked market and to see how these behaviors impact equilibrium prices at retail and wholesale levels. The theoretical model assumes that a NB manufacturer and retailers are using price as a strategic variable. Various scenarios are explained below:

1. The NB manufacturer supplies the product to the retailer, which does not have its own product (as shown in figure 1).
2. The NB manufacturer supplies both NB and PL products to the retailer, which sells both products to the consumer (see figure 2).
3. The NB manufacturer supplies the NB to the retailer and the retailer outsources a PL product but the retailer sells both NB and PL products to the consumer (see figure 3).
4. The NB manufacturer produces only the NB product and supplies it to the retailer, while retailer owns the PL production facility. Furthermore, the retailer sells both NB and PL products to the consumer (as shown in figure 4).

Case 1: Only One NB Product and No PL

In this case, we assume that only one NB product is available in the market and the retailer's role is to sell it to the final consumer. Our interest in describing this case is to compare the prices and profits for the retailer and NB manufacturer with other cases where NB and PL brands exist simultaneously. This comparison also helps us to understand whether there is a change in the pricing behavior among different competitive models when both brands are available in the market.

In this scenario, the NB manufacturer maximizes profit by setting the wholesale price, and the retailer maximizes by setting the retail price of the NB. We derive the first order conditions under various equilibrium interactions (Stackelberg leader follower and Bertrand) in a vertically linked market between the NB manufacturer and the retailer. Bertrand competitive behavior assumes that the competitor does not react to the change in the strategic variable (price) (Kadiyali et al. 2001), while in Stackelberg leader follower, the leader sets the strategic variable with knowledge of the competitor's reaction in the first stage, and in the second stage the follower sets the strategic variable (Narasimhan and Wilcox 1998).

The demand for the NB can be specified as

$$Q_{NB} = a_0 - a_1 P_{NB} \qquad (1)$$

Where Q_{NB} denote the quantity demand of the NB, P_{NB} is the price of the NB at the retail level and defined as $P_{NB} = W_{NB} + m_{NB}$

Where W_{NB} is the wholesale price and m_{NB} is the retail margin on NB and a_0, a_1 are parameters.

The above specification applies a linear functional form of demand. The reason for using this specification instead of other demand specifications (double log) has to do with computation. The double log specification complicates the analysis and violates the conditions required to estimate various market structures (Kadiyali, 1996). For example, while estimating the leader follower game, we need to estimate the first order condition of the follower and invert it to obtain prices in terms of the leader's price. We then substitute this inverted price condition into the leader's profit maximization condition. With a double log demand specification, this inversion may lead to multiple solutions or a noninvertible solution (Kadiyali, 1996). Thus, for tractability, a linear demand specification has been used in this study.

Let π_R denote the retailer's profit and W_{NB} denote the wholesale price. The profit functions of the retailer can be written as

$$\pi_R = m_{NB} Q_{NB} \qquad (2)$$

Let π_{NBM} and C_{NB} denote the manufacturer of NB's profit and cost of production of NB respectively.

$$\pi_{NBM} = (W_{NB} - C_{NB}) Q_{NB} \qquad (3)$$

Equation (3) shows the profit function of the NB manufacturer.

Equilibrium values under various competitive behaviors are given in table 1. The retail price's equilibrium values show that the cost of producing NB has a positive impact on the retail and wholesale price, which is expected according to economic theory. These theoretical results are consistent with the findings of Choi (1991). The theoretical model shows that the retail price of NB remains the same for different competitive behaviors (whether the retailer behaves as a leader or the NB manufacturer behaves as a leader) but the wholesale price differs in different competitive equilibriums. It also reveals that the total channel profit remains the same whether the retailer behaves as a leader or the NB manufacturer behaves as a leader (Choi 1991). As expected, the retailer's equilibrium profit is highest when the retailer behaves as a leader while the manufacturer's profit is the highest when the NB manufacturer behaves as a leader. Theoretical models show that industry as a whole enjoys the highest profit and consumers enjoy the lowest price when there is Bertrand competition.

Table 1: Equilibrium Values under Various Competitive Interactions When Only the NB Product is Available at Retail Level

Particulars	**Manufacturer of NB behaves as a leader & retailer as follower**	**Retailer behaves as a leader & NB manufacturer as follower**	**Bertrand Competition between retailer & manufacturer of NB**
Retail Price (P_{NB})	$\frac{1}{4}C_{NB} + \frac{3a_0}{4a_1}$	$\frac{1}{4a_1}(3a_0 + a_1C_{NB})$	$\frac{1}{3a_1}(2a_0 + a_1C_{NB})$
Wholesale Price (W_{NB})	$\frac{1}{2a_1}(a_0 + a_1C_{NB})$	$\frac{1}{4}\left(\frac{a_0}{a_1} + 3C_{NB}\right)$	$\frac{1}{3}\left(\frac{a_0}{a_1} + 2C_{NB}\right)$
Profit ($\pi_{Retailer}$)	$\frac{(a_0 - a_1C_{NB})^2}{16a_1}$	$\frac{(a_0 - a_1C_{NB})^2}{8a_1}$	$\frac{(a_0 - a_1C_{NB})^2}{9a_1}$
Profit ($\pi_{Manufacturer}$)	$\frac{(a_0 - a_1C_{NB})^2}{8a_1}$	$\frac{(a_0 - a_1C_{NB})^2}{16a_1}$	$\frac{(a_0 - a_1C_{NB})^2}{9a_1}$

Case 2: Only One NB Product and One PL

Case 2.1: NB manufacturer produces both NB and PL product

In this case, we assume that both NB and PL product are available in the market and the retailer is selling both the NB and PL products to the consumers. The manufacturer produces both the products and maximizes profit by setting the wholesale price. The retailer optimizes by setting the retail price of the NB and PL (see figure 2).

Following Choi (1991), the demand for NB and PL can be specified as

$Q_i = a_0 - a_1P_i + a_2P_j$ Where i, j = NB and PL, and i≠j (4)

Where Q_i is the demand for brand i (NB or PL) at price P_i given the price of other brand P_j. Let m_{PL} denote the retailer's margin for PL. The retailer's objective is to maximize the category profit. The retailer's profit can be written as

$$\pi_R = m_{PL} Q_{PL} + m_{NB} Q_{NB} \tag{5}$$

Let C_{PL} denote the cost of production of PL. The profit function of the NB manufacturer can be specified as

$$\pi_{NBM} = (W_{NB} - C_{NB})Q_{NB} + (W_{PL} - C_{PL})Q_{PL} \tag{6}$$

We estimated different competitive games (Bertrand Nash, Stackelberg leader follower) and the equilibrium values under various equilibrium interactions (Stackelberg leader follower and Bertrand) are given in Table 2. Equilibrium values show that reducing production costs of the NB and PL decrease the retail and wholesale prices, as expected from economic theory. Retail prices remain the same in both competitive interactions (whether the retailer behaves as a leader or the NB manufacturer behaves as a leader) but these retail prices are different from the Bertrand competition. The wholesale price, however, varies under all competitive behaviors. These results show that regardless of who becomes the leader in the market, the leader achieves higher profits (These results are available upon request).

Table 2: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer Produces Both NB and PL Products

Particulars	**Manufacturer of NB behaves as a leader and retailer as follower**	**Retailer behaves as a leader and manufacturer of NB as follower**	**Bertrand Competition between retailer & manufacturer of NB**
Retail Price (P_{PL})	$\frac{1}{4}C_{PL} + \frac{3a_0}{4(a_1 - a_2)}$	$\frac{1}{4}C_{PL} + \frac{3a_0}{4(a_1 - a_2)}$	$\frac{1}{3}C_{PL} + \frac{2a_0}{3(a_1 - a_2)}$
Retail Price (P_{NB})	$\frac{1}{4}C_{NB} + \frac{3a_0}{4(a_1 - a_2)}$	$\frac{1}{4}C_{NB} + \frac{3a_0}{4(a_1 - a_2)}$	$\frac{1}{3}C_{NB} + \frac{2a_0}{3(a_1 - a_2)}$
Wholesale Price (W_{PL})	$\frac{1}{2}C_{PL} + \frac{a_0}{2(a_1 - a_2)}$	$\frac{3}{4}C_{PL} + \frac{a_0}{4(a_1 - a_2)}$	$\frac{2}{3}C_{PL} + \frac{a_0}{3(a_1 - a_2)}$
Wholesale Price (W_{NB})	$\frac{1}{2}C_{NB} + \frac{a_0}{2(a_1 - a_2)}$	$\frac{3}{4}C_{NB} + \frac{a_0}{4(a_1 - a_2)}$	$\frac{2}{3}C_{NB} + \frac{a_0}{3(a_1 - a_2)}$

Case 2.2: NB manufacturer produces NB product and retailer outsources PL product

In this scenario the NB manufacturer produces a NB product and supplies it to the retailer (who sells NB products to final consumers). The retailer outsources the PL product and sells it to the consumers. The objective of the NB manufacturer and PL producer is to maximize profit by optimizing the wholesale price of the NB and PL respectively. The retailer's objective is to maximize retail profit by optimizing with respect to the retail price of both the NB and PL products (as shown in figure 3).

The demand for NB and PL can be written as

$$Q_i = a_0 - a_1 P_i + a_2 P_j \qquad \text{Where i= NB and PL} \qquad (7)$$

The retailer's objective is to maximize the category profit (profit from both NB and PL products). The retailer's profit function can be specified as

$$\pi_R = m_{PL} Q_{PL} + m_{NB} Q_{NB} \qquad (8)$$

The profit function of the NB and PL manufacturer can be written respectively as

$$\pi_{NBM} = (W_{NB} - C_{NB}) Q_{NB} \qquad (9)$$

$$\pi_{PLM} = (W_{PL} - C_{PL}) Q_{PL} \qquad (10)$$

Equilibrium values of competitive interactions between NB manufacturer and the retailer where he outsources the PL product have been determined under various assumption i.e. manufacturer of NB behaves as a leader and retailer as follower, retailer behaves as a leader and the manufacturer of NB as a follower and Bertrand competition between retailer and manufacturer of NB. These equilibrium values are shown in table 3. Results of the theoretical model show that there is no difference between the retail prices in both leader follower competitive interactions (retailer behaves as a leader or manufacturer behaves as a leader) but these prices are different for the Bertrand interaction. Since equilibrium values are nonlinear in parameters, it is hard to sign them. For interpretation of equilibrium values, we assign arbitrary values to the parameters using economic theory intuition (own price ≥ cross price). Comparative statistics show that if $a_1 > a_2$, then the cost of production of NBs and PLs has the positive impact on the NB and PL retail and wholesale prices.

Table 3: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer produces NB and the Retailer Outsources the PL Product

Particulars	**Manufacturer of NB behaves as a leader and retailer as follower**
Retail Price (P_{PL})	$\left(\frac{a_1^2}{4a_1^2-a_2^2}\right)C_{PL}+\left(\frac{a_1a_2}{8a_1^2-2a_2^2}\right)C_{NB}+\frac{a_0(3a_1-2a_2)}{2(a_1-a_2)(2a_1-a_2)}$
Retail Price (P_{NB})	$\left(\frac{a_1^2}{4a_1^2-a_2^2}\right)C_{NB}+\left(\frac{a_1a_2}{8a_1^2-2a_2^2}\right)C_{PL}+\frac{a_0(3a_1-2a_2)}{2(a_1-a_2)(2a_1-a_2)}$
Wholesale Price (W_{PL})	$\left(\frac{1}{4a_1^2-a_2^2}\right)(2a_1^2C_{PL}+a_1a_2C_{NB}+2a_0a_1+a_0a_2)$
Wholesale Price (W_{NB})	$\left(\frac{1}{4a_1^2-a_2^2}\right)(2a_1^2C_{NB}+a_1a_2C_{PL}+2a_0a_1+a_0a_2)$
	Retailer behaves as a leader and manufacturer of NB as follower
Retail Price (P_{PL})	$\left(\frac{a_1^2}{4a_1^2-a_2^2}\right)C_{PL}+\left(\frac{a_1a_2}{8a_1^2-2a_2^2}\right)C_{NB}+\frac{a_0(3a_1-2a_2)}{2(a_1-a_2)(2a_1-a_2)}$
Retail Price (P_{NB})	$\left(\frac{a_1^2}{4a_1^2-a_2^2}\right)C_{NB}+\left(\frac{a_1a_2}{8a_1^2-2a_2^2}\right)C_{PL}+\frac{a_0(3a_1-2a_2)}{2(a_1-a_2)(2a_1-a_2)}$
Wholesale Price (W_{PL})	$\left(\frac{(6a_1^2-a_2^2)}{2(4a_1^2-a_2^2)}\right)C_{PL}+\frac{1}{2}\frac{a_1a_2}{(4a_1^2-a_2^2)}C_{NB}+\frac{a_0}{4a_1-2a_2}$
Wholesale Price (W_{NB})	$\left(\frac{(6a_1^2-a_2^2)}{2(4a_1^2-a_2^2)}\right)C_{NB}+\frac{1}{2}\frac{a_1a_2}{(4a_1^2-a_2^2)}C_{PL}+\frac{a_0}{4a_1-2a_2}$
	Bertrand Competition between the retailer & manufacturer of NB
Retail Price (P_{PL})	$\left(\frac{3a_1^2}{9a_1^2-a_2^2}\right)C_{PL}+\left(\frac{a_1a_2}{9a_1^2-a_2^2}\right)C_{NB}+\frac{a_0(2a_1-a_2)}{(a_1-a_2)(3a_1-a_2)}$
Retail Price (P_{NB})	$\left(\frac{3a_1^2}{9a_1^2-a_2^2}\right)C_{NB}+\left(\frac{a_1a_2}{9a_1^2-a_2^2}\right)C_{PL}+\frac{a_0(2a_1-a_2)}{(a_1-a_2)(3a_1-a_2)}$
Wholesale Price (W_{PL})	$\left(\frac{6a_1^2}{9a_1^2-a_2^2}\right)C_{PL}+\left(\frac{2a_1a_2}{9a_1^2-a_2^2}\right)C_{NB}+\frac{a_0}{(3a_1-a_2)}$
Wholesale Price (W_{NB})	$\left(\frac{6a_1^2}{9a_1^2-a_2^2}\right)C_{NB}+\left(\frac{2a_1a_2}{9a_1^2-a_2^2}\right)C_{PL}+\frac{a_0}{(3a_1-a_2)}$

Case 2.3: NB manufacturer produces NB product and retailer produces PL product

In this case, it is assumed that the retailer owns the PL production facility. The NB manufacturer's role is to supply NB products to the retailer. The retailer then sells these products to the consumers. The NB manufacturer maximizes its profit by optimizing the wholesale price of the NB and the retailer maximizes its profit by optimizing with respect to the retail price of the NB and PL (see figure 4).

The theoretical model can be written as

$$Q_i = a_0 - a_1 P_i + a_2 P_j \qquad \text{Where i= NB and PL} \tag{11}$$

$$\pi_R = (P_{PL} - C_{PL})Q_{PL} + m_{NB} Q_{NB} \tag{12}$$

$$\pi_{NBM} = (W_{NB} - C_{NB})Q_{NB} \tag{13}$$

Comparative statistics of the above model are given in table 4. Results show that the retail price of the NB and PL is identical under both leader follower behaviors while the wholesale price varies in all competitive interactions. The cost of producing NBs and PLs has a positive impact on the retail price of NBs and PLs under all competitive behaviors, which is expected from economic theory. The theoretical model reveals that the retailer earns the highest profit when the retailer behaves as a leader, and the NB manufacturer makes the lowest profit when the NB manufacturer behaves as a follower. The reverse is true when the NB manufacturer behaves as a leader. The total industry profit remains the same under both leader follower behaviors (retailer behaves as a leader or NB manufacturer behaves as a leader). These results are similar to the case 1, where the results show that consumer enjoys the lowest price and industry earns the highest profit under Bertrand behavior.

Table 4: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer Produces NB and the Retailer Owns the PL Production Facility

Particulars	**Manufacturer of NB behaves as a leader and retailer as follower**	**Retailer behaves as a leader and manufacturer of NB as follower**
Retail Price (P_{PL})	$\frac{1}{2}C_{PL} + \frac{a_0}{2(a_1 - a_2)}$	$\frac{1}{2}C_{PL} + \frac{a_0}{2(a_1 - a_2)}$
Retail Price (P_{NB})	$\frac{1}{4}C_{NB} + \frac{a_2}{4a_1}C_{PL} + \frac{a_0(3a_1 - a_2)}{4a_1(a_1 - a_2)}$	$\frac{1}{4}C_{NB} + \frac{a_2}{4a_1}C_{PL} + \frac{a_0(3a_1 - a_2)}{4a_1(a_1 - a_2)}$
Wholesale Price (W_{NB})	$\frac{1}{2}C_{NB} + \frac{a_2}{2a_1}C_{PL} + \frac{a_0}{2a_1}$	$\frac{3}{4}C_{NB} + \frac{a_2}{4a_1}C_{PL} + \frac{a_0}{4a_1}$
	Bertrand Competition between retailer & manufacturer of NB	
Retail Price (P_{PL})	$\frac{1}{2}C_{PL} + \frac{a_0}{2(a_1 - a_2)}$	
Retail Price (P_{NB})	$\frac{1}{3}C_{NB} + \frac{a_2}{6a_1}C_{PL} + \frac{a_0(4a_1 - a_2)}{6a_1(a_1 - a_2)}$	
Wholesale Price (W_{NB})	$\frac{2}{3}C_{NB} + \frac{a_2}{3a_1}C_{PL} + \frac{a_0}{3a_1}$	

Econometric Model Specification

NB manufacturer produces both NB and PL products

Bertrand Behavior between PL and NB

In order to estimate the competitive interaction between NB and PL under various theoretical assumptions, we use the Bertrand model. In Bertrand competition both producers (retailer and NB manufacturer) set the price of their own products assuming that the competitor does not react to this price change (Kadiyali et al 2001).

$$Q_{PLst} = a_0 + a_1 P_{PLst} + a_2 P_{NBst} + a_3 S_{PLst} + a_4 S_{NBst} + \upsilon_{1st} \quad (14)$$

$$Q_{NBst} = b_0 + b_1 P_{NBst} + b_2 P_{PLst} + b_3 S_{NBst} + b_4 S_{PLst} + \upsilon_{2st} \quad (15)$$

$$P_{PLst} = \left(-\frac{a_2 + b_2}{2a_1}\right) P_{NBst} - \frac{(a_0 - b_2 W_{NBst} - a_1 W_{PLst} + a_4 S_{NBst} + a_3 S_{PLst})}{2a_1} + \upsilon_{3st} \quad (16)$$

$$P_{NBst} = \left(-\frac{a_2 + b_2}{2b_1}\right)P_{PLst} - \frac{\left(b_0 - b_1 W_{NBst} - a_2 W_{PLst} + b_3 S_{NBst} + b_4 S_{PLst}\right)}{2b_1} + \upsilon_{4st} \qquad (17)$$

$$W_{PLst} = \frac{1}{a_1}\left(a_1 C_{PLst} + b_2 C_{NBst} - b_2 W_{NBst} - a_0 - a_1 P_{PLst} - a_2 P_{NBst} - a_3 S_{PLst} - a_4 S_{NBst}\right) + \upsilon_{5st} \qquad (18)$$

$$W_{NBst} = \frac{1}{b_1}\left(b_1 C_{NBst} + a_2 C_{PLst} - a_2 W_{PLst} - b_0 - b_1 P_{NBst} - b_2 P_{PLst} - b_3 S_{NBst} - b_4 S_{PLst}\right) + \upsilon_{6st} \qquad (19)$$

Where Q_{PLst}, Q_{NBst} denote the quantities of PLs and NBs demanded in store s at time t respectively. S_{PL} and S_{NB} show promotional dummy variables for PL and NB products respectively. Where $\upsilon_{1st}, \upsilon_{2st}, \upsilon_{3st}, \upsilon_{4st}, \upsilon_{5st}$ and υ_{6st} denote contemporaneously correlated error terms. In this study we assume that these errors are jointly normally distributed and the equations can be estimated as a simultaneous equation system. The details of other econometric specifications are available from authors upon request.

DATA

For the purpose of analysis, we chose a case study product category and product pairings in which the regular and healthy PL and NB products were so similar that they could easily be substituted for each other. The matching criterion is based on the fact that products are direct, close substitutes within the same product category, and that both products (PL, NB) carry close to identical characteristics as identified from the product description. The analysis in this study is based on a set of proprietary scanner panel data made available through the SIEPR-Giannini Data Center (SIEPR-Giannini Data Center 2012). The data provide retail sales information for 200 UPC product categories for a major North American retail chain with stores in Canada. Aggregate weekly store level sales data are used from all retailer operational regions. The data include information at the individual UPC level for price, applicable discounts, sales quantity, and retail gross and net margin for week 1-2004 to week 27-2007.

The retailers and NB manufacturers are using quality differentiated products to attract consumers. For this purpose, several large retail chains have developed differentiated PL "good for you" product lines and labeling schemes around their healthy product options. The present study uses two case study examples to see how quality differentiation attributes affect the pricing and promotional competitive interactions between PLs and NBs in the retail categories.

PL products have traditionally been successful among brands with the lower degree of product differentiation such as meat, fruits and vegetables. In 2008, the PL dollar share increased aggressively in comparison to NBs in meat and seafood (9 percent). The PL penetration rate was the highest in oil and fats, followed by meat, fish and poultry (AAFC 2010). Among different meat products, bacon showed a significant (11.21 percent) increase in consumption during 2010 (Salvage 2011). Consumers are eating healthier, and as a result are changing their consumption patterns of processed meat products. In response, manufacturers and retailers are offering processed products with less sodium, etc. The present study uses two bacon case study examples: a) packaged sliced regular bacon; and b) packaged less-salt bacon. For the category of sliced bacon the most common health attribute is "less salt."

A retailer would have three potential production options to produce the PL product. But as a researcher, we do not know which production arrangement a retailer is using. Therefore, the present study predicts the strategic competitive behaviors between the PL and NB under different PL production arrangements. Above models derived are applied on the available data, and the model which fits best is considered to be the best representation of the competitive interaction between PL and NB, and production arrangement of PL.

In the case of bacon, retailers use following alternative production arrangements for PL products:

1. The retailer owns the meat processing facility (Safeway 2011). Safeway's annual report shows that about 14 percent of PL products are manufactured at the company-owned facility.
2. Some bacon producers supply PL bacon products only to the retailer.
3. Some manufacturers produce both NB and PL bacon products (Salvage 2012).

Table 5 shows the descriptive statistics of NB and PL regular and healthy bacon. In the present study we deflated the retail price using a consumer price index, the wholesale price using an industry price index, and the input cost using a farm price index (Statistics Canada 2012). Table 5 compares average retail and promotional prices etc. This comparison helps us to understand how retailer and NB manufacturer price their regular and vertical differentiated bacon products.

Promotional price is the price accounting for the promotional discounts, coupons and saving through membership cards, whereas shelf price is defined as the price printed on the shelf of the product at the retail store. When the product is not on promotion, the shelf price and promotion price are identical. Results show that both NB regular and healthy brands are more expensive than PL regular and healthy brands respectively. The average wholesale price of NBs and PLs also shows that the NB is expensive in both product categories.

Table 5 shows the average price difference between NBs and PLs, retail margins, promotional frequency and promotional depth for selected NB and PL products at the Canadian retail level. The second and third rows of table 5 show the difference between the average shelf and promotional prices of NB and PL products. The next two rows show the retailer margin (difference between shelf price and wholesale price) for PL and NB healthy and regular bacon. We study the promotional activities of PLs and NBs where the main variables of interest are promotional frequency and promotional depth. The promotional frequency shows the number of times a given product remains on promotion and the promotional depth measures the extent of the shelf price reduction during the promotion (Volpe 2010). The last two rows show the percentage difference between NB and PL promotional frequency and the difference between NB and PL promotional depth, respectively.

The differences between NB and PL shelf prices vary considerably between healthy and regular bacon. These values show that the NB is more expensive than the respective PL product. The highest price difference exists for regular bacon at $3.23 a package. Previous literature concluded that the price of a NB can be expected to be higher than its PL counterpart (Dhar and Hoch, 1997; Ailawadi et al. 2001; Volpe, 2010). The difference between the promotional price of NB and PL products shows that promotional price difference is higher in the regular bacon category (i.e., $2.39) as compared to healthy bacon (i.e., $0.59). This shows that the NB producers are offering more discounts on their products than the retailers do on PL products. Retailer margins for PL and NB products vary between healthy and regular bacon, as shown in table 5. Hoch and Banerji (1993) and Steiner (2004) stated that PL products are expected to be less expensive than their NB substitutes and yield higher retail margins. The data show that the dollar retail margin of NB bacon is higher than PL bacon but the percentage retail margin of PL is higher than NB healthy bacon. The reason for the higher dollar retail margin for NBs is that the NB has a higher NB shelf price than the PL.

Table 5: Price Difference, Retail Margin, Promotional Frequency and Promotional Depth for NB and PL Bacon Products

Particulars	Item	Healthy Bacon	Regular Bacon
Price Difference Between NB and PL	**Shelf Price** [a]	1.01	3.23
	Promotional Price [b]	0.59	2.39
Retailer Margin for PL and NB Product	**PL Product**	2.61	1.24
	NB Product	2.85	2.85
Difference Between NB and PL promotional Frequency & Promotional Depth	**Promotional Frequency** [c]	13.05	29.20
	Promotional Depth [d]	0.42	0.84

All prices are in Canadian $ and promotional frequency is in percentage.
[a] Shelf price: Price printed on the shelf of the product at the retail store.
[b] Promotional price: Price accounting for the promotional discounts, coupons and saving through membership cards
[c] Promotional frequency: It shows the number of times a given product remains on promotion.
[d] Promotion depth: It measures the extent of the shelf price reduction during the promotion.

Promotional frequency varies considerably between regular and healthy bacon products. Positive values show that the NB products remain on promotion more often than the PL product. In the case of regular sliced bacon, the promotional frequency is 29.2 percent, indicating that the NB product is on promotion about 29.2 percent more than the PL regular bacon. Anderson and Simester (2004) reported that more frequent promotional programs increase customer loyalty in the long term. Our data reveal that the highest promotional depth can be found in the sliced bacon category, where the price difference stands at $0.84. The NB manufacturer offers more promotions than the manufacturer of the substitute PL products. Rao (1991) obtained similar results; he concluded that NBs offer more promotional depth than PLs to keep consumers from trying PL products.

RESULTS AND DISCUSSION

Table 6 summarizes the results of the hypothesis tests of whether price competition differs for different product categories under different PL production arrangements. For the analysis purpose, demand and price reaction equations are estimated as a system. In this regard the Full Information Maximum Likelihood (FIML) method is applied and the model which gives lowest values for Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) is considered as the best model (Gujarati and Sangeetha 2007; Greene 2008).

Table 6: Values of SIC and AIC for Testing Competitive Games of Regular and Healthy Bacon

Particulars	Retailer owns production facility		NB manufacturer produces both NB & PL brand for retailer		Retailer outsources PL products	
	SIC [a]	AIC [b]	SIC [a]	AIC [b]	SIC [a]	AIC [b]
Regular Bacon						
NB Manufacturer Behaves as a Leader & retailer behaves as a follower	46717.9	46684.9	39670.2	39628.0	42424.1	42386.1
Retailer behaves as a leader & NB manufacturer as a follower	46291.5	46250.2	40344.8	40302.6	43149.6	43107.4
Retailer and NB manufacturer behaves as a Bertrand manner	48677.0	48635.7	39718.0	39680.0	**39075.8**	**39033.6**
Healthy Bacon						
NB Manufacturer Behaves as a Leader & retailer behaves as a follower	53097.3	53060.1	54158.3	54116.0	56002.1	55959.8
Retailer behaves as a leader & NB manufacturer as a follower	**52165.9**	**52124.5**	53819.5	53777.2	56171.7	56129.5
Retailer and NB manufacturer behaves as a Bertrand manner	53045.8	53008.6	54937.8	54899.7	54451.2	54408.9

[a] Schwarz Information Criterion (SIC)
[b] Akaike Information Criterion (AIC)

Table 6 shows considerable variations in the competitive behavior of PL and NB for regular and the healthy bacon products. Similar results are reported by Putsis and Dhar (1998);

however, they used horizontal price competition between PL and NB without considering the production arrangements of the retailer's brand.

The study shows leader follower competitive behavior for healthy bacon. Kadiyali et al. (1996) state that there is a greater likelihood of leader follower behavior when firms interact repeatedly. An interesting question is which firm behaves as a leader and which as a follower. In this regard, the lowest values of AIC and SIC show that the retailer behaves as a leader and the NB manufacturer as a follower for healthy bacon when the retailer owns the production facility. Kadiyali et al. (1996) report that leader follower behavior is more profit-enhancing for the leader than the Bertrand Nash price behavior. Theoretical models also show that the retailer earns the highest profit when it behaves as a leader and the lowest when it behaves as a follower. The total industry earns less profit in leader-follower than in Bertrand behavior. Results of the study indicate Bertrand Nash competition for regular bacon when the retailer outsources PL production.

We selected the best representation of the market by using the information criteria which gives us the lowest value. The estimates for these games, for the healthy and the regular bacon cases are given in tables 7. A Wald test is applied to determine how NB and PL promotion dummies[1] jointly affect the demand. The test statistic shows that all the promotional dummy variables have jointly significant impact on the demand for NBs and PLs regardless of how the PLs are produced.

The study shows that own price has a negative impact on the PL and NB in both product categories, as expected from economic theory (Kadiyali et al. 1996; Cotterill and Samson 2002; Huang et al. 2003; Akbay and Jones 2005). The cross price of PL shows positive impact on the demand of NB for regular bacon, it indicates as the price of PL goes up then the demand of NB will increase. However, all the other cross prices show complementary behavior.

Own and cross promotional responses vary depending on type of product. The own promotional dummy variable for PL bacon shows positive impact on the demand of PL regular bacon. The NB own promotional dummy variable indicates that when the NB healthy bacon is on promotion, the demand of NB will decrease.

[1] The promotional dummy for NB is equal to 1 when the NB is on promotion and zero otherwise and PL promotion is equal to 1 when the PL brand is on promotion and zero otherwise.

Table 7: Best Fitted Game of Healthy and Regular Bacon

Variable	Healthy Bacon		Regular Bacon	
	Retailer owns PL production facility		Retailer outsources PL product	
	Retailer behave as a leader		Bertrand Behavior	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	73.117 (0.598) **	68.761 (0.650) **	13.286 (0.021) **	54.903 (0.190) **
Price NB	-5.418 (0.046) **	-4.779 (0.053) **	-1.458 (0.002) **	-7.924 (0.030) **
Price PL	-4.768 (0.038) **	-4.666 (0.046) **	0.034 (0.001) **	-0.999 (0.000) **
Sales Promotion Dummy (NB)	-6.702 (0.102) **	-5.582 (0.101) **	-2.454 (0.016) **	-13.194 (0.083) **
Sales Promotion Dummy (PL)	-3.805 (0.088) **	-4.167 (0.086) **	-0.081 (0.019) **	0.032 (0.096) **
Wald Test for all promotional dummies	11050.5**		31911.6**	

** represents statistical significance at 1 % level of significance.
Heteroskedasticity consistent standard errors are in parentheses.
[a] Q_{NB} = Quantity of NB, [b] Q_{PL} = Quantity of PL

The reason for this behavior could be that when the product is on promotion, consumers perceive that the product is of poor quality or may be close to expire. In the case of healthy bacon, both promotional dummy variables (own promotional dummy and cross promotional dummy variable) show negative impact on the demand of NB and PL. There can be various reasons for such a relationship. Firstly, it may be due to strong association in the promotional activity between NB and PL. So whenever, PL is on promotion then NB is also on promotion and vice versa. Secondly, consumers may perceive negatively between the quality of the product and promotional activity and whenever the product is on promotion then the quality may be poor. Thirdly, the promotional benefits may be available to only those consumers who buy large quantity of the product, for example, get one free with a pack of four. The consumer may not be willing to buy four units in order to get benefit of an additional unit. In this case, promotional activity does not has desirable effect on the demand of the product. Finally, since we do not have detailed information of promotion (promotional expenditure, promotional instruments) and other marketing instruments that are used simultaneously, it is quite possible that the marketing instruments (advertising) used by the rival brand has bigger effect relative to the product promotion and as a result promotion has a negative impact on the demand of the product.

Elasticity Results

The own price elasticity shows that consumers are more responsive to the NB price change as compared to the PL price change in a healthy bacon when the retailer owns the production facility (see table 8). The consumers perceive that the NB product quality is higher, as NB products are more expensive than the PL products. Previous literature shows that price reduction benefits high quality brands more than low quality brands (Sivakumar and Raj 1997; Huang et al. 2010).

A PL's cross price has a positive impact on the NB demand for regular bacon when retailer outsources PL product. This positive sign is as expected, based on economic theory (Cotterill and Putsis 2000; Huang et al. 2003; Akbay and Jones 2005), and shows that the products are substitutes.

Table 8: Estimated Own and Cross Price Elasticities of Regular and Healthy Bacon

	Healthy Bacon		**Regular Bacon**	
	Retailer owns PL production facility		Retailer outsources PL product	
	Retailer behaves as a leader		Bertrand behavior	
	Q_{NB}	**Q_{PL}**	**Q_{NB}**	**Q_{PL}**
P_{NB}	-1.971**	-1.629**	-0.208**	-4.765**
P_{PL}	-1.547**	-1.419**	0.003**	-0.337**

** represents statistical significance at 1 % level of significance.
P_{NB} = Price NB, P_{PL} = Price PL, Q_{NB} = Quantity NB, Q_{PL} = Quantity PL

However, the other cross price elasticities are negative, showing that the NB and PL healthy bacon are complementary in nature (as shown in table 8). Deaton (1987) also reports complementary relationship between dry fish and fresh fish. A number of other studies found similar behavior (Kadiyali et al. 1996; Guo et al. 1999). These cross price elasticities demonstrate that an increase in the NB price will decrease demand for the PL product. These estimates indicate that whenever consumers buy PL healthy bacon, they also buy the NB. This behavior is consistent for both products (regular bacon and healthy bacon). A plausible explanation can be that as the price of NB goes up, it results in an increase in the price gap between NB and PL. Sethuraman (2009) also finds a negative relationship between PL demand and the price gap between NB and PL.

CONCLUSIONS

The present study develops a theoretical model of PL and NB competition by assuming different production arrangements for the retailer's brand (PL). Furthermore, this study develops and estimates different models to understand the Canadian retail level pricing behavior of PL and NB healthy and regular bacon product categories produced under different PL arrangements. For this purpose, the NNMC approach is used to identify pricing competition. This study contributes to develop a modeling framework by estimating different competitive behaviors of NBs and PLs produced under different arrangements (retailer owns production facility of PL, NB manufacturer produces both NB and PL products, and retailer outsources the PL product from local market). This study also extends the literature by applying the NNMC approach in food products at the Canadian retail level assuming different arrangements for producing PLs.

The theoretical model shows that retailer earns the highest profit when it behaves as a leader and makes the least profit when it behaves as a follower; a similar relationship holds for the NB manufacturer under different production arrangements. The total industry profit is highest when the retailer and NB manufacturer behave in a Bertrand Nash manner.

The empirical results of the present study show that there is no consistent pattern of competition between PLs and NBs across different food product categories. The pattern of competition also varies depending on how the PL product is produced. The present study concludes that the retailer behaves as a price leader and the NB manufacturer as a follower for healthy bacon products when the retailer owns the production facility, while the competitive behavior is different for regular bacon. PL and NB products compete in a Bertrand fashion for regular bacon when the retailer outsources the PL product. These different competitive interactions are consistent with the findings of previous economic studies. The results of the study suggest that researchers should not assume arbitrary a type of competitive interaction while doing the analysis and making conclusions. If the assumptions regarding the competitive interaction are wrong, it will result in wrong conclusions. The conclusions from these studies should be evaluated considering the assumptions that the studies make regarding the strategic competitive interaction between manufacturer and retailer.

Study results show that there is a leader follower behavior for production arrangements when the retailer owns the production facility. Marsden and Whelan (2009) indicate that welfare is maximized when both retailer and NB manufacturer behave in a Bertrand manner rather than leader-follower relationship. For both brands to behave in a Bertrand manner, government should play a role by setting competition standards to maximize consumer welfare. The theoretical model also shows that total industry profit is highest when the retailer and the NB manufacturer behave in a Bertrand Nash manner relative to the leader-follower manner. The Bertrand Nash behavior increases competition between brands (PL and NB) which has some tangible benefits for consumers as lower prices, quality improvement of the product, more choice and better service.

This study has some limitations. First, it uses scanner data, which provide product level information, but this dataset lacks consumers' demographic information. If the focus is to better understand consumer preferences for PL and NB products, and how demographic information affects the competitive pricing strategy between PLs and NBs across different product categories, then demographic information should be incorporated in the demand specifications for PLs and NBs. Another limitation of the present study is the use of linear demand model. It may be argued that other nonlinear demand models are more appropriate than the linear model but it is very difficult if not impossible to specify such competitive models. However, a linear model is widely accepted in the economic literature due to its tractability (Kadiyali et al. 1996; Roy et al. 2006). The present study analyzed competition between the PL and NB for two products, not for the entire product line, while at the retail level each competing firm supplies a complete product line. Due to the non-availability of data for other products offered by the same producer in its product line we used only one product from its entire product line. The same holds for the retailer, so the competitive behavior analyzed is based on only one NB and PL product from an entire NB and PL product line. In other words, the conclusions and implications drawn from this study are based on only two products, not on a complete product line.

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