University of Alberta

Competition between Private Label and National Brand for Differentiated Food Category: A Canadian Retail Case

by

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Abstract

Retailers in Canada have introduced private labels to gain vertical bargaining power over manufacturers' national brands and to establish customer loyalty. Product differentiation in quality and increasingly product formulation is an emerging trend for both private labels and national brands in many grocery categories. This thesis applies a model derived from a random utility nested logit model to estimate structural demand for differentiated canned soup products. Using a Distance-Matrix (DM) approach we identify the location of both private labels and national brands in the ingredient attribute space within the canned soup category. To empirically estimate and test the impacts of private label usage on the competitive interactions between retailers and manufacturers, we estimate supply-side Cost-Price Margin (CPM) equations. Our results strongly suggest that retailers' private label is acting as an effective strategic tool to generate market power over upstream manufacturers.

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This thesis would have remained a dream without the excellent guidance and assistance of several individuals who contributed their knowledge and kindness to the completion of this study. First of all, I would express my deepest gratitude to Dr. Sven Anders for his outstanding assistance and mentorship, all the way through proposing initial ideas of this study to completion of my program. I am greatly impressed by his respectable tolerance, humor and down-to-earth working spirits. It is my life-long honor to work with him. It is also with tremendous gratitude that I acknowledge the support and help of Dr. Philippe Marcoul. I consider it great honor to work with Dr. Philippe Marcoul whose patience and preeminent expertise helped me significantly accelerate the completion of my program. I would also thank my committee members, Dr. James Rude and Dr. Joseph Marchand for their guidance and thought-provoking suggestions for my study. Finally, I would like to thank my loved ones, who have been supporting me through my program and giving me the strength to keep calm and carry on.

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Chapter 1 Introduction

1.1 Background: Private Label Development in North America

Private labels (PL)[1], also known as store brands, are branded product lines owned and operated by a specific retail chain rather than food producers or manufacturers. This constellation is known to have two major implications. First, it is the retailers who own and control PL brands, whereas this was traditionally the role of national brand (NB) food manufacturers. Second, the retailers have exclusive rights over PL products, which mean that different retailers sell differentiated PL products to distinguish themselves from their competitors and attract additional consumer demand (Bergès-Sennou et al., 2004). Over time PL brands have been growing in importance in many developed retail markets, especially North America and Europe. Figure 1 reveals that North America and Europe enjoy the highest PL introduction rates, while developing countries in Asia Pacific and Middle East/ Africa are catching up quickly in terms of PL penetration. According to data released by *Private Label Manufacturers Association* (*PLMA*), PL brands comprised an all-time high of 21.3 % market share by units sold and 16.4% share in dollar sales for North America in 2006 (*PLMA*, 2007). Between 1999 and 2003, PL brands grew at an annual rate of 17.9% compared to 14% for NBs during the same period (*PLMA*, 2004). However, the current popularity of retailers' PLs has developed through a long and complicated historical evolution.

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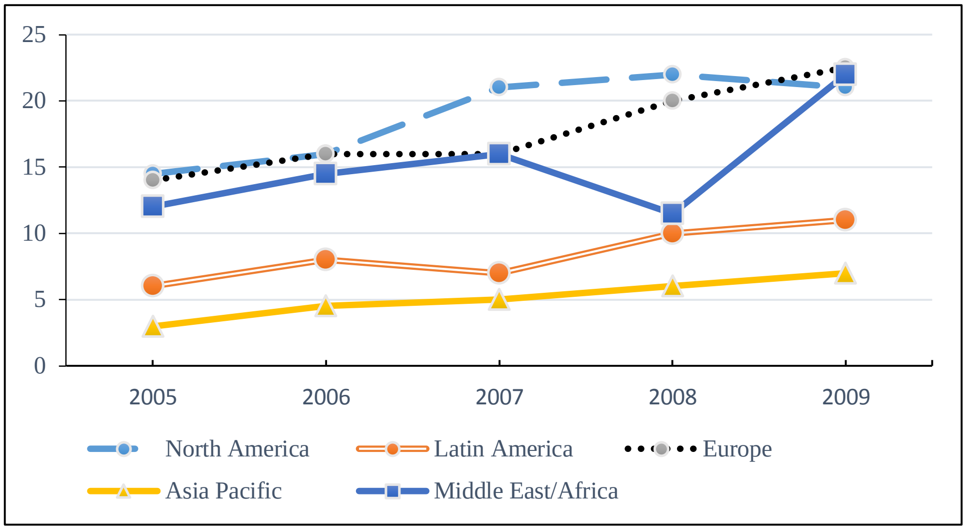
[1] Throughout the thesis, "PL" is used to represent "private label" and "NB" is short for "national brand".

Figure 1: PL Introduction Rate by Region



Source: Jago, D. (Mintel Corporation Group, 2009). The vertical axis represents PL introductions as a percentage of all product introductions (%).

For the main part of the twentieth century, retailers in North America were acting as price takers, rather than price setters since they were relatively small compared to large branded food manufacturers. The PL products were initially introduced by *Sainsbury* in 1869 in UK (Collins and Bone, 2008). As well, the great *Atlantic & Pacific Tea Company* (*A&P*) was partially built upon its *8 O'Clock Coffee* in the early 1900's (Collins and Bone, 2008). The success of *Sears & Roebuck* (now well-known as *Sears*) was partially attributed to its strategy of purchasing and developing its own brands (*Craftsman*, *Kenmore*, etc.), which are now still acting as key American brands (Paine, 2010). In Europe, introduction and proliferation of store brands helped significantly establish the successful retail empires of *Migros*, *Aldi* and *Tesco* (Paine, 2010). Especially after the 2nd World War, retailers began to expand into national, even international retail chains, which offered more opportunities to gain control over product prices and market power in the relationships with food manufacturers. In North America, grocery chains such as *Safeway* and *Kroger*, and wholesale and retail cooperatives such as *IGA* and *Certified Grocers*, were all prominent in the development and use of PLs during this period of time (Hoch and Banerji, 1993). As of the late 1990's, every major retailer had developed a reasonably competitive line of PL products (Grier, 2003). Viewed as a single brand, statistics released by *Selling Areas Marketing, Inc*. (*SAMI*), a marketing research company, indicated that PLs are the No.1 seller in 77 categories, out of more than 250, and one of the top three sellers in 41% of *SAMI* categories (Hoch and Banerji, 1993). Table 1 shows the PL sale shares for top ten U.S. food retailers in 2000.

Table 1: PL SKU[2] count and shares for Top Ten Food Retailers in US

Company	Total Sales	PL SKU count	PL Share
Wal-Mart	54200	5000	20%
Kroger	49700	6000	20%
Safeway	32500	3000	20%
Albertons' Inc.	21000	6000	16%
Ahold USA	28100	2000	20%
Costco	17700	500	7%
Delhaize America	14700	6500	17%
Winn Dixie Store	14323	2700	23%
Publix Super Markets Inc.	14100	1200	16%
A&P	10500	2300	23%

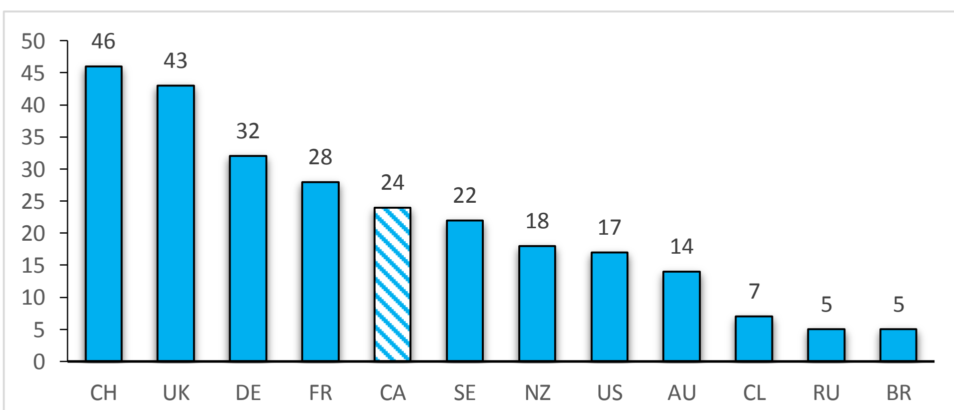
Note: Source: 2001 Report –Top 40 Supermarket/Wholesalers. *Private Label*, March-April 2001, pp. 27-32. Total sales are measured in millions.

In terms of PL penetration rate, Canada ranks either third or fourth behind some European countries and US, as shown in Figure 2. However, as shown in Figure 3

[2] SKU is short for Stock-Keeping Unit. It is a common retailer code to identify each unique product or item for sale in a store or other business.

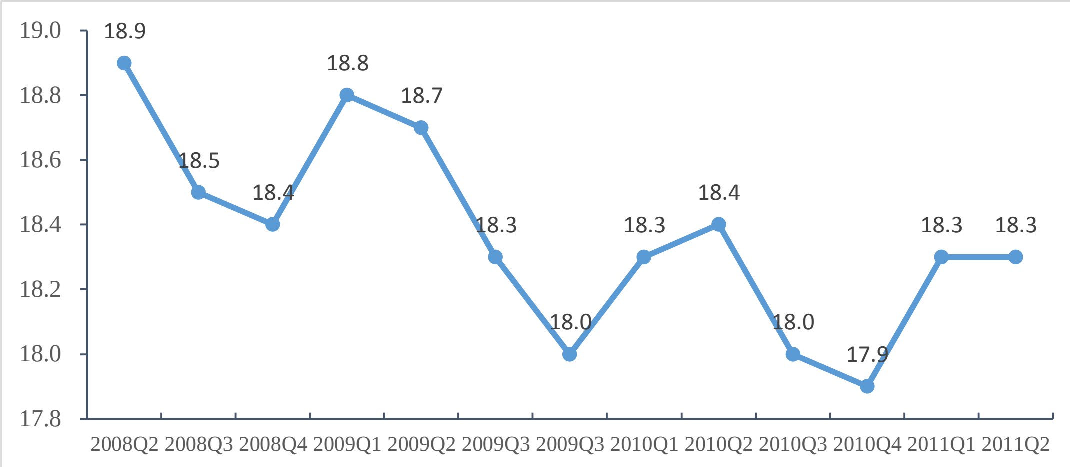
released by the *Nielsen Company* in 2011, Canadian PL sales growth rate already began to consolidate. The *Nielsen Company* also reports that PL sales share has went through a six consecutive slightly-decreasing years since 2005, when it stood at 19.3%. Therefore, retail experts argued that the penetration of PLs in Canada might have reached a stage of maturity (The Nielsen Company, 2011). However, Grier (2003) indicates that the PL sales are moving to the next plateau as increased understanding of cost and consumer demand lead to increased PL quality. Moreover, the *Nielsen Company* (2011) indicates that PL growing development and proliferation will definitely be a consequence of increasing Canadian retail concentration, with the top five retailers accounting for the majority of retail sales. Besides, *Agriculture and Agri-Food Canada* also shows that as baby boomers reach their retirement ages, consumers tend to seek health-related and wellness food and beverage to get rid of health problems. And also young consumers are increasingly aware of food health-related issues (Agriculture and Agri-Food Canada, 2010). In all, continuing growth of PL development in Canada can be expected in the following years.

Figure 2: PL Market Shares by Country (2009) (%)



Source: The Nielson Company (2011).Country abbreviations: CH (Switzerland), UK(United Kingdom), DE (Germany), FR (France), CA (Canada), SE (Sweden), NZ (New Zealand), US (United States), AU (Australia), CL (Chile), RU (Russia), BR (Brazil).

Figure 3: Quarterly PL Dollar Share in Canadian Retail Market



Source: The Nielsen Company (2011).

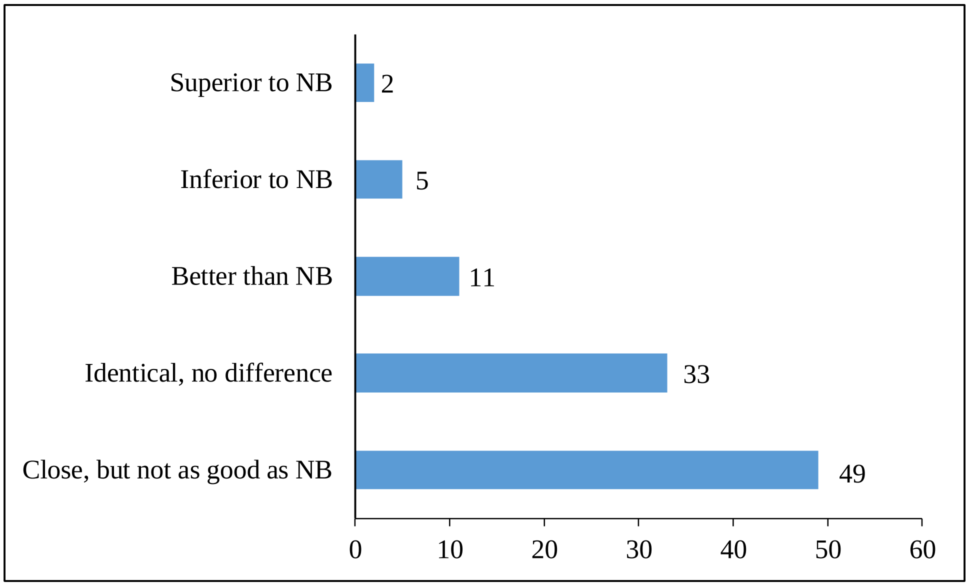
1.2 Quality Differentiation of PLs over Time and Consumers' Attitudes

When first introduced PLs were generic, commodity-based products developed to undercut higher-priced traditional NB products (Agriculture and Agri-Food Canada, 2010), PLs often sacrificed quality to reduce costs and appealed primarily to lower-income consumers. Today, generic, commodity-based products still account for roughly 30% of total PL sales and provide price discounts of up to 40% compared to their NB competitors (Colins and Bone, 2008). According to a report released by the *Nielsen Company* (2011), on average, Canadian PL products are priced 28% below NBs, almost 36% below regular NB prices. However, this gap reduces to just 19% during temporary price reductions. In the 1980s, "me-too", or "copy-cat" PL lines were introduced by simply mimicking name brands in terms of product quality as close as possible. These brands have similar product quality with NB offerings, also usually put side-by-side on shelves to NBs to capture consumers' attention. During the 1990s, retailers first began to introduce premium quality-differentiated PL products, targeting consumers with preference for higher-quality products, and with willingness to pay higher prices. Premium PLs tend to be present in categories where a store's product developers can add value and have access to cooperative manufacturers (Grier, 2003). This can increase consumer loyalty and increase marketing margins for retailers. *Information Resources Inc.* (*IRI*), a Chicago-based marketing research company, argues that by expanding into three-tiered PL lines, retailers can reach a much wider consumer base and gain effective control over products' quality offerings.

As the majority of retailers have developed their multi-tier PL portfolios, some retailers began to bring about more quality differentiation to stand out in the increased horizontal and vertical competition. Most of the innovation happens in the health-related attributes since they are watched over more often than ever by consumers. For instance, retailers tend to provide products with reduced "bad for you" nutrients and offer specific health-related claims, such as "*Reduced Fat*", "*No Sugar"*, "*25% Reduced Sodium*", in products' front-labels to highlight health benefits. Moreover, the introduction of natural and organic products has been another PL innovation by retailers since they fit well with retailers' efforts to position themselves as the source of fresh and wellness products, especially in food categories (The Nielsen Company, 2011).

Increased quality for PL lines has resulted in a wide acceptance of PL products among consumers. A recent survey conducted by the *Nielsen Company* in the U.S. and Canada indicates that 75% of shopper surveyed see PL products as "good alternatives" to NBs, 66% see store brands as of "equal quality" to NBs and more than 40% believe that "some PL products had better quality" than NBs (The Nielsen Company, 2011). Figure 4 summarizes similar survey results released by the *Hartman Group* (2006). Almost 33% of respondents see no absolute difference between PLs and NBs, and 49% regard PLs as close to NBs in terms of quality. These survey results suggest that from the perspective of many consumers, the quality gap between PLs and NBs is narrowing, or even closing. PLs are growing to become close substitutes for NBs in many consumers' shopping decisions.

Figure 4: Survey Results for Gap between PL and NB



Source: The Hartman Group (2006). The horizontal axis illustrates the % of respondents choosing the respective answer when asked how similar PLs were to NBs in quality.

The household penetration rate of PL products among Canadian family households is essentially 100%, with consumers buying PL products during every grocery shopping trip (Grier, 2003). According to data released by the *Nielsen Company*, the top ten PL departments in Canada in 2010 were: refrigerated dairy [$134 per household per year], frozen foods [$121], prepared foods [$58], condiments/sauces [$45], bakery goods [$56], snacks [$55], UPC-coded produce [$49], beverages [$57], paper products [$32], and baking ingredients [$29] (The Nielsen Company, 2011). According to Hoch and Banerji (1993), the market shares of PL products can be closely linked to the overall economic condition. The authors' model results showed that changes in the share of PLs are inversely related to changes in disposable income (Hoch and Banerji, 1993). Statistics indicate that lower income households have a higher tendency to purchase PL products (The Nielsen Company, 2011). However, this trend has shifted and today consumers across all socio-economic groups and levels of income purchase PLs (Agriculture and Agri-Food Canada, 2010). A study by *Datamonitor* (2008), a marketing research company, find that consumers, regardless of income level, are trading down, increasing PL consumption and giving up their favorite brands in response to deteriorating economic conditions.

1.2 Economic Problem

Retailers' development of multi-tier PL portfolios and innovation in PL's characteristics[3] (mainly in health-related attributes) facilitate the products' heterogeneity in retail markets and significantly foster both vertical and horizontal products' differentiation. Consequently, for the majority of categories, retail markets are highly differentiated in terms of product characteristics so that traditional economic theories dealing with perfectly homogenous goods are not theoretically and empirically applicable. In empirical models dealing with differentiated product oligopolies, retailers are often assumed to behave as price-setting oligopolists, as such retailers are assumed to control products offerings, brand proliferation, price setting, shelf positioning, and in-store brand promotion. In addition, as noted by Anderson, de Palma and Thisse (1989), and Pinkse, Slade and Brett (2002), in segmented retail markets, retailers tend to be less competitive in their localized markets and competition is often not symmetric.

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[3] Throughout this thesis, the terms "characteristic" and "attribute" will be used interchangeably.

On the other hand, manufacturers are also acting as oligopolistic price-setters in the upstream manufacturing markets (Stein, 2004). They tend to exert their market power in determining wholesale prices, product offerings and NB proliferation relative to retailers. As retailers continue developing their PL lines into store shelves, competition between retailers and manufacturers ranges completely from contracting wholesale prices to placing products in store shelves. Retailers are now starting to squeeze market shares and profits directly from upstream suppliers, rather than merely act as name brand manufacturers' downstream partners, and manufacturers have to find counter-strategies in order to keep their market shares and profits from running away to not only competing manufacturers but also their downstream cooperative retailers. In other words, the introduction of multi-tier PL portfolios by retailers (e.g. premium quality PLs) has intensified the oligopolistic competition between retailers and manufacturers, thus bringing about changes in the structure of retail markets (Sudhir, 2002; Chintagunta, et al., 2002; Stein, 2004; Richards, Hamilton and Patterson, 2010). The changes resulting from the introduction of PL lines are interesting economic problems for many economists that need to be theoretically and empirically investigated.

The first economic problem relates to the impact of the introduction of PL lines on the competition between retailers and name brand manufacturers in general, and on market share in particular. Many studies have confirmed that the primary function of PLs for retailers is to create competitive pressures on NBs, to increase retailers' gross margins, increase consumers' store and chain loyalty and gain better bargaining positions and power in negotiations with branded food manufacturers (NB producers) (Hoch and Banerji, 1993; Mills, 1995; Mills, 1999; Sayman, Hoch and Raju, 2002; Meza and Sudhir, 2010). Moreover, several studies have investigated the factors that influence the competitive interactions between PLs and NBs. For instance, Sayman, Hoch and Raju (2002) argue that by closely mimicking characteristics of the leading NB products, "me-too" PLs can help retailers reduce the uncertainty of acceptance in the downstream consumer market. However, Richards, Hamilton and Patterson (2010) show that merely locating PL products close to their NB substitutes in attributes space can be less effective at differentiating one retail chain from another. In other words, PL product lines can be an important tool for intra-retailer competition and also vertical differentiation (Steiner, 2004). Unfortunately, few studies have been devoted to discuss how vertical interactions and competition between retailers and manufacturers (market power and market share, etc.) are affected by the introduction of PL lines (Hoch and Banerji, 1993; Bontems, el al., 1999; Cotterill, et al., 2000; Sayman, et al., 2002). In addition, even though some spatial competition models have been put forward to estimating the competition between retailers and upstream manufacturers, as well as competition between retail banners (Ben-Akiva and Palma, 1989; Anderson, Palma and Thisse, 1992; Berry, 1994; Berry, Levinsohn and Pakes, 1995; Nevo, 2001; Smith, 2004; Richards, Hamilton and Patterson, 2010), empirical studies that focus on estimating the degree of spatial PL competition are rare (Richards, Hamilton and Patterson, 2010).

The second economic question will be factors that have significantly affected the spatial competition. Several factors have been investigated by previous studies that affect the competitive success of PLs against NBs (Hoch and Banerji, 1993; Abe, 1995; Bontemps, et al., 1999; Cotterill, et al., 2000; Choi, 2004; Benedict, et al., 2010; Richards, Hamilton and Patterson, 2010; Pepe, et al., 2011). For instance, by using superstore sales data for 40 product categories in Spain, Suarez (2005) finds that there is a positive relationship between shelf space allocated to

PLs and their overall market share. In contrast a factor that has been less researched in the retail industrial organization literature is the impact of more recent and intricate trends in product differentiation following shifting consumer preferences in favor of high quality products. Consumers across North America are becoming more aware and concerned about health and nutrition. Survey data by *Mintel* (2011), an international marketing research company, shows that 67% of respondents states that they choose healthier food to stay well, among which 31% do so to lose weight, and 30% eat healthier food to maintain their weight status. Due to increasing health-related concerns and changing lifestyles, consumers are also becoming more selective in their shopping decision, resulting in the rapidly growing sales of health-differentiated products (Schroeter and Foster, 2004). For instance, consumers are increasingly paying attention to the Nutrition Facts Table information. Neuhouser, Kristal and Patterson (1999) find that most of their survey respondents stated they read labels all the time, and of those 21% indicated that they always read the nutrition fact tables. The study also finds that the most frequently-read component in the Nutrition Facts Table is fat content, followed by calories and cholesterol. Neuhouser, Kristal and Patterson (1999) conclude that consumers tend to judge the value of food products based on their assessment of the specific health-related properties contained by each product. Thus differences in the nutritional composition and other attributes relevant to consumers' purchase decision can be regarded as important factors in the competitive interactions between PLs and NBs.

To cater to consumers' increasing demand for health and wellness in food products, manufacturers have done much to introduce new and health-differentiated products, and maintain consumer trust and brand credibility through new labeling systems. For instance, since December 2007, it was legislated in "Food and Consumer Safety Action Plan" for manufacturers to include nutrition facts, ingredients lists and some other nutrition claims (nutrition content claims and general health claims) on their food labels so that nutrition labelling becomes mandatory for all prepackaged food in Canada (Health Canada and Canadian Food Inspection Agency, 2010). For example, despite a few exceptions, it is mandatory for all pre-packaged food to include Nutrition Fact Table on front of labels, indicating the amount of 13 core nutrients[4] and calories, as well as "% Daily Value" for consumes to better manage daily diets. More importantly, innovation in nutritional properties has been a major concern for many food manufacturers in order to attract the attention and demand from health-oriented consumers. A report by *Agriculture and Agri-Food Canada* (2009) revealed that around 32% of branded food products (PLs and NBs) in the Canadian retail market carry at least one health-related product attribute or label. For instance, in the canned soup market, a highly differentiated category, many products feature "low sodium" contents on front-of-package labels (Mintel, 2011). Even though PLs tended to be considered lower-priced alternatives of relatively lower quality, major retailer PL lines have expanded into health-differentiated product lines and labeling schemes. For instance, Canadian retail PL lines "*President Choice Blue Menu*" (Loblaw's) and "*Eating Right*" (Safeway's) products are good examples in North America. Thus, it can be said that greater choice of health-related attributes in PLs and their NB counterparts may have had a considerable influence on consumer demand, and on the competitive interactions between brands, thus leading to shifts in the distribution of brand market shares. However, few economic studies have estimated the effects of product differentiation through ingredient formulation on the demand of PLs and

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[4] These thirteen nutrients include fat, saturated fat, trans fat, cholesterol, sodium, carbohydrate, fiber, sugar, protein, Vitamin A, Vitamin C, calcium and iron.

on the vertical NB competition in the retail market. Even though theoretical and empirical methods to identify the nutritional location of product in a market are available (Pinske and Slade, 2004; Pofahl and Richards, 2007; Richards, et al., 2010), their application to issues of product differentiation and competition between PLs and NBs is lacking to date. Reliable empirical estimates of the role and impact of health-related attribute differentiation of PLs on vertical PL-NB competition is able to not only provide new insights into the strategic interactions of PLs and NBs in today's competitive retail environment but also advance academic research in the areas of brand competition and retail industrial organization more broadly.

As discussed in Section 1.1 (page 6, Figure 2) , the Canadian retail market enjoy a comparatively low PL penetration rate; yet, Canadian consumers show relatively strong preferences for PL products, due to not only their low prices, but also their comparatively high quality-price ratio relative to their NB competitors (The Nielsen Company, 2011). Especially during periods of economic down-turn or recession, consumers tend to become more price-sensitive, shifting brand preferences and market shares towards PL products (Akbay and Jones, 2005). As indicated by Grier (2003) and the *Nielsen Company* (2011), Canadian PL market would reach its next development stage as retail concentration increases and retailers continue to innovate in PL quality differentiation. Unfortunately, few studies have focused on the Canadian retail competition between PLs and NBs. This study would contribute to the literature by exclusively focusing on the Canadian retail market and revealing current trends in the under-researched Canadian retail market.

1.3 Thesis Objective

The objective of this thesis is to analyze the role and impacts of PL usage and its quality differentiation on a retailer's ability to exert horizontal and vertical market power. The specific focus of this analysis is on the extent of PL and NB product differentiation in observable product attributes, including nutritional and other brand properties. An important part in achieving this objective is the estimation of a model of spatial competition on demand and supply, between differentiated PL and NB products, while explicitly considering the degree of product differentiation based on observable product attributes.

To better understand the extent of PL differentiation in the competition between retailers and manufacturers, this study will:

1. Analyze statistically the demand, pricing, promotional strategies, and degree of differentiation in product-level nutritional composition (e.g. sodium) of PL and NB products;
2. Quantify the impact of PL usage and product differentiation on the demand for competing PL and NB products;
3. Investigate the impacts of PL usage on the margins for both retailers and upstream manufacturers; and,
4. Determine changes in the distribution of brand/manufacturer pricing power resulting from PL usage and its impact on the vertical competitive interactions between retailers and brand manufacturers.

The analysis in this thesis builds on a nested logit model (NML) framework of individual consumer choice behavior (McFadden 1978; Berry 1994). To investigate the issue of PL differentiation in nutritional properties and spatial competition with NB manufacturers, we estimate a brand-level demand system for the highly differentiated category of canned soup in the Canadian retail market. The issue of brand-level product differentiation is modeled after Pinske, Slade and Brett's (2002) Distance-Matrix (DM) approach[5] which allows the researchers to identify the location of individual PL and NB products in the respective attribute space (nutritional/ingredient composition, brand, manufacturer, store, flavor, etc.)[6]. The empirical analysis combines the estimation of a nested-logit brand-level demand model with a multi-product retailer and manufacturers' Cost-Price Margin (CPM) functions to quantify a multi-product retailer and NB manufacturers' pricing behavior in the canned soup market. Gross margin data will be derived from model estimates in order to quantify changes in the distribution of vertical market power between the retailers and upstream manufacturers as a result of PL usage in the Canadian canned soup market.

The analysis is based on two sets of proprietary database. The retail store-level scanner data is made available by the *SIEPR-Giannini Data Center* at *University of California, Berkeley*. The data contains sales information at the *UPC*[7] level across Canadian stores for a major U.S.-based retail chain (UPC price, discounts, sales quantity, UPC wholesale price, retail gross and net margins) for the period of week 1 of 2004 to week 22 of 2007 (a total of 178 weeks). The second proprietary source of data is the *Global New Products Database* (*GNDP*) by *Mintel* (2013). The *GNDP* database consists of detailed retail product information, for products sold in the Canadian and U.S. markets: brand, manufacturer, nutrition facts, ingredients, on-package labeling, etc.), which we use to obtain information on the

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[5] The Distance-Matrix (DM) approach will be discussed in more detail in Section 3.2.
[6] In the rest of the thesis, the approach will be called DM/NML.
[7] Universal Product Code (*UPC*) is barcode system widely used in U.S., Canada, New Zealand, Australia, UK and some other countries to track trade items and store inventory. Some more detail about *UPC* will be provided in Chapter 4.

nutritional composition (e.g. sodium, calorie, fat contents, and other observable attributes) for each PL and NB product considered in the analysis.

1.4 Thesis Organization

This thesis is organized into a total of eight chapters. The first two chapters offer an overview of the thesis research objectives and lay the foundation for the proceeding chapters where the theoretical model, empirical model results, and discussion are presented. Following the introduction on the background covering the historical development and current trends in retail PLs across North America, Chapter 1 also talks about the economic problems that are the foundation of this thesis as well as its focus, and research objectives. Chapter 2 then presents a review of previous, relevant literature on retail PLs, PL-NB competitive interactions, and particularly brand and product differentiation in grocery retailing.

Chapter 3 provides an overview of the theoretical model framework employed in this thesis. This includes the derivation of the brand-level demand model based on the DM/NML framework and pricing equations for a single multi-product retailer and NB manufacturers in the Canadian canned soup market. A sub-chapter is dedicated to the Distance-Matrix (DM) approach, which is used in this thesis to identify the location of PL and NB brands in their respective attribute space.

Chapter 4 describes in more detail the two proprietary sets of data used in the empirical analysis, and describes statistically the Canadian canned soup retail market, together with summary statistics for sub-sample data used in the empirical model.

Chapter 5 outlines the empirical estimation strategy and procedures, including the choice of instrumental variables. Chapters 6 presents the estimation results and discussions. Chapter 7 summarizes analysis of this thesis and also provides some implications for policy makers, academia and recommendations for retailers and manufacturers. Finally, Chapter 8 concludes the thesis with last remarks, as well as summary of all contributions made by this thesis and further extensions that could be used in future research.

Chapter 2 Literature Review

In this chapter, we review the literature on PL and NB competition. First, the significance of carrying PL lines for retailers in the retail grocery will be investigated. This section will review PL's effects on retail prices of incumbent products and the competitive advantages for retailers to carry PL lines. Second, vertical competition between PL and NB products will be discussed, mainly in terms of pricing, promotion and other competitive interactions. Third, recent developments in PL's quality differentiation towards NB products will be described.

2.1 Significance of PL on Retail Grocery

PLs have been developed by retailers to compete with upstream manufacturers on store shelves, which increases retail competition within stores. The direct significance of PL introduction on retail grocery is the changes in the retail prices of incumbent NB products. Industrial organization theory predicts that the introduction of new products into the market will lead to an increase in competition, with the consequence that prices for existing products decrease in order to keep market share. A number of studies confirm that PL introduction results in decreased prices of incumbent NB products (Petrin, 2002; Hausman and Leonard, 2002; Chintagunta, Bonfrer and Song, 2002; Bonfrer and Chintagunta, 2003; Bergman and Rudholm, 2005; Pofahl and Richards, 2009). For instance, Chintagunta, Bonfrer and Song's (2002) analyze oats products category based on store-level data and show that the introduction of PL oats products leads to a decrease in the price of established NB products and to an increase in NB promotional activities in the ready-to-eat breakfast cereal market. The authors conclude that the introduction of PL oats products positively affects consumer surplus. However, some of other empirical studies also find increased retail prices could be the consequence of the introduction of PL products into retail grocery (Frank and Salkever, 1997; Ward, Shimshack, Perloff and Harris, 2002; Bontemps, 2005; Gabrielsen, Steen and Sørgard, 2002; Bontemps, Orozco and Requillart, 2008). For example, the empirical research on the US markets by Bontemps, Orozco and Requillart (2008) shows that the introduction of a generic products or low-priced PLs frequently causes an increase in the prices of incumbent products. The manufacturers of generic products or low-priced PLs can attract switching consumers who have high price-sensitivity and low brand loyalty, while incumbent brands concentrate on the inelastic part of the demand function, which explains the price increase (Bontemps, Orozco and Requillart, 2008). In addition, Gabrielsen and Sørgard (2007) use a theoretical model to prove that in some cases the introduction of PLs may lead to higher retail prices for NBs, which can be detrimental to consumer welfare as well as total welfare.

Effects of PL lines on price changes for incumbent NB products are less obvious, while advantages of carrying PL have been analyzed greatly by empirical and theoretical studies (Hoch and Banerji, 1993; Mills, 1995; Bergès, Bontems and Réquillart, 2004; Bontemps, Orozco, Requillart, 2008, etc.). As reported in a French survey by LSA/Frontier (1996), the main reason developing PLs is to increase customer loyalty (16%), to improve their positioning (18%), to improve margins (25%), and to lower prices (3%).

The first objective of PL lines for retailers is to build and reinforce customer loyalty and horizontally differentiate retailers' products from those sold in other retailers.[8] Leading supermarkets chains are able to establish at least some brand loyalty for their own brands by continuously increasing PL varieties (e.g. multi-tier PL portfolios) and PL quality differentiation. For instance, generic PL is aimed at consumers who have low price sensitivity and premium PL at high brand-loyalty consumers. In addition, nowadays, store names or logos are always included in the PLs so that it can be easy for consumers to identify the products in which way PL products are differentiated from their competitors. By carrying the retailers' own name or logo in the PLs, private labels supplement a retailer's image and strengthen its relationship with consumers (Pepe, Abratt and Dion, 2011). For example, North America retail chain company *Trader Joe* carries all its PLs under its store name, such as *Trader Giotto*'s for Italian food, *Trader Ming*'s for Chinese food and *Trader Josef*'s for bagels. In addition, PL also acts as an effective tool to differentiate themselves from products sole in other retailers. Since PL products are sold and operated under a specific retailer, the supply of products in the markets will be no longer identical. This is especially the case in the food sector, where exclusive agreements are infrequent. In the absence of PLs, retailers always sell identical products. As PLs are specific to each retailer, their introduction thus enhances differentiation between retailers, and acts as a way to keep brand-loyal consumers in the market (Bergès, Bontems and Réquillart, 2004).

Another important objective for retailers is to increase their bargaining position when negotiating vertical supply contracts with national manufacturers. Retailers are not only customers of national manufacturers, but also upstream suppliers for consumers in the downstream market. They have strong control over promotional

[8] Customer loyalty is defined, for instance, by Huddleston, Whipple and Auken (2004) as "creating the strongest possible relationship between the retailer and customer, so that people feel they will miss something if they go to another place".

activities and shelf space placement. Scott-Morton and Zettekmeyer (2000) use a bargaining framework model to show theoretically that the strategic positioning of a PL in a category increases the bargaining over supply term between a retailer and NB manufacturers by placing the PLs side-by-side with NBs and mimicking the product characteristics of NBs. This finding is consistent with a number of other studies (Schmalensee, 1978; Corstjens and Lal, 2000; Sayman, Hoch and Raju, 2002). However, Sayman, Hoch and Raju (2002) argue that, in order to maximize the retailers' profits, they should target the leading NBs in the markets since retailers also make large part of money by selling the NBs. Furthermore, premium PLs act as an important tool for retailers to negotiate with their upstream suppliers, who are often big market monopolist or oligopolies. The interview conducted by Morton and Zettekmeyer (2002) shows that a former high-level marketing executive for the *Coca-Cola*, an oligopolist in the shelf stable drink and juice market, told them that *Coca-Cola* lowered significantly the wholesale prices of its products in response to the introduction and aggressive shelf placement of a premium store brand by a large supermarket chain.

Finally, perhaps the most important and fundamental significance for retailers is to increase their profits, or margins. Kumar and Steenkamp (2007) estimate that retailers' gross margins on PLs are on average 25 to 30% higher than that for NBs. On one hand, since retailers are able to place their PLs side-by-side with similar NBs (Sayman, Hoch and Dhar, 2002), always highlighted with their lower prices, they cost less on the promotional activities and marketing expenses. On the other hand, economic theories indicate that retailers can get higher margins in selling PLs by reducing double-marginalization problems (Tirole, 1988)[9]. The double marginalization problem occurs since manufacturers and retailer set their

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[9] See Tirole (1988) for detailed discussion of double-marginalization.

wholesale prices and retail prices, respectively, above their marginal costs, which leads to the fact consumers buy products at a price higher than the monopoly price (Bontems, Monier-Dilhan and Réquillart, 1999; Bergès, Bontems and Réquillart, 2004). By developing and selling PLs, retailers are able to integrate vertically and set retail prices based on the actual marginal costs of production and distribution, which significantly lowers the retail prices, at the same time increasing retailers' margins (Mills, 1995). This is consistent with the finding in the empirical study conducted by Cotterill (1999) and Cotterill and Putsis (2000) in the food industry. Through vertical integration with manufacturers, retailers increase their vertical market power over contract manufacturers and gain a tool to internalize the manufacturing margins (Richards, Hamilton and Patterson, 2010).

However, PL may also result in some insignificance for the retail grocery, especially in the long run. For instance, since Scott-Morton and Zettekmeyer (2000) suggest that retailers should place the PLs side-by-side with NBs and mimic the product characteristics of NBs to gain more vertical bargaining power, Bergès, Bontems and Réquillart (2004) indicate that some PLs are clearly free riding on R&D efforts from national manufacturers, thus discouraging efforts devoted to the development of new products in the long run. This will lead to increased competition due to less product differentiation between retailers, thus lowering retailers' profits (Bergès, Bontems and Réquillart, 2004).

2.2 Vertical Competition between PLs and NBs

The introduction of PL lines has changed the competition between retailers and NB manufacturers on several dimensions. Retailers are now acting both as purchasers and competitors with upstream national manufacturers. Mills (1995) indicates in his model that PL marketing strengthens the retailers' hand in their dealing with the brand manufacturers, and improves their performance in the vertical structure. However, NB manufacturers have their own counter-strategies to compete with retailers in the downstream markets to maintain their market power (Mills, 1999).

2.2.1 PLs and NBs Competition in Price and Promotion

PLs and NBs compete, mostly, in prices. As such, the existing literature has paid most attention to the price competition between NBs and PLs (Hoch and Banerji, 1993; Mills, 1995; Bontemps et al., 2008; Stein, 2004; etc.). By integrating vertically, the PL products reduce the dead-weight loss that arises in double marginalization, thus leading to lower prices, which attract consumers from NBs. However, Borden (1942) indicates that setting the prices of PLs too far below that of competing NBs could be harmful since consumers will perceive a bad signal regarding quality. Steiner (2004) documents a lot of facts to demonstrate that, as a counter-strategy, the leading NBs are more likely to cut their NB product prices to counter their competition with the introduction of PLs. For example, as a response to a rise in PL market share during the period of 1988-1992 from 14.1% to 20.4%, in 1992, *Procter and Gamble* cut prices three times on its pioneer disposable diapers brand, *Pampers*, and in 1993, cut the price of its *Luvs* brand by 16% (Steiner, 2004). According to Sayman, Hoch and Raju (2002), retailers always position their PL products side-by-side with leading NBs. The price-decreasing strategy of NBs are able to narrow the price difference with PLs to attract consumers. However, some other empirical and theoretical studies find opposite strategies of NBs (Gabrielsen, Steen and Sørgard, 2002; Ward, et al., 2002; Bonfrer and Chintagunta, 2004; Bontemps, Orozco and Requillart, 2008). For example, Ward, Shimshack, Perloff and Harris (2002) analyze the strategies of PL introduction by retailers in 32 food categories about how NBs react to PL introduction for each category. They show that with an increase in the PL market share, the NB manufacturers tend to increase their NBs' prices to compete, with a decrease or no change in the average prices. Also, some studies found mixed reactions. Bonfrer and Chintagunta (2004) analyze a data set from 5 stores containing 104 categories over a period of 104 weeks to determine the effect of PL introduction on leading NBs' prices, which tend to fall following the entry of a PL. Store brand entry raises the prices of incumbent NBs half of the time, especially in categories without a dominant NB, perhaps to increase the retailers' profit by encouraging consumer trial of its PLs. This is consistent with findings by Bontemps (2005) and Gabrielsen and Sørgard (2007). Gabrielsen and Sørgard (2007) indicate that these reactions by NB manufacturers are in line with the idea that, NBs are targeted towards brand-loyal consumer, and PLs are targeted toward "switching consumers" who have higher price sensitivity. They conclude that leading and nationally-distributed name brands have a higher probability to increase their prices to compete with introduction PLs since they have a large number of brand-loyal consumers. Regional brands, also known as fringe brands, which are distributed in a restricted region tend to decrease their prices in most of the categories analyzed in their study. In addition, Cotterill and Putsis (2000) argue that price cuts by PLs and leading NBs bring about asymmetric effects on them. They show that NB manufacturers' price cuts hurt PLs more than PLs price cuts hurt the NBs. Moreover, in this case with price cuts for NBs and PLs, consumer have higher consumer surplus.

Besides, price cuts by national manufacturers and retailers are, in numerous cases, mainly conducted by promotion activities. Volpe (2010) argues that PLs are promoted, in the weekly flyers and the television advertising, more frequently than NBs. The PLs are always promoted. In Volpe's dataset, nearly 7200 unique products are on promotion at least 85% of the time during his data collection. Cotterill and Putsis (2000) conclude that feature advertising in local media, display and point of sale (POS) are an effective tool for retailers to increase PL sales. In addition, retailers develop two different effective strategies in general, everyday-low-price (EDLP) and high-low-price (HiLo). Under EDLP pricing, the retailers tend to set prices low and offer less promotion activities. Under HiLo pricing, the retailers always set high prices, and provide consumers with frequent discounts through regular or periodic sales and promotions. Dekimpe, Hanssens and Silva-Risso (1999) use unit-root techniques to show that promotional activities have temporary impacts on brands' sales and market shares. However, they further show that their cumulative impact is limited. PLs' brand promotions, on the other hand, can expand the market, and actually enhance the performance of NBs. Meanwhile, since NB manufacturers do not have control over the shelf display, they have less options of promotional activities. Coupon is an important role of price promotion for NBs to compete with PLs. Mills (1999) evaluates some of the counterstrategies that national manufacturers adopt to compete with PLs. He concludes that if the manufacturers have sufficient information on the consumers' preferences, optimally distributed coupons targeted toward consumers who otherwise would be most prone to buy the PLs are an effective way to combat PL marketing. They also show that randomly distributed coupons do not change the relative share of PLs and NBs. The coupon program constitutes a form of price discrimination that would ambiguously improve the performance of the vertical structure (Mills, 1999).

2.2.2 PLs and NBs Competition in Shelf Space Allocation

The NBs and PLs also compete in the shelf space of retailers, which is often considered to be retailers' scarce resource. Many studies have been devoted to the importance of the allocation of scarce shelf space for marketing success (Drèze, Hoch and Purk, 1994; Urban, 1998; Nogales and Suarez, 2005; Suarez, 2005; etc.). Suarez (2005) analyzes data from 40 product categories in a Spanish sample and finds that there is a direct relationship between the space occupied by PLs and their market shares. Although leading NB manufacturers continuously offer retailers various incentives to obtain preferred positions on their shelves, retailers still have "the final say as to the location and space accorded to the various leading NBs and their own PLs on the store shelves and fixture" (Steiner, 2000). Retailers do not have to pay slotting allowances to obtain distribution on the retailers' shelves (Hoch, 1996). Nogales and Suarez (2005) conduct a fieldwork in 2003 in 26 Spanish outlets selling PLs in their stores. They find that the PL is the only one on the shelves in some outlets, occupying all the space devoted to the products. It occupies more than 75% of the space in some other outlets and categories. On average, the space occupied by the PLs varies between 18% and 36%. In some chains, the space occupied by PLs is twice as large as the space occupied by the average of the established name brands. This finding is consistent with that of Agustin and Iniesta (2001) which reveals that retailers support their PLs in the shelves by devoting more space non-proportionally with their market shares. However, there also exits a so-called "maximum shelf point" with the PLs. This indicates that the retailers, generally, cannot allocate all their shelf space to their PLs. The "overmerchandizing" of own brands by retailers can penalize the global profitability of the category (Nogales and Suarez, 2005). This is remarkable in categories where there are one or more leading NBs with great market shares and consumer reputation so that the retailers should allocate more space for these name NB brands. If they do not allocate enough space for the leading NBs, they will lose sales and profits, as well as consumer loyalty. Since retail shelf space is valuable real estate for retailers (Drèze, Hoch and Purk, 1994), NB manufacturers do not have direct control over the product shelf space allocation. The national manufacturers should try to choose a collaborative strategy rather than a confrontation with retailers, especially in promotions and when new products are introduced onto the shelves (Nogales and Suarez, 2005).

2.2.3 PLs and NBs Competition in Quality Differentiation

PLs and NBs are also competing strongly in the product quality, which is one of the fundamental concerns for consumers. Improved product quality, as accepted by most marketing literature, is one of the determinant factors to attract consumers. Hoch and Banerji (1993) find six variables that can explain 70% of the variance in PL shares. The top two variables for PLs' market shares are PL quality and quality variability relative to the NBs. This can explain the reason that retailers started to introduce "me-too" products since 1980s and premium PL products since 1990s, which have much higher quality relative to generic PL products. However, as Sayman, Hoch and Raju (2002) point out, the optimal strategy for the retailers is to position their products as close as possible to the stronger NB as most of PLs are simply copies of successful leading NBs. The staff in retailers who are in charge of PL operation approach a PL supplier with merely product specifications and a target price (Steiner, 2004). In addition, since retailers stock and sell hundreds of categories in their stores, even the largest retailers cannot afford first rate R&D staff, nor can PL producers, who are typically forced to sell products to retailers at very thin markups over variable cost (Steiner, 2004).

Thus, it becomes more difficult and less viable for retailers to have product quality improvement first and innovation in the product differentiation. Product innovation or differentiation is one of the most important tools for NB manufacturers against PL introductions. Steiner (2004) argues that a major innovation by manufacturers "leaves the category's PLs in the unfortunate position of imitating yesterday's favorites". PL growth can also be dampened by a continuing program of small improvements. Mills (1999) points out that the principal manufacturers' tactic to widen quality gap between NBs and PLs is to improve their product in some way that raises a barrier to imitation by the retailers. Barriers may be rooted in uncertain imitability, intellectual property protection, or reputational considerations (Mills, 1999). However, the NB manufacturers need to invest in product-specific research and market investigation to introduce and improve these barriers. Unfortunately, since most studies take the quality of NBs as exogenous, we cannot study the optimal choice of quality for name NB manufacturers (Bergès, Bontems and Réquillart, 2004). But, a lot of examples has been devoted to emphasizing the competition between NBs and PLs in the product quality (Narasimhan and Wilcox, 1998; Mills, 1995; Mills, 1999; Steiner, 2004).

2.2.4 PLs and NBs Competition in Brand Advertising

Finally, PLs and NBs compete severely in the brand advertising. Advertising plays a very important role in the competition between PLs and NBs, often strategically used by NB manufacturers who cannot risk modifying a product's physical quality "in fear of consumer backlash" (Parker and Kim, 1997). Sutton (1991) argues that advertising expenditure could generate a barrier to deter the entry of PLs. In some categories with one leading strong NBs, retailers find it difficult to introduce any

PL products, even at much cheaper prices, since the NBs advertise their brands so strongly that consumers refuse to accept any other brands (Borden, 1942; Parker and Kim, 1997; Abe, 1995; Cotterill and Putsis, 2000).[10] And recently, a number of studies have shown that there is an inverse relationship between NB advertising expenditures and PL shares (Hoch and Banerji, 1993; Abe, 1995; Hoch, 1996; Dhar and Hoch, 1997; Cotterill and Putsis, 2000; Ward, Shimshack, Perloff and Harris, 2002; Steiner, 2004; Tuner, 2010). Even though advertising expenditures could be a major cost for name NB manufacturers, this can be offset by creating tremendous sales for them. On the other hand, PLs are considered to be in disadvantageous condition compared with NBs, since retailers always carry hundreds of categories in their stores. They cannot afford to advertise their PLs strongly in the print, television ads, and other advertising channels. As well, Halstead and Ward (1995) argues that more expenditures of PLs in brands' advertising, packaging, sales promotion would result in the higher average retail prices and/or lower gross margins for retailers. Thus, the advantages of PLs to both consumers and distributors will diminish, illustrating the historical "wheel of retailing"[11] (Halstead and Ward, 1995). That is why we find most of the advertisements for PLs in store flyers or catalogs. However, some large retail chains are becoming large brand advertisers for their PLs, including *Sears*, *Wal-Mart*, and *Carrefour*. Steiner (2004) believes that with *Wal-Mart*'s increasing focus on its PL program and its huge and growing volume of sales, it may well achieve scale economies to become an important PL advertiser in a number of

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[10] This result can be partially found in the drink category dominated by *Coca-Cola*. In 2010, *Coca-Cola* spent more than 2.9 billion dollars on advertising in print, radio, television and other advertising channels.

[11] Hollander (1960) explained that "Wheel of Retailing" is referred to a retail pattern: "retailers usually enter the market as low-status, low-margin, and low-price operators. Gradually they acquire more elaborate establishments and facilities, with both increased investments and higher operating costs. Finally they mature as high-cost, high-price merchants, vulnerable to newer types who, in turn, go through the same pattern."

local markets and perhaps nationally, as well. Online advertising provides an advisable channel for retailers to advertise effectively and at low cost. According to data released by *eMarketer*, a marketing research company, retailers were already the top-ranking category in online spending at 5.47 billion dollars in 2010. As consumers are increasingly researching online before they make final purchase decisions, the online advertising expenditures in search engine, store ads and online weekly ads can promote PLs successfully and help to compete with NBs.

2.2.5 PLs and NBs Competition in Other Dimensions

Moreover, competition between PLs and NBs also happens in other dimensions. For instance, NBs tend to differentiate themselves by providing more attractive and impressive value-added packaging (Qulech and Harding, 1996). They compete in the vertical structure to gain a greater share of incremental profits (Mills, 1999). However, Steiner (2004) points out that retailers and name NB manufacturers are in a mutual dependence structure in which profit of each is substantially dependent on that of the other. The mutual dependence structure not only softens the usually hard vertical bargaining, but also produces very high margins at both stages (Steiner, 2004). In some cases, competition between PLs and NBs results in an increase of consumer surplus since consumers can purchase their products at lower prices with higher quality.

2.3 PL Quality Differentiation

Information Resources Inc. (*IRI*) (2007), a marketing research company, reports that as PL products are now present in almost every category, there are fewer and fewer sectors that can be exploited by retailers in PL introduction. Thus, *IRI* (2007) suggests that retailers should expand their PL lines into three-tiered offerings[12] to differentiate their PL product from NB lines. Geyskens et al. (2010) argue that the "three-tied" PL differentiation follows a "good, better and best" approach: generic PL lines are manufactured to "economize on more expensive ingredients to reduce cost" (Geyskens et al., 2010) to attract price-sensitive consumers; "me-too" PL lines are aimed to mimic mainstream NB products in quality to act as mid-quality alternatives (Kumar and Steenkamp, 2007); premium PL lines deliver differentiated quality that is on par or even higher than high-quality NB products but are sold at relatively lower prices. Bontemps et al. (2009) believe that "me-too" PL lines have the strongest effects on NB prices and competition between retailers and manufacturers since they enable retailers to offer value alternatives at a significantly lower price in order to gain consumers' trust and loyalty. However, Burt (2000) argues that since generic PL offerings have no quality-equivalent NB products, they are able to exert discounter threat to NB manufacturers by providing acceptable quality products at greatly-lower prices. This finding is confirmed by Kumar and Steenkamp (2007) and Bontemps et al. (2009). However, to the contrary, Geyskens et al. (2010) empirically show that the introduction of generic PL lines always increases incumbent NB products marker shares because these products become "middle points" in the retailers' category assortment.

In addition to three-tier differentiation, PL quality differentiation is also represented in features.[13] For example, in canned soup market, many of PL products are highlighted by their characteristic of "low sodium" on their front

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[12] The retailers' introduction of "three-tier" PL lines has been discussed in Chapter (pp. 5-6).

[13] Choi and Coughlan (2007) indicated that feature differentiation in PL refers to "the degree to which products have different forms, sizes or packaging". Feature differentiation can include some characteristics that "more is not always better" and where varieties are valued by consumers.

packages (Mintel, 2011), and salad dressing highlighted by the "*Gluten-free*" shelf tag and health claims on the packages. Contrary to three-tier differentiation, many retailers tend to minimize quality differentiation in features by making their PL products look particularly similar to their competing NB brands in terms of front packaging, size and labelling. This is in line with findings by some studies reporting that minimal differentiation in features for PL products is optimal for them to compete with incumbent NB lines (Raju et al., 1995; Sayman, Hoch and Dhar, 2002). For example, Sayman et al. (2002) add one PL brand into a market where two incumbent NBs are maximized in feature differentiation. They find that it is optimal for the retailers to minimize the features of PL and imitate the stronger incumbent NB in quality differentiation to maximize retailers' profits. However, Choi and Coughlan (2006) argue that the positioning of PL products in the attribute space relative to NBs depends on the nature of NB competition and its own characteristics. They find that if the incumbent NBs are undifferentiated in features, the optimal strategy for the retailers is to maximize PLs' feature differentiation.

The measure of quality differentiation in features has often been considered by address/location models (Anderson et al., 1989; Anderson et al., 1992; Feenstra and Levinsohn, 1995; Pinkse et al., 2002; Pinkse and Slade, 2004; Pofahl and Richards, 2009; Richards et al., 2010). Insight standing behind these models is that products can be regarded as a bundle of selected attributes (brand, flavor, ingredients, nutrient and packaging, etc.) and products can be located in the multi-dimensional attribute space. The size of the space occupied by products' attributes represents precisely their quality differentiation in features. For instance, Richards, Hamilton and Patterson (2010) adopt the Distance-Matrix (DM) approach, which was originally developed by Pinkse, Slade and Brett (2002), to estimate effects of product differentiation in features (store, brand, flavor and nutrient) on the vertical and horizontal competition between PLs and NBs in the ice cream category. They find that just locating PLs close to NBs in attribute space cannot significantly increase their retail margins. Instead, PLs' differentiation in brand, flavor and nutrient content helps retailers seize market shares effectively from upstream manufacturers.

Chapter 3 Model Development

One of the main objectives in this thesis is to investigate the competition between retailers and national manufacturers, considering product differentiation. Thus, both the demand and supply models for PL and NB products will be examined. First, the structural demand model for both PL and NB products, derived from the random utility model, will be estimated. More specifically, Distance-Matrix (DM) approach will be adopted to assess product quality differentiation. Second, cost-price margin (CPM) equations for both retailers and manufacturers will be estimated to compare their competition and market powers.

3.1 Brand-Level Demand Equation

To estimate the market demand for a particular selection of goods, researchers can choose from a series of well-established models. However, many of these models rest on the assumption of homogeneous goods. In grocery retailing, perfectly homogeneous goods markets are rare. Product differentiation is a common feature in almost every market section. Thus, empirical approaches to estimate the demand for highly differentiated products have received much attention in the economic literature (Hotelling, 1929; Chamberlin, 1933; Stone, 1954; Deaton and Muellbauer, 1980; Perloff and Salop, 1985; Anderson, De Palma and Thisse, 1989; Berry, 1994). However, many of these empirical approaches have a major challenge dealing with the product “dimension problem” (Nevo, 2001) that a large number of differentiated products need to be estimated (Deaton and Muellbauer, 1980; Berry, 1994; Nevo, 2001; Pofahl and Richards, 2009).

A lot of attempts have been made by researchers to circumvent the "dimensionality problem" (Nevo, 2001). All of these attempts are aimed at reducing the dimensions to make the estimation more flexible so that more products can be included in the model to better simulate the market structure. One of the most commonly-used approaches is the random utility model, such as the multinomial logit (McFadden, 1974), the nested logit (NML) (McFadden, 1978) and random coefficient logit (Berry, 1994; Berry, Levinsohn and Pakes, 1995; Nevo, 2000; Nevo, 2001). These models circumvent the "dimensional problem" by "projecting the products onto a characteristic space, hence making the product dimension the dimension of characteristics" (Nevo, 2001), instead of number of products. Moreover, the multinomial logit model suffers from the well-known "independent from irrelevant alternatives" (*IIA*)[14] problem for all the choice products which, in most cases, would lead to an unrealistic forecast (Train, 2003). Though the random coefficient (mixed) logit model circumvents the inflexibility by adopting an intuitive relationship between proximity in attribute space and competition with alternatives (Pofahl and Richards, 2009), it still lacks the direct consideration of attribute difference (Pofahl and Richards, 2009), and has a relatively high requirement for the data structure (Train, 2003) and computational complexity (Berry, 1994). Therefore, a nested logit model is comparatively appropriate for analysis of demand for oligopolistic differentiated product demand to circumvent the "dimensional problem" as well as get rid of traditional "*IIA*" property.

The random utility model based on nested logit (NML) framework depends on the assumption that consumers make hierarchical purchasing decisions. For example,

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[14] "Independent from Irrelevant Alternatives" (*IIA*) issue is always exhibited in multinomial logit model, which shows that substitution ratio between *i* and *k* is independent from any other alternatives other than *i* and *k*. See Train (2003) for detailed description of "*IIA*".

since shopping trips always involve significant search and travel cost, consumers first choose what to buy and then decide among the available superstores, outlets or convenient stores. Then consumers tend to choose among brands and product types (e.g. flavors) to decide which specific product to buy. It is natural for us to follow this hierarchical step for consumers since it is easier for consumers to substitute among brands and flavors within a store than among stores within brands and flavors.[15] Figure 5 shows the nesting structure assumption in product line for the case of the canned soup category. It is assumed that when it comes to purchase food category for consumers, they tend to choose product type (e.g. flavors) first and then decide which brand to go. Market survey statistics by *Mintel* (2013) show that in the soup category, the top three important attributes assigned by consumers are price (76%), flavor-related ingredients (64%) and brand (61%). Specifically, young consumers are much more motivated by flavor-related ingredients in their purchase decisions. This assumption is also plausible for two reasons: (1) consumers may have larger inclination toward product type (e.g. flavors) than to brands; (2) manufacturers (both for NBs and PLs) have developed a full range of varieties in product type (e.g. flavor), especially the most popular ones.[16] This assumption is important for the study since it determines the groups and substitution patterns.

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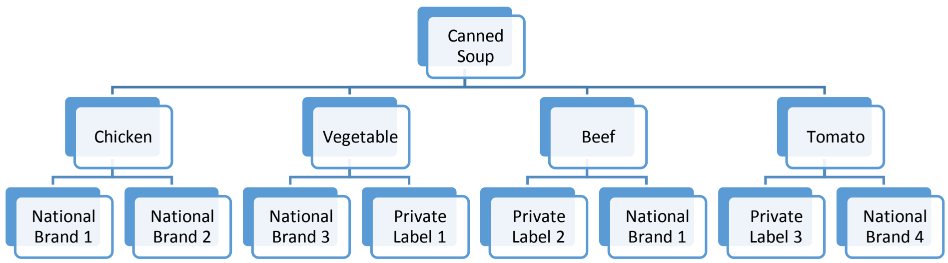
[15] Since this thesis will focus on one single multi-product retailer, we will not discuss the choice between stores for consumers. See Section 4.1 for more detail.

[16] This assumption is confirmed in many categories (e.g. wine). On the other hand, actually some other studies have assumed that consumers will choose brand over flavor (Baltas et al., 1997; Richards, 2007; Richards et al., 2010). The *Nielsen Company* (2006) also shows that in some pourable food categories (e.g. salad dressing), brand is placed in higher level than flavor in the consumer decision tree. However, the objective of this thesis is to investigate the relative competition between retailers and manufacturers, the choice of consumer decision tree would not have great impacts on the final specification of demand and supply models, as would be indicated in the following pages. Additionally, the consumer decision tree listed in Figure 5 will enable us to easily compare the impacts of PL usage and product differentiation on brand-level demand, rather than flavor-level. Therefore, based on all the arguments above, the flavor-over-brand consumer decision tree is preferred in this thesis.

Figure 5: Consumers Decision Tree Example



We therefore adopt a nested multinomial logit model (NML) (McFadden, 1978; Train, 2003) to derive the demand equation. It is assumed that the utility of consumers choosing individual food product depends on the characteristics of this product. There are *I* brands, *J* product types (e.g. flavors). To be more specific, the mean utility of consumer *h* choosing brand *i* of product type *j* in store *m* in week *t* (the time and store subscript is suppressed below) is represented below by:

(1) $$u_{ijh} = \delta_{ij} + \epsilon_{ijh},$$

where $\delta_{ij} = X_{ij}\beta - \alpha p_{ij} + \xi_{ij}$ is the total mean utility, X_{ij} is observed product characteristics by the econometricians, p_{ij} is the shelf price, ξ_{ij} represents the unobserved product characteristics that are believed to influence consumer *h*'s purchase utility, and ϵ_{ijh} captures the consumer-specific term that are unobserved by the econometricians. The product attributes vector, X_{ij}, includes the product's nutritional content such as sodium and others, which will be discussed in proceeding chapters. Furthermore, Berry (1994) noted that ξ_{ij} might be thought of as the mean of consumers' valuations of an observed product characteristic such as brand premium and product quality, while ϵ_{ijh} represents the distribution of consumer preferences about this mean, which captures the heterogeneity of consumers' preferences. To further investigate more about consumers' preference for brand and product type, following Berry (1994), we adopt the variance component formulation of the nested logit model used by Cardell (1997) and Richards, Patterson and Hamilton (2010). In the demand model,

$$\epsilon_{ijh} = \nu_{jh} + (1 - \sigma)\psi_{ij}, \tag{2}$$

where ϵ_{ijh} is identically and independently extreme-value distributed, which captures the unobserved consumer-specific characteristics and ν_{jh} is common to all products branded by i, specifically for consumer h, whose distribution relies on parameter of σ $(0 \leq \sigma < 1)$ (Berry, 1994; Cardell, 1997; Villas-Boas and Zhao, 2005). Cardell (1997) showed that ν_{jh} possesses a unique distribution so that $\nu_{jh} + (1 - \sigma)\psi_{ij}$ is also extreme-value distributed. Consistent with Berry (1994) and Richards, Patterson and Hamilton (2010)'s arguments, the parameter of σ is the inverse measure of brand heterogeneity, which captures the intra-brand substitution pattern. For instance, if σ approaches 1, the within brand group correlation goes to one, indicating that brands are taken as perfect substitutes for consumers and as σ approaches 0, the within-brand correlations goes to 0, which collapses the nested logit model (NML) to a standard logit model (Train, 2003). Thus, adoption of the variance component formulation allows us to interpret correlation within groups of similar products, and also allows correlation patterns to depend only on groupings of products that are determined prior to estimation (Berry, 1994).

For simpler notation, we assign a unique identifier (say, product *ij*) to every product according to their brand identifier (say, brand *i*) and product type identifier (say, type *j*). Then we assume that product *ij* belongs to the group J, where all products inside belong to product type *j*. The market share of product *ij* in the above nested logit model is the product of the conditional market share of brand *i* given that type is *j* ($s_{ij|J}$), and the marginal share of type *j* in the total canned soup retail market (s_J) (Berry, 1994; Train, 2003). To be expressed in arithmetic term is:

(3) $$s_{ij} = (s_{ij|J})(s_J).$$

The well-known formula for the conditional market share of brand *i* given the product type is in *j*th group is

(4) $$s_{ij|J} = \frac{e^{\delta_{ij}/(1-\sigma)}}{E_I},$$

where the denominator of this expression is

(5) $$E_I = \sum_{ij \in J} e^{\delta_{ij}/(1-\sigma)},$$

with $ln\, E_I$ being the inclusive value (*IV*) term for the brand choice. Furthermore, the marginal market share of product type *j* in the retail market can be written as

(6) $$s_J = \frac{E_I^{1-\sigma}}{\sum_{ij} E_I^{1-\sigma}}.$$

Thus, the market share of product *ij* is

(7) $$s_{ij} = \left(s_{ij|J}\right)\left(s_J\right) = \frac{e^{\delta_{ij}/(1-\sigma)}}{E_I^{\sigma} \sum_{ij} E_I^{1-\sigma}}.$$

In addition, we include an outside good in the model, allowing for the possibility of consumers not purchasing any of the brands included in the sub-sample. Its price is not set in response to the prices of the available products (Berto

Villas-Boas, 2007), which means that preference ordering over brands available in the sub-sample is not affected by preference orderings over brands that consist of the outside good group (Chintagunta, Bonfrer and Song, 2002). The outside good is assumed to be all the other products sold in this retail chain except for the selected ones, including some other brands which have relatively small market shares. With the outside good as the only product in the group zero and with $\delta_0 = 0, E_0 = D_0 = 1,$ we have

(8) $$s_0 = \frac{1}{\sum_{ij} E_I^{1-\sigma_j}}.$$

Based on the basic model, we are able to derive a model for mean utility levels. Taking logs of the market share equation shows

(9) $$ln\, s_{ij} - ln\, s_0 = \frac{\delta_{ij}}{(1-\sigma)} - \sigma\, ln\, E_I.$$

This equation depends on the unknown parameter E_I, which makes it difficult to estimate. After some calculation and substitution, we can write our demand model as

(10) $$ln\, s_{ij} - ln\, s_0 = X_{ij}\beta - \alpha p_{ij} + \sigma ln s_{ij|J} + \xi_{ij}.$$ [17]

Following Slade (2004), to make Equation (10) more flexible than the ordinary nested multinomial logit (NML) model, we allow the coefficient of p_{ij} to depend on the product's own characteristics. In other words, $\alpha_{ij} = \alpha(x_{ij})$. The choice of product attributes, which are included in product-attribute vector X_{ij} will be investigated in the proceeding chapters. Thus, we can estimate the price changes

[17] For a detailed calculation and derivation, see Berry (1994).

of product ij in response to products' attributes. Therefore, Equation (10) can be re-written as:

(11) $$ln\, s_{ij} - ln\, s_0 = X_{ij}\beta - \alpha_{ij}p_{ij} + \sigma ln s_{ij|J} + \xi_{ij}.$$

However, even though this approach provides a more flexible substation pattern than standard nested logit model, Slade (2004) argues that the cross price elasticity between product ij and lm still depends only attributes of lm, independent of attributes of ij. Moreover, Slade (2004) notes that the cross price-elasticities between any product and lm take at most two values, depending on the fact whether this product lies in the same group with lm or not. Absolutely, this is not always consistent with reality. For example, Berry, Levinsohn and Pakes (1995) illustrate this by arguing that under the standard random utility model, an economy Yugo car and a luxury Mercedes car have the same cross-price elasticities with respect to any third car. This contradicts our intuition that products with similar characteristics should have higher cross-price elasticities. Our expectation would be that a luxury BMW car should have a larger cross-price elasticity with respect to a luxury Mercedes car than to an economy Yugo car. To solve this contradiction and make the standard random utility model more consistent with intuition and empirical reality, Berry (1994) and Berry, Levinsohn and Pakes (1995) develop a random coefficient utility model, which has a relatively high requirement for the data structure (Train, 2003) and computational complexity (Berry, 1994). Thus, the following sub-section will talk about a practical and feasible approach developed by Pinkse, Slade and Brett (2002), Pinkse and Slade (2004), Slade (2004), Richards, Hamilton and Patterson (2010) to estimate structural demand for differentiated products in oligopolistic markets.

3.2 The Distance-Matrix (DM) Approach

The section above outlined the demand model framework used to estimate the demand for differentiated products. However, the demand model does not impose the type of product differentiation to be considered.

Equation (11) assumes that consumers judge the value of products merely based on their prices and own characteristics. However, it is not always the case. As consumers are more concerned by food nutrition, and health, any difference in product composition and/or related attributes, such as sodium content, may have a significant effect on consumers' purchasing behaviors. For example, assume we have two products: product *A* is priced at 2 dollars with 2000mg/cup of sodium, and canned soup product *B* is priced at 3 dollars with only 200mg/cup of sodium, with other attributes the same across these two products. Even though price of *B* is 50% higher than *A*, it is more likely that consumers still prefer *B* since it contains less sodium and is healthier than *A*. Similar examples also apply to other nutritional properties such as fat, calorie, cholesterol and protein. That is to say, consumers have a complete and subjective assessment of two products' true values based on any difference in the characteristics between these two products (Pofahl and Richards, 2009; Richards, et al., 2010). It is much more likely for consumers to form this assessment when they purchase food in retailers' stores since food is more directly related to health-related differentiation than any other product categories. Thus, a new method, Distance-Matrix (DM) approach, developed by Pinkse, Slade and Brett (2002), Pinkse and Slade (2004) and Slade (2004) will be helpful to take this assessment into consideration.

The Distance-Matrix (DM) approach has been developed as a new method to address the degree of product differentiation. The insight behind this approach is that product can be viewed as a bundle or a collection of series of characteristics and substitution patterns between these products depend not only on their prices, but also on their relative distance within characteristics (Pofahl and Richards, 2009). In the nested logit model (NML), the cross-price elasticity between product i and j ($i \neq j$) depends only on the characteristics of j. However, as Pofahl and Richards (2009) note, the DM approach allows the substitution patterns to be "spatially determined", which captures the notion that distance between two products in their multi-dimensional attribute space should influence their competition, or more precisely, cross-price elasticity. In particular, it is commonly assumed that consumers possess a subjective assessment of product characteristics in the attribute space and then rank collections of product characteristics to form their utility or preference orderings (Lancaster, 1966; Pofahl and Richards, 2009; Richards, Hamilton and Patterson, 2010). Richards et al. (2010) further indicate that it can be assumed that consumers form a perception of the extent to which one product is differentiated from others based on its distance from all others. That is to say, not only price, but also distance in attribute space matters in consumers' purchasing behaviors.

To estimate the distance between two products, we assume two products, one with brand i and type j, the other with brand l and type m. Distance, or its analog described in Pinkse et al. (2002) and Richards et al. (2010), proximity, can be measured in three major ways: (1) brand distance (*db*) (two products belong to the same brand, i=l); (2) type distance (*df*) (two products belong to the same product type, j=m); (3) nutrient distance (*dn*) (how far two products are in the multi-nutrient attribute space, which will be discussed below). Among all the three measurements of distance, brand distance and type distance are discrete, while nutrient distance is continuous. We define a separate element, *d*, for each of these five different measurements, *d*=1 for brand distance and 2, 3 for product type (e.g. flavor) and nutrient, respectively. Since our interest is on the distance between any two product pair in their attribute space, we should further define distance functions for these two products *ij* and *lm*, that is, $g_{ij,lm}(d_n)$, in which *n*=1 to measure the distance in brand perception, 2 for type distance, 3 for nutrient distance, respectively.

For the two discrete distance measurements, we can create the zero-one DM function as follows:

(12) $$g_{ij,lm}(d_n) = \begin{cases} 1, & \text{if product } ij \text{ and } lm \text{ share the same level for attribute } d_n \\ 0, & \text{otherwise} \end{cases},$$

where $d_n \in \{\text{brand}, \text{type}\}$. While Pinkse and Slade (2004) point out that other notions can be used in addition to the discrete notion already defined above, such as Voronoi diagrams mapping, Pofahl and Richards (2009) argue that this definition is straightforward in intuition. For example, d_1 is able to capture the within brand substitution patterns if most shoppers are brand loyal. Similar intuition applies to other dimensions (Pofahl and Richards, 2009). In addition, specifically, as an example of brand distance for the canned soup category, if product *ij* is branded by *Campbell* and *lm* is also branded by *Campbell*, the brand distance element for *ij* and *lm* takes the value 1, namely $g_{ij,lm}(d_1) = 1$. However, if canned soup product *ij* is the chicken flavor, and canned soup product *lm* is the beef flavor, the type distance element for *ij* and *lm* takes the value 0, namely $g_{ij,lm}(d_2) = 0$. Similar specification applies to other distance elements for company (d_2), and for nutrient (d_3).

Euclidian distance is often constructed in previous studies to measure how far apart two products are in their respective attribute space, since it is a preferred multi-dimensional measure for continuous attribute. However, Pinkse and Slade (2004) suggest that using an inverse Euclidian distance measure can be of great significance so that it is a reflection of how close two products are, rather than how far apart. In this thesis, we still follow this method by Pinkse and Slade (2004), and Pofahl and Richards (2009). Specifically, the nutrient distance (proximity) for products *ij* and *lm* given their coordinates in the nutrient attribute space is calculated as

(13) $$g_{ij,lm}(d_4) = \left(1 + 2\sqrt{\sum_k \left(n_{ij,k} - n_{lm,k}\right)^2}\right)^{-1},$$

where k represents the number of continuous nutrients examined in the thesis, $n_{ij,k}$ is the nutrient *k*'s content for product *ij* . As an example of nutrient proximity, consider Figure 6. We can calculate the proximity between two canned soup products (expressed product *12* and *34*) in our database, with their nutrition fact table shown in Figure 6. The nutrient proximity for these two products is calculated as

$$g_{12,34}(d_4) = \frac{1}{1+2\sqrt{(80-110)^2+(1-2.5)^2+(0-10)^2+(620-650)^2+(15-21)^2+(2-2)^2+(7-11)^2+(2-1)^2}} = 0.0112. \quad (14)$$

Figure 6: Nutrition Facts Table Examples

Nutrition Facts Serving Size: 1 cup Serving Per Container: 4	
Amount Per Serving	
Calorie 80	Calorie from Fat 10
	% Daily Value
Total Fat 1g	2%
Saturated Fat 0g	
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 620mg	26%
Potassium -	
Total Carbohydrate 15g	5%
Dietary Fiber 2g	10%
Sugars 7g	
Protein 2g	

Nutrition Facts Serving Size: 1 cup Serving Per Container: 2	
Amount Per Serving	
Calorie 110	Calorie from Fat 25
	% Daily Value
Total Fat 2.5g	4%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Cholesterol 10mg	3%
Sodium 650mg	27%
Potassium -	
Total Carbohydrate 21g	7%
Dietary Fiber 2g	8%
Sugars 11g	
Protein 1g	

As noted before, it is assumed that consumers possess a subjective assessment of product differentiation that is measured by the distance between two products given their coordinates in the attribute space. Consequently, Pinkse, Slade and Brett (2002) create an arbitrary matrix, which consists of measures of the distance between two products, and is multiplied by the product's shelf price so that shelf prices are adjusted according to consumers' subjective perception of each product's degree of differentiation. This approach goes back to Pinkse and Slade (2004) and Richards, Hamilton and Patterson (2010). Following this method, we create a separate attribute-distance-adjusted price vector for each of these five measures, P_{d_n} for n=1 (brand), 2 (product type), and 3 (nutrient). This vector consists of the adjusted attribute-related price given consumers' judgment of product differentiation in terms of a given product attribute, which is obtained by multiplying the shelf price vector P by the attribute-distance-differentiation matrix G_{d_n}. The distance-differentiation matrix consists of the distance function defined above, that is, $G_{d_n} = \left[g_{\,ij,lm}(d_n)\right]_{ij*lm}$ which is a $IJ \times IJ$ symmetric matrix. To sum up, $\widehat{P_{d_n}} = G_{d_n}P$. The distance-differentiation matrix for each attribute is then row-normalized so that the elements of each row sum to one (Pinkse and Slade, 2004; Richards, et al., 2010). Pinkse and Slade (2004) explain that the normalization is performed so that when the price vector is multiplied by the distance-differentiation matrix, the corresponding element in the distance-adjusted price vector is the average price of products of the same type. Finally, to account for all the attribute-distance effects on consumers' judgment of shelf prices, a linear sum is conducted to form the adjusted price vector. In addition, adding a constant term to account for own-price elasticities, the adjusted price vector is expressed in matrix notation as:

$$(15) \qquad \widehat{\mathrm{P}} = \Psi_0\widehat{P_{d_0}} + \Psi_1\widehat{P_{d_1}} + \Psi_2\widehat{P_{d_2}} + \Psi_3\widehat{P_{d_3}},$$

where $\widehat{\boldsymbol{P}_{\boldsymbol{d_0}}}$ is an identity matrix and $\boldsymbol{\Psi_n}$ is interpreted as spatial-autoregressive coefficients (n=0, 1, 2, 3) (Richards et al., 2010). Using typical elements in each of the matrix in the notation, the adjusted price for products which is branded by *i* and typed in *j* is calculated as:

(16) $\widehat{p_{ijt}} = \psi_0 \sum_l \sum_m g_{\,ij,lm}(d_0) p_{lmt} + \psi_1 \sum_l \sum_m g_{\,ij,lm}(d_1) p_{lmt} +$

$$\psi_2 \sum_l \sum_m g_{\,ij,lm}(d_2) p_{lmt} + \psi_3 \sum_l \sum_m g_{\,ij,lm}(d_3) p_{lmt},$$

where $g_{\,ij,lm}(d_1)$, $g_{\,ij,lm}(d_2)$, $g_{\,ij,lm}(d_3)$ are elements of the brand, product type, and nutrient distance differentiation matrixes, respectively, whose definitions are indicated above, and $\boldsymbol{\psi_n}$ (n=0, 1 , 2, 3) are to be estimated. This adjusted price will be adopted into the demand equation, which not only accounts for the effects of product differentiation on the brand-level demand, but also reduces the estimates that need to be estimated without any *a priori*, compared to traditional differentiated product demand functions.

Based on DM approach, we can re-write Equation (11) as:

(17) $$ln\, s_{ij} - ln\, s_0 = X_{ij}\beta - \alpha_{ij}\widehat{p_{ij}} + \sigma ln s_{ij|j} + \xi_{ij}$$

Hence, the DM/NML model predicts that the own-price elasticity for product *ij* is:

(18) $$\varepsilon_{ij,ij} = \alpha_{ij}\overline{p_{ij}}\left[\overline{s_{ij}} + \frac{1}{(1-\sigma)} + \frac{\sigma}{(1-\sigma)}\overline{s_{ij|J}}\right],$$

where J is the sub-group that product *ij* belongs. The cross-price elasticities for products within-group (the same type) are given by:

(19) $$\varepsilon_{ij,lm} = \alpha_{ij,lm}\overline{p_{lm}}\left[\frac{-1}{(1-\sigma)}\overline{s_{lm}} + \frac{-\sigma}{(1-\sigma)}\overline{s_{lm|J}}\right],$$

where $i \neq l$ and $j = m$. Similarly, the cross-elasticities for products in different groups are given by:

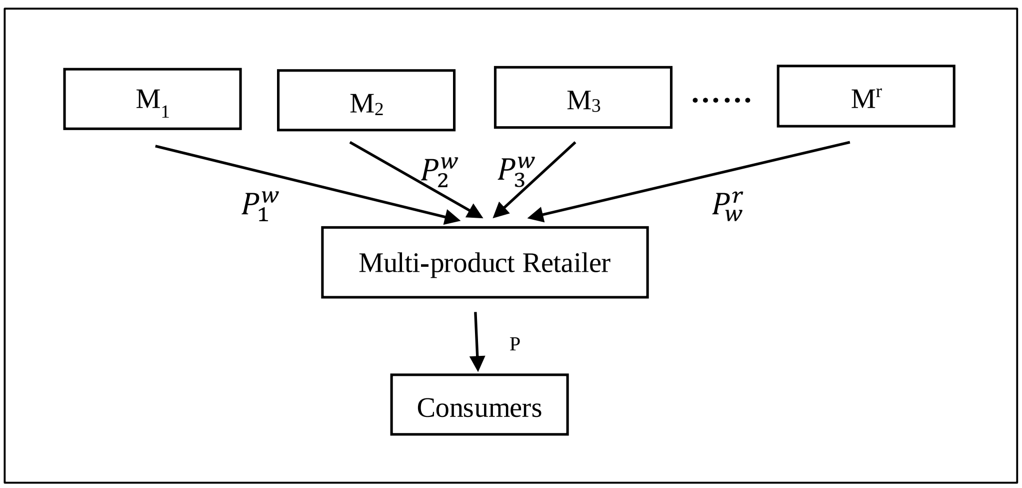
$$\varepsilon_{ij,lm} = \alpha_{ij,lm}\overline{p_{lm}}\left(\frac{-1}{1-\sigma}\overline{s_{lm}}\right), \quad (20)$$

where $i \neq l$ and $j \neq m$. It is no longer as indicated by Slade (2004) that "the cross-price elasticity between *i* and *j* is independent of *i*. This means that the off-diagonal elements in a column of the elasticity matrix take on at most two values, depending on whether the rival product is in the same or a different group". Rather, in our case, the cross-price elasticity between *i* and *j* depends on both *j*'s characteristics (Pinkse and Slade, 2004; Slade, 2004) and *i*'s distance from *j* in the characteristics space (Pinkse, Slade and Brett, 2002; Richards, Hamilton and Patterson, 2010). This method (DM/NML) not only circumvents the "dimensionality" problem (Nevo, 2001), but also provides much more flexibility for within-group substitution patterns than the traditional Nested Logit model (NML) does.

3.3 Retailer and Manufacturers' Brand-level Cost-Price Margin (CPM) Functions

The purpose of the DM/NML model is to estimate the brand-level demand for PL and NB products. However, in order to investigate the vertical competitive interactions between NB manufacturers and the retailers (PL owners), we need to explicitly estimate the supply-side interactions in the underlying demand conditions. In order to achieve this objective, we follow the structural retailer-manufacturer model proposed and previously used in the brand-level supply literature (Bresnahan, 1989; Berry, Levinsohn and Pakes, 1995; Sudhir, 2001; Chintagunta, Bonfrer and Song, 2002; Villas-Boas and Zhao, 2005; Berto Villas-Boas, 2007; Meza and Sudhir, 2010; Richards, Hamilton and Patterson, 2010). The supply-side equations investigate one multi-product retailer's competitive pricing decisions and the way in which these decisions are influenced by their interactions and competition with the upstream manufacturers.[18] Figure 7 illustrates the relationship between this multi-single retailer and its upstream manufacturers. Upstream NB manufacturers, $M_n(n = 1,2,3, ...)$, supply their NB products to this multi-product retailer according to their contracted wholesale prices, $P_n^w(n = 1,2,3, ...)$, respectively. In particular, manufacturers of PL lines[19] provide PL products to this retailer at wholesale price of P_w^r. Based on the offerings of both NB and PL from upstream manufacturers, the retailer set retail price, as measured by P in Figure 7, to provide these products to downstream consumers.

Figure 7: Retailer & Manufacturers' Relationship



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[18] Due to data availability, this thesis will analyze only one multi-product retailer, as its relationship with upstream manufacturers is shown in Figure 7. Two major impacts should be considered if we include multiple retailers in the model: 1) In the demand side, consumers' decision tree should include a higher level choosing among stores (retailers); 2) In the supply side, we should take into cross-store competition into consideration. However, the exclusion of multiple retailers simplifies model specification with no extra loss of validity.

[19] According to *Fact Book* released by this retail chain company in 2012, as measured by sales dollars, approximately 14% of its PL products are manufacturered in company-owned plants, and the remainder is purchased from third parties. As well, PL products can be manufacturered in NB manufacturers in order to fully utilize their production capacity (Agriculture and Agri-Food Canada, 2010).

3.3.1 Model of Retailer's Pricing Behavior

It is assumed that the multi-product retailer sets the prices for both PLs and NBs to jointly maximize profit across all brands (Villas-Boas and Zhao, 2005). Furthermore, Bertrand-Nash behavior[20] is assumed in which manufacturers and the retailer respectively set wholesale prices and retail prices simultaneously to maximize category profits (Villas-Boas and Zhao, 2005; Berto Villas-Boas, 2007; Richards, Hamilton and Patterson, 2010). On the retailer side, the retailer chooses retail prices for all products in a specific category conditional on their given wholesale prices. Based on these assumptions, the retailer's profit equation can be written as (time subscript *t* is suppressed subsequently for simpler notation):

$$(21) \qquad \max_{p_{ij}} \pi^r = \sum_{i=1}^{I} \sum_{j=1}^{J} (p_{ij} - w_{ij} - r) s_{ij} Q - R,$$

where π^r is retailer's aggregated profit, p_{ij} is the retail price of product *ij*, w_{ij} is its wholesale price, r is the retailer's (constant) marginal cost, and s_{ij} is market share. Q is the total market size (including the outside goods), and R is the (constant) fixed cost of retail operation. Assuming a pure Nash equilibrium, the first-order condition for the retailer's profit equation (Berto Villas-Boas, 2007) is:

$$(22) \qquad \frac{\partial \pi^r}{\partial p_{ij}} = Q s_{ij} + Q \sum_{l=1}^{I} \sum_{m=1}^{J} (p_{lm} - w_{lm} - r) \frac{\partial s_{lm}}{\partial p_{ij}} = 0,$$

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[20] Stackelberg-Nash equilibrium is another available pricing behavior for the retailers and manufacturers' pricing competition. However, in our case, there is no absolute market pricing leader in the retail market and pricing is repeated period after period. Both retailers and manufacturers are exerting their pricing power to negotiate better wholesale prices to gain more markups for themselves (Mills, 1999). Thus, the assumption of Bertrand-Nash equilibrium is preferred in this thesis.

where J is the number of product types and I is the number of brands sold by the retailer in aggregate. Since the retailer is assumed to jointly maximize profits across all brands it sells, the first-conditions in Equation (22) captures the pricing strategy of this multi-product retailer. Formally, Equation (22) implies that when the retailer makes the pricing decisions for one particular brand sold in its stores, it takes into account not only the effects of its pricing decision on the market demand for this brand, but also the cross-effects on the demand of other related brands which the retailer sells (Villas-Boas and Zhao, 2005). The solution to the first-order condition can be simplified greatly through matrix notation:

(23) $$(\mathrm{p} - \mathrm{w} - \mathrm{r}) = -\nabla_{\mathrm{r}}^{-1}\mathrm{s},$$

where ∇_r is the retailer's response matrix, including the first derivatives of all brand-level market shares with respect to all retail prices. Equation (23) provides an estimable structure, with the retailer's endogenous gross-margin on the left-hand side, and price-to-market-share response matrix on the right-hand side, which captures the horizontal brand-level competition within and across stores of the same retail chain. Other, vertical interactions can be investigated through explicitly modeling the pricing decisions for upstream manufacturers (Richards, Hamilton and Patterson, 2010).

The above assumptions are restrictive in that it is not always the case that the retailer and manufacturers stay in Bertrand-Nash equilibrium (Bresnahan, 1989; Corts, 1999; Richards and Patterson, 2005). To account for deviations from Bertrand-Nash equilibrium, researchers often employ a general conduct parameter in the cost-price margin (CPM) function in the vertical competition relationship, which "yields an elasticity-adjusted price cost margin and also nests the three possible competition models in a single equation" (Corts, 1999). We follow the methodology proposed by Chintagunta, Bonfrer and Song (2002), Villas-Boas and Zhao (2005) and include a conduct parameter φ_{ij} in the cost-price equation (23), which interacts with typical elements in the price-to-market-share response matrix $\Delta_{\boldsymbol{r}}$.

The majority of previous studies assume that deviations from the Bertrand-Nash equilibrium are constant for particular brands across stores and product types (see Villas-Boas and Zhao (2005)). However, Draganska and Klapper (2007) found that deviations from Bertrand-Nash equilibrium vary depending on retailer environment and product characteristics. Following Chintagunta, Bonfrer and Song (2002) and Draganska and Klapper (2007) we assume that the retailer's conduct parameter depends on the product characteristics present in a specific category. As such the conduct parameter can be estimated not only to quantify the relative distribution of market power between the retailer and its brand suppliers, but also to assess the impact of difference in product attributes on market power. Hence, the conduct parameter φ_{ij} is written as a linear function of product characteristics, in which brand fixed effects and nutritional properties are included. Following Richards, Hamilton and Patterson (2010), we include a discrete private-label indicator in the linear function to explicitly consider potential differences in the retailer's pricing between PLs or NBs, an important measure of the degree of vertical retailer-manufacturer competition between the retailer and its suppliers. Thus, the retailer's conduct parameter is specified as:

(24) $$\varphi_{ij} = \varphi_0 + \varphi_1 pl_{ij} + \varphi_2 brand_{ij} + \varphi_{\mathrm{k}} \sum_{k=3}^{10} nutrient_{k,ij},$$

where *pl* is defined as the PL indicator, and *nutrient* are product nutritional properties examined in the thesis. The choice of nutrients corresponds to those in the product attribute vector X_{ij}, which will be discussed in the proceeding chapters.

Villas-Boas and Zhao (2005) showed that if $\varphi_{ij} = 1$, the retailer maximizes category profits. If $\varphi_{ij} > 1$, the retailer charges PL brand-level prices higher than is optimal, acting above the Bertrand-Nash equilibrium. Draganska and Klapper (2007) also argue that the estimated coefficients, φ_i, not only provide evidence regarding which product characteristic leads to the deviations from equilibrium, but also evidence about the direction of impacts for individual factors. Moreover, as indicated by Richards, Hamilton and Patterson (2010), if the parameter φ_1 is greater than zero, it shows that stocking a PL in its store shelves allows the retailer to price above Bertrand-Nash equilibrium. Similar results can be obtained based on the conduct coefficient for other product attribute variables included in the retailer's conduct parameter function.

3.3.2 Model of Manufacturers' Pricing Behavior

In order to model the pricing behaviors of food manufacturers in the provision of NB products, we assume that each NB manufacturer sets the wholesale prices for individual brand to maximize their profits while simultaneously considering the retailer's pricing reactions. In the case of manufacturers carrying more than one brand, we assume that the manufacturer operates the pricing and distribution of its sub-brands separately (see Section 4.3 for more description). Based on this assumption, each brand sold by the retailer is associated with a different (unique) manufacturer. In the context of this thesis, the focus on a single multi-product retailer simplifies the above model as we do not have to account for different wholesale prices for the same "physical product" sold through different retail chains (Berto Villas-Boas, 2007). With these assumptions in mind, the aggregate profit function for an individual manufacturer *f* can be written as:

(25) $$\max_{w_{ij}} \pi_f^m = (w_{ij} - m_f)s_{ij}Q - M_f,$$

where m_f is the supplier *f's* marginal production cost for product *ij*, which is assumed to be constant across all product types and brands produced by manufacturer *f* and only dependent on exogenous variables. M_f is the (constant) fixed cost which is dependent on exogenous manufacturer characteristics, and F_f and B_f are respectively subsets of product type and brands produced by manufacturer *f*. The first order condition of the manufacturer *f*'s profit equation can be written as:

(26) $$\frac{\partial \pi_f^m}{\partial w_{ij}} = Qs_{ij} + Q(w_{ij} - m_f)\sum_{l=1}^{F_f}\sum_{m=1}^{B_f}\left(\frac{\partial s_{lm}}{\partial w_{ij}}\right) = 0$$

where $\sum_{l=1}^{F_f}\sum_{m=1}^{B_f}\left(\frac{\partial s_{lm}}{\partial w_{ij}}\right)$ contains all the derivatives of the market shares of all products with respect to all the wholesale prices, which are called the extent of pass-through and cross pass-through in Villas-Boas and Zhao (2005) and Berto Villas-Boas (2007). It shows that individual manufacturer takes into account the effects of changes in the wholesale prices of product *ij* on the demand of all the other products it sells. Further, the manufacturer margin can be written as

(27) $$(w_{ij} - m_f) = -s_{ij}\left(\sum_{l=1}^{F_f}\sum_{m=1}^{B_f}\left(\frac{\partial s_{lm}}{\partial w_{ij}}\right)\right)^{-1},$$

with

(28) $$\frac{\partial s_{lm}}{\partial w_{ij}} = \left(\frac{\partial s_{lm}}{\partial p_{st}}\right)\left(\frac{\partial p_{st}}{\partial w_{ij}}\right),$$

for all other brand s and product types t. $\frac{\partial s_{lm}}{\partial p_{st}}$ can be derived from demand parameters, while $\frac{\partial p_{st}}{\partial w_{ij}}$, the derivative of wholesale price with respect to retail price, cannot be computed directly from the underlying data. However, totally differentiating the retailer's FOC with respect to the wholesale price set by the manufacturer (see also in Sudhir, 2001; Villas-Boas and Zhao, 2005; Berto Villas-Boas, 2007; Richards, Hamilton and Patterson, 2010; Dubois and Jódar-Rosell, 2010) yields:

(29) $$\sum_{l=1}^{I}\sum_{m=1}^{J}\frac{\partial s_{lm}}{\partial p_{lm}}\frac{\partial p_{lm}}{\partial w_{ij}}+\sum_{l=1}^{I}\sum_{n=1}^{J}(p_{ln}-w_{ln}-c)\left(\frac{\partial^2 s_{ln}}{\partial p_{ln}\partial p_{lm}}\right)\left(\frac{\partial p_{lm}}{\partial w_{ij}}\right)=\frac{\partial s_{ij}}{\partial p_{lm}},$$

for any i and j.

The above arithmetic expression in Equation (29) can be further simplified using matrix notation. First of all, we have to define three matrixes: Δ_w is the response matrix containing all derivatives of market shares for all products with respect to all wholesale prices containing the typical element $(ij, lm)=\frac{\partial s_{ij}}{\partial w_{lm}}$; Δ_r is a IJ vector which shows how the market share of each product changes with respect to the prices of all other products; Δ_p is a vector for the pass-through, containing the typical element $\frac{\partial p_{st}}{\partial w_{ij}}$. Secondly, to obtain Δ_w, we can notice that $\Delta_{\mathrm{w}}=\Delta_{\mathrm{p}}'\Delta_{\mathrm{r}}$ and $\boldsymbol{G}\Delta_p=\Delta_r'$, where $\boldsymbol{G}$ is a symmetric, $IJ\times IJ$ matrix with typical element (ij, lm) written as:

(30) $$g_{ij,lm}=\frac{\partial s_{ij}}{\partial p_{lm}}+\frac{\partial s_{lm}}{\partial p_{ij}}+\sum_{s=1}^{I}\sum_{t=1}^{J}(p_{st}-w_{st}-c)\left(\frac{\partial^2 s_{st}}{\partial p_{ij}\partial p_{lm}}\right),$$

where the first and second derivatives of the market shares can be directly obtained according to the estimates on the demand model. Also we can note that

Δ_r' is the *ij* column in response matrix ∇_r. Hence, solving for the pass-through vector Δ_p, the vector containing the typical element $\frac{\partial p_{st}}{\partial w_{ij}}$, yields:

(31) $$\Delta_p = G^{-1}\Delta_r'.$$

Therefore, the manufacturer's margin can be re-written in matrix notation as:

(32) $$(w - m) = -s(\Delta_r G^{-1}\Delta_r')^{-1}.$$

With the manufacturer's margin written as the function of estimable retail-demand parameters, the retail price-cost function can then be re-written as:

(33) $$p - r = m - s(\Delta_r G^{-1}\Delta_r')^{-1} - \nabla_r^{-1}s,$$

where m is an $IJ \times 1$ vector of manufacturers' marginal costs. In the case where marginal costs for m are not observed, marginal costs are assumed to be a linear function of an observable vector of cost shifters $\boldsymbol{Z}$, $m + r = \boldsymbol{Z}\gamma + \eta$. γ contains the estimable coefficients of cost factors, and η captures random market shocks, assumed to be normally distributed (Villas-Boas and Zhao, 2005). To linearize the manufacturers' marginal cost function, Richards, Hamilton and Patterson (2010) propose to assume unit manufacturing costs M_f of normalized quadratic form with output quantity and input prices as cost shifters. Our choice of cost shifters as part of the marginal cost function will be addressed in the Chapter 5.

Similar to the procedure for the retailer-margin and pricing equations, we can introduce a second conduct parameter in the manufacturer-margin equation to capture the manufacturers' pricing behavior (see also Scott-Morton and Zettelmeyer, 2004; Villas-Boas and Zhao, 2005; Draganska and Klapper, 2007). Similar to the retailer's conduct parameter, we assume that the manufacturers' conduct parameter θ_{ij}, depends on the same products characteristics discussed shown above for the retailer's conduct parameter in Equation (24). Thus, the manufacturers' conduct parameter θ_{ij}, can be expressed as:

(34) $$\theta_{ij} = \theta_0 + \theta_1 pl_{ij} + \theta_2 brand_{ij} + \theta_{\mathrm{k}} \sum_{k=3}^{10} nutrient_{k,ij}.$$

Unlike the retailer's conduct parameter, this manufacturers' conduct parameter has no direct interpretation (Richards et al., 2010). Yet, we can infer manufacturer market power by comparing θ_{ij} to competitive and non-competitive benchmarks (Richards, Hamilton and Patterson, 2010). For example, if θ_{ij}=1, then the manufacturer is acting according to the Bertrand-Nash equilibrium. And if θ_{ij}=0, the manufacturer sets wholesale prices competitively and does not charge the retailers differential brand prices as a measure and expression of market power. More interesting than the individual conduct parameters is the interpretation of their relationship. For example, if θ_1>0, the introduction of PL can bring about more retailer-manufacturer margins compared to NBs. If this is the case, it indicates that market powers for upstream NB manufacturers can be reduced given the introduction of PL lines by the retailer. Similar interpretation can be applied to other estimates for other product's attributes (brand indicator and nutritional properties).

Based on the complete model specification of the retailer-manufacturer price-setting behavior and integrated both conduct parameters we can derive the final retail pricing function as:

(35) $$p - r = m - s\theta(\Delta_r G^{-1} \Delta_r')^{-1} - \left(\left(\frac{1}{\varphi}\right) \nabla_r^{-1}\right) s.$$

The final pricing function can be re-written in matrix notation as:

(36)

$$\left[p_{ij} - r\right]_{IJ\times 1} = \left[Z_{ij}\right]_{IJ\times 1}\gamma + \left[\theta_{ij}\frac{-s_{ij}}{\left[\frac{\partial s_{ij}}{\partial p_1}\ \frac{\partial s_{ij}}{\partial p_2}\cdots\frac{\partial s_{ij}}{\partial p_J}\right]G^{-1}\left[\frac{\partial s_{ij}}{\partial p_1}\ \frac{\partial s_{ij}}{\partial p_2}\cdots\frac{\partial s_{ij}}{\partial p_J}\right]'}\right]_{IJ\times 1}$$

$$+\begin{bmatrix} \frac{1}{\varphi_1}\frac{\partial s_1}{\partial p_1} & \frac{1}{\varphi_1}\frac{\partial s_2}{\partial p_1} & \cdots & \frac{1}{\varphi_1}\frac{\partial s_J}{\partial p_1} \\ \frac{1}{\varphi_2}\frac{\partial s_1}{\partial p_2} & \frac{1}{\varphi_2}\frac{\partial s_2}{\partial p_2} & & \frac{1}{\varphi_2}\frac{\partial s_J}{\partial p_2} \\ \vdots & & \ddots & \vdots \\ \frac{1}{\varphi_J}\frac{\partial s_1}{\partial p_J} & \frac{1}{\varphi_J}\frac{\partial s_2}{\partial p_J} & \cdots & \frac{1}{\varphi_J}\frac{\partial s_J}{\partial p_J} \end{bmatrix}_{IJ\times IJ}^{-1} \begin{bmatrix} -s_1 \\ -s_2 \\ \vdots \\ -s_J \end{bmatrix}_{IJ\times 1} + \left[\delta_{ij}\right]_{IJ\times 1},$$

where

(37)

$$G = \begin{bmatrix} 2\frac{\partial s_1}{\partial p_1} + \sum_{k=1}^{J}(p_k - w_k - c)\frac{\partial^2 s_k}{\partial p_1^2} & \frac{\partial s_1}{\partial p_2} + \frac{\partial s_2}{\partial p_1} + \sum_{k=1}^{J}(p_k - w_k - c)\frac{\partial^2 s_k}{\partial p_1 \partial p_2} & \cdots & \frac{\partial s_1}{\partial p_J} + \frac{\partial s_J}{\partial p_1} + \sum_{k=1}^{J}(p_k - w_k - c)\frac{\partial^2 s_k}{\partial p_1 \partial p_J} \\ & \vdots & \ddots & \vdots \\ \frac{\partial s_J}{\partial p_1} + \frac{\partial s_J}{\partial p_1} + \sum_{k=1}^{J}(p_k - w_k - c)\frac{\partial^2 s_k}{\partial p_J \partial p_1} & \frac{\partial s_J}{\partial p_2} + \frac{\partial s_2}{\partial p_J} + \sum_{k=1}^{J}(p_k - w_k - c)\frac{\partial^2 s_k}{\partial p_J \partial p_2} & \cdots & 2\frac{\partial s_J}{\partial p_J} + \sum_{k=1}^{J}(p_k - w_k - c)\frac{\partial^2 s_k}{\partial p_J^2} \end{bmatrix}_{J\times J}.$$

Equation (36) presents the final regression equation of observed product prices, market shares, cost shifters and estimated substitution patterns (based on the structural demand model). Based on equation (36) we can segment its each brand-level retail margin into three unique fractions: variable manufacturing and distribution costs, retailer margin, and manufacturers' margin. Changes in any fraction of the retail margin, especially the latter two, can result in shifts in the distribution of market power between retailers and upstream manufacturers. Thus, the conduct parameters in these two fractions are direct indicators of vertical market power. Moreover, even though manufacturers' (wholesale) prices are no longer directly included in Equation (36), it still contains large sets of variables and estimates that can be obtained from either estimates in the structural demand model or reliable proprietary database. Whether we can consistently estimate this equation largely depends on the data availability and accuracy. Hence, the following chapter will present the data used in the thesis and discuss the appropriate econometric approaches used to consistently estimate both demand model in Equation (17) and cost-price margin function in Equation (36).

Chapter 4 Data

The following chapter describes two proprietary datasets used in this thesis to consistently estimate Equation (17) and (36) in Chapter 3. The first database consists of weekly store-level scanner data for a major North American retail chain. The data was made available through the *SIEPR-Giannini Data Center* at the University of California Berkeley (*SIEPR-Giannini*, 2013), which is available at http://are.berkeley.edu/SGDC/. The second dataset consists of brand-level product information containing information about packaging, labeling, ingredients, and nutrition information provided by *Mintel*'s *Global New Product Database* (*GNPD*), an international market research company (see Table 2).

Table 2: Descriptions of Proprietary Datasets

Name	***SIEPR-Giannini Data***	***Global New Product Database* (*GNPD*)**
Source	Stanford Institute for Economic Policy Research (*SIEPR*)	Mintel Group, Ltd.
Time	Weekly 01/2004 to 22/2007	Annual 2000 to 2008
Link	http://are.berkeley.edu/SGDC/.	http://gnpd.mintel.com.
Info	Price, discounts, sales quantity, wholesale price, retail gross and net margins (all based on *UPC* codes)	Detailed product information (brand, packaging, nutrition facts, ingredients, etc.)
Location	USA/Canada	USA/Canada

In addition to the description of both datasets, this chapter will also introduce the canned soup category, which is selected as the case study application for the analysis of private label usage and quality differentiation on the vertical competition between PLs and NBs. Then descriptive analysis of the Canadian canned soup market will be provided, in terms of retail sale and market shares, retail prices and promotion, wholesale prices and retail margins, and product nutritional differentiation. Finally, the selected sub-sample data will be discussed.

4.1 Description of Proprietary Datasets

The first proprietary dataset used in this thesis is retail scanner data (*SIEPR-Giannini*, 2013) from one of the largest retail corporations in North America. The chain operates 1678 stores in the United States and Western Canada, and employs more than 178,000 people. Figure 8 shows the geographical locations of the Canadian retail stores which are included in the dataset. Different colored dots represent stores belonging to different retailer management and distribution divisions. The available data covers product-level sales for over 200 grocery categories with a total of over 60,000 items. All items are identified by unique *UPC* (Universal Product Code) numbers, a barcode system globally used to track retail items and inventories. In most common cases, *UPC* consists of 12 numerical digits, which are uniquely assigned to each item.

Figure 8: Geographical Distribution of Stores

Source: *SIEPR-Giannini* (2013).

The available dataset contains sales data with a week/store/category format (identification). Individual branded products are identified by unique *UPC* codes, including weekly net revenue, gross revenue, sold quantities (weight for bulk items) and adjusted gross profit (AGP). The average weekly retail price for an individual sold product can be measured by dividing net revenue by sold quantities. Since net revenue is generated after discounts are taken into account from gross revenue, a price discount can be detected by the difference between gross and net revenue. The dataset also consists of information describing individual stores, including their location, total building size, total selling area and division identification.

For the case of Canada, the retail chain operates a total of **220** stores predominantly across Western and Central Canada (British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario). Table 3 describes the geographical distribution of stores in select Canadian cities. The retailer operates groups of stores into three Canadian divisions, Vancouver (in charge of **75** stores in British Columbia), Alberta (in charge of **89** stores in Alberta) and Winnipeg (in charge of **56** stores in Saskatchewan, Manitoba and Ontario).

Table 3: Geographical Distribution of Retail Stores

City	Store Quantity	City	Store Quantity
Vancouver	12	Victoria	1
Calgary	6	Edmonton	4
Saskatoon	3	Regina	1
Winnipeg	13	Thunder Bay	3

Source: *SIEPR-Giannini* (2013). This table shows only part of investigated stores in select cities in Western and Central Canada.

Despite the high quality of this retail scanner database, there are some potential limitations that have to be dealt with. Firstly, there are missing observations in some weeks for individual products due to the fact that no items were sold during that time. Secondly, some irregular observations in the dataset have been removed such as observations with negative sales and negative prices. These observations also include some prices and sold quantities that come in negative numbers. Finally, some outliers in the dataset have been detected and dropped due to their questionable values. For example, some observations present extremely high retail margins that are abnormal in retail markets.

The second proprietary dataset is obtained from *Mintel*'s *Global New Product Database* (*GNPD*), which offers product records for 46 categories and 271 subcategories in more than 50 countries all over the world. In addition, it provides product information for millions of consumer packaged products based on *UPC* identification. All product information was collected by *Mintel*'s employees over the world, 4-6 weeks on average after the launch of new products. What is most important for the thesis is that the *Mintel*'s *GNPD* consists of products' nutrition, ingredients, brand, manufacturer, package size and type, which determine product quality differentiation. For example, the Nutrition column in this database records detailed nutrient content ranging from calories to protein, as well as their Daily Value (%DV).

4.2 Description of Case Study Application: Canned Soup Category

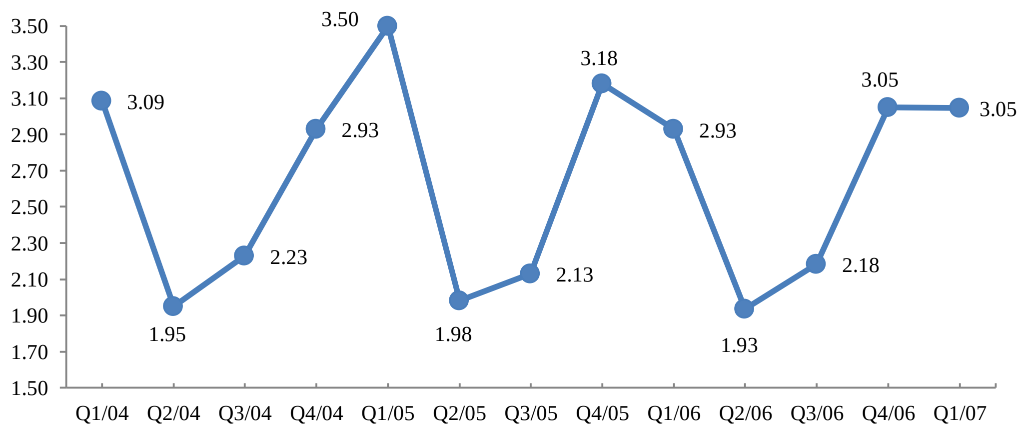
The focus of this thesis is to estimate the impacts of private label usage on the vertical competition and interaction between quality-differentiated PLs and NBs in the Canadian retail market. Concentrating the empirical analysis on one specific product category will enable us to control intra-categorical product differentiation and competition patterns more precisely. Two factors influence the choice of product category: 1) degree of intra-categorical quality differentiation and PL penetration since 2004; 2) the degree of existing category differentiation in product quality (ingredients and nutrition, etc.). Based on these two factors and general availability of consistent category sales data, the canned soup category is selected for this analysis.

Soup is a world-wide popular food, typically made by combining ingredients such as meat, vegetable and other condiments, and has wide appeal for its convenience among consumers across North America. A survey conducted by *Mintel* shows that nearly 91% of respondents agree that canned soup is good to keep in the pantry just in case it is needed. In addition, most respondents (74%) eat soup as part of an individual meal, followed by 57% of respondents eating it as part of a family meal. The following sub-sections will statistically describe trends and development of the canned soup category in the Canadian retail market.

4.2.1 Retail Sale and Market Shares

Canned soup is an established, traditional retail category that has trailed other categories in terms of market growth. In North America, sales value of soup increased by only 2% in 2011 to reach 684 million dollars for Canada and by only 1% to reach 6.47 billion in United States (Mintel, 2012; Datamonitor, 2012). However, Grier (2003) predicts the soup category soups would bounce back to a continuous growth path, mainly based on the fact that the recent period of slow economic growth has made consumers eat at home rather than eat out. Furthermore, a number of marketing surveys indicate that seniors and those aged above 55 make up the majority of soup consumers. Due to the growing population aging, seniors' demand for soup is predicted to increase. *Mintel* (2012) points out that as the generation of *Baby Boomers* continues to age, they will make up the majority of consumers in the soup market.

Figure 9: Quarterly Sale of Canned Soup in Canada: 2004-2007 (Millions)



Source: *SIEPR-Giannini* (2013). Due to data availability, retail sale in the second quarter of 2007 is not illustrated.

Figure 9 shows the quarterly retail sale of canned soup products in this investigated retail chain from the first week of 2004 to the 22nd week of 2007. It can be confirmed in this figure that Canadian canned soup sale has been in stagnation and did not show any obvious upward/downward inclination. Moreover, it is indicated in this figure that retail sale of canned soup products enjoys significant seasonal changes: retail sale in the first and fourth quarter is definitely higher than the second and third quarter. There is a common perception that canned soup is a cold-weather meal that consumers prefer eating in the winter which always comes in the first and fourth quarter in Canada (Mintel, 2012).[21]

Besides retail sale, market share is another important indication of development in the Canadian canned soup market. Table 4 presents the brand-level market shares in this investigated retail chain, including the net revenue share, absolute and relative shares in terms of sales quantities, as relative quantity sale is measured in $/cup. All market shares are calculated as the weekly average for the entire data period. It is noted that there is a dominant brand in canned soup market, *NB1*, with over **70%** market share. And PL accounts for **8.26%** of net revenue share and **11.41%** of relative quantity share, making it the second largest brand in this market, followed by three other NBs, *NB2*, *NB4* and *NB3*.[22] Another discovery is that the quantity shares for PL are much higher than its net revenue share, which is a justification that PL has a lower price. The dominant market power by a leading NB in the canned soup market makes it an appropriate and interesting

[21] Due to geographical location, most parts in Canada have low temperature in the first and fourth quarter. However, this case cannot be applied to other locations in the world. This is a very specific assumption in the Canadian retail market.

[22] Throughout the rest of the thesis, the term "PL" indicates private label in general, while "*SB*" stands for the specific store brand sold by the investigated retail chain. Similar notation applies to the national brands: the term "NB" represents national brand in general and "*NB1*", "*NB2*" , "*NB3*" , "*NB4*" indicate four specific national brands in the investigated retail chain.

research case since PLs always mimic and are positioned near the leading NB to gain leverage over manufacturers (Mills, 1995).

Table 4: Brand-level Market Share

	Net Revenue Share (%)	Absolute Quantity Sale Share (%)	Relative Quantity Sale Share (%)
NB1	76.83(8.4)	73.12(9.4)	69.69(12.1)
SB	8.26(3.0)	14.65(5.3)	11.41(4.3)
NB2	6.42(5.8)	5.96(6.7)	7.9(8.6)
NB4	4.95(4.5)	4.45(5.5)	8.41(9.1)
NB3	1.46(0.8)	0.55(0.3)	1.25(0.9)
Others	2.08(2.3)	1.27(3.4)	1.34(2.6)
Total	**100**	**100**	**100**

Source: Calculation results from *SIEPR-Giannini* (2013) and *GNPD* (2013). Relative quantity sale share is measured as the percentage of brand-level sold cups in the entire sold cups. Standard errors are in parentheses.

In addition to brand-level market share, Table 5 shows the market shares at the flavor-level, also including net revenue share, absolute and relative quantity sale shares, which are the weekly averages for the period of investigation. Contrary to the brand-level shares, the flavor-level shares are much more dispersed across the brand sample with the leading flavor, chicken soup making up **27.82%** of all products, followed by popular mushroom and tomato soup flavors. Mixed vegetable and beef soup also account for a large section of the canned soup market.[23] Interestingly, when comparing the absolute and relative quantity shares

[23] Aggregation of diverse flavors in the canned soup category is based on its main highlighted ingredient in the label name. Accordingly, chicken flavor includes flavors of chicken, chicken noodle, grilled chicken with rice and chicken broth. Tomato flavor includes flavors of tomato and tomato basil. Mixed vegetable flavor includes flavors of vegetable, minestrone and vegetable garden. Beef flavor includes flavors of beef, beef noodle, beef barley and beef burger.

across flavors, we find that, for mushroom and tomato, the relative sales quantity shares are always lower than their corresponding absolute shares, which implies that consumers tend to purchase these two flavors in smaller package sizes. The category "*Others*" accounts for around **20%** of the market, and consists of more than **15** different flavors, including potato, celery and pea. Even though individual flavor carries a relatively small market share, they provide various mechanisms for the retailer (PL) to compete with NB manufacturers in flavor differentiation through nutritional and ingredients improvements and innovations.

Table 5: Flavor-level Market Share

	Net Revenue Share (%)	Absolute Quantity Sale Share (%)	Relative Quantity Sale Share (%)
Chicken	27.82(2.9)	27.41(3.0)	29.47(3.4)
Mushroom	14.58(4.2)	16.81(3.6)	12.65(3.4)
Tomato	12.01(3.0)	14.19(2.9)	11.11(2.8)
Mixed vegetable	11.26(2.8)	10.73(3.2)	12.15(4.7)
Beef	11.63(2.4)	10.89(2.2)	12.74(2.7)
Others	22.7(2.4)	19.97(3.6)	21.88(3.1)
Total	**100**	**100**	**100**

Source: Calculation results from *SIEPR-Giannini* (2013) and *GNPD* (2013). Relative quantity sale share is measured as the percentage of sold cups in absolute quantity sales. Standard errors are in parentheses.

4.2.2 Retail Prices and Promotion

Strategic pricing and promotion are important competitive measures among brands in canned soup market which suffers from lukewarm market performance.

Table 6 provides a first comparison of retail prices for canned soup products at the brand level.

Table 6: Retail Price Summary for Brand-Level Products

	Absolute Price	Relative Price	Average Cups
All Products:	2.18(1.62)	1.37(1.40)	1.81(0.79)
PLs	1.03(0.23)	0.85(0.26)	1.36(0.70)
NBs	2.30(1.66)	1.42(1.46)	1.86(0.79)
SB	1.03(0.23)	0.85(0.26)	1.36(0.70)
NB1	2.21(1.81)	1.52(1.64)	1.65(0.67)
NB3	2.16(0.41)	0.68(0.13)	3.18(0)
NB4	2.74(0.32)	1.55(0.43)	1.85(0.32)
NB2	2.10(0.43)	0.97(0.21)	2.17(0.04)
Others	4.05(0.86)	1.69(0.58)	2.74(1.15)

Note: Source: Calculation results from *SIEPR-Giannini* (2013 and *GNPD* (2013). Relative price is measured as $/cup. Standard errors are in parentheses.[24]

On average, the retail PL (*SB)* is priced at **$0.85/cup**, which is almost **40%** below the average for NBs at **$1.42/cup**. Since *SB* in the thesis is a generic quality brand, this finding is consistent with our hypothesis that PL is priced lower than NBs to attract demand from price-sensitive consumers. This fact also holds for the comparison of absolute prices and average cup sizes. The absolute PL price at **$1.03/can** is almost half the prices of the average NB counterpart, while the average $/cup for PL is only **26.9%** lower than that for NBs. In addition, at the brand-level, PLs are cheaper than most NBs. *NB4* is the only brand which has a

24 Throughout the rest of thesis, if not illustrated specifically, all prices are measured in Canadian dollar.

lower relative price than PL. Comparing the last column in table 6, we find that the PL has the smallest average package size of **1.36** cups (equal to ***340*** ml), which is consistent with findings for other food categories made in a study using the same retailer scanner sales data by Bocionek (2011). Bocionek (2011) points out those products of smaller package size usually carry lower shelf prices since packaging often adds more to production cost than other inputs, and lower shelf prices can leave an important positive first impressions with price sensitive consumers.

Table 7: Brand-Level Promotion Frequency and Promotion Depth

	Average Discount ($)	Promotional Frequency (%)	Promotional Depth (%)
All Products:	0.18	24.4	5.9
NBs	0.19	24.1	6.3
PLs	0.03	27.0	2.7
SB	0.03	27.0	2.7
NB1	0.18	22.2	5.7
NB4	0.19	26.8	8.1
NB3	0.23	27.2	4.7
NB2	0.24	31.4	10.1
Others	0.21	34.2	6.6

Source: Calculation based on *SIEPR-Giannini* (2013). Average discount is measured as mean of the difference between regular price and discounted price. Promotion depth is measured as the mean of the percentage of discount in the relative retail price. Promotion frequency is measured as the time each product is on promotion over the range of investigated period.

Moreover, both retailers and national manufacturers frequently offer price discounts to attract consumers and increase store traffic, especially in holiday seasons (Mills, 1995; Müller, et al., 2008; Bocionek, 2012). Promotional prices are net final prices considering promotional discounts, coupons and other savings through membership cards (e.g. *club cards*). Promotional marketing strategies can be measured in two dimensions (Rao, 1991; Anders and Ahmad, 2011): promotional frequency and promotional depth. Promotional frequency is measured as the time each product is on promotion over the range of investigated periods and promotional depth is measured as the share of the difference between promotional price and regular price over the regular price. Table 7 shows the brand-level indicators of promotional frequency and promotional depth for the canned soup category. PLs and NBs differ widely in their average promotional indicators: PLs only **$0.03** on average, far behind the **$0.19** for NB. A reason behind this result is the fact that PLs always carry lower shelf prices than their competing NBs, leaving the retailer less room for heavy absolute discounting in the canned soup category. In terms of promotion frequency, however, PLs enjoy one of the highest promotion frequencies (***27%***), following *NB2* with **31.4%**. The leading NB, *NB1*, has the lowest promotional frequency with only **22.2%**, underlining its market dominance and brand loyalty in the canned soup market. In terms of promotional depth, PLs show the lowest figure, **2.7%**, far behind any of their competing NBs. To sum up, we can conclude that the investigated retailer promotes its PL frequently, but not much with lower prices. These findings are confirmed by Rao (1991) and Anders and Ahmad (2011) for other food categories. Both studies conclude that NBs tend to offer higher promotional depth, thus giving up some of their profit margins to keep up competitive pressure against retailer’s PLs.

4.2.3 Retail Margins and Wholesale Prices

Table 8 provides summary statistics for the retailer's margins and brand-level wholesale prices, as well as percentage margins, calculated as the relative share of the retailer's margin in the shelf price.

Table 8: Retail Margin and Wholesale Price Summary

	Absolute Retail Margin	Relative Retail Margin	Percentage Margin (%)	Absolute Wholesale Price	Relative Wholesale Price
All Products:	0.62 (0.63)	0.39 (0.49)	30.06 (0.20)	1.56 (1.48)	0.98 (1.30)
PLs	0.55(0.22)	0.45(0.21)	51.77(0.10)	0.48(0.06)	0.40(0.10)
NBs	0.63(0.66)	0.38(0.51)	27.62(0.19)	1.68(1.51)	1.04(1.35)
SB	0.55(0.22)	0.45(0.21)	51.77(0.10)	0.48(0.06)	0.40(0.10)
NB1	0.56(0.66)	0.39(0.56)	27.40(0.19)	1.65(1.71)	1.13(1.52)
NB4	0.68(0.40)	0.21(0.13)	28.21(0.18)	1.49(0.09)	0.47(0.03)
NB3	1.77(0.67)	0.51(0.21)	38.07(0.11)	2.75(0.47)	0.80(0.21)
NB2	0.57(0.41)	0.26(0.19)	23.90(0.19)	1.53(0.12)	0.70(0.08)
Others	1.08(0.58)	0.65(0.39)	32.25(0.13)	2.04(0.11)	1.21(0.24)

Source: Calculation results from *SIEPR-Giannini* (2013) and *GNPD* (2013). Relative retail margins are measured as margin per cup. Percentage margins are measured as the percentage of the relative retail margin in the relative retail price. Relative wholesale prices are measured as the wholesale price per cup. Standard errors are in parentheses.

The descriptive analysis of retail margins reveals that NBs carry higher absolute margins than PLs. One plausible explanation is that PL products on average have smaller package sizes and hence lower absolute shelf prices (***55%*** lower as indicated in Table 6). All other figures in Table 8 are consistent with widely-accepted findings in other literature (Hoch and Banerji, 1993; Mills, 1995; Mills, 1999; Stein, 2004; Benedict et al., 2010). More specifically, relative retail margins for PLs are valued at **$0.45/cup**, nearly **15.6%** higher than NBs. PLs also enjoy considerably higher percentage margins (***51.77%***) compared to NBs (***27.62%***). These findings provide evidence of the common notion that PLs are more profitable for retailers than NBs (Cotterill, 1999; Cotterill and Putsis, 2000; Kumar and Steenkamp, 2007). In addition, when brand-level retail margins are considered, Table 8 shows that PLs possess higher retail margins and percentage margins than any of the competing NBs. This finding is consistent with several previous studies suggesting that PLs enable retailers to increase product margins (Dhar and Hoch, 1997; Mills, 1999; Meza and Sudhir, 2010).

In order to further investigate the reasons behind higher retail margins for PLs, we look at the brand-level wholesale prices paid by the retailer (shown in the last two columns of table 8). Since the retailer produces part of its PLs in own-operated plants, it is likely to have **60%** lower relative wholesale prices of **$0.40/cup**, which is lower than for any of the competing NBs. Even though PLs sell at **26.9%** lower retail prices, the **60%** lower wholesale prices compensate the net-revenue effect and enable the retailer to enjoy higher retail margins for PLs.

4.2.4 Nutritional Differentiation

Brand manufacturers compete with each other by introducing product innovations to differentiate their brands in terms of flavor, packaging, ingredients, processing and even labelling attributes. For instance, a market report released by *Mintel* (2013) indicates that there were 349 and 277 new soup launches in US in 2011 and 2012, respectively.[25] Brand-new products and new variety/range extension account for the majority of new launches (***42.3%*** and ***39.5%***, respectively). Among all the varieties and new products launches, health and wellness have been mainly concentrated by these manufacturers as growth in consumers' food-health concerns and problems (e.g. obesity) makes them pay more attention to food nutrition choices. Table 9 summarizes attributes that consumers pay most attention to when purchasing canned soup products (Mintel, 2012). This table shows that sodium, fat, calories, sugar and fibre are widely watched by consumers as intake of these nutrients are highly associated with blood pressure, heart disease and even forms of kidney health problems (Mintel, 2013).

Table 9: Important Attributes when Purchasing Soup by Gender

"When you are looking at which soup to purchase, how important is each of the following attributes?" (%)

Attributes	**All (n = 1608)**	**Male (n = 726)**	**Female (n = 882)**
Price/Special offers	79	78	79
Quality of ingredients	79	76	81
Brand	69	67	70
Low sodium	61	58	63
Low fat	56	51	60
Low calorie	53	48	57
Sugar content	49	48	50
High fibre	47	45	49
Easily digested carb	44	43	44
Natural	41	42	41
Number of ingredients	40	42	38
Organic	26	27	25
PL	24	27	21
Gluten free	24	25	23

Source: *Mintel* (2012).

[25] According to *Mintel* (2013), these new product launches consist of brand-new products, new variety/range extension, new packaging, new formulation and product re-launch.

To investigate nutritional differentiation of canned soup products sold in this retail chain, Table 10 shows the nutritional content for every 250ml (per cup) in brand-level in the canned soup market, including eight of the most important nutrients which are mandatorily required by the Canadian federal government: calories, fat (including saturated fat and trans fat), cholesterol, sodium, carbohydrates, fiber, sugar and protein.

Table 10: Brand-level Nutritional Content

	calories	fat(g)	cholesterol(mg)	sodium(mg)	carbohydrate(g)	fiber(g)	sugar(g)	protein(g)
All Products:	138.85(68.1)	4.09(4.1)	7.68(7.4)	911.33(408.8)	19.57(10.6)	2.98(2.7)	4.80(4.8)	5.04(3.2)
NBs	141.83(69.0)	4.20(4.5)	8.03(7.5)	891.49(398.0)	20.21(10.4)	3.20(2.7)	4.93(4.6)	5.14(3.3)
PLs	112.87(52.3)	3.09(2.6)	4.68(5.9)	1083.82(458.0)	14.04(10.6)	1.12(1.2)	3.72(6.2)	4.18(2.3)
SB	112.87(52.3)	3.09(2.6)	4.68(5.9)	1083.82(458.0)	14.04(10.6)	1.12(1.2)	3.72(6.2)	4.18(2.3)
NB1	154.19(70.7)	4.69(4.9)	9.1(7.6)	971.55(406.5)	21.38(11.0)	3.21(2.8)	5.01(45.0)	5.57(3.4)
NB4	129.55(45.6)	1.97(1.7)	4.19(3.4)	794.23(75.5)	21.92(7.1)	5.75(3.2)	3.79(2.0)	5.91(2.9)
NB3	67.19(42.4)	1.19(1.1)	0.00(0.4)	502.48(74.3)	11.76(9.2)	1.04(1.0)	3.3(2.8)	1.41(0.5)
NB2	83.84(24.9)	2.05(0.6)	2.72(3.9)	506.68(220.2)	14.18(10.0)	2.21(1.0)	5.32(3.1)	3.05(2.2)
Others	130.16(29.0)	6.01(1.1)	13.25(5.6)	793.97(127.2)	17.04(4.8)	3.21(1.2)	5.36(2.4)	3.83(1.8)

Source: Calculation based on *SIEPR-Giannini* (2013) and *GNPD* (2013). Content of fat, fibre, sugar and protein is measured in g/cup. Content of cholesterol and sodium is measured in mg/cup. Standard errors are in parentheses.

Among all these eight nutrients, fat, cholesterol, sodium and sugar are the "bad for you" ones which consumers should intake less of and fiber is the "good for you" one. Firstly, it is apparent from Table 10 that PL offers **112.87** calories per cup, which is **20.42%** lower than that of NBs (***141.83/cup***). Of all brands, *NB3* is the only NB which has lower calories than PL. Too many calories will be stored as fat and gain weight. In terms of fat and cholesterol content, PL also does better than most of NBs, with its **26.43%** lower fat content and **41.72%** lower cholesterol content. It is *NB3*, a well-known organic NB, which has both the lowest fat content (***1.19g/cup***) and both lowest cholesterol content (***0mg/cup***). In addition, a similar case appears that PL also has lower sugar content than most of NBs, just following *NB3*. However, PL does not so well in the sodium content, with the highest sodium content (***1083.82mg/cup***) of all. To sum up, it is *NB3* that does best in containing more of the "good for you" nutrients and less of "bad for you" nutrients, followed by PL.

Table 11: Flavor-level Nutritional Content

	calories	fat(g)	cholesterol(mg)	sodium(mg)	carbohydrate(g)	fiber(g)	sugar(g)	protein(g)
All:	138.85(68.1)	4.09(4.1)	7.68(7.4)	911.33(408.8)	19.57(10.6)	2.98(2.7)	4.80(4.8)	5.04(3.2)
Chicken	99.62(33.00)	2.55(1.10)	14.57(6.91)	851.11(346.86)	12.42(3.71)	1.12(0.76)	1.90(1.02)	5.75(1.75)
Mushroom	205.71(19.17)	10.07(5.27)	6.43(4.79)	1499.95(268.35)	25.00(6.71)	2.00(0.00)	8.43(8.63)	4.00(0.00)
Tomato	124.42(40.46)	1.50(1.25)	0.00(0.00)	778.60(277.82)	24.27(7.46)	2.00(0.00)	14.82(4.08)	3.03(0.81)
Mixed vegetable	141.74(46.33)	2.08(2.00)	1.31(2.20)	993.84(289.54)	24.66(5.75)	5.33(2.81)	6.02(3.80)	5.34(2.59)
Beef	140.03(17.30)	2.88(0.22)	12.51(4.33)	634.98(8.65)	21.50(2.60)	3.00(0.00)	3.50(0.87)	7.25(1.30)
Others	136.87(74.51)	5.00(5.51)	3.34(4.09)	529.34(112.55)	18.18(7.33)	3.23(2.13)	3.14(2.40)	4.41(2.60)

Source: Calculation based on *SIEPR-Giannini* (2013) and *GNPD* (2013). Content of fat, fibre, sugar and protein is measured in g/cup. Content of cholesterol and sodium is measured in mg/cup. Standard errors are in parentheses.

Besides brand-level nutritional differentiation, Table 11 illustrates flavor-level nutritional differentiation for every 250ml (per cup) of canned soup products for the top five flavors: chicken, mushroom, tomato, mixed vegetable and beef. It indicates that there is systematic difference between flavors in nutrient content level: mushroom flavor has the highest level of calorie (***205.71/cup***), fat (***10.07g/cup***), sodium (***268.35mg/cup***), and carbohydrates (***25.00g/cup***); chicken flavor has the lowest level of calorie (***99.62/cup***), fibre (***1.12g/cup***) and sugar (***1.90g/cup***). Meanwhile chicken flavor has the highest level of cholesterol (***14.57mg/cup***). Other flavors do not stand out so much in nutrition content level compared to these two top flavors (as indicated in Table 5 in terms of their market share).

4.3 Description of Sample Data

Although the retailer in the thesis sells hundreds of unique canned soup SKUs, we should focus on an important subset of brands that are available in shelves. Two justifications can support our focus on the sub-sample instead of the entire database. First, as argued earlier, the canned soup category is an oligopolistic market with just a few leading brands. Most of the weak brands have relatively small market shares so that they cannot exert market power over the leading brands. Second, including too many brands and flavors will definitely increase the size of the spatial weight matrix shown in Section 3.2 since its size increases with the square of the number of products investigated (Richards, Hamilton and Patterson, 2010). Therefore, focusing on a sub-sample is both practical and feasible.

The brands selected in sub-sample have both the largest market shares and the flavor varieties of all, including five brands: *NB1*, *SB*, *NB2*, *NB3* and *NB4*. As shown in Table 4, these five brands account for over **90%** of the total canned soup market volume in the panel. The sub-sample data also includes the top five flavors by category share within each brand. We also include an "*others*" category including all other brands and flavors that are not presented in our focus sub-sample. The detailed category share for each brand and each flavor is presented in Table 12. The top five flavors offered by each brand tend to be very similar, but not identical. Moreover, not all the select products were present in the market at the beginning of our investigated period, with product 1 (*id*) and 21(*id*) introduced into market in the 4th week of 2004 and 46 week of 2005, respectively. Since these two products have relatively large market shares in the canned soup category, ruling them out from our sub-sample may generate biased substitution patterns and oligopolistic competition results.[26]

Table 12: Prices and Market Shares for Select Canned Soup Products

Brand	Flavor	MAP	MRP	MDS	MCS	*id*
SB	Tomato	0.86	0.76	1.70	2.42	6
SB	Cream of Mushroom	0.90	0.79	1.75	2.35	8
SB	Chicken Broth	1.12	0.31	0.44	1.50	10
SB	Chicken Noodle	0.90	0.79	0.97	1.31	9
SB	Vegetable	0.90	0.79	0.62	0.84	7
NB1	Cream of Mushroom	5.22	4.59	8.11	6.17	15
NB1	Tomato	0.97	0.85	3.94	5.04	11
NB1	Chunky New England Clam Chowder	2.39	1.11	2.35	2.37	12
NB1	Chicken Noodle	1.75	0.95	4.02	4.62	14

26 Specifically, while *NB2* and *NB3* are owned by different companies, *NB1* and *NB4* are owned by the same manufacturer. While since *NB4* is exclusively available in Canada and *NB1* is a world-wide brand, it is reasonable to assume that this manufacturer would operate these two brands independently. Thus, assumption in Section 3.3.2 (page 51) that each brand sold in this retailer is associated a unique manufacturer could be feasible.

NB1	Chunky Beef	2.24	1.04	3.47	3.60	13
NB2	Beef Barley	2.12	0.98	1.01	1.24	4
NB2	Chicken	2.11	1.00	0.79	0.94	3
NB2	Lentil	2.12	0.98	0.72	0.84	2
NB2	Grilled Chicken with Rice	2.09	0.93	0.56	0.73	1
NB2	Chicken Noodle	2.09	0.97	0.54	0.68	5
NB3	Tomato	4.52	1.13	0.51	0.68	25
NB3	Butternut Squash	4.38	1.46	0.31	0.37	22
NB3	Sweet Potato	4.92	1.23	0.26	0.24	21
NB3	Potato Leek	4.92	1.23	0.16	0.13	24
NB3	Sweet Corn	4.89	1.23	0.13	0.12	23
NB4	Pea and Ham	2.18	0.68	1.21	2.03	16
NB4	Pea	2.18	0.68	1.07	1.78	18
NB4	Chicken Noodle	2.16	0.68	0.73	1.27	20
NB4	Minestrone Traditional	2.15	0.68	0.69	1.18	17
NB4	Vegetable	2.16	0.68	0.66	1.12	19
Others[27]	Others	2.13	1.44	63.28	56.43	-

Note: 1. Source: Calculation results from *SIEPR-Giannini* (2013) and *GNPD* (2013). Relative price is measured in $/cup. The column of *id* is shown for convenience of product identification. 2. MAP is men absolute price. MRP is mean relative price. MDS is mean dollar share. MCS is mean cups share. MAP and MRP are measured in Canadian dollars, while MDS and MCS are measured in percentage.

[27] The "*Others*" group includes seven national brands. These brands either do not have large market shares relative to the top five brands, or were introduced between 2004 and 2007 and do not cover the entire investigated period.

Chapter 5 Estimation Procedure

The DM/NML demand model, Equation (17),

$$ln\, s_{ij} - ln\, s_0 = \boldsymbol{X_{ij}}\beta - \alpha_{ij}\widehat{\boldsymbol{p_{ij}}} + \sigma ln s_{ij|j} + \xi_{ij},$$

with product attributes vector, shelf-adjusted price and conditional share on the right-hand side, plays an important role in the analysis. It not only provides evidence of impacts of product differentiation on PL and NB competition, but also determines parameters and cross-price elasticities that will be used in the pricing model. However, first of all, some econometric estimation issues must be addressed to assure consistent and reliable model estimation. A two-stage estimation approach will be adopted: Equation (17) is estimated in the first stage and equation (36) is then estimated in the second stage (Nevo, 2001; Villas-Boas and Zhao, 2005; Richards, Hamilton and Patterson, 2010). Estimates derived from the first stage regression enter the computation of cost-price margins for the retailer and brand manufacturers. Thus, the empirical results in this thesis rely on the consistent estimation of demand-side parameters in Equation (17), which lay the foundation for the estimation of price-cost margin functions.

First, the endogeneity of retail prices and distance-weighted price index, $\widehat{\boldsymbol{p}_{ijt}}$, must be addressed in the estimation of Equation (17), as the retailer is assumed to take all product characteristics of the competing brands into account when setting retail prices for the canned soup products. Both the observed product characteristics X_{ij} and the unobserved product characteristics ξ_{ij} together with their changes and valuations are considered by the retailer (Berto Villas-Boas, 2007). We therefore include a brand fixed effect in Equation (17) to capture constant, unobserved brand effects over time. Further, a quarterly dummy variable is included to capture unobserved seasonal effects in the demand for the canned soup products. Finally the error term, ξ_{ij}, captures non-seasonal unobserved product characteristics that remain unobserved to the researcher (shelf placement, in-store advertising, changes in consumer preference, and unobserved and non-quantifiable product characteristics (reputation, style, prestige)) (Berry, Levinsohn and Pakes, 1995; Dubois and Jodar-Rosell, 2010).[28] These non-observed product characteristics are highly likely to be correlated with adjusted shelf-price and lead to endogeneity problem.

In order to account for the endogeneity contained in Equation (17) an instrumental variable (*IV*) approach is used. Suitable instrumental variables are those correlated with the brand prices, but uncorrelated with the unobserved product characteristics in the error term, ξ_{ij}. Following similar modeling approaches used by Nevo (2001), Chintagunta, Bonfrer and Song (2002), and Berto Villas-Boas (2007), we construct instrumental variables by interacting manufacturer input prices (or input price indexes) with brand dummy variables. The selected instruments are input prices and price indexes of weekly average diesel retail price, the mean weekly interest rate, average weekly earnings in the Canadian food manufacturing sector, the Canadian non-residential electric power selling price index, the price index for raw material vegetable products, and the energy price index (see Table 13). We argue that it is reasonable to assume that manufacturers' input prices or sector-specific price indexes are uncorrelated with

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[28] Some of these unobserved product characteristics are not really "unobservable". For example, in-store advertising can be observed by econometricians by visiting stores frequently to collect corresponding data. However, it is difficult to obtain these product characteristics and they are also not included in the datasets that are available to this thesis. Thus, these "unobservable" and "unobtainable" product characteristics enter the error term. This issue also applies to the endogeneity discussion in the CPM functions.

the unobserved product characteristics in the error term ξ_{ij}. For instance, changes in in-store advertising for the canned soup products are more likely to be uncorrelated with manufacturers' input prices such as for labor and capital. In addition, the intuition standing behind interacting manufacturers' input prices with brand dummy variables is to allow each input to enter the production function of each brand differently (Berto Villas-Boas, 2007). Berto Villas-Boas (2007) further explains that inclusion of brand dummy variables in the structural demand model makes the instrumental variables (cost shifters) un-correlated with constant unobserved product characteristics in the error term.

The second endogeneity issue relates to the conditional shares in Equation (17). Here we argue that it is reasonable to assume that unobserved changes in product characteristics (by the econometricians) are correlated with the conditional market share for a given brand. For example, it is likely that in-store advertising for a given brand will increase its consumer demand and, hence, its market share. Thus, an instrumental variable is needed to account for these variations. Berry, Levinsohn and Pakes (1995) suggest that the market share of a given product is affected by various characteristics of its competing products in the marketplace, so the characteristics of competing products can be considered suitable instruments. Thus, following Pinkse and Slade (2004) and Richards, Hamilton and Patterson (2010), we construct a weighted average of nutritional attributes of other competing brands/flavors by multiplying a vector of continuous nutritional contents by the nutrient-weighted matrix G_{d_4}, which is defined in Section 3.2 (pp. 47). For example, let F represent the vector of fat content of all brands/flavors; then $G_{d_4}F$ should contain the weighted average fat content of all competing products. Similar instruments are created for additional nutritional attributes in such way that the model is over-identified (Pinkse and Slade, 2004).

Similar endogeneity problems apply to Equation (36). Specifically, a set of instruments that make the error term in the cost-price margin equation exogenous to both retailer and manufacturers' pricing decisions. Following Richards, Hamilton and Patterson (2010), we adopt a set of instrumental variables that consist of brand, flavor, PL indicator and seasonal dummies, continuous nutritional properties and weighted average nutritional attributes. We argue that it is reasonable to assume that these pre-determined factors are not correlated with either retailer and manufacturer pricing decisions, yet correlated with their markup strategies. For instance, some systematic factors, such as changes in taxation system, are correlated with retailers and manufacturers' markups, but most likely not with their products' attributes.

With econometric issues addressed above, Table 13 illustrates summary statistics for the major independent variables used in both Equation (17) and Equation (36). In the structural demand model, the product attribute vector X_{ij} includes the seasonal dummy (*se*), binary indicators for PL (*pl*), brand (*brand*), an binary indicator whether the product is offered in an in-store discount (*promotion*), and product's nutritional content variables (*cal* for calories, *fat* for fat, *cho* for cholesterol, *sod* for sodium, *carb* for carbohydrate, *fib* for fiber, *sug* for sugar and *pro* for protein) and an indicator (*hc*) showing the number of health claims in the front-facing label of this product.[29] Based on results in Figure 9, seasonal dummy (*se)* is defined to be 1 for the first and fourth quarter, and 0 for the other two quarters. Besides, all the seven cost shifters have been summarized: the weekly average wage, the weekly average diesel retail price, weekly mean interest rate,

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[29] Definition of dummy variables: *pl*=0 if product is private label, and 0 otherwise. *Brand*=1 *(NB1), brand*=2 *(SB), brand*=3*(NB2), brand*=4*(NB3), brand*=5*(NB4).*

vegetable price index, non-residential electricity selling price index, energy price index, and industry price index for canned soup manufacturers. In addition, the vegetable price index, non-residential electricity price index, and canned soup industry price index are only available in monthly sets, and have been transformed into weekly sets using spline interpolation.

Table 13: Summary Statistics for Major Variables Used in This Study (N=337598)

Variables	Mean	Std. Dev.	Min	Max
Demand model				
Absolute Price ($/can)	2.29	1.90	0.15	13.92
Relative Price ($/cup)	1.17	1.54	0.13	12.25
Absolute Margin ($/can)	0.64	0.75	-5.63	5.26
Relative Margin ($/cup)	0.30	0.49	-4.96	4.54
PL Indicator	0.19	0.39	0.00	1.00
Probability of Discount	0.26	0.44	0.00	1.00
Calories (per cup)	132.14	53.17	20.00	250.00
Fat (g/cup)	3.64	3.92	0.00	15.00
Cholesterol (mg/cup)	7.91	7.64	0.00	20.00
Sodium (mg/cup)	846.60	377.13	360.00	1700.00
Carbohydrate (g/cup)	19.18	7.54	2.00	34.00
Fiber (g/cup)	2.56	3.01	0.00	10.00
Sugar (g/cup)	5.09	5.44	0.00	20.00
Protein (g/cup)	5.19	2.22	1.00	9.00
Number of Health Claims	1.07	1.03	0.00	3.00
Supply model Integrated				
Diesel Price[1]	56.23	9.95	36.10	74.50
Interest Rate[2]	3.12	0.86	2.00	4.25

Vegetable Price Index[3]	90.89	7.13	81.20	104.70
Energy Price Index[2]	238.76	48.50	158.60	388.00
Electricity Price Index[3]	99.76	4.65	90.80	110.70
Canned Soup IPI[3]	113.12	3.37	105.90	117.10
Wage[3]	833.90	32.97	771.90	887.83

Note: 1. Source: *Natural Resource Canada* (2012). Weekly average wholesale price in cents/liter is selected. 2. Source: *Bank of Canada* (2012). Target for overnight rate is selected as the interest rate. Energy price index measures the commodity price index for crude oil, natural gas and coal. 3. Source: *Statistics Canada* (2012). 2002=100. Vegetable price index measures price changes in vegetables purchased by industries in Canada for further processing. Electricity price index measures the change in the cost of electric power to the non-residential customer. Canned soup IPI measures the Industry Price Index in canned soup manufacturing section. Average weekly earnings in $/week for food manufacturing section is selected.

Chapter 6 Results and Discussion

In this chapter, estimation results for Equation (17) and Equation (36) will be shown and discussed. Demand model estimation results will focus on PL and NB competition considering product differentiation measured by Distance-Matrix (DM) approach, while pricing models will address the market power distribution between retailers and manufacturers. The statistical software package STATA 11.0 will be used for model estimation, which works well with large sample panel data.

6.1 Demand Model Results

As part of the empirical estimation procedure, we test (a) the justification of the proposed nesting structure (NML); (b) the validity of instrumental variables for brand prices and conditional market shares; (c) the significance of the DM approach in identifying the location of individual brands in the attribute space; and (d) the effects of brand-level product differentiation on the market demand for competing PL and NBs. In order to perform the necessary tests for these four objectives, four different specifications of the complete model will be estimated.

The results of the alternative DM/NML model specifications are presented in Table 14. The results in column (i) were obtained from the most basic specification which excludes instrumental variables and DM approach. The results in columns (ii) and (iii) include only the instrumental variables and only the DM approach, respectively. Column (iv) presents the regression results considering both instrumental variables and DM approach.

Model Specification and Tests

First of all, we evaluate the justification of the proposed nesting structure (NML) (as shown in Figure 5) for the canned soup demand model. The coefficient of conditional share (***σ=0.590***) is positive and significant at the 99% significance level. More importantly, the coefficient values (***0.445, 0.223, 0.545, 0.590***) in four different specifications range between 0 and 1, indicating that consumers do substitute among brands within the same flavor group. This finding is consistent with previous studies such as Pham and Prentice (2010) who show that consumers choose brands among “Discount” and “Mainstream” groups of cigarettes. Moreover, the significance of both brand (***Brand-Distance=0.294***) and flavor distance parameters (***Flavor-Distance=0.289***) also justifies the choice of nesting structure. Our findings are consistent with those reported by Richards, Hamilton and Patterson (2010) for the ice-cream category for the same retailer in the U.S. retail market.

Second, the validity of instrumental variables used in the analysis can be verified by comparing the results from the basic specification (i) with those in the specification (ii). First, the robust standard errors in the specification (ii) are much higher than those in the basic specification, since the latter includes price and conditional share directly as instrumental variables. The finding of larger standard errors is consistent with theoretical results reported by Greene (2007) and Stock and Yogo (2005).

Second, demand is much more price sensitive in the specification (ii) and (iv) than (i) and (iii), which is consistent with results reported by Villas-Boas and Zhao (1995) and Richards, Hamilton and Patterson (2010). Third, in the basic model we find surprisingly negative promotional effects on demand, while the sign shifts to positive in the specification (iv), indicating that temporary promotions would boost sales. More specifically, when we apply the well-known Durbin-Wu-Hausman (Greene, 2008) test (abbreviated by "DWH" in the proceeding tables) for endogeneity, a test statistic of **394.9** significantly rejects the null hypothesis of no endogeneity in the structural demand model, which justifies the use of instrumental variables to remove endogeneity issues in the demand model.

Table 14: Demand Model Estimation Results

Variable	i		ii		iii		iv	
	Estimates	**t-ratio**	**Estimates**	**t-ratio**	**Estimates**	**t-ratio**	**Estimates**	**z-ratio**
Seasonal	-0.111	-56.77	-0.125	-48.42	-0.125	-62.13	-0.058	-23.68
Division	-0.060	-333.04	-0.058	-265.52	0.001	2.53	0.055	49.23
Promotion	-0.583	-195.56	-0.600	-137.12	-0.493	-180.60	0.180	16.37
Brand	-0.082	-118.54	-0.150	-171.90	-0.184	-271.16	-0.103	-38.66
PL	-0.947	-95.29	-1.446	-101.59	-1.239	-111.20	-1.353	-47.18
Calorie	-0.011	-30.58	-0.016	-42.44	0.024	17.96	-0.142	-7.51
Fat	0.069	20.73	0.159	47.88	-0.130	-11.66	1.523	10.46
Cholesterol	0.038	70.32	0.041	78.49	-0.044	-32.15	-0.207	-27.77
Sodium	0.001	161.51	0.002	83.55	-0.001	-41.39	-0.003	-26.64
Carbs	-0.015	-8.59	0.013	7.56	-0.204	-35.80	0.466	6.88
Fiber	0.054	27.94	0.132	69.22	0.061	33.25	-0.185	-30.46
Sugar	0.111	170.07	0.105	164.84	0.116	147.64	0.031	22.73
Protein	0.200	110.81	0.111	58.34	0.206	32.64	1.258	12.35
Health Claims	-0.241	-137.82	-0.337	-136.81	-0.389	-222.34	0.001	0.09*
Brand-Distance	-	-	-	-	-0.794	-114.32	0.294	21.64
Flavor-Distance	-	-	-	-	0.120	17.69	0.289	29.98
Nutrient-Distance	-	-	-	-	-0.075	-12.10	-0.315	-14.26

Price	-0.026	-34.80	-0.369	-57.10	-2.543	-113.50	-6.914	-60.99
Price-Calorie	-	-	-	-	-0.019	-14.26	0.147	6.85
Price-Fat	-	-	-	-	0.138	11.66	-1.629	-9.39
Price-Cholesterol	-	-	-	-	0.578	15.68	0.252	38.27
Price-Sodium	-	-	-	-	0.062	47.75	0.005	31.15
Price-Carbs	-	-	-	-	0.148	26.65	-0.475	-6.11
Price-Protein	-	-	-	-	-0.116	-18.33	-1.235	-12.23
σ	0.445	204.25	0.223	72.54	0.545	288.47	0.590	132.70
Adjusted R-squared	0.9795		0.9990		0.9784		0.9999	
							DWH=394.9	

Note: All estimates are significant at the 5% level, except the estimate highlighted by *. Brand-Distance, Flavor-Distance and Nutrient-Distance are distance measures in brand and flavor (1=same, 0 otherwise), nutrient (inverse Euclidean measure). Price-Calorie, Price-Fat, Price-Cholesterol, Price-Sodium, Price-Carbs (Carbohydrates), Price-Protein are price-response measures showing how price changes in response to products' attributes. The estimate of σ is a nesting structure that measures the within-group substitution pattern and heterogeneity.

Next we evaluate the significance of the DM approach as a measure of defining product differentiation in quality and nutritional brand attributes. Although the relevance of the DM approach is given by the significance of all the DM parameters (***Brand-Distance=0.294***, ***Flavor-Distance=0.289, Nutrient-Distance=-0.315***), additional evidence can be found in the direct comparison of the DM parameters across columns (i) to (iv). For example, failure to account for brand-level product differentiation would not only lead to underestimation of the price effects and degrees of within-flavor substitution for canned soup products, but also may revert the coefficient signs for some quality-related attributes (e.g. sodium) on which consumers may base their purchase decisions. Similar findings by Richard, Hamilton and Patterson (2010) confirm the usage of the DM approach in this thesis analysis.

Distance Parameters Discussion

As discussed above, all the distance-related parameters are significantly different from zero. Recall that the brand shelf prices are multiplied by the continuous and discrete distance measures (brand-distance, flavor-distance and nutrient-distance) to express consumers' assessment of the degree of product differentiation. Specifically, the brand distance parameter (***Brand-Distance=0.294***) is significantly different from zero, which indicates that brand differentiation matters for the market share between PL and NB. Besides, the positive sign of brand distance parameter shows that, if the retailer or manufacturers carry more of one brand within the same flavor group (*e.g.* mixed vegetable), the distance-weighted brand market share is expected to increase. In other words, conditional on price, flavor and other product characteristics, a positive brand distance parameter suggests that if the retailer carries more brand within a specific flavor group this would boost the brand's overall market share. This finding is in line with results by Richards et al. (2010).

The flavor distance parameter (***Flavor-Distance=0.289***) is also statistically different from zero, indicating the importance of flavor differentiation to increase market share for PL and NB products. As to the brand distance parameter, the positive sign also shows that conditional price, brand and other product attributes, if the retailers carry more flavor within a specific brand group (e.g. *SB*), this could increase this flavor's overall market share. Taking two discrete distance parameters into consideration together, we could find that varieties in both brand and flavor do help retailers/manufacturers increase sales. This finding is consistent with that by Draganska and Mazzeo (2003), who find that, in the case of the ice cream category, retailers tend to provide product portfolios in such way that the same flavors from the same brand would not be sold at the same time on store shelves. Draganska and Mazzeo (2003) further analyze empirically that this strategy would help retailers reduce inter-brand competition within quality tiers.

A different interpretation applies to the case of the nutrient-distance parameter (***Nutrient-Distance=-0.315***). Recall that the nutrient-distance variable indicates the proximity of two products in term of their nutritional properties (quality-related attributes). A negative parameter, ***Nutrient-Distance=-0.315***, implies that, conditional on price, flavor and brand, if one product is closer in the attribute space with regards to others, its market share is expected to be lower (Pinkse and Slade, 2004; Slade, 2004; Richards, et al., 2010). For example, if the retail decreases its sodium content in PL product, its proximity to other NB products will be increased and its market share would be boosted. Our findings differ from those reported by Sayman, Hoch and Raju (2002), who found that if NBs mimic other NBs' characteristics, this would cannibalize overall NB sales and increase PL market shares. However, our results suggest that, in terms of nutritional properties, consumers tend to prefer nutritional variety and attach importance to individual brands' health-related attributes. Besides, this finding is confirmed by Feinberg, Kahn and McAlister (1992), who find that, keeping brand preference constant, positioning a brand close to some other brand would lead to a loss in its market share. They also further indicated that a gain in market share would be resulted in for the "uninvolved brand".[30]

Product Attributes Parameters Discussion

Another important parameter in the structural demand model is the PL dummy indicator. As opposed to many other findings (Hoch and Banerji, 1992; Mill, 1995;

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[30] Feinberg et al. (1993) also provided an empirical example: *Coke*'s and *Pepsi*'s lost their market shares to *7-Up* caused by *Coke* and *Pepsi* being indistinguishable in the blind taste test.

Sayman, Hoch and Raju, 2002; etc.), we find a significant and consistent negative effect of PL on the market share across model specifications ***(-0.947, -1.446, -1.239, -1.353***). This result seems somewhat counterintuitive compared to the literature and theoretical model predictions. A plausible explanation is that the Canadian canned soup market consists of a large number of NBs that are in direct competition, as indicated in the Table 7 (pp. 71). The descriptive statistics indicate strong price and promotional competition among NBs in the canned soup category. Our findings are theoretically and empirically consistent with results reported by Raju, Sethuraman and Dhar (1995), who find that, in retail categories where a large number of NBs compete, the introduction of a PL brand may increase category profits, but may not necessarily lead to a large market share. Moreover, the literature argues that in large-volume retail categories (fast moving consumer goods (*FMCG*), including the canned soup category), a higher intensity of price competition among incumbent NBs (higher NB cross-price sensitivity) can make the introduction of a PL less attractive to a retailer and depress the PL's market share (Raju, Sethuraman and Dhar, 1995). Moreover, Sethuraman (1992) find empirical evidence of a significant and negative relationship between NB promotional strategies (e.g. retailer in-store discounts or manufacturer coupons) and PL market shares, indicating that intense price competition among NBs may, in fact ,inhibit the introduction and growth of PLs. Similar results are also found by Dhar and Hoch (1997) and Narasimhan and Wilcox (1998). Hence, the success of PLs depends not only on the retailers' marketing strategy, but also on the market characteristics of corresponding product category.

The results regarding the price-nutrient response parameters in the structural demand model suggest that nutritional properties and elasticities are closely related. Allowing the slope (or the own price-elasticity) to vary with its own nutritional characteristics is therefore important in the perspective of manufacturers (Slade, 2004). Consistent with findings by Richards et al. (2010), we observe that consumers tend to be more price-elastic in cases of high fat and high protein soups. Both fat and protein canned soup products (***Price-fat=-1.629, Price-protein=-1.235***) have steeper (i.e., more negative or positive) slope coefficients compared to other nutrients. This is a reasonable result, which has also been reported by Huang (1996) who indicates similar relationship between product price and nutrient content for beef products. Moreover, contrary to a previous statement in this thesis that sodium should be a big concern (from the view of consumers) in the canned soup category, we find that sodium has the least steep slope of all nutrients, and lowest price elasticity (***Price-sodium=0.005***). While this result may seem somewhat counterintuitive, it is probably evidence of the fact that consumers' perception of health in convenience soup products (sodium content typically also influences perceptions of flavor) deviates from the accepted scientific evidence.

Other parameters provide evidence on how category market shares vary with seasonal market changes, store location, promotional activities and by brand, capturing product fixed effects that influence individual brands' market shares. The seasonal parameter (***Seasonal=-0.058***) suggests that canned soup products have a **5.8%** higher market share during the winter quarter than during the summer periods. This is consistent with the statistical evidence found in our raw data (shown in Figure 9). Accounting for product differentiation especially in nutrition-related attributes and endogeneity issues reverts the signs, from negative to positive, for the impact of promotional activities on brand market shares (Hoch and Banerji, 1993; Mills, 1995; Chintagunta, Bonfrer and Song, 2002).

Own- and Cross-Price Elasticity

Using the estimated demand parameters in the complete structural model (specification (iv) in Table 14), Table 15, Table 16, Table 17 and Table 18 report the matrixes of own- and cross-price elasticities of demand for the selected canned soup brands. Each entry (*i*, *j*), where *i* indexes row and *j* column, indicates the percentage change in the market share of *i* with respect to a 1% change in the mean price of *j*. Rather than measuring the price elasticities at their mean or median value (as did in Nevo (2001)), our elasticity values are obtained for the 22nd week of 2007 (last week in dataset) when all 25 products were available in the retailer's stores. As expected, all own-price elasticities carry negative signs, consistent with economic theory and most previous studies (Nevo, 2001; Villas-Boas, 2007). Products of the same brand, flavor, or nutritional properties tend to be closer substitutes than those possessing differential characteristics. Put differently, products tend to be more sensitive to changes in the prices of close substitutes, which is in line with our expectations (Nevo, 2001; Villas-Boas, 2007; Pham and Prentice, 2010; Richards, Hamilton and Patterson, 2010). For example, *NB2 Hearty Beef Barley* soup is most sensitive to price changes in *NB1 Beef Burger*, and least sensitive to price changes in *NB2 Grilled Chicken with Rice* and *NB2 Hearty Lentil*. Contrary to Slade (2004), who adopts a traditional nested logit model specification to estimate the demand for differentiated product, our elasticities measure price elasticities between product *i* and *j* as being dependent on both *i* and *j*. More specifically, all cross-price elasticities vary with both the product attributes of *j* and the distance (proximity) between *i* and *j* in the attribute space.

In addition, we find that the two premium NBs, *NB1* and *NB3*, have the highest own-price elasticities, which indicates that consumers are most price-sensitive to these two premium brands, while PL has the lowest own-price elasticity, which indicates that the consumers of PL s are more brand-loyal. This result can also be confirmed by the cross-price elasticities for *SB* (***0.000159*** to ***0.029825***). More specifically, the coefficient estimates in rows (6)-(10) show that price changes in NB products have the least effect on the market share of PL. Unlike other studies (Sayman, et al., 2002; Mintel, 2012) which show that consumers are most price-sensitive to low-quality products, the strong consumers brand loyalty for PL may be the result of the retailer's PL brand-reputation and retailer loyalty.

Table 15: Demand Price Elasticities

id	1	2	3	4	5	6	7	8	9	10	11	12	13
1	**-0.466889**	0.001930	0.005677	0.001939	0.005685	0.002663	0.002663	0.002663	0.007763	0.002663	0.002665	0.002665	0.002669
2	0.018485	**-4.186710**	0.018485	0.018485	0.018485	0.019278	0.019278	0.019278	0.019278	0.019278	0.019281	0.019279	0.019279
3	0.052448	0.017969	**-3.181523**	0.017984	0.052460	0.018945	0.018944	0.018945	0.055226	0.018944	0.018948	0.018948	0.018956
4	0.020504	0.020487	0.020508	**-2.583692**	0.020511	0.021898	0.021898	0.021898	0.021898	0.021898	0.021901	0.021902	0.107596
5	0.010975	0.003747	0.010976	0.003758	**-1.021322**	0.004385	0.004384	0.004385	0.010953	0.004384	0.004386	0.004386	0.004390
6	0.003357	0.003357	0.003357	0.003357	0.003357	**-0.120711**	0.002008	0.003452	0.002008	0.002008	0.014449	0.003357	0.003357
7	0.000292	0.000292	0.000292	0.000292	0.000292	0.000159	**-0.018773**	0.000159	0.000156	0.000158	0.000292	0.000292	0.000292
8	0.003969	0.003969	0.003969	0.003969	0.003969	0.004082	0.002374	**-0.122065**	0.002375	0.002374	0.003969	0.003969	0.003969
9	0.027631	0.009479	0.027631	0.009478	0.029825	0.010243	0.010239	0.010243	**-0.930107**	0.010241	0.009478	0.009478	0.009478
10	0.001592	0.001592	0.001592	0.001592	0.001592	0.001351	0.001352	0.001351	0.001352	**-0.483982**	0.001592	0.001592	0.001592
11	0.045294	0.045295	0.045294	0.045292	0.045293	0.298839	0.045283	0.045284	0.045283	0.045283	**-1.230273**	0.041935	0.041938
12	0.143564	0.143553	0.143567	0.143567	0.143565	0.143550	0.143547	0.143550	0.143547	0.143547	0.137343	**-6.332148**	0.137360
13	0.107984	0.107926	0.108018	0.521142	0.107999	0.107919	0.107915	0.107919	0.107915	0.107915	0.099189	0.099206	**-2.440527**

Table 16: Demand Price Elasticities (Extended)

id	1	2	3	4	5	6	7	8	9	10	11	12	13
14	0.097680	0.033447	0.097747	0.033606	0.080627	0.033442	0.033440	0.033442	0.080316	0.033440	0.027464	0.027470	0.027530
15	0.011702	0.011701	0.011702	0.011702	0.011702	0.011704	0.011710	0.046893	0.011709	0.011708	0.007402	0.007402	0.007402
16	0.046341	0.449652	0.046341	0.046342	0.046342	0.046341	0.046338	0.046341	0.046338	0.046338	0.046340	0.046342	0.046342
17	0.007633	0.007631	0.007633	0.007633	0.007633	0.007632	0.055208	0.007632	0.007631	0.007631	0.007632	0.007632	0.007633
18	0.043066	0.417795	0.043069	0.043071	0.043068	0.043054	0.043053	0.043054	0.043053	0.043053	0.043058	0.043066	0.043091
19	0.006257	0.006255	0.006257	0.006258	0.006258	0.006255	0.038196	0.006255	0.006254	0.006254	0.006256	0.006256	0.006257
20	0.018412	0.006314	0.018411	0.006316	0.015749	0.006315	0.006314	0.006315	0.015743	0.006314	0.006315	0.006315	0.006316
21	0.008734	0.008734	0.008734	0.008733	0.008734	0.008732	0.008732	0.008732	0.008732	0.008732	0.008753	0.008733	0.008734
22	0.015818	0.015819	0.015818	0.015817	0.015818	0.015814	0.015814	0.015814	0.015814	0.015814	0.015859	0.015817	0.015818
23	0.004869	0.004867	0.004869	0.004868	0.004869	0.004867	0.004867	0.004867	0.004867	0.004867	0.004868	0.004867	0.004868
24	0.008070	0.008071	0.008070	0.008070	0.008070	0.008069	0.008068	0.008069	0.008068	0.008068	0.008078	0.008069	0.008070
25	0.013943	0.013937	0.013943	0.013947	0.013944	0.088364	0.013935	0.013936	0.013935	0.013935	0.088376	0.013939	0.013942

Table 17: Demand Price Elasticities (Extended)

id	14	15	16	17	18	19	20	21	22	23	24	25
1	0.007788	0.002663	0.002664	0.002664	0.002667	0.002665	0.007768	0.002665	0.002665	0.002667	0.002665	0.002667
2	0.019279	0.019278	0.187072	0.019279	0.187077	0.019279	0.019279	0.019281	0.019281	0.019280	0.019282	0.019279
3	0.055269	0.018944	0.018946	0.018946	0.018951	0.018948	0.055232	0.018947	0.018947	0.018949	0.018947	0.018949
4	0.021937	0.021898	0.021900	0.021901	0.021909	0.021904	0.021902	0.021901	0.021901	0.021903	0.021901	0.021909
5	0.010986	0.004384	0.004385	0.004385	0.004388	0.004386	0.010958	0.004386	0.004386	0.004387	0.004386	0.004388
6	0.003357	0.003357	0.003358	0.003358	0.003357	0.003358	0.003358	0.003357	0.003357	0.003357	0.003357	0.014453
7	0.000292	0.000292	0.000292	0.002111	0.000292	0.001096	0.000292	0.000292	0.000292	0.000292	0.000292	0.000292
8	0.003969	0.015055	0.003971	0.003970	0.003969	0.003970	0.003970	0.003969	0.003969	0.003969	0.003969	0.003970
9	0.029825	0.009477	0.009478	0.009478	0.009478	0.009478	0.029825	0.009478	0.009478	0.009478	0.009479	0.009478
10	0.001592	0.001592	0.001592	0.001592	0.001592	0.001592	0.001592	0.001592	0.001592	0.001592	0.001592	0.001592
11	0.041937	0.041928	0.045286	0.045286	0.045291	0.045288	0.045287	0.045390	0.045393	0.045295	0.045346	0.298875
12	0.137352	0.137330	0.143556	0.143556	0.143583	0.143559	0.143556	0.143559	0.143559	0.143557	0.143558	0.143562
13	0.099284	0.099164	0.107929	0.107931	0.108061	0.107942	0.107934	0.107938	0.107938	0.107942	0.107935	0.107955
14	**-0.664410**	0.027449	0.033450	0.033453	0.033495	0.033463	0.080362	0.033453	0.033453	0.033462	0.033452	0.033481

Table 18: Demand Price Elasticities (Extended)

id	14	15	16	17	18	19	20	21	22	23	24	25
15	0.007402	**-0.233718**	0.011702	0.011702	0.011702	0.011702	0.011702	0.011702	0.011702	0.011702	0.011702	0.011702
16	0.046342	0.046338	**-3.405799**	0.043805	0.424955	0.043797	0.043798	0.046340	0.046340	0.046340	0.046339	0.046344
17	0.007633	0.007631	0.006723	**-1.328186**	0.006719	0.048633	0.006725	0.007632	0.007632	0.007632	0.007632	0.007634
18	0.043074	0.043053	0.396206	0.040831	**-3.515228**	0.040834	0.040832	0.043058	0.043058	0.043059	0.043058	0.043064
19	0.006258	0.006254	0.005266	0.038116	0.005266	**-0.966254**	0.005272	0.006256	0.006256	0.006256	0.006255	0.006264
20	0.015750	0.006314	0.005388	0.005392	0.005387	0.005393	**-1.014452**	0.006315	0.006315	0.006315	0.006315	0.006318
21	0.008733	0.008732	0.008732	0.008732	0.008733	0.008733	0.008733	**-4.933281**	0.008178	0.008075	0.146584	0.008074
22	0.015817	0.015814	0.015815	0.015815	0.015817	0.015816	0.015815	0.014644	**-5.950471**	0.014425	0.014449	0.014423
23	0.004868	0.004866	0.004867	0.004867	0.004868	0.004867	0.004867	0.004429	0.004429	**-6.278046**	0.004429	0.004429
24	0.008070	0.008068	0.008069	0.008069	0.008069	0.008069	0.008069	0.137063	0.007561	0.007552	**-5.839615**	0.007551
25	0.013946	0.013935	0.013939	0.013941	0.013942	0.013951	0.013943	0.012390	0.012390	0.012392	0.012390	**-3.217997**

Note: 1. Each entry is measured as the own- and cross- price elasticities in the 22nd week of 2007. 2. id is used to identify products easily, which has been shown in Table 12 3. Each entry (*i*,*j*), where *i* indexes row and *j* column, indicates the percentage change in the market share of *i* with respect to a one-percent change in the mean price of *j*.

6.2 Cost-Price Margin Estimation

6.2.1 Attribute-dependent Conduct Parameters

The above section explained the effects of PL usage on the horizontal competition between PL and NB, considering product differentiation in the structural demand model. What is more, pricing models related to both retailer and manufacturers would reveal effects of PL usage on margins of both the multi-product retailer and manufacturers. Similar to the structural demand model, three different models of brand-level supply have been estimated and their results are presented in Table 19 and Table 20. The first and second pricing model specifications assume perfectly competitive patterns in downstream (retailer's side) and upstream (manufacturers' side) markets, respectively. The third pricing model assumes oligopolistic competition (Nash-Bertrand equilibrium) for both downstream retailer and upstream manufacturers. In Table 19, cost shifter parameters (indexed by γ in Equation (36)) show the effects of selected six cost variables, as shown in Table 13, on the manufacturers' margin; conduct parameters for retailer and manufacturers (indexed by φ and θ and in Equation (24) and Equation (34), respectively) illustrate the effects of product attributes (brand, PL indicator, and nutritional content) on the upstream and downstream conduct parameters.

Model Specification and Tests

Firstly, we have to evaluate the importance of the assumption of oligopolistic competition in downstream and upstream markets. Comparing the empirical results across the three models, we are able to test the validity of hypothesized assumptions regarding the nature of the oligopolistic competition between the multi-product retailer and brand manufacturers considered in the analysis. Failing to account for oligopolistic downstream and upstream pricing reverts the sign of PL indicator for both retailer and manufacturers' conduct parameters. Moreover, a Wald test statistics reject both models that only account for downstream or upstream oligopolistic pricing behavior, indicating that, both the retailer and the brand manufacturers exert some degree of market power in the price-setting behavior.

Secondly, as discussed in Chapter 5, we test the endogeneity issue in the cost-price margin functions. Similar to the structural demand model, a Durbin-Wu-Hausman (Greene, 2008) test is used to verify the existence of endogeneity issues. The Durbin-Wu-Hausman (DWH) statistics is **35188.7**, which significantly rejects the null hypothesis that independent variables are exogenous in the pricing model. Hence, we can conclude that instrumental-variable-adjusted estimators are preferred. Therefore, according to two arguments above, we can verify the model which considers both upstream and downstream oligopolistic competition (Nash-Bertrand equilibrium), which will be our focus in the following discussion for the pricing model results.

Table 19: Retailer/Manufacturers Pricing Equation Estimation Results

Parameters	Variable	Manufacturers Pricing		Retailer Pricing		Manufacturers & Retailer Pricing	
		Estimate	z-ratio	Estimate	z-ratio	Estimate	z-ratio
Cost Shifters (γ)	Diesel Price	-0.0706	-17.72	0.0231	21.81	0.0396	6.29
	Interest Rate	-0.3532	-25.99	-0.1145	-17.46	-0.2221	-5.89
	Vegetable PI	0.0738	47.87	0.01452	23.55	0.0477	28.87
	Energy PI	0.0146	34.29	-0.0055	-28.33	0.0031	5.49
	Electricity PI	0.0395	14.14	0.0308	24.21	0.0405	8.23
	Industry PI	0.1692	31.21	0.0392	20.10	0.0313	4.12
	Weekly Wage	-0.0127	-23.74	-0.0033	-16.96	-0.0190	-21.13
Manufacturers' Conduct Parameters (θ)	θ(0)	-0.0085*	-0.92	-	-	-0.0937	-5.03
	θ(PL)	-0.0090	2.07	-	-	0.0657	9.16
	θ(brand)	-0.0122	-11.83	-	-	-0.0114	-7.53
	θ(fat)	0.0133	25.13	-	-	0.0052	2.20
	θ(calorie)	-0.0001	-17.7	-	-	-0.0006	-5.06
	θ(sodium)	0.0001	27.43	-	-	0.0002	18.94
	θ(cholesterol)	0.0012	2.51	-	-	0.0091	10.68
	θ(protein)	-0.0024	-1.04	-	-	-0.0234	-8.73

Table 20: Retailer/Manufacturers Pricing Equation Estimation Results (cont'd)

Parameters	Variable	Manufacturers Pricing	Retailer Pricing	Manufacturers & Retailer Pricing

		Estimate	z-ratio	Estimate	z-ratio	Estimate	z-ratio
Retailer's Conduct Parameter (φ)	φ(0)	-	-	6.1109	24.33	-4.7814	-6.75
	φ(PL)	-	-	30.3791	87.16	-8.1054	-2.63
	φ(brand)	-	-	2.1313	117.21	0.9255	10.44
	φ(fat)	-	-	-1.0356	-49.13	0.4708	3.59
	φ(calorie)	-	-	0.107	48.25	-0.0519	-5.02
	φ(sodium)	-	-	-0.0335	-97.75	-0.0162	-30.12
	φ(cholesterol)	-	-	0.5875	73.01	0.4136	5.79
	φ(protein)	-	-	-1.5058	-47.68	1.2310	14.35
						DWH=35188.7	

Notes: 1. All estimates are significant at 10% level, except the estimate highlighted by *. 2. Parameters of γ measure upstream manufacturers' marginal cost variations in diesel price, interest rate, vegetable price index, energy price index, non-residential electricity selling price index, canned soup industry price index and average weekly wage. Parameters of θ measure effects of products' attributes on upstream manufacturers' pricing behaviors, including mean effect, private label effect, brand effect and nutritional effect (fat, calorie, sodium, cholesterol, protein). Parameters of φ are defined similarly with parameters of θ in the downstream retailer's pricing behaviors. Due to space limitation, coefficients for constant terms are not listed here.

PL Effects on Margins

The individual conduct parameters represent different determinants of upstream and downstream margins. On the retailer's side, the significant and negative parameter for the PL indicator (***φ (PL) =-8.1054***) in the manufacturers and retailer pricing model suggests that the PL brand has a negative effect on the margins earned by the retailer. Even though this result is consistent with the negative PL dummy variable coefficients found in the structural demand model specifications (discussed in Section 6.1, page 92 and 93), it deviates from results of the descriptive analysis, which showed that the retailer enjoys higher retail margins from its PL products compared to the margins earned for selling NB products (as shown in Table 8). This result also, at least partially, opposes the widely-accepted convention that retailer margins benefit from the introduction of PLs (Mills, 1995; Kumar and Steenkamp, 2007). However, considering the stiff competition in the canned soup market, it is reasonable to conclude that in order to capture market share from the dominant NB (*NB1*) and to build up market power over other leading NBs, the PL retailer has to undercut NB competitors' prices (below Bertrand-Nash equilibrium). Thus the retailer's margins on PLs are lower. More specifically, even though PLs earn lower retail margins, they are still considered an important strategic tool in negotiations with upstream NB soup manufacturers. Thus, more broadly speaking, the retailer's low PL margins are compensated and benefits from lower negotiated wholesale prices for NBs, which may outweigh PL margin losses over time. This strategic competitive process may be the key incentive for a retailer to introduce and continuously and heavily promote its PL brands. As such, our finding confirms previous studies by Scott-Morton and Zettekmeyer (2000), Schmalensee (1978), Corstjens and Lal (2000), Sayman, Hoch and Raju (2002), and also present an extension to the findings by Hoch and Raju (2002), who claim that premium PLs target established NBs and are acting as a negotiation tool for retailers in their bargaining with upstream NB suppliers. Our finding concludes that their conclusion also applies to the low-priced PL (*SB* in this thesis).

The interpretation of other individual supply-side conduct parameters provides interesting insights for the role of PLs in establishing retailer's market power. The estimated PL conduct parameter (***θ(PL)=0.0675)***) in the manufacturers' side is positive and significant, indicating that manufacturing PL results in higher margins than manufacturing NBs. Recall that this national retailer manufactures a large part of PLs products in its own-operated plants. More specifically, the retailer tends to earn lower retail margins from selling PLs (***φ (PL) = -8.1054***), but they earn higher margins as manufacturing their own store brand (***θ (PL) = 0.0675***). While this is not direct evidence that manufacturing and selling PLs may increase a retailer's aggregated margins, it rather implies that manufacturing PLs does compensate some of loss in retailer' retail margin incurred by selling low-priced PLs. This explanation is straightforward. As both the upstream manufacturer and downstream supplier of PLs, the retailer is able to earn higher margins since it can take greater share of total margin (Richards, Hamilton and Patterson, 2010) and vertically integrate the supplying structure (Tirole, 1988). Thus our finding is consistent with Mill (1995), who indicates that by integrating vertically and setting retail prices based on the actual marginal costs of production and distribution, the retailer can significantly lower its PL retail prices and yet increase its own total margins. As a consequence, the double-marginalization problem can be solved (Mill, 1995; Bontems, Monier-Dilhan and Réquillart, 1999).

Product Differentiation Effects on Market Power

Brand fixed effects were included in the conduct parameters functions to control for unobserved "potential heterogeneity" of different manufacturers that may affect retailers and manufacturers' pricing behaviors (Draganska and Klapper, 2007). Recall that brand dummy was defined according to brand market shares (as shown in Table 17 and its footnote). The significant and positive brand fixed effect in the retailer's conduct parameter (***φ (brand) =0.9255***) shows that selling "less-visible" brand would boost retailer's margins significantly. It is not direct evidence that the retailer has absolute pricing market power relative to "less-visible" brands in the market, but to some extent reveals that the retailer benefits more selling "less-visible" brands in their stores. This is in line with the brand fixed parameter in the manufacturers' conduct parameter (***θ(brand)=-0.0114***), which indicates that wholesale pricing market power for manufacturers is positively related to market share: the dominant NB has the largest pricing power in the wholesale price setting when negotiating with its contracted retailers. This finding is consistent with empirical findings by Draganska and Klapper (2007) in the ketchup category.

The parameters related to product's nutrient content in two conduct parameter functions are included to investigate how retailer and manufacturers' pricing power, or their retail/manufacturing margins, varies depending on their choice in product nutritional properties. Effects of nutritional differentiation on both the retailer and manufacturers' pricing power are mixed. For example, the parameter for sodium (***φ (sodium) =-0.0162***) indicates that product's low-sodium property would increase retailer's margin significantly, while the parameter for fat (***θ (cholesterol) =0.0091***) suggests that high-cholesterol property helps increase manufacturers' margins. Similar results have been found by Nevo (2001), yet without providing further interpretation. This seems counterintuitive and not consistent with widely-accepted content that consumers prefer low-fat and low-sodium. However, Nayga, Tepper and Rosenzweig (1999) explain that this evidence seems to suggest that consumers' brand and consumption choices are motivated more by their taste preference than "desirable eating habits based on established dietary guidelines" (Nayga, Tepper and Rosenzweig, 1999). For instance, a shopper trying to decide between noodle soup and beef noodle soup will probably pick the beef noodle soup due to common taste preferences even though the latter has a higher fat, sugar, and calorie content. This finding is in line with nutrition parameters in the empirical results of structural demand model, as shown in Table 14. It also suggests that if the retailer or manufacturers choose to differentiate their product (PL or NB) from others in nutritional properties, taste also should be taken into account, as well as nutrition level.

6.2.2 Brand-specific Conduct Parameters

Table 19 and Table 20 presented the determinants of retail and manufacturing margins for the retailer and NB manufacturers in their respective upstream and downstream markets. The results showed that the retailer obtains higher margins as manufacturing PL products than as a retailer in selling PLs. However, conduct parameters for the retailer and manufacturers have not yet been estimated. For example, as indicated in page 54, if $\varphi_{ij} > 1$, the retailer charges PL brand-level prices higher than is optimal, acting above the Bertrand-Nash equilibrium level. Thus, it is difficult to directly estimate and compare the market power distribution across the multi-product retailer and brand manufacturers. More specifically, in order to quantify the relative degree of competitiveness between PL and its competing NBs, we need to estimate individual conduct parameters for the retailer and brand manufacturers relative to their brands. Thus, to solve this issue, Equation (36) from page 59 was re-estimated, assuming that each conduct parameter (θ, φ) is brand-specific and independent of individual brand-level attributes. Similar to Table 19 and Table 20, results for the three pricing models are shown in Table 21 and Table 22.

Table 21: Brand-specific Conduct Parameters Estimation Results

Parameters	Variable	Manufacturers Pricing		Retailer Pricing		Manufacturers & Retailer Pricing	
		Estimate	**z-ratio**	**Estimate**	**z-ratio**	**Estimate**	**z-ratio**
Cost Shifters (γ)	Diesel Price	-0.0006	-1.63	0.0056	19.52	-0.0013	-3.73
	Interest Rate	-0.0875	-36.49	-0.0616	-30.33	-0.0433	-17.68
	Vegetable PI	0.0073	34.74	0.0045	24.39	0.0044	18.95
	Energy PI	9.17E-10*	0.00	-0.0006	-10.73	0.0002	4.02
	Electricity PI	0.0033	8.07	0.0023	6.58	0.0045	11.02
	Industry PI	0.0118	18.65	0.0032	5.77	0.0053	8.43
	Weekly Wage	0.0003	4.48	-0.0006	-10.03	-0.0003	-5.20
Manufacturers' Conduct Parameters (θ)	θ(*NB1*)	0.2055	20.45	-	-	0.3760	27.59
	θ(*SB*)	-0.1846	-10.28	-	-	0.0344	8.06
	θ(*NB2*)	-0.0006	-1.86	-	-	0.0069	7.60
	θ(*NB3*)	-5.3398	-47.33	-	-	0.4083	1.50
	θ(*NB4*)	0.3406	17.61	-	-	0.5796	21.01

Table 22: Brand-specific Conduct Parameters Estimation Results (cont'd)

Parameters	Variable	Manufacturers Pricing		Retailer Pricing		Manufacturers & Retailer Pricing	
		Estimate	z-ratio	Estimate	z-ratio	Estimate	z-ratio
Retailer's Conduct Parameter (φ)	φ(*NB1*)	-	-	0.2280	28.06	0.6005	42.66
	φ(*SB*)	-	-	1.3572	93.46	0.8815	54.11
	φ(*NB2*)	-	-	-0.5401	-11.47	0.6598	9.97
	φ(*NB3*)	-	-	1.3848	31.25	3.6843	18.93
	φ(*NB4*)	-	-	1.4183	48.38	2.1761	45.06

Note: 1. All estimates are significant at 10% level, except the estimate highlighted by *. 2. Parameters of γ measure upstream manufacturers' marginal cost variations in diesel price, interest rate, vegetable price index, energy price index, non-residential electricity selling price index, canned soup industry price index and average weekly wage. 3. Parameters of θ are upstream manufacturers' conduct parameters measured respectively for manufacturers of *NB1*, *SB*, *NB2*, *NB3* and *NB4*. Parameters of φ are downstream retailer's conduct parameters measured respectively for retailer's selling *NB1*, *SB*, *NB2*, *NB3* and *NB4*. 4. Due to space limitation, coefficients for constant terms are not listed here.

To verify the assumption of oligopolistic brand-level competition in upstream and downstream markets, we employ a test comparing the estimates of restricted model with those of unrestricted full model specifications. Even though the estimates of cost shifters are approximately the same as in the restricted models, failing to account for upstream or downstream oligopolistic competition tends to result in negative conduct parameters coefficients, which have no empirical interpretation. Moreover, Wald test results reject the null hypothesis that any of the conduct parameters is equal to zero. The test statistics indicates that both restricted model specifications need to be rejected in favor of the model assuming joint upstream and downstream oligopolistic pricing behaviors.

As to the manufacturers' conduct parameters in Table 21, we find that the conduct parameter for *NB3* is not significantly different from 0. Considering that retail price setting may differ across stores or regional management divisions, which might explain differentials in pricing rather than represent competitive strategies (Richards, Hamilton and Patterson, 2010). Overall, Wald tests on the manufacturers' conduct parameters θ reject the null hypothesis that these parameters are significantly equal to neither 1 nor 0, which confirm their plausible parameters range between 0 and 1, indicating that manufacturers tend to price their brands lower than the Bertrand-Nash equilibrium prices. Consequently, manufacturers' cost-price margins (CPM) would be lower than those expected for profit-maximization manufacturers. This result is unlike those found by previous studies. For instance, Kadiyali, Vilcassim and Chintagunta (1999) argue that cost-and-demand-advantaged established name brands in the yoghurt category should possess relative pricing power as compared to more vulnerable brands, resulting in CPMs above predicted Bertrand-Nash equilibrium levels. However, this does not necessarily apply to the canned soup category where retail channels dominate the sales of canned soups (Kadiyali, Vilcassim and Chintagunta 1999). Villas-Boas and Zhao (2005) provide an interesting explanation for this phenomenon in terms of the role of supply-contracts. They argue that contracts between a manufacturer and a retailer typically involve quantity-discounts, which lower a retailer's wholesale price for every unit purchased when the retailer's total purchase exceeds a given quantity threshold (Kolay, Shaffer and Ordover, 2004; Villas-Boas and Zhao, 2005). Thus, the marginal wholesale prices paid by the retailer to its contracted manufacturers would be lower than the marginal wholesale prices set in their supply-contracts. Thus, the wholesale prices paid by the retailer to manufacturers depend largely on wholesale quantity (Monahan, 1984), and the extent to which the manufacturer contributes to the retailer's profit (Villas-Boas and Zhao, 2005). In certain cases, payments are made directly by manufacturers to the retailers in form of allowances (e.g. slotting allowance) to ensure scarce shelf space for manufacturers in stores (Shaffer, 1991; Sullivan, 1997; Mills, 1999; Azzam, 2001). Since grocery retailing is the dominant distribution channel for canned soup manufacturers, upstream manufacturers would have to sacrifice margin to motivate retailer's collusion. Moreover, the conduct parameter (***θ (SB) =0.0344***) for PL strengthens this argument since it is the smallest in magnitude among all manufacturers' conduct parameters shown in Table 18. Since the retailer manufactures a large part of its own PLs, it can set the wholesale price at marginal cost to internalize its pricing externalities, which are assumed to be lower than those paid to NB manufacturers. To sum up, the less-than-one upstream conduct parameters imply retailer's bargaining power over NB soup manufacturers in the Canadian retail market.

As for the downstream conduct parameters presented in Table 18, Wald tests on the parameters **φ** indicate that all retailer's conduct parameters are significantly different from one, suggesting that the retailer is an imperfect category manager in setting retail prices to maximize its own joint category profits (Villas-Boas and Zhao, 2005). The magnitudes of conduct parameters are distributed around a value of one: φ for *NB1* (***φ(NB1)=0.6005***), *SB* (***φ(SB)=0.8815***) and *NB2* (***φ(NB2)=0.6598***) are significantly smaller than one, while those for *NB3* (***φ(NB3)=3.6843***) and *NB4* (***φ(NB4)=2.1761***) are significantly larger than one. These findings suggest that the retailer is pricing *NB1*, *SB* and *NB2* lower than joint profit-maximization would suggest, and higher than joint profit-maximization for *NB3* and *NB4*. Contrary to the uniform explanation for the upstream conduct parameters (quantity discounts), several justifications are possible to the results found in this analysis.

***SB*:** The coefficient estimate for *SB* **(*φ (SB) =0.8815*)** is consistent with the results presented in Table 17. The retailer exerts complete control over the pricing of its PL, without considering of upstream effects or collusive contracts. As the seller of PLs, the retailer realizes lower brand margins since the price of the PL is intentionally set below Bertrand-Nash equilibrium in order to exert bargaining power over NB manufacturers, to create brand loyalty, and increase consumer traffic. This is consistent with our demand-side findings presented in Table 17 and Table 18 that the PL enjoys lower own-and cross-price elasticities than competing NBs. Specifically, the PL is acting as a strategic tool to negotiate for better contracts with manufacturers, rather than a margin lifter.

NB1* and *NB2*:** they are the leading two NB brands in terms of market share in the Canadian canned soup retail market (as shown in Table 4). This result is consistent with Villas-Boas and Zhao (2005), who also find that the most visible brand in the marketplace showed the lowest retailer conduct parameters relative to competing brands. They explained that it would not be rational for the retailers to force these brand's prices below Bertrand-Nash equilibrium intentionally, since lowering the prices of the most well-known consumer brands could cannibalize the market power threat brought on by its own PL brand (Chintagunta, el al., 2002). It is more likely that upstream manufacturers coordinate with the retailer as part of their vertical distribution relationship (Berto Villas-Boas, 2007). In other words, the retailer may be obligated by the leading brand manufacturers to cut their NB prices in order to maintain the competitive advantages of these two leading brands. More specifically, this finding underlines the pricing power of brands *NB1*and *NB2* relative to PL. What's more, the lowest magnitude of the conduct parameter for *NB1* (φ (NB1) =0.6005***) suggests that *NB1* prices its brand even lower than *NB2* in order to maintain its competitive advantages, thus indicating its pricing market power exceeds that of *NB2* (***φ* (NB2) =0.8815**) with lower retail prices to extract profits from the retailer.

***NB3* and *NB4*:** Being two "less visible" brands in the Canadian canned soup market, *NB3* and *NB4* have smaller market shares compared to *NB1* and *NB2*, as shown in Table 4. A lower degree of horizontal brand differentiation may result in a smaller shelf display and lower probability of "catching" the consumers' attention and establishing brand loyalty. The retailer's behavior of setting prices higher than Nash equilibrium would be significant to its own PL in order to accumulate shelf-price advantages that highlight its competitive position compared to these two NBs. Consequently, the retailer's market power relative to these "less-visible" NB manufacturers may contribute to increases in retailer benefits from vertical contracts. This finding contradicts previous studies (Petrin, 2002; Bergman and Rudholm, 2003; Bonfrer and Chintagunta, 2004; and Pofahl and Richards, 2009), but is an extension of the findings by Ward et al. (2003) and Gabrielsen and Sørgard (2007). The findings of the latter two suggest that manufacturers tend to increase shelf-prices for NBs in order to maintain manufacturing profits. Our findings provide empirical evidence of the fact that price increases in the incumbent NBs are not due to manufacturers' voluntarily pricing decisions, but more due to increasing retailer's pricing power in setting retail prices. In other words, the retailer is able to "squeeze" the profits of "less-visible" NB manufacturers. This finding confirms the evidence shown in previous section (page 107).

Chapter 7 Summary and Implication

PL is an important marketing strategy for retailers to compete directly with upstream NB name manufacturers. This thesis focuses on effects of PL on the vertical interaction and competition between one single multi-product retailer and its NB manufacturers.

Originally, PL was introduced by retailers as a role of undercutting NB prices to increase consumer traffic in their stores. Thus, traditionally, PL lines have been regarded as products with low prices and low quality relative to name NBs in the market. However, recently, retailers have made great efforts to change such perceptions in consumers' minds. They started to introduce multi-tier PL lines, including "me-too" and premium PL lines into store shelves: "me-too" PL products have similar quality and lower prices relative to name NB product and premium PL products have even better quality than name NB products to add extra value and build up store/brand loyalty. What is more, retailers also focus their efforts in increasing quality for PL lines and differentiating their products from other NB ones in nutritional properties/ingredients. One of the major goals for retailers to differentiate PL from NB products is to increase their bargaining power with upstream NB manufacturers, which is often discussed in previous studies. When faced with the threat of market power flowing to PL products and negotiating power undermined by retailers, NB manufacturers also take counter-measures to bring about product innovation and differentiate their products relatively in order to soften PL effects. The PL usage and its increase quality do have effects on the relationship between retailers and manufacturers. Accordingly, this thesis is devoted to investigating two major objectives: 1) how PL usage and quality differentiation have influence on PL & NB demand; 2) Based on PL &NB demand model, how is PL effect on the vertical market power distribution between retailers and manufacturers.

The available proprietary datasets are coming from *SIEPR-Giannini* (2013) and *Mintel*'s *GNPD* (2013), respectively. The *SIEPR-Giannini* database consists of weekly scanner sales data from a major retail chain in North America, beginning from the first week of 2004 to the 22nd week of 2007 (a total 178 weeks). It provides individual item sale data, including net revenue, gross revenue, sold quantity, etc., in the identification of *UPC* codes. The Canned soup category in the Canadian retail market is selected as the case study application in this thesis since it is one of consumers' favorite categories and enjoys multi-dimensions of varieties in flavors, ingredients and nutrition facts. In addition, *Mintel*'s *GNPD* (2013) dataset provides detailed product information for the canned soup category in the Canadian retail market, including flavor, ingredients, nutrition facts, packaging size, and nutrition claims. Descriptive analysis illustrates that the PL canned soup products have relatively lower retail prices and higher retail margins compared to those of NBs if the same packages size is taken into consideration. It also indicates the PLs enjoy much lower wholesale prices than NBs. The canned soup industry is highly brand-concentrated, with a dominant NB, *NB1*, and some other relatively smaller brands. The only PL in the dataset, *SB*, also plays an important role in this industry, with approximately 11% market share (measured in sold quantity). Measured in both promotion frequency and promotion depth, both PL and NB products are frequently and heavily promoted in the retail chain stores to attract consumers. Descriptive statistics also show that PL and NB are highly differentiated in terms of nutrient content, including calories, fat, cholesterol, sodium, carbohydrates, fibre, sugar and protein.

Empirically, this thesis estimates the structural demand for canned soup products (both PL and NB) in the Canadian retail market, considering product differentiation in terms of brand, flavor and nutrient content. The nested logit model (NML) is adopted to derive the structural demand equation, in which the Distance-Matrix (DM) approach is used to identify product locations in their attribute space and address product' differentiation. This method circumvents the traditional "*IIA*" and "dimensional" problem (Nevo, 2001), and makes it more flexible to estimate demand based on random utility models. Our empirical results show that both the DM approach and nested logit model (NML) are appropriate for estimating demand in the canned soup category.

This thesis estimates the structural demand model for canned soup products first. We find an intriguing result that contradicts previous studies: retailers' PL usage does not significantly help increase its market share. The strong price competition among incumbent NBs and large numbers of brands is theoretically believed to be the barrier for the success and performance of PL. Different findings have been found in other categories (such as ready-to-eat breakfast cereal and bacon) that PL usage helps gain market shares for retailers. However, finding in this thesis provides evidence that cross-categorical analysis to find effects of PL usage on PL & NB competition is not empirically practical and theoretically feasible since it will blur the inter-category differences.

Moreover, products' distance parameters (store-distance and flavor-distance) also show that retailers' carrying more of the same brand and flavor do benefit the retail sales. It means, for example, given a particular brand, flavor varieties within this brand could sufficiently boost its market share. In addition, the nutrient distance parameter shows that, conditional on price, brand, flavor and other properties, differentiation from other products in terms of nutrient content can foster products' market share significantly. PL's strategies to mimic NB's characteristics (locate PL close to NB in the characteristics space) would decrease its market share, which is not consistent with many of previous studies. This result provides an especially important insight for retailers who are aiming to compete for market share from manufacturers.

Other important findings in the demand model also include that products with similar attributes (brand, flavor and nutrient content) tend to be closer substitutes than those possessing different characteristics. It also shows that PL products have the lowest own-price elasticity, indicating higher brand-loyalty among consumers than name NB products.

Given the structural demand model, the cost-price margin (CPM) model for both one single multi-product retailer and its upstream NB providers is estimated, based on the assumption that they would maximize their category profits jointly in Bertrand-Nash equilibrium. Both retailer's and manufacturers' conduct parameters are adopted in the CPM model to allow for their pricing deviation from Nash-Bertrand behavior, in order to investigate the effects of PL and product attributes on their pricing behavior power. Thus, through model specifications in this study, we could not only test the market power relative to PL or NBs, but also relate the market power to products' attributes (brand, PL and nutrient content).

Estimation results from the CPM model suggest some new insights into the relationship between retailers and manufacturers. It is shown that PL usage does have a great effect on the competitive interactions between retailers and manufacturers. First of all, PL usage has a negative effect on the retailers' retail margins: it does not help increase retail margins significantly for the retailers as a role of PL sellers to consumers. This finding contradicts some previous studies, but may be explained by the fact that retailers tend to price-discriminate their PL products in order to attract consumers' attention. In addition, PL does create higher margins for its manufacturers than NB. As well, as a role of manufacturing some of PL products in their own plants, manufacturing PL products can increase retailers' total margins. This may not only compensate some of the loss the retailers take in selling PL products, but also act as a strategic tool to negotiate with manufacturers to obtain better contracts and create market power over manufacturers.

Furthermore, in estimating the brand-specific conduct parameters, we found that, in such an oligopolistic competitive canned soup market, some leading brand-name manufacturers still maintain their market power over the retailer in the retailer-side pricing behaviors; they can force the retailers to price below Nash equilibrium to squeeze profits at the retail level. This market power is even greater for the market leader brand. On the other hand, PL does help the retailers significantly to obtain the pricing power over disadvantaged brands to gain its advantages for PLs in store shelves since they can price-discriminate these disadvantaged brands higher than Nash-Bertrand equilibrium would predict. In short, in the canned soup category, which is quite different from categories studied before, PL is a strong strategic tool for the retailer to gain “partial” market power: their profits extracted from disadvantaged brands and also squeezed by leading brands in market.

We also show that brand differentiation does have an effect on margins for both retailers and manufacturers. It also confirms the findings in the brand-specific-conduct-parameter pricing model that the leader name NB brings about the highest margin for manufactures and lowest retail margins for retailers. In addition, even though nutrient differentiation would help boost products’ market shares, its effects on retailers and manufacturers’ margins are less obvious. Results in this thesis explain that tastes also play an important role in determining consumers’ purchasing decisions and that consumers’ food consumption is motivated more by their taste preference than by “desirable eating habits based on established dietary guidelines” (Nayga, Tepper and Rosenzweig, 1999). This intriguing result would certainly bring an insight for both retailers and manufacturers to make a trade-off between adoption of product differentiation and tastes: not all kinds of differentiation (especially in nutrient content) can increase margins for retailers and manufacturers, and there should be a practical balance between differentiation and consumers’ taste preference. It suggests that for both retailers and manufacturers when they choose the design of products in terms of flavor and nutrient content, market research on consumers’ taste preference and trends would contribute much to the design of PLs’ locations in the attribute space.

Chapter 8 Conclusion Remarks

The descriptive analysis shows that the retail chain company has a stock of varieties of canned soup products in terms of flavor (chicken, beef, etc.), brand (PLs and NBs) and nutrient content (calories, fat, sodium, etc.). Focusing on this single multi-product retailer implicitly assumes that this retailer is acting as a localized monopolist in the Canadian retail market. However, the majority of upstream manufacturers always negotiates with and provides NBs to more than one retailer simultaneously. Though it is reasonable to do so since retailers always possess high market power in regional market, extension of such a case to more retailers in the Canadian retail market would reveal more intra-retailer competition into the model framework, and better simulate the true competitive retail market in Canada.

Distance-Matrix (DM) approach was used to address products' differentiation in terms of attribute dimensions, which is fundamentally constructed based on products' corresponding attributes that are easily observed by the researchers. Thus, it implicitly assumes that product attributes are exogenous and pre-determined in unobserved games (Richards, et al., 2010). However, product attributes may also be determined by endogenous factors such as input costs, which directly affect retailers and manufacturers' pricing behaviors. If there is any evidence indicating the internal relationship between products' attributes and pricing game between retailers and manufacturers, the implicit assumption of exogenous attributes may not be applied properly. Keeping a closer look at this relationship and investigating more about the unobserved games that determine products' attributes in the processing stage would be significant for revealing more insights in the competition between retailers and manufacturers in the retail market. This aspect should be paid more attention in future research in order to better simulate reality.

In addition, Distance-Matrix (DM) approach is aimed to measuring the distance between two products in their attribute space. Distance, or its analog proximity, is a relatively geographic measurement terminology. In the thesis, it is defined that two products with the same brand/flavor have distance (proximity) of 1 and inverse Euclidean distance is used to measure the nutrient proximity. However, this measurement is still a subjective assessment of distance since we cannot truly find their locations in the attribute space. What is more, in the thesis, for the two discrete distance measurements, it is defined that any two products that have different flavors have the distance (proximity) of 0. However, further detection of distance would reveal that, for example, in the subjective consumers' perceptions, chicken flavor may actually have different distances to beef flavor and mixed-vegetable flavor. Thus, it is necessary for researchers to determine a more objective distance measurement that can get rid of the above two issues.

Another aspect that should be kept in mind in future research is the choice of product attributes in the demand and pricing models. In the thesis, product differentiation is defined in terms of some selected attributes (brand, flavor and nutrient content, etc.). Though these attributes are believed to be important for consumers' purchasing decisions and that any of them differs will affect consumers' quality-related perceptions, there are still some product attributes that are either less important or unobserved by researchers (as the factors that remain in the econometric error in the structural demand model). Inclusion of these attributes in model framework would help estimate models more consistently. Thus, datasets that may include more detailed information on product attributes, and methods that can precisely measure the less-obvious product attributes should be more closely examined. What is more, due to data availability, it is implicitly assumed that product attributes keep constant throughout the investigated time period. Though manufacturers may not bring about too large changes to their large-volume-sale products in the market, it is much more likely that small changes (such as increase in the fibre content, etc.) would still result in data inconsistency. Datasets that record detailed historical changes in product attributes would be a top priority for such research.

Furthermore, vertical interactions between retailers and brand manufacturers also depend on the underlying structure of the relevant consumer population and thus heterogeneity in consumer preferences. Empirical studies which do not consider individual consumer preferences may lead to inconsistent results as they may fail to account for downstream (consumers) response to upstream pricing decisions (Villas-Boas and Zhao, 2005). Thus, a potential further extension to this thesis may include consumer characteristics into the existing model framework and estimate their impact on the competitive interactions between NB manufacturers and the retailers (PL).

The final aspect that need to keep in mind is retailers' horizontal competition. Even though large retailers could be regarded to have a strong local market power, it is always the case the retailers compete horizontally. Furthermore, upstream name brand manufacturers supply their NB products simultaneously to different retailers, probably at different wholesale prices. For instance, Tirole (1988) indicated that more competition in downstream retail market would benefit both manufacturers and consumers. Thus, taking multiple retailers into consideration would reveal a more general competition pattern in the retail market.

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