University of Alberta

Three Essays on Food Retailing in Canada

By

Waseem Ahmad

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Agricultural and Resource Economics

Department of Resource Economics and Environmental Sociology

Fall 2013

Edmonton, Alberta

For my parents and brothers

ABSTRACT

The overall purpose of this dissertation is to identify the demand of fast moving consumer goods (FMCG) and to analyze the issues of brand level competition in FMCG markets product categories at the Canadian retail level. The analysis develops and applies industrial organization and price analysis methods using proprietary scanner data for the Canadian market.

The first essay deals with the monetary valuation of brands, convenience and other quality attributes in FMCG product categories in grocery retailing in Canada by using scanner data. The method extends the hedonic model by using the least squares dummy variable approach. The analysis contributes the literature by establishing the relationship between attributes (brands, quality and convenience) and price using two examples of FMCG products at the Canadian retail level. The results show that branding, quality and convenience attributes have a significant influence on the price of FMCG product categories. The study concludes that dominant brands charge a premium price relative to other competing brands in the market.

The second essay examines the type of competition between the private label (PL) and national brand (NB) under various retailer-manufacturer production arrangements for PLs. The empirical implementation based on proprietary store-level scanner data expands the Non-Nested Model Comparison (NNMC) approach. The theoretical model reveals that different production arrangements of the retailer's brand have an impact on the wholesale price of the PL and NB. The empirical model results for the selected product categories

indicate no consistent pattern of competition between the PL and NB. The strategic games played vary with different FMCG product categories and for different production practices of the PL brand.

The third essay focuses on the competitive relationship between the NB and PL in varying socioeconomic environments. The analysis extends the PL-NB competition model by explicitly incorporating socioeconomic characteristics (income) for individual retail store locations. For empirical purposes, retail scanner information is segmented by considering the store location spread. Results show that the elasticity of PL and NB varies for quality differentiated products and with consumers' varying socioeconomic environments.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Dr. Sven Anders, my supervisor, for his scholastic guidance, supervision, cooperation and untiring advices. His enthusiasm in research has motivated me to complete my study. I greatly appreciate his comments and suggestion for thesis drafts. I also want to thank the rest of the committee members, Dr. Scott Jeffrey and Dr. Philippe Marcoul, who helped in critically reviewing and providing me valuable comments and suggestions about my thesis research.

The help extended by graduate students, friends and supporting staff of the Department of Resource Economics and Environmental Sociology is also gratefully acknowledged.

Finally, I am very grateful to my parents, brothers and nieces for their love, sacrifice, encouragement and patience during my studies. Their love during my stay at the University of Alberta was a source of strength and encouragement for me to reduce the home sickness.

Table of Content

Title	Page
Chapter 1: Introduction to the Three Essays	
1.1: Introduction	1
1.2: Summary of Three Research Chapters	3
1.3: References	8
Chapter 2: The Value of Brand and Convenience Attributes in Highly Processed Food Products	
2.1 Introduction	11
2.2: Review of Literature	14
2.3: Data	17
2.4: Model Development	21
2.5: Results and Discussion	27
2.5.1: Frozen Value-Added Chicken	27
2.5.1.1: Brand	27
2.5.1.2: Package size	30
2.5.1.3: Product form	31
2.5.1.4: Process form	32
2.5.2: Frozen Value-Added Seafood	33
2.5.2.1: Brand	34
2.5.2.2: Package size	36
2.5.2.3: Species	37
2.5.2.4: Product form	38
2.5.2.5: Process form	39
2.6: Conclusions	40
2.7: References	44
Chapter 3: Strategic Competition between Private Label and National Brand in a Vertically Linked Market	
3.1: Introduction	50
3.2: Review of Literature	56
3.3: Model Development	60
3.3.1: Case 1: Only One NB Product and No PL	64

3.3.2: Case 2: Only One NB Product and One PL 69
3.3.2.1: Case 2.1: NB manufacturer produces both NB and PL product 69
3.3.2.2: Case 2.2: NB manufacturer produces NB product and retailer outsources PL product 70
3.3.2.3: Case 2.3: NB manufacturer produces NB product and retailer produces PL product 73
3.3.3: Econometric Model Specification 75
3.3.3.1: NB Manufacturer Produces Both NB and PL Products 75
3.3.3.1.1: Bertrand behavior between PL and NB 75
3.3.3.1.2: NB manufacturer behaves as a leader and retailer behaves as a follower 76
3.4: Data 77
3.5: Results and Discussion 85
3.5.1: Elasticity Results 89
3.6: Conclusions 90
3.7: References 94
Chapter 4: Store Level Competition between Private Labels and National Brands: The Role of Consumer Profiles
4.1: Introduction 99
4.2: Review of Literature 103
4.3: Data 106
4.4: Model Development 114
4.4.1: Econometric Model Specification 118
4.5: Results and Discussion 121
4.5.1: Demand Estimates 122
4.5.1.1: Price and Expenditure Effects 122
4.5.1.2: Promotional Effects 127
4.5.1.3: Time Effects 127
4.5.1.4: Regional Effects 128
4.5.1.5: Price Difference Effects 129
4.5.2: Reaction Function 129
4.6: Conclusions 133

4.7: References 136

Chapter 5: Summary and Conclusion

5.1: Summary and Main Conclusions of Three Main Research Topics 143

5.1.1: Paper1: The Value of Brand and Convenience Attributes in Highly Processed Food Products 143

5.1.2: Paper 2: Strategic Competition between Private Label and National Brand in a Vertically Linked Market 144

5.1.3: Paper 3: Store Level Competition between Private Label and National Brand: The Role of Consumer Profiles 145

5.2: Extensions and Limitations 147

5.3: References 148

APPENDIX A: Profit Functions of the Retailer and the NB Manufacturer under Various Competitive Interactions 149

APPENDIX B: Econometric Model Specifications 153

APPENDIX C: Results for Various Competitive Games for Healthy and Regular Bacon 159

APPENDIX D: Results Obtained for NB and PL Competitive Interactions in Different Socio-economic Neighborhoods 163

List of Tables

Table 2.1: Summary Statistics of Variables Used in the Analysis for Value-Added Chicken 19

Table 2.2: Summary Statistics of Variables Used in the Analysis for Value-Added Seafood 20

Table 2.3: Wald Statistics for Testing the Significance of Attribute Category 28

Table 2.4: OLS Estimates of Log-Linear Hedonic Model for Value-Added Chicken 29

Table 2.5: OLS Estimates of Log-Linear Hedonic Model for Value-Added Seafood 35

Table 3.1: Equilibrium Values under Various Competitive Interactions When Only NB Product is Available at Retail Level 68

Table 3.2: Equilibrium Values Under Various Competitive Interactions When the NB Manufacturer Produces Both NB and PL Products 70

Table 3.3: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer Produces NB and the Retailer Outsources the PL Product 72

Table 3.4: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer Produces NB and the Retailer Owns the PL Production Facility 74

Table 3.5: Descriptive Statistics for NB and PL Regular and Healthy Bacon 80

Table 3.6: Price Difference, Retail Margin, Promotional Frequency and Promotional Depth for NB and PL Bacon Products 82

Table 3.7: Contingency Table of Healthy Bacon Promotion 83

Table 3.8: Contingency Table of Regular Bacon Promotion 84

Table 3.9: Values of SIC and AIC for Testing Competitive Games of Regular and Healthy Bacon 86

Table 3.10: Best Fitted Game of Healthy and Regular Bacon 88

Table 3.11: Estimated Own and Cross Price Elasticities of Regular and Healthy Bacon 90

Table 4.1: Descriptive Statistics for Bread for Stores Located in Different Neighborhoods 109

Table 4.2: Descriptive Statistics for Salad Dressing for Stores Located in 110

Different Neighborhoods

Table 4.3: Price Difference, Retail Margin, Promotional Frequency and Promotional Depth for Selected NB and PL Products for Different Neighborhoods 111

Table 4.4: Definition of Variables Used in the Analysis 119

Table 4.5: Values of LR and Wald Tests for Stores Located in Different Neighborhoods 122

Table 4.6: Elasticity Estimates of Bread by Store Location 124

Table 4.7: Elasticity Estimates of Salad Dressing by Store Location 126

List of Figures

Figure 3.1: NB Manufacturer Produces Only NB and Retailer Does not has PL Product 60

Figure 3.2: NB Manufacturer Produces both NB and PL Products 61

Figure 3.3: Retailer Outsources PL Product and NB Manufacturer Produces NB Brand 61

Figure 3.4: Retailer Owns the Production Facility and NB Manufacturer Produces NB Brand 62

CHAPTER 1: INTRODUCTION TO THE THREE ESSAYS

1.1: INTRODUCTION

The economic function of any retail organization is to provide and distribute services together with the products themselves, or to provide services to consumers at the retail level (Betancourt 2004). Grocery retailing is an important sector in terms of both value and volume in any developed economy (Burt 1995). Retailing represents the most visible point for the consumer in the food supply chain. Changes in this sector have a direct impact on consumer demand. Over the past decade, Canadian food retailing has become a highly competitive and consolidated industry. According to Zafiriou (2005), the consolidation process in the Canadian grocery retail sector has occurred in response to several changes in consumer preferences and food demand in Canada.

In a market environment, where consumers want to reduce time spent on cooking meals at home, ready-to-eat frozen foods have shown a significant increase in retail sales. To respond to changes in consumer preferences, retailers and food manufacturers need information about how consumers value different attributes. Convenience, quality and brand information are critical for the success and innovation of food products. A brand provides the guarantee about the reliability, uniformity and assurance of a product's quality (Motameni and Shahrokhi 1998). Further brands are also considered to be a crucial point for differentiation and a source of competitive advantage in business markets (Beverland et al. 2007). For several decades food manufacturers have been the

main source of branded consumer products at the retail level. This situation, however, has changed over time as retail chains themselves have started to introduce their own branded product lines, known as private label (PL) brands (Wu and Wang 2005). Further, brands play an important role in intra and inter-store competition. The complex nature of the competitive interactions between brands has become a concern not only to marketing managers in food industries, but also to economists and policy makers responsible for competition policy and fair practices along the horizontal and vertical food marketing channels (Cotterill et al. 2000).

The economic problem of this dissertation roots in the market failure, which results market equilibrium to be inefficient. Market failure has a negative impact on the economy because an optimal allocation of resources is not attained. The presence of asymmetric information in the consumer market and the imperfect competition between PL and NB present two market failures that are addressed in this thesis. For the case of asymmetric information, the manufacturers do not have complete information about how consumers are valuing different product attributes in processed food products; compounded by the fact that grocery retailers typically have exclusive access to consumer information regarding their preference and shopping behaviour. In the context of competing NB and PL brands, imperfect competition is intensified by the increasing degree of brand-level product differentiated between retailers and manufacturers.

The objective of this dissertation is to identify consumer demand in a category with high degree of differentiation and to estimate the horizontal and vertical competitive interactions between brands in the Canadian retail market in the context of imperfect competition. The results of this dissertation are expected to provide new and detailed insights about the valuation of differentiated attributes by consumer and the nature of competitive interactions between manufacturers and retailer. This information is useful for policy implications and recommendations for food manufacturers and retailers.

1.2: SUMMARY OF THREE RESEARCH CHAPTERS

The increasing product differentiation among competing brand manufacturers to attract consumer demand has largely focused on the specific product attribute categories: convenience, premium quality, environment and health. Zafiriou (2005) stated that Canadian consumers have increased their retail spending, especially on foods with proven quality attributes and enhanced health characteristics. A common approach for estimating the value of food attributes has been via the hedonic pricing method. Previous hedonic pricing models have largely focused on non-food items (e.g., housing in Ajide and Kareem (2010)) and mostly perishable food products (e.g., Kristoffersson and Rickertsen (2007)). Few studies exist in the literature that uses CPG products (Roheim et al. 2007; Garmendia 2010). These studies conclude that the price of CPG products depends on a number of quality and brand characteristics. To the best of my knowledge no

study has been conducted using hedonic methods to highly differentiated and processed packaged foods, especially in the context of the Canadian retail market.

The first essay, *"The Value of Brand and Convenience Attributes in Highly Processed Food Products,"* focuses on the relative valuation of brand, quality and convenience attributes. The main research objective in this essay is the monetary valuation of brands, convenience and other quality attributes in FMCG product categories at the Canadian retail level. A hedonic pricing model is applied to estimate implicit attribute prices for a cross-section of branded food products offered by the Canadian retailers.[1] For this purpose, the first essay uses Nielsen weekly scanner data from 2000 to 2006. The data include weekly sales, product prices and Universal Product Code (UPC) information about branded frozen and processed chicken and seafood at the Canadian retail level. The present study contributes to the hedonic and food marketing literature by estimating and comparing monetary values of different attributes (i.e., product form, process form, package size and brand) of processed chicken and seafood at the Canadian retail level.

For the last several decades, manufacturers have been the main producers of branded products (Wu and Wang 2005). To counter manufacturers' dominance in branded product marketing, major retail chains in Europe and North America have developed and introduced PL product lines (Berges-Sennou et al. 2004). The rapid growth in PLs has led to increasing product differentiation in the Canadian retail sector. Newly introduced retailer brands such as Loblaws' "President's

[1] A paper based on this thesis essay has been published in the Canadian Journal of Agricultural Economics.

Choice Blue Menu" or Safeway's "Eating Right" line of PL products have contributed to the growth in PL sales in Canada. Retailers have further extended their role by producing PL products (Kumar and Steenkamp 2007).

Economic literature has discussed various issues relating to PL production such as factors affecting PL production (Berges and Bouamra-Mechemache 2011); advantages and disadvantages to the NB manufacturer for PL production (Wu and Wang 2005). Another stream of literature has discussed various issues affecting PL brands, including their economic significance to retail chains (Chintagunta et al. 2002), price and quality relationship (Apelbaum et al. 2003), growth and development of PL product markets (Hoch and Banerji 1993), competition between PLs and NBs (Raju et al. 1995; Narasimhan and Wilcox 1998; Cotterill et al. 2000; Sayman et al. 2002; Huang et al. 2003; Wu and Wang 2005; Bontemps et al. 2005; Bontemps et al. 2008; Karray and Herran 2009; Volpe 2010), and the use of PLs in exerting retail market power (Narasimhan and Wilcox 1998; Meza and Sudhir 2010). The literature has shown that retailers are using PL products as a strategic tool to exert market power, specifically when competing in price, quality and promotion against NB products.

There is, however, still a gap in the economic and retail literature regarding the nature of competitive interactions between PLs and NBs under different production arrangements and across individual product categories, specifically in the context of the Canadian retail market. One reason behind the lack of widespread empirical studies of retail behavior in Canada has been the lack of available and sufficiently detailed scanner data that would allow

researchers to identify and model competitive games played among retail brands. In addition, limited empirical evidence exists, to date, on the extent to which product differentiation in health-related food attributes affects the competitive interaction between PLs and NBs under different production arrangements of the PL. To address this gap, the second proposed essay is titled *"Strategic Competition between Private Labels and National Brands in a Vertically Linked Market."* This paper develops and tests different theoretical models of competition in vertically linked markets under different production arrangements. Hypotheses regarding the strategic positioning of individual competing PLs and NBs are tested empirically for different production arrangements of the retailer's brand (PL). For this purpose, a game-theoretical menu approach is applied (Roy et al. 2006). The present study uses retail scanner panel data information for a major North American retail chain that has stores located in Canada. Knowledge of strategic positioning of PL and NB brands is crucial in assessing the effectiveness of different marketing instruments. It also helps policy makers to take measures in order to increase the welfare of the society.

Another issue related to the competitive conduct of PLs that has received limited empirical attention is that of understanding the factors that determine PLs' market share across different product categories. Previous studies estimated how different factors have an impact on the share of PLs and NBs in different product categories (Cotterill and Putsis 2000; Cotterill et al. 2000; Cotterill and Samson 2002; Huang et al. 2003 and Du and Stiegert 2009). Despite a significant increase in the share of PL products in the Canadian retailing market, no study has been

undertaken to estimate how price, promotional expenditure, expenditure, quality and different regions have affected the share of PL and NB products in the Canadian food market. Furthermore, no study has been done with regards to the emergence of health-related product differentiation.

The third essay, *"Store Level Competition between Private Labels and National Brands: The Role of Consumer Profiles,"* addresses the aforementioned issues. It is concerned with the competitive relationship between NBs and PLs in selected FMCG product categories in different socioeconomic environments. For empirical purposes, a retail demand system and corresponding price-reaction functions are jointly estimated on retail scanner information segmented by considering the store location spread. An understanding of PL/NB competition for stores located in different socioeconomic neighborhoods will help manufacturers and retailers to design optimal strategies.

The next chapter discusses how consumers value different brands, quality and convenience attributes in highly processed food products at the Canadian retail level. Chapters 3 and 4 discuss the vertical and horizontal competition between PLs and NBs in the Canadian retail sector. The final chapter provides a summary, conclusions and policy recommendations.

1.3: REFERENCES

Ajide, B. K and I. O. Kareem. 2010. Hedonic Analysis of Residential Housing Market in a Third World City: A Preliminary Investigation. *The Social Sciences* 5(6): 520-524.

Apelbaum, E., E. Gerstner and P. A. Naik. 2003. The Effects of Expert Quality Evaluation Versus Brand Name on Price Premiums. *The Journal of Product and Brand Management* 12: 154-165.

Berges, F. and Z. Bouamra-Mechemache. 2011. Is Producing a Private Label Counterproductive for a Branded Manufacturer? *European Review of Agricultural Economics*: 1-27.

Berges-Sennou, F., P. Bontems, V. Requillart. 2004. Economics of private labels: A survey of the literature. *Journal of Agricultural and Food Industrial Organization* 2 Article 3.

Betancourt, R. R. 2004. The Economics of Retailing and Distribution Published by Edward Elgar Publishing Limited. Glensanda House Montpellier Parade Cheltenham Glos GL50 1UA UK.

Beverland, M., J. Napoli and A. Lindgreen.2007. Industrial Global Brand Leadership: A Capabilities View. *Industrial Marketing Management* 36: 1082-1093.

Bontemps, C., V. Orozco and V. Requillart. 2008. Private Labels, National Brands and Food. Prices. *Review of Industrial Organization* 33: 1-22.

Bontemps, C., V. Orozco, V. Requillart and A. Trevisiol. 2005. Price Effects of PL Development. *Journal of Agricultural and Food Industrial Organization* 3: 1-16.

Burt, S. 1995. Understanding the Arrival of Limited Line Discount Stores in Britain. *European Management Journal* 13(1): 110-119.

Chintagunta, P. K., A. Bonfrer and I. Song. 2002. Investigating the Effects of Store Brands Introduction on Retailer Demand and Pricing Behavior. *Management Science* 48(10): 1242-1267.

Cotterill, R. W. and W. P. Putsis, Jr. 2000. Market Share and Price Setting Behavior for Private Labels and National Brands. *Review of Industrial Organization* 17: 17-39.

Cotterill, R. W. and P. O. Samson. 2002. Estimating A Brand Level Demand System For American Cheese Products to Evaluate Unilateral and

Coordinated Market Power Strategies. *American Journal of Agricultural Economics* 84(3): 817-823.

Cotterill, R. W., W. P. Putsis, Jr and R. Dhar. 2000. Assessing The Competitive Interaction Between Private Labels and National Brands. *The Journal of Business* 73(1): 109-137.

Du, Y. and K. W. Stiegert. 2009. Strategic Vertical Pricing in the U.S. Butter Market. Paper presented at the Agricultural and Applied Economics Association 2009 AAEA & ACCI Joint Annual Meeting, Milwaukee, Wisconsin, July 26-29, 2009.

Garmendia, J. M. 2010. Application of Hedonic Price Modeling to Consumer Packaged Goods Using Store Scanner Data. *Journal of Business Research* 63: 690-696.

Hoch, S. J. and S. Banerji. 1993. When Do Private Labels Succeed? *Sloan Management Review* 34(4): 57-67.

Huang, M. H., D. E. Hahn and E. Jones. 2003. A Socioeconomic Approach to Assessing Price Competition Between Private Labels and National Brands: The Case of Shredded Cheese. Presented at the American Agricultural Economics Association Annual Meeting, Montreal, Canada July 27-30, 2003.

Karray, S and G. M. Herran. 2009. A Dynamic Model For Advertising and Pricing Competition Between National and Store Brands. *European Journal of Operational Research* 193: 451-467.

Kristofersson, D. and K. Rickertsen. 2007. Hedonic Price Models for Dynamic Markets. *Oxford Bulletin of Economics and Statistics* 69(3): 387-412.

Kumar, N. and J. B. E. M. Steenkamp. 2007. Private Label Strategy How to Meet the Store Brand Challenge. Harvard Business School Press Boston Massachusetts.

Meza, S. and K. Sudhir. 2010. Do Private Labels Increase Retailer Bargaining Power? *Quantitative Marketing Economics* 8: 333-363.

Motameni, R and M. Shahrokhi. 1998. Brand Equity Valuation: A Global Perspective. *Journal of Product and Brand Management* 7(4): 275-290.

Narasimhan, C and R. T. Wilcox. 1998. Private Labels and the Channel Relationship: A Cross Category Analysis. *The Journal of Business* 71(4): 573-600.

Raju, J. S., R. Sethuraman and S. K. Dhar. 1995. The Introduction and Performance of Store Brands. *Management Science* 41(6): 957-978.

Roheim, C. A., L. Gardiner and R. Asche. 2007. Value of Brands and Other Attributes: Hedonic Analysis of Retail Frozen Fish in the UK. *Marine Resource Economics* 22: 239-253.

Roy, A., N. Kim and J. S. Raju. 2006. Assessing New Empirical Industrial Organization (NEIO) Methods: The Cases of Five Industries. *International Journal of Research in Marketing* 23: 369-383.

Sayman, S., S. J. Hoch and J. S. Raju. 2002. Positing of Store Brands. *Marketing Science* 21(4): 387-397.

Volpe, R. J. 2010. NB and PL Pricing and Promotional Strategy. presented at the Agricultural and Applied Economics Association, AAEA, CAES and WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010.

Wu, C. C. and C. J. Wang. 2005. A Positive Theory of Private Label: A Strategic Role of Private Label in a Duopoly NB Market. *Marketing Letters* 16(2): 143-161.

Zafiriou, M. 2005. Food Retailing in Canada Trends, Dynamics and Consequences. Paper Presented at the Pacific Economic Cooperation (PECC) Meetings Pacific Food Systems Outlook Kunming, China.

Chapter 2: The Value of Brand and Convenience Attributes in Highly Processed Food Products

2.1: INTRODUCTION

According to Nielsen (2010), more than 90% of consumers in the United States (US) state that eating healthily is important. But recent studies (Barreiro-Hurle et al. 2010; Binkley and Golub 2010) and anecdotal evidence suggest that for most consumers the nutritional value of food is not a major choice criterion. This is despite the increasing awareness, consumer knowledge and widespread labeling of diet-health facts from trans-fats to fiber and omega-3. An even more significant shift in eating habits across North America has been the continuous rise in the demand for further processing and convenience as cooking skills and time for meal preparation have decreased (Capps et al. 1985).

In a market environment where consumers have limited cooking skills (AAFC 2010; Harris and Shiptsova 2007), which have eroded overtime (as the culinary skills are not passed from generation to generation (AAFC 2010)), and face mounting time constraints, home meal replacements and ready-to-eat frozen foods have seen strong retail growth and increasing product differentiation (Darian and Cohen 1995). Retailers and food manufacturers respond to these trends by providing consumers with convenience products to meet taste and quality preferences of diverse consumer segments. These product differentiations are important drivers of industrial innovation (Coad 2009).

Lancaster (1966) was of the view that utility from the consumption of a product is derived from the attributes of the product instead of the product itself.

For example, consumers do not purchase meat; rather they buy different bundles of meat attributes: brand, product cut, process form, package size, etc. For designing a product, manufacturers need information how consumers are valuing different attributes. If manufacturers do not incorporate these changes into their product innovation then they might design a product that has less demand. As a result, there resources will be wasted, and both the manufacturers and society will suffer. The attribute information is critical for the success of the food product. Winger and Wall (2006) reported that only 5 percent of new products achieve sustainable market success. The present study aims to improve the understanding of consumer demand for differentiated food products. It helps manufacturers to understand what the consumers are actually buying from the market and, also, which and how much of a product's attributes contribute to a product's price. The present study helps manufacturers to design a product on the basis of different quality attributes for making long term investment. Further at this point, it is not clear to producers how consumers value various attributes of highly differentiated food products at the Canadian retail level.

The objective of this study is to use a hedonic pricing model (HPM) to estimate the monetary values that Canadian consumers place on a wide array of brand, convenience, and other quality attributes in highly processed and frozen consumer packaged meat and seafood products. Given the increase in consumer's awareness about healthy diet, we have chosen chicken and seafood products, which are both preferred over red meat (Unnevehr and Bard 1993). We selected this category (chicken and seafood) because it has shown the highest growth in

the convenience product development and processing in the Canadian retail market. So the focus of present study is to see how consumers are valuing different attributes of processed chicken and seafood products.

This analysis extends and contributes to research on consumers' valuation of quality attributes in food products. Previously this valuation largely relied on stated preference methods. Past applications of HPMs in food markets have been limited to fresh foods, including meat cuts, and have been less frequently applied to processed consumer packaged goods (Garmendia 2010). This study contributes to the hedonic and food marketing literature by estimating and comparing hedonic values for a variety of brand, product and processing attributes across a wide selection of consumer packaged meat and seafood products in Canadian grocery retailing.

We follow the definition coined by Capps et al. (1985) of "complex convenience foods." These are characterized by high degrees of processing, which save consumers a significant amount of time and which have built-in culinary expertise. Data collected by *Nielsen* Canada shows a 9.5% annual growth rate in retail sales of packaged and frozen meat products from 2000 to 2006.[2] Increasing product differentiation and associated proliferation in labeling at the retail level also means that consumers are likely to incur non-negligible search costs when making purchase decisions. Moreover, with quality being an ambiguous term that means different things to different consumers, product choice decisions often depend on individual attribute preferences, prior product experiences and

[2] Frozen packaged meat and seafood products include further processed and frozen products of fixed weight typically identified by a Universal Product Code.

available information from package labeling (Grunert et al. 2004). In response, retailers have made efforts to directly target different consumer segments with a variety of brands and product packaging. In the case of fresh meats and seafood, retail pricing is significantly affected by attributes including origin, branding and quality relating to underlying food production practices (Salayo et al. 1999; Loureiro and McCluskey 2000; Boland and Schroeder 2002; Grunert et al. 2004; Parcell and Schroeder 2007).

2.2: REVIEW OF LITERATURE

Little research has applied HPMs to decompose the prices paid for heterogeneous consumer packaged goods such as value-added frozen meat or seafood products. The majority of previous studies used stated preference and experimental methods to elicit values for the various attributes within fresh meat products: eating quality (Melton et al. 1996; Hahn and Matthews 2007), fat content (Shongwe et al. 2007), organic (Boland and Schroeder 2002), packaging (Harrison et al. 2004), and labeling (Loureiro and McCluskey 2000; Loureiro and Umberger 2003). In addition, studies by Froehlich et al. (2009), Enneking (2004), Loureiro and Umberger (2007) and Alfnes and Rickertsen (2003) focused on brand, food safety, traceability and origin attributes that may indirectly influence prices paid. With regards to applying HPMs to seafood product markets, previous research has largely focused on how consumers value sustainability in fisheries (Brecard et al. 2009; Johnston et al. 2001), quality of crustacean products (Salayo et al. 1999), health (Marette et al. 2008), fishermen's attribute valuation

(Kristofersson and Rickertsen 2004), fish auction markets (McConnell and Strand 2000; Kristofersson and Rickertsen 2007), and species and processing attributes (Wessells and Wilen 1994; Roheim et al. 2007). Researchers agree that further research is needed to quantify the economic value consumers place on food products that carry complex combinations of search, experience and credence quality attributes (Ward et al. 2008).

In this context, recent studies have made use of more widely available scanner data to estimate HPMs for differentiated consumer packaged meat or seafood products, branded beef (Schulz et al. 2010; Ward et al. 2008), individual beef and pork cuts (Parcell and Schroeder 2007) and low-fat ground beef (Brester et al. 1993; Unnevehr and Bard 1993). Several papers paid special attention to the issue of retail product branding, recognizing its importance for product differentiation and in providing purchase cues to consumers. Estimated brand premiums for differentiated fresh beef steaks ranged from -$1.30 to $5.80/lb. (Schulz et al. 2010) and up to $6.20/lb. for all retail beef cuts (Ward et al. 2008). Implicit price premiums for branded fresh seafood estimated by Roheim et al. (2007) for the retail market in the United Kingdom were approximately 10% compared to the price of comparable retail private label (PL) products. Roheim et al. is the only study to include retail PL products (store brands) that have become a major contributor to product differentiation and growth in North American grocery retailing. Sales of PL products now account for 25% and 23.7% of the grocery retail market in Canada and the US, respectively (PLMA 2010).

While manufacturer's and retail brands may help consumers to distinguish product quality based on previous purchase experience, convenience attributes play an important and recurrent role in product selection (Harris and Shiptsova 2007). In the case of value-added chicken products, the demand for convenience, such as ease of preparation and versatile usage, may have been a contributing factor to the relative increase in the demand for poultry products compared to beef (Verlegh and Candel 1999). Furthermore, poultry largely benefited from the dissemination of diet-health related information (Kinnucan 1997) and differentiation in the "ready meals" category through package size, product form, degree of processing and flavour innovations (Grunert et al. 2004; Harris and Shiptsova 2007).

Package size may affect product valuation through differences in consumer preferences for quantity–serving size. Previous HPM studies largely confirm an inverse relationship between product price and package size (e.g. "family pack" discounts) (Ward et al. 2008; Parcell and Schroeder 2007). Roheim et al. (2007) emphasize that the package size plays an important role in the positioning of retail seafood products. In addition, the favourable nutrition and health properties of seafood have increased its popularity with consumers (Myrland et al. 2000).

The literature cited above suggests that retail shoppers rely on a combination of searchable attributes such as brand, package size, process and product form when making product choice decisions in the categories of value-added chicken and seafood products. Different attribute levels deemed to be in

combination determine a product's use value, which in turn provides preference rankings for different levels of the same attribute as well as the relative importance of different attributes.

2.3: DATA

The Nielsen Market Track scanner data used in this study is based on a Nielsen Canada's Market Track data panel. Retail point-of-sale purchase information is collected from participating retail chains through continuous tracking of consumer sales from scanning cash-registers, in-store audits of merchandise and retail invoices. The data sample includes observations for the 4th week of each month. It contains information of aggregate sales ($ volume and quantities sold) and product prices for all UPC-coded branded frozen and processed (boxed) chicken and seafood products available in participating Canadian retail chains[3] from December 2000 to October 2006. Analysis of product prices data overtime indicates no evidence of significant trend in price.

In this study, we aggregate fish and crustaceans into a single seafood category. Salvanes and DeVoretz (1997) use a separability test to determine whether or not they can aggregate both types of species. The results of the study conclude that different fish species (fish and crustaceans) should not be analyzed separately. Asche et al. (1997) and Salvanes and DeVoretz (1997) also argue that fish and crustacean species can be viewed as substitutes.

[3] Unfortunately the data source does not provide information about the retailer, so we could not incorporate this information in the analysis.

Individual product identifiers provided detailed descriptions of brand, product form (e.g. breast, fillet), process form (e.g. breaded, teriyaki), and product package size (in grams). Retail sales data for all PL value-added products are available in the form of aggregate weekly sales across all 39 PL brands tracked by Nielsen in the Canadian retail market. As the selection of value-added meat and seafood products has constantly grown in the Canadian retail market, not all available products were tracked by Nielsen over the entire time period. Given the considerable degree of product differentiation in the data and to avoid estimation problems due to a highly unbalanced panel, we selected only those UPC codes with a time series of 76 weeks of observations. We selected 131 value-added chicken and 119 value-added seafood products with 9880 and 9044 observations, respectively. Tables 2.1 and 2.2 provide variable definitions and summary statistics for the leading national manufacturer brands and their most common product attributes used in the HPM.

Among all value-added chicken offerings, the highest premium price, $7.27 per package, is for the souvlaki process form. Table 2.1 also confirms that producers charge a premium price for chicken fillet and for smaller package sizes. For seafood species, producers charge premium prices for prawn and crab seafood species (Table 2.2). The average retail price per pound for seafood is $5.15, slightly higher than chicken at $4.90. The average price of PL products across both product categories is $4.60.

Table 2.1: Summary Statistics of Variables Used in the Analysis for Value-Added Chicken

Particulars	**Retail Average Price ($/lb.)**	**Standard Deviation**
Product price	4.9	1.8
Brand		
Schneider	5.29	1.61
Flamingo	4.77	1.24
Janes	6.22	1.27
Pintys	5.03	0.78
Lilydale	4.81	2.21
Maplelodge	4.82	0.58
Golden Skillet	2.42	0.67
Sunrise	1.55	0.65
Other brands[a]	5.26	2.00
Package size (g)		
$Size_1$ (0-500)	6.23	0.99
$Size_2$ (500-1000)	5.42	1.48
$Size_3$ (1000-2000)	3.38	1.65
$Size_4$ (>2000)	2.54	1.30
Product Form		
Breast	5.45	1.57
Wing	5.55	1.24
Burger	3.55	1.41
Nuggets	3.89	1.15
Strips	4.17	1.07
Boneless	5.25	1.46
Fillet	6.36	0.78
Skinless	4.62	1.15
Other product forms[b]	4.13	2.06
Process form		
Barbecue	5.32	0.87
Breaded	3.97	1.51
Honey-garlic	5.68	0.97
Souvlaki	7.27	2.14

Buffalo	5.36	1.06
Village	3.54	0.36
Other process forms[c]	5.61	1.96

Source: Calculations based on Nielsen (2007) Market Track data. [a] Other brands include a number of smaller manufacturer brands as well as retail private labels (in aggregate) that account for 23% of value-added chicken products sold in Canada (Nielsen 2007)). [b] Other product forms include products such as chicken fingers and patties. [c] Other process forms summarize less popular processed chicken flavours and spices (e.g. curry).

Table 2.2: Summary Statistics of Variables Used in the Analysis for Value-Added Seafood

Variable	Retail Average Price ($/lb.)	Standard Deviation
Product price	5.15	3.25
Brand		
Highliner	4.69	1.61
Janes	6.91	0.94
Aquastar	10.55	5.27
Bluewater	3.84	0.67
Ferma	2.90	1.02
Ocean Jewel	3.05	0.87
Northern King	3.40	1.02
Other brands[a]	5.32	3.27
Package size (g)		
$Size_1$ (0-500)	6.00	3.76
$Size_2$ (500-1000)	4.87	2.78
$Size_3$ (1000-2000)	4.35	4.15
Species		
Cod	4.75	2.05
Pollock	3.67	0.78
Salmon	7.09	3.54
Crab	8.65	4.79
Shrimp	5.69	3.36
Squid	2.78	1.34
Prawns	12.49	4.98
Haddock	6.02	1.58

Sole	5.95	1.23
Other Fish [b]	3.17	0.73
Other Seafood [c]	5.14	2.98
Product Form		
Fillet	5.44	1.57
Sticks	4.07	1.69
Legs	12.26	6.88
Slices	7.32	5.25
Rings	4.35	0.48
Steak	3.34	0.76
Whole fish	3.13	1.03
Other product forms[d]	4.11	1.63
Process form		
Breaded	6.54	4.41
Smoked	10.18	4.32
Fried	6.14	4.09
Battered	4.74	1.47
Cook	6.60	0.98
Raw	10.27	6.10
Seasoned[e]	5.21	1.23
Other process forms[f]	6.72	2.61

Source: Calculations based on Nielsen (2007) Market Track data. [a] Other brands include a number of smaller manufacturer brands as well as retail private labels (in aggregate) that account for 29% of value-added seafood products sold in Canada (Nielsen 2007)). In aggregate, private labels brands account for 26% of all value-added meat and seafood product sales in Canada. [b] Other fish includes species less commonly used in processed frozen seafood products (e.g. sole). [c] Other seafood includes crustaceans and seafood used in value–added seafood products (e.g. clams). [d] Other product forms include products such as fish fingers and popcorn shrimp. [e] Seasoned summarizes number of popular seafood flavors and spices such as herb, garlic, dill, etc. [f] Other process forms summarize less popular forms of processing such as crispy and classic.

2.4: MODEL DEVELOPMENT

Although HPMs are widely used by applied economists, the underlying theory is not always well understood. The HPM rests on the assumption that

consumers select goods for purchase as a function of product attributes, therefore maximizing utility by selecting those products that maximize the sum of partial utilities obtained from each individual attribute (Lancaster 1966; Rosen 1974). Rosen (1974) discussed the hedonic model of a competitive market and assumed that the utility function U(Z, x_1, x_2, …x_n) is well behaved. Where x_i is i^{th} characteristic of the differentiated food product and Z includes all the other goods. The objective of the consumer is to maximize utility subject to his budget constraint. From the well behaved utility function and budget constraint, consumer's bid function[4] can be derived as $\theta(x;u,y)$. The bid function represents the consumer's willingness to pay for different amount of characteristics at a given level of utility and consumer's income. The supplier's willingness to accept for different characteristics at a given level of profit when the products are produced optimally is represented by an offer function $\phi(x;\pi,\beta)$ (Rosen 1974; Tauber 2010). The hedonic model is the locus of equilibrium of different bid functions and offer functions with varying amount of characteristics (Steiner 2004).

The functional relationship between product price at time *t* and its attributes, *x*, can be written as:

$$p_{it} = x'_{it}\beta + \varepsilon_{it} \qquad (2.1)$$

[4] The literature also used the term value function or indifference curve for the bid function (Tauber 2010)

where x_{it} is a vector of attribute levels for transaction *i* at time *t*, β is a vector of parameters representing the marginal price of attributes and ε_{it} is a vector of error terms. The marginal price of each attribute can be calculated as:

$$\frac{\partial p_{it}}{\partial x_{it}} = \beta_i \qquad (2.2)$$

Despite the widespread use of the HPM, economic theory provides limited guidance about the preferred functional form of the relationship between a good's price and its attributes. However, the choice of functional form is fundamental as it directly relates to the relationship between marginal prices and attributes. This lack of clarity makes the ultimate specification of the HPM an empirical issue (Triplett 2004). Transformations of dependent and independent variables have frequently been used to select between linear and non-linear model specifications (Ward et al. 2008). The binary nature of the explanatory variables in this analysis makes selecting a control variable an essential issue. Gardeazabal and Ugidos (2004) show that the choice of control variable can significantly affect the magnitude and/or sign of the coefficient estimate. To circumvent such problems, while maintaining the comparability of estimates across attribute categories, we pursue an alternative estimation strategy developed by Suits (1984) and Kennedy (1986), and previously applied by Steiner (2004) and Fogarty (2009). The variable modification involved in this process only alters the interpretation of the dummy variable coefficients, without affecting any other data or estimation properties.

To illustrate the approach, consider the HPM $P_i = \beta_0 + \beta_1 D_{1i} + \beta_2 D_{2i} + \varepsilon_i$, where D_{1i} and D_{2i} are dummy variables such that $\sum_{j=1}^{2} D_j = 1$ would lead to multicollinearity. Now, let w_j represent the share of non-zero dummy variable observations. Imposing the constraint $\sum_{j=1}^{2} \beta_j w_j = 0$ on the above hedonic equation results in $\hat{\beta}_0 = \bar{P}_i$ so that $\hat{\beta}_1$ and $\hat{\beta}_2$, the estimates of the dummy variables, are now interpreted as deviations from the average of the dependent variable (Oczkowski 1994). Rewriting the constraint as $\beta_1 = -\beta_2 \left(\frac{w_2}{w_1} \right)$ and substituting into the above equation yields, $P_i = \beta_0 + \beta_2 \left[D_2 - \left(\frac{w_2}{w_1} \right) D_1 \right] + \varepsilon_i$, which allows the re-estimation using ordinary least square (OLS) of the original hedonic model.

Curry et al. (2001) state that many previous HPMs have applied flexible functional forms, yet frequently neglected potentially important two-way (or even higher power) interaction effects. Such interdependencies might be especially important in cases of highly differentiated consumer packaged food products distinguished along multiple hedonic dimensions (Coad 2009)[5].

The use of interaction terms may also provide additional flexibility in terms of the specification process of the HPM (Steiner 2004). To account for multiple attribute dimensions we extend the HPM in equation (2.1) to include an interaction term combining variables of product form and process form. In

[5]Coad (2009) presents an extension of Lancaster's (1966) original theoretical hedonic model to formally incorporate multiplicative interactions among individual hedonic attributes that are considered in this analysis.

particular, motivated by anecdotal evidence on the rising popularity of flavored chicken wing products (Meatingplace 2010) we test the following interaction terms for chicken: Buffalo*Wing, BBQ*Wing, Honey-garlic*Wing. Given the leading market position of skinless boneless chicken breast (in $ sales) in the Canadian market (Nielsen 2007), we include interaction terms for Skinless*Boneless*Breast or, alternatively, Skinless*Breast and Boneless*Breast. Motivated by similar considerations and the results published by Roheim et al. (2007), we test the following interaction terms for seafood: Smoked*Salmon, Seasoned*Salmon and Breaded*Shrimp.

The binary variables in this HPM limit the choice of functional form to linear or log-linear specifications. We assume that retail customers cannot trade product attributes directly as they are bundled within specific products. The choice of a log-linear functional form rests on the assumption in Lancaster's (1966) model that attributes are bundling within products, thus limiting the number of possible attribute combinations in the market place. As a consequence, equilibrium prices may not be linearly decomposed as proposed by Lancaster. Mutually advantageous exchanges of attributes by consumers may not be possible, resulting in marginal utilities that may not be proportional in equilibrium. This leads us to the following log-linear specification of the HPM for value-added frozen chicken (eq. 2.3) and seafood products (eq. 2.4):

$$\begin{aligned}\ln P_{it} &= \beta_0 + \beta_1 Brand_{it} + \beta_2 Size_{it} + \beta_3 \mathrm{Pr}oductForm_{it} + \beta_4 \mathrm{Pr}ocessForm_{it} \\ &+ \beta_5 (Buffalo^{*} wing)_{it} + \beta_6 (BBQ^{*} wing)_{it} + \beta_7 (Honey-garlic^{*} wing)_{it} \\ &+ \beta_8 (Skinless^{*} Boneless^{*} Breast)_{it} + \varepsilon_{it}\end{aligned} \qquad (2.3)$$

$$\ln P_{it} = \alpha_0 + \alpha_1 Brand_{it} + \alpha_2 Size_{it} + \alpha_3 Species_{it} + \alpha_4 \text{Pr}oductForm_{it} + \alpha_5 \text{Pr}ocessForm_{it} + \alpha_6 (Smoked^{*} Salmon)_{it} + \alpha_7 (Seasoned^{*} Salmon)_{it} + \alpha_8 (Breaded^{*} Shrimp)_{it} + \mu_{it} \quad (2.4)$$

In the log-linear specification, each marginal implicit price is a nonlinear function of the entire set of characteristics, which supports the idea that attributes are bundled in specific products. For the chosen specification, the coefficient of a dummy variable measures the percentage effect on the dependent variable of the presence of the factor represented by the dummy variable. Following Kennedy (1981) the true impact of a dummy variable coefficient estimate *g* can be obtained through,

$$g = exp\left(\hat{\beta} - \frac{1}{2} var\left(\hat{\beta} \right) \right) - 1 \quad (2.5)$$

Heteroskedasticity and autocorrelation frequently pose problems in panel data. We performed likelihood ratio tests for heteroskedasticity and Wooldridge's test for autocorrelation on the unconstrained variants of models (2.3) and (2.4) with the attribute categories' "other" as controls. The Wooldridge autocorrelation tests suggest no autocorrelation in either model. We found a moderate level of heteroskedasticity suggesting the use of more appropriate feasible generalized least square estimators (FGLS) (Greene 2008). However, using FGLS would not allow us to impose a series of identifying restrictions on the HPM. Given these restrictions and the large sample sizes, we opted to re-estimate the constrained HPM using a robust variance least-squares dummy-variable approach (rLSDV) (White 1980).

2.5: RESULTS AND DISCUSSION

Each attribute category (e.g., brands) can be thought of as contributing to product differentiation and segmentation at the retail level. Hence, a series of Wald tests is employed (table 2.3) to test the null hypothesis of no differences in product prices due to differences in product attribute categories. The estimates of the HPM regression models (2.3) and (2.4) are reported in Tables 2.4 and 2.5. Computed values of the generalized squared correlations between the predicted and actual values are 0.71 and 0.72, indicating that the rLSDV estimation approach has good explanatory power.[6]

2.5.1: Frozen Value–Added Chicken

The empirical results for the category of value-added frozen chicken confirm a priori expectation: product unit price increases in branding and other quality and convenience attributes. However, not all positive attributes are valued equally. Combinations of product form, brand and package size have the greatest impact on the retail price paid by consumers (table 2.3).

2.5.1.1: Brand

Brand names are a simple search attribute, yet the powerful purchase cue relevant to many consumers. Retail branding and differentiation of meat has been

[6] We also estimated both models using Feasible Generalized Least Squares (FGLS), deemed more appropriate when autocorrelation and/or heteroskedasticity are present in the data. In comparison, the reported rLSDV coefficient estimates are largely robust, and generalized adjusted R-squares improve (0.71) for the chicken model and remain stable (0.72) in the seafood model.

particularly prevalent in processed meat products, with product differentiation designed to meet consumer demands. Not surprisingly, the Wald test rejects the null hypothesis of no price variation for different retail chicken brands (table 2.3).

Table 2.3: Wald Statistics for Testing the Significance of Attribute Category

Attribute category	Chicken	Seafood
Package Size	726.45 (0.00)	264.87 (0.00)
Brand	190.72 (0.00)	681.45 (0.00)
Species	—	565.29 (0.00)
Product Form	569.46 (0.00)	226.84 (0.00)
Process Form	256.20 (0.00)	353.92 (0.00)

Brand coefficient estimates reported in Table 2.4 differ from previously published higher brand premiums of up to US$1.30/lb. for fresh branded beef and pork products in the U.S. market (Ward et al. 2008; Parcell and Schroeder 2007). With the exception of one dominant premium brand (*Janes*) and one heavily discounted brand (*Sunrise)*, other major national brand manufacturers command much smaller brand premiums or discounts relative to the average category retail price.

Unfortunately, no comparable studies of poultry exist to compare our results. One plausible explanation for the predominantly small range of brand premiums (discounts) is the growing share of PL brands in the Canadian value-added meat market. Increasing market share, price and margin pressure from fast growing PLs may have eliminated earlier discounts of 10 to 40% relative to

manufacturer brands (Halstead and Ward 1995). In fact, leading Canadian PLs (e.g. President's Choice, Safeway Select) account for roughly 26% of all retail sales of value-added meats and seafood between 2000 and 2007 (Nielsen 2007). Marginal differences in brand premiums may also reflect the strategic category positioning of PL products aimed at forcing brand manufacturers to engage in price competition to decrease margins (Cotterill and Putsis 2000). Successful marketing and branding strategies for PLs through improvements in package design, labeling, and advertising may have contributed to a narrowing price gap (Collins-Dodd and Lindley 2003). Unfortunately, data on PL sales in Canadian stores are only available in aggregate and, hence, cannot be explicitly considered in this analysis.

Table 2.4: OLS Estimates of Log-Linear Hedonic Model for Value-Added Chicken

Independent Variable	Coefficient	St. Err	Relative Impact[a]	
			%	Dollar ($)
Constant	1.248**	0.006		
Brand				
Schneider	0.125**	0.006	13.31	$0.65
Flamingo	0.049**	0.007	5.02	$0.25
Janes	0.261**	0.009	29.82	$1.46
Pintys	0.029**	0.009	2.94	$0.14
Lilydale	0.068**	0.013	7.04	$0.34
Maplelodge	-0.038**	0.009	-3.73	$-0.18
Golden Skillet	-0.078**	0.015	-7.50	$-0.37
Sunrise	-0.457**	0.02	-36.68	$-1.80
Other brands	0.04**	0.008	4.08	$0.20
Package size				
$Size_1$ (0-500)	0.470**	0.013	60.00	$2.94
$Size_2$ (500-1000)	0.216**	0.009	24.11	$1.18
$Size_3$ (1000-2000)	-0.100**	0.009	-9.52	$-0.47
$Size_4$ (>2000)	-0.587**	0.014	-44.40	$-2.18

Product form				
Breast	0.215**	0.009	23.99	$1.18
Wing	0.255**	0.011	29.05	$1.42
Burger	-0.280**	0.01	-24.42	$-1.20
Nuggets	-0.170**	0.007	-15.63	$-0.77
Strips	-0.180**	0.007	-16.47	$-0.81
Boneless	0.109**	0.012	11.52	$0.56
Skinless	0.201**	0.02	22.26	$1.09
Fillet	0.005	0.011	0.50	$0.02
Other product forms	-0.154**	0.009	-14.27	$-0.70
Process form				
Breaded	0.057**	0.011	5.86	$0.29
Barbecue	-0.020**	0.014	-1.98	$-0.10
Honey garlic	-0.470**	0.039	-37.50	$-1.84
Souvlaki	0.491**	0.014	63.39	$3.11
Buffalo	-0.113**	0.015	-10.69	$-0.52
Village	-0.024**	0.013	-2.37	$-0.12
Other process forms	0.079**	0.009	8.22	$0.40
Interaction terms				
Buffalo*Wings	0.074**	0.022	7.68	$0.38
Honey-garlic*Wings	0.450**	0.048	56.81	$2.78
Observations	8943			
Generalized R^2	0.713			
Root MSE	0.25			
F	812.3			

Dependent variable: retail price for value-added chicken products ($/lb., average price $4.90). All independent variables are in binary form. ** represents statistical significance at the 1% level. t-values are based on White's heteroskedasticity consistent standard errors. [a] The relative impact (%, $) measures the individual attribute coefficient estimate's percentage / retail price impact on the product price evaluated at the sample mean. Calculations were based on equation (2.5).

2.5.1.2: Package Size

Package size can be thought of as another critical variable in product positioning at the retail level for different consumer segments. We confirm the finding in the literature of premium prices for small (e.g. single serving) packaging and "value-pack" savings for family-sized large packages. The

majority of convenience chicken products offered are 500g-1000g, primarily targeting households, and providing 2-3 servings per package. Other package sizes are available on both ends of the distribution but are skewed towards large "value-pack" products. Our findings are consistent with previous studies on packaged fresh meats by Parcell and Schroeder (2007), Dutton et al. (2007), and Ward et al. (2008), indicating that a linear increase in package size reduces the unit product price by $0.06 to $0.23/lb.

2.5.1.3: Product Form

Wald test (table 2.3) confirms the importance of different parts of the chicken carcass (product forms) in retail price formation and product differentiation. Chicken-breast-based products account for almost one-third of all products offered in Canadian retail stores. Our results reveal an average price premium of 23.9% for chicken breast products. This premium could be associated with the perceived health and convenience attributes of chicken breast, as reported by Goddard et al. (2007).

Chicken wings have received much media and consumer attention. Traditionally perceived as a low-quality product, chicken wings have enjoyed an increase of more than 9% in retail sales, reaching $22.4 million in 2010, an increase in value of 16% from 2009 (Meatingplace 2010). Canadian consumer preferences and strong demand for wing products resulted in a 29.1% price premium over the average category price. This result is confirmed by significant

and positive coefficient estimates of interaction effects for Buffalo*Wings and Honey-garlic*Wings with price premiums of 7.7% and 56.8% respectively.

Other product forms such as skinless or boneless chicken, commonly associated with lower fat content and convenience, yield price premiums of 22.3% and 11.5 %, respectively.[7] This result is in line with findings reported by Anders and Moeser (2010) that emphasize the role of health attributes in Canadian meat demand. In comparison, product forms that involve higher degrees of processing (e.g., chicken nuggets) aimed at convenience-seeking consumers are heavily discounted up to 15.6%. The same holds for a large numbers of other product forms on which the Canadian retail consumers place little value.

2.5.1.4: Process Form

Different forms of further processing are another contributor to product differentiation, indicating that product price is not independent of process form (table 2.3). However, despite the diversity in process attributes offered by the value-added chicken category, Canadian consumers pay discounted price for the majority of process forms. One plausible interpretation is that consumers only pay a premium for products of sufficiently high quality, and a more "natural" product appearance is important when selecting processed chicken products. Preferences for diet-health related attributes (e.g., natural, lower fat) trump convenience-focused processing attributes as shown by significant price discounts for further

[7] The inclusion of an interaction term for Skinless*Boneless*Chicken Breast or, alternatively, Skinless*Breast and Boneless*Breast ,resulted in unsustainable levels of multicollinearity and elimination of this interaction term from the model.

processed products such as chicken burgers. The above results also suggest that manufacturers' attempt to add more even value to value–added chicken products through further processing and ease of preparation may not always add value in the eyes of Canadian consumers.

2.5.2: Frozen Value-Added Seafood

The estimated hedonic values of frozen value-added seafood products contribute to the empirical evidence on how to value the retail seafood product attributes of different species (Roheim et al. 2007). Nevertheless, this analysis confirms previous findings that a combination of manufacturer's brand and fish species is the main factor contributing to the retail prices of value-added seafood in Canada (table 2.3).

As expected, Canadian seafood consumers do not place equal value on all convenience or processing attributes. It is worthwhile noting that 29% of all value-added seafood is sold through PLs, compared to 23% for chicken. Contrary to the general assumption that salmon is the most popular seafood among North American consumers (Knapp et al. 2007); the data indicate that Pollock, a new and cheaper competitor for cod, dominates processed seafood products. Fillet is the leading product form in retail seafood demand, with a 23% market share. This is of comparable magnitude to chicken breast, which accounts for 28% of processed chicken products.

2.5.2.1: Brand

National manufacturer brands are particularly important in retail demand for value-added seafood. The leading seven national brand manufacturers compete with a total of 21 PLs. The top three manufacturer brands, *Highliner*, *Ferma*, and *Bluewater*, which are sold at most major Canadian retail chains (e.g., Safeway), account for a 42% market share.

Brand equities measured against the category average can be thought of as a preference ranking for the leading consumer brands. The estimates indicate that one major brand, *Highliner*, exhibits a positive brand valuation of 16.7% relative to other brand competitors (table 2.5). Much smaller in market share, *Aquastar* (6%) and *Janes* (6%) commanded significant brand premiums of over 54.2% and 50.5%, respectively. This reflects their perceived higher quality and related brand reputation among Canadian consumers. Despite their 29% market share and degree of brand differentiation, PL products sold at an average discount 6%. This result confirms previous literature findings that seafood consumers are willing to pay price premiums for familiar branded products over PL substitutes (Roheim et al. 2007). This holds true despite evidence of the increasing overall product quality of PL foods reported by Appelbaum et al. (2003). Increasing consumer awareness of eco-labeling of fishery products as part of a global strategy to promote sustainable fisheries may contribute to the positive brand equities of selected brands (Caswell and Anders 2009).

Table 2.5: OLS Estimates of Log-Linear Hedonic Model for Value-Added Seafood

Independent Variable	Coefficient	St. Err	Relative Impact[a]	
			%	Dollar ($)
Constant	1.477**	0.007		
Brand				
Highliner	0.154**	0.012	16.65	$0.86
Janes	0.409**	0.012	50.53	$2.60
Aquastar	0.433**	0.022	54.18	$2.79
Bluewater	0.057**	0.012	5.86	$0.30
Ferma	-0.600**	0.013	-45.12	$-2.32
Ocean	-0.071**	0.017	-6.86	$-0.35
Northern	-0.376**	0.019	-31.34	$-1.61
Other brands	-0.006	0.009	-0.60	$-0.03
Package Size				
$Size_1$ (0-500)	0.185**	0.01	20.32	$1.05
$Size_2$ (500-1000)	0.089**	0.011	9.31	$0.48
$Size_3$ (1000-2000)	-0.274**	0.014	-23.97	$-1.23
Species				
Cod	-0.191**	0.01	-17.39	$-0.90
Pollock	-0.515**	0.012	-40.25	$-2.07
Salmon	0.108**	0.014	11.40	$0.59
Shrimp	0.443**	0.022	55.73	$2.87
Crab	0.481**	0.017	61.77	$3.18
Squid	-0.496**	0.019	-39.10	$-2.01
Prawns	1.014**	0.038	175.64	$9.05
Haddock	-0.158**	0.014	-14.62	$-0.75
Sole	-0.355**	0.022	-29.88	$-1.54
Other fish	-0.390**	0.025	-32.30	$-1.66
Other seafood	0.060**	0.019	6.18	$0.32
Product Form				
Fillet	0.186**	0.008	20.44	$1.05
Sticks	0.038**	0.009	3.87	$0.20
Legs	0.139**	0.026	14.91	$0.77
Slice	0.233**	0.013	26.24	$1.35
Rings	0.296**	0.019	34.44	$1.77
Steaks	-0.701**	0.027	-50.39	$-2.60
Whole	-0.055**	0.017	-5.35	$-0.28
Other product forms	-0.137**	0.012	-12.80	$-0.66
Process Form				

Breaded	0.359**	0.016	43.19	$2.22
Smoked	0.631**	0.018	87.95	$4.53
Fried	-0.743**	0.024	-52.43	$-2.70
Battered	0.072**	0.008	7.47	$0.38
Cooked	0.148**	0.028	15.95	$0.82
Raw	-0.380**	0.029	-31.62	$-1.63
Seasoned	-0.028	0.019	-2.76	$-0.14
Other process forms	-0.059**	0.018	-5.73	$-0.30
Interaction Terms				
Seasoned*Salmon	-0.074**	0.024	-7.14	$-0.37
Breaded*Shrimp	-0.100**	0.034	-9.52	$-0.49
Observations	8135			
Generalized R^2	0.722			
Root MSE	0.3			
F	1516.98			

Dependent variable: retail price for value-added seafood products ($/lb., average price $5.15). All independent variables are in binary form. ** represent statistical significance at 1% level. t-values are based on White's heteroskedasticity consistent standard errors. [a] The relative impact (%, $) measures the individual attribute coefficient estimate's percentage / retail price impact on the product price evaluated at the sample mean. Calculations based on equation (2.5).

2.5.2.2: Package Size

Product segmentation by package or portion clearly matters. The majority of seafood products (68%) fall into the 500g to 1000g "family size" portion range. Value-added seafood is not sold in units exceeding 2000g, offering less variety to value-oriented retail consumers. As expected, smaller unit sizes of less than 500g are most valued in the market. Surprisingly, however, the related price premium is only 20.3%, compared to 60% for chicken. Unit price is not a linear function of package size. This finding supports the notion that seafood brands have a dominant role in product differentiation and rely less on other extrinsic attributes in retail pricing and demand.

2.5.2.3: Species

Confirming previous research (Roheim et al. 2007; Wessells and Wilen 1994), our analysis shows that species attributes, together with manufacturer brands, significantly contribute to market segmentation in the Canadian retail seafood market (table 2.3). Popular and familiar fish species such as salmon achieve a price premium (11.4%). This is exceeded, however, by significant premiums for crustaceans such as shrimp, crab and prawns, the prices of which range from 55.7% to 175.6% above the average category price of $5.15 per pound. While these premiums may reflect higher input prices, they are also a function of the popularity and versatility of crustacean products among consumers.

In contrast, less popular and/or familiar species face an average retail price discount of 32.3%. Although cod faces a 17.4% discount, it is still more expensive than its popular substitute, Pollock, which is discounted by 40.3%. Our results differ from the hedonic values for species reported by Roheim et al. (2007) for frozen fish in the UK market. However, the authors do not include crustaceans and, hence, neglect potentially important attribute interaction effects.

Finally, two additional factors may be relevant in explaining the relative pricing differences across seafood species. First, strong price competition between Canadian supermarket chains may stand behind specific pricing decisions targeted at market and consumer segments.[8] Second, the frequent usage of seafood

[8]Loblaws Real Canadian Superstore increasingly targets Asian customers with sales and product promotions of popular foods, including a greater selection of fish and seafood products.

products such as frozen shrimp in retail price promotions may create competitive pressure on PL and manufacturer brand-species combinations, as has been pointed out by Roheim et al. (2007). However, it is beyond the scope of this analysis to look at the impact of front-of-package labeling of, for instance, health-related claims (e.g., omega-3) that may have contributed to category segmentation and consumer product valuation.

2.5.2.4: Product Form

As the degree of species-based product differentiation far exceeds other meat categories; product form plays an important role in seafood price determination and retail segmentation (table 2.3). However, in line with Roheim et al. (2007), substantial variations in the market share of different product forms exist across brands and over time. Previous literature confirms the high frequency of innovation introductions and withdrawals within the frozen value-added food category in an effort to meet consumer preferences for variety, convenience and, increasingly, health and natural product attributes (Barrena and Sanchez 2010).

The attribute fish fillet is valued above other product forms. Frozen whole fish receives a price discount of 5.4%. Surprisingly, the attribute steak, commonly associated with tuna or salmon, products is heavily discounted.[9] Crab legs, the most common and valued seafood product form, receives an average premium of 14.9% (table 2.5).

[9] The Nielsen (2007) data indicate that the majority of frozen salmon steak products are based on lower quality chum salmon offered at below-category average retail prices.

2.5.2.5: Process Form

The quality of processed products as perceived by consumers becomes particularly relevant as the "healthiness" of foods has emerged as a key criterion for product selection and a driving force in food manufacturer innovation (Lahteenmaki et al. 2010). For seafood, generally perceived as healthful for its fatty-acid profiles and high protein content, further processing to increase its convenience value or hide lower quality species inputs, may not necessarily increase the overall perceived quality in the eye of the consumer. For instance, the interaction term Breaded*Shrimp indicates a discount of 9.5%. Lahteenmaki et al. (2010) state that health-related attributes claims may also affect the consumer's perception of other product attributes and, therefore, indirectly influence the overall evaluation of product quality.

Underlying health preferences are also reflected in a substantial price discount of 52.4% for fried seafood products often associated with high levels of saturated fats. Seasoned*Salmon is discounted 7.1% as added spices and flavours may be associated with higher levels of sodium or salt. Convenience quality attributes such as breaded, battered, and pre-cooked tend to be among the preferred attributes in the Canadian seafood market.

Finally, our results differ from the negative hedonic values for processing attributes (battered, breaded, smoked) found by Roheim et al. (2007). We do, however, confirm the authors' conclusion that the process of adding further value to value-added products may not always be appreciated by the consumer (e.g. fried, seasoned).

2.6: CONCLUSIONS

Changing consumer preferences are shaping North American meat demand patterns. Consumers want variety, convenience and increasingly, more natural and healthy foods. On the supply side, continuous product innovation, particularly in frozen and processed (value-added) foods, has led to a diversified and highly segmented retail market. This development has coincided with the rapid emergence of PL brands in Canadian grocery retailing, putting additional pressure on established national brand manufacturers.

This study illustrates the capacity of the hedonic pricing model (HPM) to explain the implicit choices retail customers make when faced with highly differentiated branded processed food products in the Canadian retail market. Findings suggest branding, package size, meat cut and seafood species, as well as product and process forms, add distinct value to value-added chicken and seafood products. Among the contributions made by this study is the valuation of national manufacturer brands in light of strong competitive pressure from PL product lines (e.g., Loblaws' President's Choice) that account for a 26% market share in the value-added chicken and seafood category. Sizeable brand equities held by manufacturer's brands and retail labels underpin the role of brand reputation and its implications for consumer loyalty and quality assurance. We also find that consumers prefer perceived natural and health attributes as opposed to price discounts for products with higher degrees of processing. Across both categories, our results indicate that adding value to food products by processing them further is intricate and depends on multiple other indicators of product quality. As such,

certain consumers may consider frozen natural chicken and seafood products substitutes for fresh meat and seafood. This finding may carry further implications for retail pricing and marketing of lower value cuts and seafood species. Our results largely confirm the findings in existing literature, that there is a negative relationship between package size and total product value, granting price discount to consumers buying larger “family size” value- priced packages.

The present study helps manufacturers to design products based on the valuation of various attributes like package size, product form, process form and species (only for seafood). The manufacturers should concentrate on those attributes where consumers are willing to pay a premium price. For example, in the case of chicken, consumers are paying price premium on small package sizes, breast and wings product forms, souvlaki and breaded process forms. Similarly, in seafood, consumers are paying price premium on small package sizes; prawn, crab and shrimp species; rings, slice and fillet product forms; and smoked and breaded process forms. Since the price premium for various attributes indicate that these attributes are signaling a higher quality to the consumer, manufacturers should incorporate these aspects while designing new products to mitigate risks of innovation failure and wastage of economic resources. Manufacturers can also use attribute information to propagate product quality to consumer, which may help them to identify and select products with desirable quality attributes (Unnevehr et al. 2010).

This study illustrates how valuable hedonic pricing analysis is to food manufacturers and brand managers. Comparative analysis of brand equities and

their attributes mixes allows companies to gather additional information about the relative market value of different product or process attributes. Such information may be of particular interest to brand managers concerned with the ranking and performance of their brand's image and/or recent innovations. The producers of processed meat and seafood are investing in higher quality products such as those targeted at health conscious consumers (e.g. natural). This study supports those investment decisions (Steiner 2004). Most previous studies that investigated consumers' food product choices have typically relied on survey or experimental auction methods. In contrast, the HPM has been predominantly applied to durable goods markets (e.g. cars) and less frequently to more price elastic consumer packaged goods in modern retail. Aside from a large number of hedonic studies on wine, this study represents one of the few empirical hedonic analyses on consumer packaged products in the North American market.

However, there are some limitations of using HPM and scanner data to estimate implicit attribute values for differentiated food products. First, since the analysis is based on aggregated data, it does not provide insight into individual consumer preferences. All conclusions and implications drawn from the analysis pertain only to the retail market level. Scanner data, however, have the advantage of providing detailed product-level information that most other data sources cannot match. If the focus is better understanding of individual consumer preferences, experimental economics methods and survey tools provide a better alternative. Finally, the HPM relies on actual retail prices of products available in stores. Differences in pricing and brand availability are likely to affect consumers'

purchase decisions and willingness to pay. Hence, the results presented in this study should be interpreted within the context of the cross-section of products included in the analysis.[10]

[10] A version of this chapter has been published. Ahmad, W. and S. Anders. 2012. The Value of Brand and Convenience Attributes in Highly Processed Food Products. *Canadian Journal of Agricultural Economics* 60: 113-133.

2.7: REFERENCES

Agriculture and Agri-Food Canada. 2010. Consumer Trend Report Convenience. Agriculture and Agri-Food Canada 1341 Baseline Road, Tower 5, 4th Floor Ottawa, ON Canada K1A 0C5.

Alfnes, F. and K. Rickertsen. 2003. European consumers' willingness to pay for US beef in experimental auction markets. *American Journal of Agricultural Economics* 85: 396-405.

Anders, S. and A. Moeser. 2010. Consumer Choice and Health: The Importance of Health Attributes for Retail Meat Demand in Canada. *Canadian Journal of Agricultural Economics* 58(2): 249-271.

Apelbaum, E., E. Gerstner and P. A. Naik. 2003. The Effects of Expert Quality Evaluations versus Brand Name on Price Premium. *Journal of Product & Brand Management.* 12(3): 154-165.

Asche, F., K. J. Salvanes and F. Steen. 1997. Market Delineation and Demand Structure. *American Journal of Agriculture Economics* 79: 139-150.

Barreiro-Hurle, J., G. Azucena and T. de-Magistris. 2010. Does Nutrition Information on Food Products Lead to Healthier Food Choices? Food Policy 35 (3): 221-229.

Barrena, R. and M. Sánchez. 2010. Differences in Consumer Abstraction Levels as a Function of Risk Perception. Journal of Agricultural Economics 61 (1): 34-59.

Binkley, J. and A. Golub. 2010. Household food choice in four food categories: healthy or unhealthy? Working Paper # 10-2. Department of Agricultural Economics, Purdue University.

Boland, M. and T. Schroeder. 2002. Marginal Value of Quality Attributes For Natural and Organic Beef. *Journal of Agricultural and Applied Economics* 34(1): 39-49.

Brecard, D., B. Hlaimi, S. Lucas, Y. Perraudeau and F. Salladarre. 2009. Determinants of Demand for Green Products: An Application to Eco-label Demand for Fish in Europe. *Ecological Economics* 69(1): 115-125.

Brester, G.W., P. Lhermite, B.K. Goodwin and M.C. Hunt. 1993. Quantifying the Effects of New Product Development: The Case of Low Fat Ground Beef. *Journal of Agricultural and Resource Economics* 18(2): 239-250.

Capps, O., J.R. Tedford, and J.Jr. Havlicek. 1985. Household Demand for Convenience and Non-convenience Foods. *American Journal of Agricultural Economics* 67(4): 862-869.

Caswell, J.A. and S. Anders. 2009. The Economics of Market Information Related to Certification and Standards in Fisheries. Report to the OECD Agriculture and Fisheries Directorate, OECD Fisheries Policies Division, Round Table on Eco-Labeling and Certification in the Fisheries Sector, April 22-23 2009, The Hague, Netherlands.

Coad, A. 2009. On the distribution of product price and quality. *Journal of Evolutionary Economics* 19: 589-604.

Collins-Dodd, C. and T. Lindley. 2003. Store brands and retail differentiation: the influence of store image and store brand attitude on store own brand perceptions. *Journal of Retailing and Consumer Services* 10 (6): 345-352.

Cotterill, R.W and W. P. Putsis, Jr. 2000. Market Share and Price Setting Behavior for Private Labels and National Brands. *Review of Industrial Organization* 17: 17-39.

Curry, B., P. Morgan and M. Silver. 2001. Hedonic regressions: Mis-specification and neural networks. *Applied Economics* 33: 659-671.

Darian, J. C. and J. Cohen. 1995. Segmenting by Consumer Time Shortage. *Journal of Consumer Marketing* 12(1): 32-44.

Dutton, J.M., C.E. Ward and J.L. Lusk. 2007. Implicit Value of Retail Beef Brands and Retail Meat Product Attributes. Proceeding of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting and Market Risk Management. Chicago, IL. www.farmdoc.illinois.edu/nccc134/conf_2007/ pdf/confp15-07.pdf (accessed November 4, 2010).

Enneking, U. 2004. Willingness-to-Pay for Safety Improvements in the German Meat Sector: The Case of the Q&S Label. *European Review of Agricultural Economics* 31(2): 205-223.

Fogarty, J.J. 2009. Expert Opinion and Cuisine Reputation in the Market for Restaurant Meals. AAWE Working Paper No. 51, Economics, November 2009, 23p. www.wine-economicsorg/workingpapers/aawae_wp51.pdf (accessed October 2, 2010).

Froehlich, E.J., J.G. Carlberg, and C.E. Ward. 2009. Willingness-To-pay for Fresh Brand Name Beef. *Canadian Journal of Agricultural Economics* 57:119-137.

Gardeazabal, J. and A. Ugidos. 2004. More on Identification in detailed wage decompositions. *The Review of Economics and Statistics* 86(4): 1034-1036.

Garmendia, J.M. 2010. Application of Hedonic Price Modeling to Consumer Packaged Goods Using Store Scanner Data. *Journal of Business Research* 63: 690-696.

Goddard, E., B. Shank., C. Panter., T. Nilsson and S. Cash. 2007. Canadian Chicken Industry: Consumer Preferences, Industry Structure and Producer Benefits From Investment in Research and Advertising. Project Report # 07-04 Department of Rural Economy, University of Alberta. www.consumerdemand.re.ualberta.ca/Publications/Network_Working_Papers/PR%2007-04.pdf (accessed October 4, 2010).

Greene, W.H. 2008. Econometric Analysis. Pearson Education, Inc. Upper Saddle River, New Jersey.

Grunert, K.G., L. Bredahl and K. Brunsø. 2004. Consumer perception of meat quality and implications for product development in the meat sector—a review. *Meat Science* 66(2): 259-272.

Hahn, W.F. and K.H. Mathews Jr. 2007. Characteristics and Hedonic Pricing of Differentiated Beef Demands. *Agricultural Economics* 36: 377-393.

Halstead, D., and C. Ward. 1995. Assessing the Vulnerability of Private Label Brands. *Journal of Product and Brand Management* 4(3): 38-48.

Harris, J.M., and R. Shiptsova. 2007. Consumer Demand for Convenience Foods: Demographics and Expenditures. *Journal of Food Distribution Research* 38(3): 22-36.

Harrison, G.W., R.M. Harstad and E.E. Rutstrom. 2004. Experimental Methods and Elicitation of Values. *Experimental Economics* 7(2): 123-140.

Johnston, R.J., C.R. Wessells, H. Donath, and F. Asche. 2001. A Contingent Choice Analysis of Ecolabeled Seafood: Comparing Consumer Preferences in the United States and Norway. *Journal of Agricultural and Resource Economics* 26(1): 20-39.

Kennedy, P.E. 1981. Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equations. *The American Economic Review* 71(4): 801.

Kennedy, P.E. 1986. Interpreting Dummy Variables. *The Review of Economics and Statistics* 69: 174-75.

Kinnucan, H.W. 1997. Effects of Health Information and Generic Advertising on U.S. Meat Demand. *American Journal of Agricultural Economics* 79(1): 13-23.

Knapp, G., C.A. Roheim, and J.L. Anderson. 2007. The Great Salmon Run: Competition Between Wild and Farmed Salmon. Washington, DC: TRAFFIC North America, World Wildlife Fund.

Kristofersson, D. and K. Rickertsen. 2004. Efficient Estimation of Hedonic Inverse Input Demand Systems. *American Journal of Agricultural Economics* 86(4): 1127-1137.

Kristofersson, D. and K. Rickertsen. 2007. Hedonic Price Models for Dynamic Markets. *Oxford Bulletin of Economics and Statistics* 69(3): 387-412.

Lahteenmaki, L., P. Lampila, K. Grunert, Y. Boztug, Ø. Ueland, A. Åström and E. Martinsdóttir. 2010. Impact of health-related claims on the perception of other product attributes. *Food Policy* 35: 230-239.

Lancaster, K.J. 1966. A New Approach to Consumer Theory. *Journal of Political Economy* 74(2): 132-157.

Loureiro, M.L. and J.J. McCluskey. 2000. Assessing Consumer Response to Protected Geographical Identification Labeling. *Agribusiness* 16(3): 309-320.

Loureiro, M.L. and W.J. Umberger. 2003. Estimating Consumer Willingness to Pay for Country-of-Origin Labeling. *Journal of Agricultural and Resource Economics* 28(2): 287-301.

Loureiro, M.L. and W.J. Umberger. 2007. A Choice Experiment Model for Beef: What US Consumer Responses Tell Us About Relative Preferences For Food Safety, Country of Origin Labeling and Traceability. *Food Policy* 32: 496-514.

Marette, S., J. Roosen, S. Blanchemanche and P. Verger. 2008. The Choice of Fish Species: An Experiment Measuring the Impact of Risk and Benefit Information. *Journal of Agricultural and Resource Economics* 33(1): 1-18.

McConnell, K.E. and I.E. Strand. 2000. Hedonic Prices for Fish: Tuna Prices in Hawaii. *American Journal of Agriculture Economics* 82: 133-144.

Meatingplace. 2010. FoodFocus Wings: Causing a flap. September 2010, pg. 62: Available at: http://www.meatingplace.com/MembersOnly/archives/details.aspx?item=3949 (accessed Oct. 15, 2010).

Melton, B.E., W.E. Huffman and J.F. Shogren. 1996. Economic Values of Pork Attributes: Hedonic Price Analysis of Experimental Auction Data. *Review of Agricultural Economics* 18(4): 613-627.

Myrland, O., T. Trondsen., R.S. Johnston and E. Lund. 2000. Determinants of Seafood Consumption in Norway: Lifestyle, Revealed Preferences and Barriers to Consumption. *Food Quality and Preference* 11: 169-188.

Nielsen. 2007. Total Fresh Meats Random Weight. Nielsen Market Track, National Grocery Banners, 52 Weeks, Period Ending July 2007.

Nielsen. 2010. U.S. Healthy Eating Trends Part 1: Commitment Trumps the Economic Pinch. http://blog.nielsen.com/nielsenwire/consumer/healthy-eating-trends-pt-1-commitment-trumps-the-economic-pinch (accessed October 29, 2010).

Oczkowski, E. 1994. A hedonic price function for Australian premium table wine. *Australian Journal of Agricultural Economics* 38(1): 93-110.

Parcell. J.L. and T.C. Schroeder. 2007. Hedonic Retail Beef and Pork Product Prices. *Journal of Agricultural and Applied Economics* 39(1): 29-46.

Private Label Manufacturers' Association (PLMA).2010. Store Brands Again Outpace National Brand. PLMA 2010 Yearbook. http://plma.com /pressupdate/pressupdate.asp#ID43 (accessed November 15, 2010).

Roheim, C.A., L. Gardiner and R. Asche. 2007. Value of Brands and Other Attributes: Hedonic Analysis of Retail Frozen Fish in the UK. *Marine Resource Economics* 22: 239-253.

Rosen, S. 1974. Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy* 82(1): 34-55.

Salayo, N.D., T.J.P. Voon and S. Selvanathan. 1999. Implicit prices of Prawn and Shrimp Attributes in The Philippine Domestic Market. *Marine Resource Economics* 14: 65-78.

Salvanes, K. G. and D. J. DeVoretz. 1997. Household Demand for Fish and Meat Products: Separability and Demographic Effects. *Marine Resource Economics* 12: 37-55.

Schulz, L.L., T.C. Schroeder and K. White. 2010. Value of Beef Steak Branding: Hedonic Analysis of Retail Scanner Data. Paper presented at the Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010. www. ageconsearch.umn.edu/handle/61596 (accessed August 26, 2010).

Shongwe, M., A. Jooste, A. Hugo, Z. Alemu and A. Pelser. 2007. Will Consumers Pay For Less Fat on Beef Cuts? The Case in Bloemfontein, South Africa. *Agrekon* 46(4): 475-493.

Steiner, B. 2004. French Wines on the Decline? Econometric Evidence from Britain. *Journal of Agricultural Economics* 55(2): 267-288.

Suits, D. 1984. Dummy variables: Mechanics v. interpretation. *The Review of Economics and Statistics* 66(1): 177-180.

Teuber, R. 2010. Estimating the Demand for Sensory Quality-Theoretical Considerations and an Empirical Application to Specialty Coffee. *German Journal of Agricultural Economics* 59(3): 173-186.

Triplett, J. 2004. Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products. OECD Science, Technology and Industry Working Papers 2004/9, OECD Publishing, Paris.

Unnevehr, L.J. and S. Bard. 1993. Beef Quality: Will Consumers Pay For Less Fat? *Journal of Agricultural and Resource Economics* 18(2): 288-295.

Unnevehr, L., J. Eales, H. Jensen, J. Lusk, J. McCluskey and J. Kinsey. 2010. Food and Consumer Economics. *American Journal of Agricultural Economics.* 92(2): 506-521

Verlegh, P.W. J and M.J.J.M. Candel. 1999. The Consumption of Convenience Foods: Reference Groups and Eating Situations. *Food Quality and Preference* 10: 457-464.

Ward, C.E., J.L. Lusk and J.M. Dutton. 2008. Implicit Value of Retail Beef Product Attributes. *Journal of Agricultural and Resource Economics* 33(3): 364-381.

Wessells, C.R., and J.E. Wilen. 1994. Seasonal Patterns and Regional Preferences in Japanese Household Demand for Seafood. *Canadian Journal of Agricultural Economics* 42(1): 87-103.

White, H. 1980. A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica* 48(4): 817-838.

Winger, R and G. Wall. 2006. Food Product Innovation A Background Paper. Agriculture and Food Engineering Working Document # 2, Food and Agriculture Organization of The United Nations Rome, 2006.

Chapter 3: Strategic Competition between Private Labels and National Brands in a Vertically Linked Market

3.1: INTRODUCTION

For the last several decades, manufacturers have been the main producers of branded consumer packaged products at the retail level. This leadership position has eroded over time as major grocery retail chains have introduced their own branded products - private label (PL) brands (Wu and Wang 2005; Kumar and Steenkamp 2007). PL products showed significant increase in sales at the retail level, as in 1998 they were among the top three brands in 70 percent of all superstore product categories (Wu and Wang 2005), and sales were $ 11.4 billion in Canada in 2010 (Nielsen 2010). The rapid emergence of retail brands (PLs) over the past decades has created new and stiff competition for many established NB manufacturers. Increase in competition has a significant impact on the welfare of society as retailers and NB manufacturers use their resources efficiently and innovate in the long term (Ezrachi and Bernitz 2009). Retailers are using PL products as a strategic negotiating tool at the retail level (Gomez and Benito 2008). Economic literature shows introducing PL products affects horizontal and vertical competition (Berges and Bouamra-Mechemache 2011).

Retailers are using three different production arrangements for PL products (Berges-Sennou 2006). Some own the production facility to gain more control on the production; in this regard, Doug Rauch, president of Trader Joe's (which carries about 80 percent PL products), said "we could put our destiny in our own hands" (Kumar and Steenkamp 2007). In 2011, one major retail chain in

Canada owned about 14 percent of total sales production facilities (Safeway 2011). Retailers also outsource PL products from local markets. Kumar and Steenkamp (2007) stated that thousands of firms focus exclusively to produce PL products. Also, NB manufacturers produce PL products for retailers. For instance, Chen et al. (2010) reported that more than 50 percent of PL products are being supplied by the NB manufacturers. These different production arrangements (retailer owns the production facility for PL products, retailer outsources PL products, NB manufacturer produces PL products) raise concerns for retailers, NB manufacturers and policy makers regarding competitive behavior.

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

The previous economic literature has discussed various issues relating to PL production, such as the advantages and disadvantages of NB manufacturers producing PL products (Verhoef et al. 2002; Wu and Wang 2005), factors affecting PL production (Berges and Bouamra-Mechemache 2011), and how alternative production arrangements of PL brands has an impact on retailer's bargaining and customer loyalty (Berges-Sennou 2006). Another stream of

literature discusses various competitive interactions between PL and NB manufacturers but this literature assumes a particular type of production arrangement such as the retailer outsourcing PL products (Raju et al. 1995; Narasimhan and Wilcox 1998; Cotterill and Putsis 2001), the NB manufacturer producing both NB and PL products (Wu and Wang 2005) and the retailer owning the production facility (Karray and Herran 2009). All of these studies assume the leader follower competitive interaction. The exception is Cotterill and Putsis (2001), who tested various competitive interactions between PL and NB in a vertically linked market. Cotterill and Putsis (2001) concluded that there is no consistent pattern of competition between NB and PL across different product categories.

To assess the effectiveness of different marketing instruments (price and promotion), it is important to know the underlying production arrangements and competitive interactions between NB and PL. Previous economic studies analyzed competition between NB and PL (Wu and Wang 2005; Karray and Herran 2009). However these studies made assumptions about underlying production arrangements and competitive interaction between PL and NB. In reality the competitive interaction may differ for different product categories and under alternative PL production arrangements. So the wrong assumptions regarding PL and NB competitive interaction may result in false conclusions. It is important to determine the type of competitive interaction between PL and NB under different PL production arrangements instead of assuming a particular type of competitive interaction.

Based on the literature review conducted in this subject area, there is no study that tested the nature of competitive interactions under different production arrangements. Thus, the purpose of this study is to develop the theoretical model that reflects possible vertical relations in the context of competing PL and NB at the retail level. This study also develops an empirical model framework to explicitly test for different competitive models incorporating alternative vertical production arrangements.

The main objective of this study is to see the type of competition between PL and NB in a vertically linked market when there are different PL production arrangements. We extend the theoretical model of competition, assuming different production arrangements of PL products. Furthermore, we estimate the model empirically by using Canadian retail data and identifying the competitive interaction between PL and NB that actually exists in the market. The empirical analysis helps us to identify how NB and PL prices influence the demand for these products in the Canadian context. In this regard, we use retail scanner data for the period 2004 to 2007. The dataset contains retail sales information (price, applicable discount, sales quantity, retail margin) for 200 Universal Product Code (UPC) product categories available at a major North American retail chain with stores in Canada.

The fast growth of PLs plays an important role in both intra- and inter-store retail competitions. As PL products are often less expensive than their NB substitutes, they often produce higher retail margins, making PL products an important source of retailer revenue and profit (Hoch and Banerji 1993). There is

sufficient evidence that availability/introduction of PL reduces or avoids double marginalization problem which has positive impact on the social welfare (Berges-Sennou et al. 2004). Further Sethuraman (2009) stated that there is no double marginalization when retailer buys PL product directly from the producer. Retailers are using PL marketing as an instrument to overcome the problem of double marginalization. The net effect of PL marketing results in an improvement in the performance of distribution channel. Narasimhan and Wilcox (1998) found that PL products are often used as strategic weapons by retail chains in their competition against NB food manufacturers. To date, evidence from the economic literature suggests that retailers may be effectively using PL brand lines to exert market power against many NB manufacturers (Narasimhan and Wilcox 1998; Sayman, et al. 2002; Meza and Sudhir 2010). The complex nature of the competitive interactions between PLs and NBs has become a concern (to set the price of NB and PL, to increase profit, share etc.) not only to marketing managers in food industries, but also economists and policy makers responsible for competition policy and fair practices along vertical food marketing channels (Cotterill et al. 2000).

Volpe (2010) and other researchers (Corstjens and Lal 2000; Cotterill and Putsis 2000) note that increasing levels of product quality have significantly contributed to the penetration of PLs in many retail product categories. The quality of PLs is also documented by a large number of publications in the retail press (e.g., Progressive Grocer) that show a rise in PL popularity and retailer efforts to promote higher quality PLs to consumers in order to maximize sales and

increase category market shares. The shift to and focus on PL quality over time has intensified brand competition (Volpe 2010). Behind this development stands the observation that consumers in many markets, including Canada, increasingly recognize the quality of PL products and have developed preferences for many PL brand lines (e.g. Loblaws' President's Choice). New and increasingly differentiated PL product lines are used to attract additional consumer demand and, therefore, intensify competition between PLs and NBs. Several large retail chains have developed differentiated PL "good for you" product lines and labeling schemes around their healthy product options. For example, Canadian Loblaws developed "President's Choice Blue Menu" and Safeway developed "Eating Right" healthy product lines. These healthy product lines focus on reducing or removing unfavourable ingredients (e.g., fat, sodium, sugar, salt, etc.) (Anders and Moeser 2010). In the present study, consider the case of vertical "quality" product differentiation to investigate issues in NB and PL competitive interactions.

The availability of store scanner information allows manufacturers and retailers to better monitor the movement of rival brands. Under these conditions, it becomes very important to determine the appropriate pricing and promotional strategies while considering the rival firm's strategies relating to these marketing instruments. In this study we attempt to develop and estimate models to see how price and promotion affect the demand for NB and PL assuming different competitive interactions under various production arrangements of PL at the Canadian retail level.

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

3.2: REVIEW OF LITERATURE

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

Berges and Bouamra-Mechemache (2011) studied various factors affecting the PL production process. The study shows that if production cost is low, the retailer prefers to buy its product from independent firms, and if production cost is high then it is beneficial for the retailer to get its products from NB manufacturers. The study also observes that when the NB manufacturer's bargaining power goes up, there are fewer chances for the retailer to buy PL products from the NB manufacturer. The authors further conclude that if the

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

A number of economic studies assume a particular production arrangement (Narasimhan and Wilcox 1998; Raju et al. 1995; Wu and Wang 2005; Karray and Herran 2009). For example, Narasimhan and Wilcox (1998) and Raju et al. (1995) assume that retailers outsource PL products. Raju et al. (1995) further assume that retailers buy PL products at a fixed per unit price. They conclude that introducing PLs in a product category with a large number of competing NBs would increase the retailer's profit in the respective product category. Narasimhan and Wilcox (1998) show that the penetration of PL products across categories is associated with overall higher margins for the retailers. Wu and Wang (2005) assume the NB manufacturer produces both NB and PL products. They discuss the economic benefits for the NB manufacturer to produce PL products. For this purpose, they develop a theoretical model that

considers the interaction of two NBs and one store brand. The study concludes that if the NB manufacturer supplies PL products to the retailer, it benefits the NB manufacturer as it decreases its promotional expenditures. Karray and Herran (2009) assume that the retailer owns the production facility for PL products. They analyze the impact of advertising on product sales over time. The authors conclude that the effect of advertising on brand sales depends on whether the manufacturer and retailer's advertising are competitive or complementary in nature. In the case of competitive advertising from the manufacturer, the advertising expenditure has a negative relationship with the retail price of both NB and PL brands.

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

bread) the PL behaves as the leader. Cotterill and Putsis (2001) apply a non-nested model comparison approach on US data. The study assumes that retailers outsource their products from the manufacturer. The results show that vertical Nash is most common type of competition between the PL and NB, while only 2 out of 12 product categories show the manufacturer as a Stackelberg leader.

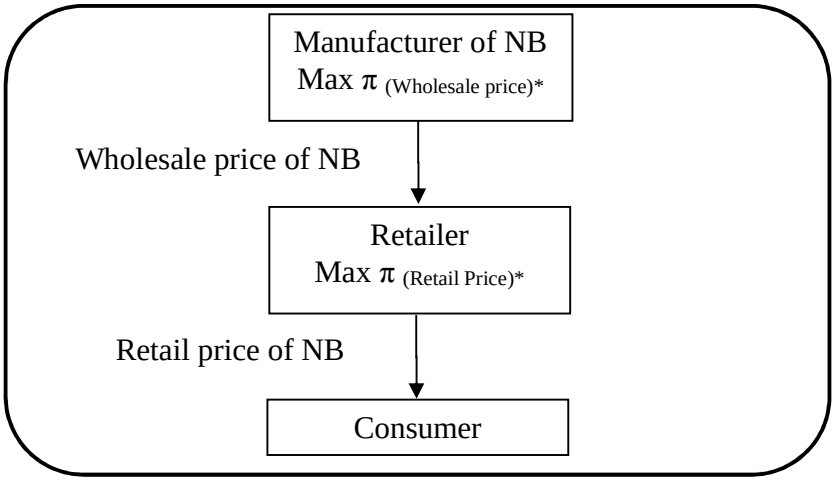
Previous theoretical literature either assumes a particular competitive interaction between PL and NB or tests different competitive interaction games. However, these articles do not take into account the variation in how PL products are produced. In reality, retailers are using three different production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

helps to draw conclusions regarding pricing strategies between PLs and NBs in different product categories under different production arrangements.

3.3: MODEL DEVELOPMENT

Historically, before the introduction of PL products, manufacturers were considered to be the main producers of consumer products. Manufacturers produced and supplied branded products to retailers, who supplied these products to consumers in the marketplace (as shown in figure 3.1). Figure 3.2 describes the changes in the marketing organization after PL products are introduced in the marketplace. In this case, the NB manufacturer produces PL products for the retailer (Chen et al. 2010).

Figure 3.1: NB Manufacturer Produces Only NB and Retailer Does not has PL Product



The manufacturer's maximizes profit not only with the production of NBs, but also with PLs. As in Figure 3.2, the manufacturer produces and supplies both products to the retailer and the retailer sells these products to the consumers.

Figure 3.3 shows the case where the retailer outsources PL products. In this scenario, different manufacturers produce PL and NB separately and supplies the products to the retailer who sells them to the consumers.

Figure 3.2: NB Manufacturer Produces both NB and PL Products

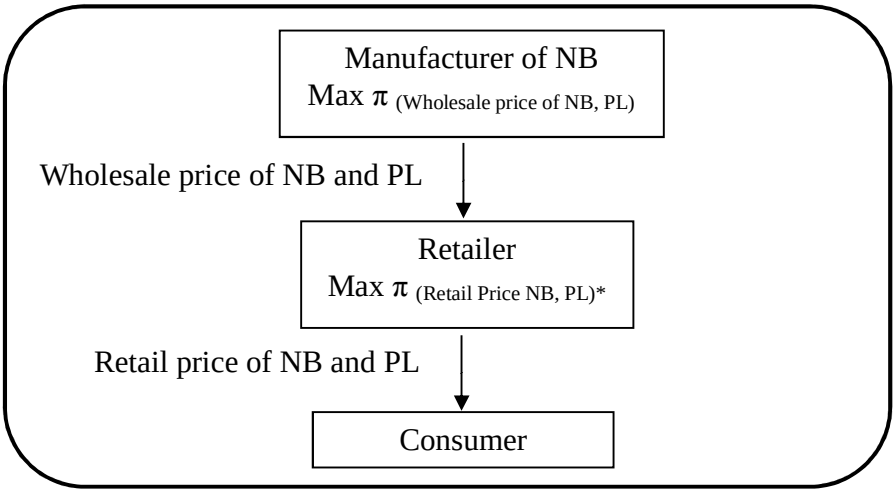
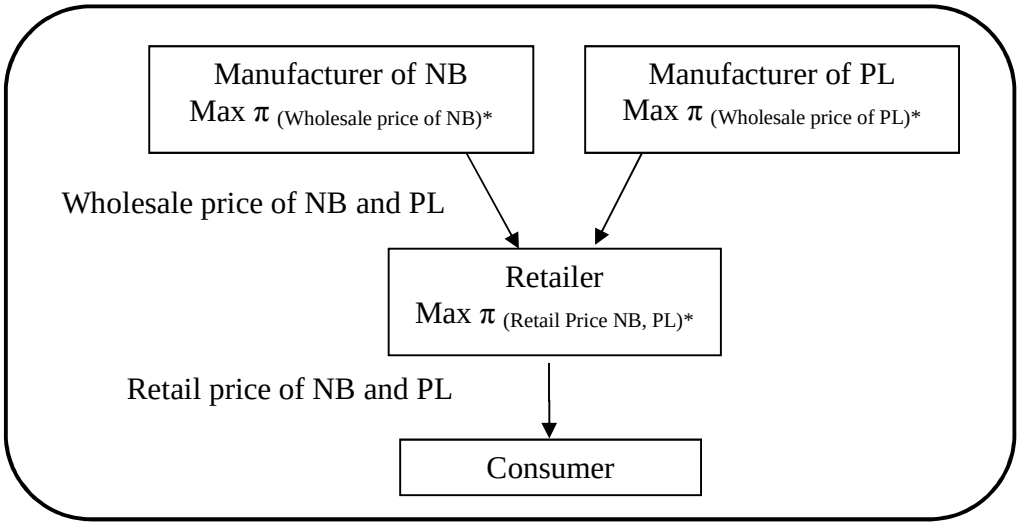
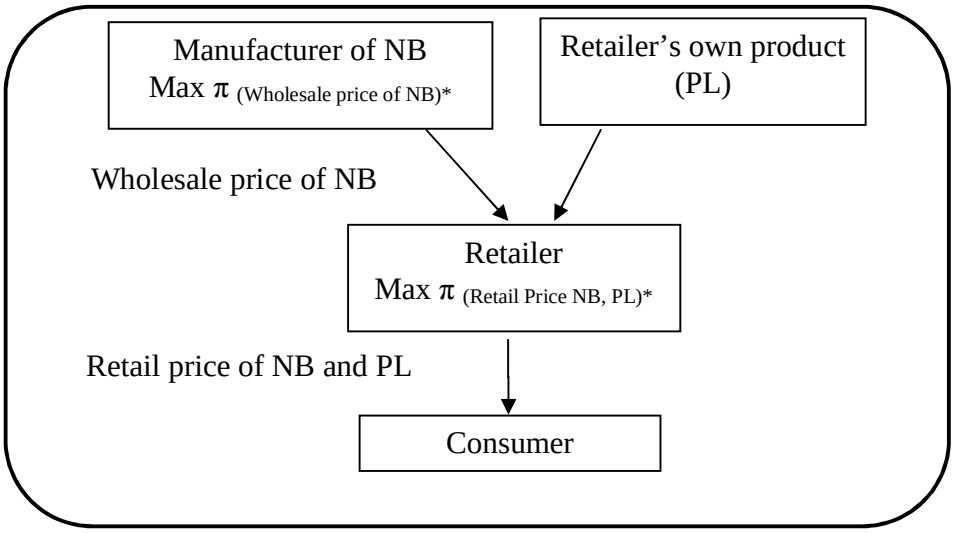


Figure 3.3: Retailer Outsources PL Product and NB Manufacturer Produces NB Brand



In figure 3.4, we assume that the retailer owns the production facility. In this case, the retailer's function is to produce and sell PL products to the consumers, whereas the NB manufacturer also supplies its products to the retailer, who then sells both products (NB and PL) to the consumers.

Figure 3.4: Retailer Owns the Production Facility and NB Manufacturer Produces NB Brand



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

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

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

Roy et al. (2006) compared different estimation approaches (e.g., CV and NNMC) and concluded that the NNMC approach performs better than the CV

approach. Since the present study deals with two brands and uses retail scanner data, it is easy to use the NNMC approach to understand different competitive behaviors in a vertically linked market and to see how these behaviors impact equilibrium prices at retail and wholesale levels. The theoretical model assumes that a NB manufacturer and retailers are using price as a strategic variable. Various scenarios are explained below:

1. The NB manufacturer supplies the product to the retailer, which does not have its own product (as shown in figure 3.1).
2. The NB manufacturer supplies both NB and PL products to the retailer, which sells both products to the consumer (see figure 3.2).
3. The NB manufacturer supplies the NB to the retailer and the retailer outsources a PL product but the retailer sells both NB and PL products to the consumer (see figure 3.3).
4. The NB manufacturer produces only the NB product and supplies it to the retailer, while retailer owns the PL production facility. Furthermore, the retailer sells both NB and PL products to the consumer (as shown in figure 3.4).

3.3.1: Case 1: Only One NB Product and No PL

In this case, we assume that only one NB product is available in the market and the retailer's role is to sell it to the final consumer. Our interest in describing this case is to compare the prices and profits for the retailer and NB manufacturer with other cases where NB and PL brands exist simultaneously.

This comparison also helps us to understand whether there is a change in the pricing behavior among different competitive models when both brands are available in the market.

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

The demand for the NB can be specified as

$$Q_{NB} = a_0 - a_1 P_{NB} \qquad (3.1)$$

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

$$P_{NB} = W_{NB} + m_{NB}$$

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

The above specification applies a linear functional form of demand. The reason for using this specification instead of other demand specifications (double log) has to do with computation. The double log specification complicates the

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

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

$$\pi_R = m_{NB} Q_{NB} \tag{3.2}$$

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

$$\pi_{NBM} = (W_{NB} - C_{NB}) Q_{NB} \tag{3.3}$$

Equation (3.3) shows the profit function of the NB manufacturer.

In case of Bertrand Nash, each competitor (retailer and NB manufacturer) takes the price of rival as given. NB manufacturer takes the retail price and retailer margin as given for its own brand and retailer takes the wholesale price of NB as given (Choi 1991). Equation 3.3 can be written as

$$\pi_{NBM} = (W_{NB} - C_{NB})(a_0 - a_1 (W_{NB} + m_{NB})) \tag{3.4}$$

The NB manufacturer reaction function can be given as

$$W_{NB} = \frac{1}{2a_1}(a_0 + a_1 C_{NB} - a_1 m_{NB}) \textbf{ OR } W_{NB} = \frac{1}{a_1}(a_0 + a_1 C_{NB} - a_1 P_{NB}) \tag{3.5}$$

$$\pi_R = m_{NB}\left(a_0 - a_1\left(W_{NB} + m_{NB}\right)\right) \tag{3.6}$$

The retailer price reaction function can be written as

$$m_{NB} = \frac{1}{2a_1}\left(a_0 - a_1 W_{NB}\right) \textbf{ OR } P_{NB} = \frac{1}{2a_1}\left(a_0 + a_1 W_{NB}\right) \tag{3.7}$$

In case a NB manufacturer behaves as a Stackelberg leader, he incorporates the retailer's price reaction functions[11] (equation 3.7) into its profit maximization (equation 3.3). The price reaction function of the manufacturer can be written as

$$W_{NB} = \frac{1}{2a_1}\left(a_0 + a_1 C_{NB}\right) \tag{3.8}$$

Under the assumption when the retailer behaves as a Stackelberg leader and NB manufacturer as a follower, the retailer incorporates the price reaction function of NB manufacturer[12] (equation 3.5) into its profit maximization (equation 3.2). The price reaction function of retailer (Stackelberg leader) is given as

$$P_{NB} = \frac{1}{4a_1}\left(3a_0 + a_1 C_{NB}\right) \tag{3.9}$$

Equilibrium values under various competitive behaviors are given in table 3.1. The retail price's equilibrium values show that the cost of producing NB has a positive impact on the retail and wholesale price, which is expected according to economic theory. These theoretical results are consistent with the findings of Choi (1991). The theoretical model shows that the retail price of NB remains the same

[11] The retailer's price reaction should contain only the wholesale price and exogenous variables only.
[12] The NB manufacturer's price reaction is function of retail price/retail margin and exogenous variables only.

for different competitive behaviors (whether the retailer behaves as a leader or the NB manufacturer behaves as a leader) but the wholesale price differs in different competitive equilibriums. It also reveals that the total channel profit remains the same whether the retailer behaves as a leader or the NB manufacturer behaves as a leader (Choi 1991). As expected, the retailer's equilibrium profit is highest when the retailer behaves as a leader while the manufacturer's profit is the highest when the NB manufacturer behaves as a leader. Theoretical models show that industry as a whole enjoys the highest profit and consumers enjoy the lowest price when there is Bertrand competition.

Table 3.1: Equilibrium Values under Various Competitive Interactions When Only NB Product is Available at Retail Level

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

3.3.2: Case 2: Only One NB Product and One PL

3.3.2.1: Case 2.1: NB manufacturer produces both NB and PL product

In this case, we assume that both NB and PL product are available in the market and the retailer is selling both the NB and PL products to the consumers. The manufacturer produces both the products and maximizes profit by setting the wholesale price. The retailer optimizes by setting the retail price of the NB and PL (see figure 3.2).

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

$$Q_i = a_0 - a_1 P_i + a_2 P_j \qquad \text{Where i, j = NB and PL, and i} \neq \text{j} \qquad (3.10)$$

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

$$\pi_R = m_{PL} Q_{PL} + m_{NB} Q_{NB} \qquad (3.11)$$

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

$$\pi_{NBM} = (W_{NB} - C_{NB}) Q_{NB} + (W_{PL} - C_{PL}) Q_{PL} \qquad (3.12)$$

Using the similar approach as of case 1, we estimated different competitive games (Bertrand Nash, Stackelberg leader follower) and the equilibrium values under various equilibrium interactions (Stackelberg leader follower and Bertrand) are given in Table 3.2. Equilibrium values show that reducing production costs of the NB and PL decrease the retail and wholesale prices, as expected from economic theory. Retail prices remain the same in both

competitive interactions (whether the retailer behaves as a leader or the NB manufacturer behaves as a leader) but these retail prices are different from the Bertrand competition. The wholesale price, however, varies under all competitive behaviors. These results show that regardless of who becomes the leader in the market, the leader achieves higher profits (as shown in the appendix A).

Table 3.2: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer Produces Both NB and PL Products

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

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

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

profit by optimizing with respect to the retail price of both the NB and PL products (as shown in figure 3.3).

The demand for NB and PL can be written as

$$Q_i = a_0 - a_1 P_i + a_2 P_j \qquad \text{Where i= NB and PL} \qquad (3.13)$$

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

$$\pi_R = m_{PL} Q_{PL} + m_{NB} Q_{NB} \qquad (3.14)$$

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

$$\pi_{NBM} = (W_{NB} - C_{NB}) Q_{NB} \qquad (3.15)$$

$$\pi_{PLM} = (W_{PL} - C_{PL}) Q_{PL} \qquad (3.16)$$

Using a similar approach as used in case 1, equilibrium values of competitive interactions between NB manufacturer and the retailer where he outsources the PL product have been determined under various assumption i.e. manufacturer of NB behaves as a leader and retailer as follower, retailer behaves as a leader and the manufacturer of NB as a follower and Bertrand competition between retailer and manufacturer of NB. These equilibrium values are shown in table 3.3. Results of the theoretical model show that there is no difference between the retail prices in both leader follower competitive interactions (retailer behaves as a leader or manufacturer behaves as a leader) but these prices are different for the Bertrand interaction. Since equilibrium values are nonlinear in parameters, it is hard to sign them. For interpretation of equilibrium values, we assign arbitrary values to the parameters using economic theory intuition (own price $\geq$ cross price).

Table 3.3: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer produces NB and the Retailer Outsources the PL Product

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

Comparative statistics show that if $a_1 > a_2$, then the cost of production of NBs and PLs has the positive impact on the NB and PL retail and wholesale prices.

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

In this case, it is assumed that the retailer owns the PL production facility. The NB manufacturer's role is to supply NB products to the retailer. The retailer then sells these products to the consumers. The NB manufacturer maximizes its profit by optimizing the wholesale price of the NB and the retailer maximizes its profit by optimizing with respect to the retail price of the NB and PL (see figure 3.4).

The theoretical model can be written as

$$Q_i = a_0 - a_1 P_i + a_2 P_j \qquad \text{Where i= NB and PL} \qquad (3.17)$$

$$\pi_R = (P_{PL} - C_{PL}) Q_{PL} + m_{NB} Q_{NB} \qquad (3.18)$$

$$\pi_{NBM} = (W_{NB} - C_{NB}) Q_{NB} \qquad (3.19)$$

Comparative statistics of the above model are given in table 3.4, using the similar approach as in case 1. Results show that the retail price of the NB and PL is identical under both leader follower behaviors while the wholesale price varies in all competitive interactions. The cost of producing NBs and PLs has a positive impact on the retail price of NBs and PLs under all competitive behaviors, which is expected from economic theory. The theoretical model reveals that the retailer earns the highest profit when the retailer behaves as a leader, and the NB manufacturer makes the lowest profit when the NB manufacturer behaves as a follower. The reverse is true when the NB manufacturer behaves as a leader. The

total industry profit remains the same under both leader follower behaviors (retailer behaves as a leader or NB manufacturer behaves as a leader). These results are similar to the case 1, where the results show that consumer enjoys the lowest price and industry earns the highest profit under Bertrand behavior.

Table 3.4: Equilibrium Values under Various Competitive Interactions When the NB Manufacturer Produces NB and the Retailer Owns the PL Production Facility

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

3.3.3: Econometric Model Specification

This section briefly describes the derivation of different competitive interactions between PLs and NBs under different production arrangements of PL products.

3.3.3.1: NB manufacturer produces both NB and PL products

3.3.3.1.1: Bertrand Behavior between PL and NB

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

$$Q_{PLst} = a_0 + a_1 P_{PLst} + a_2 P_{NBst} + a_3 S_{PLst} + a_4 S_{NBst} + \upsilon_{1st} \quad (3.20)$$

$$Q_{NBst} = b_0 + b_1 P_{NBst} + b_2 P_{PLst} + b_3 S_{NBst} + b_4 S_{PLst} + \upsilon_{2st} \quad (3.21)$$

$$P_{PLst} = \left(-\frac{a_2 + b_2}{2a_1} \right) P_{NBst} - \frac{\left(a_0 - b_2 W_{NBst} - a_1 W_{PLst} + a_4 S_{NBst} + a_3 S_{PLst} \right)}{2a_1} + \upsilon_{3st} \quad (3.22)$$

$$P_{NBst} = \left(-\frac{a_2 + b_2}{2b_1} \right) P_{PLst} - \frac{\left(b_0 - b_1 W_{NBst} - a_2 W_{PLst} + b_3 S_{NBst} + b_4 S_{PLst} \right)}{2b_1} + \upsilon_{4st} \quad (3.23)$$

$$W_{PLst} = \frac{1}{a_1} \left(a_1 C_{PLst} + b_2 C_{NBst} - b_2 W_{NBst} - a_0 - a_1 P_{PLst} - a_2 P_{NBst} - a_3 S_{PLst} - a_4 S_{NBst} \right) + \upsilon_{5st} \quad (3.24)$$

$$W_{NBst} = \frac{1}{b_1} \left(b_1 C_{NBst} + a_2 C_{PLst} - a_2 W_{PLst} - b_0 - b_1 P_{NBst} - b_2 P_{PLst} - b_3 S_{NBst} - b_4 S_{PLst} \right) + \upsilon_{6st} \quad (3.25)$$

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

3.3.3.1.2: NB manufacturer behaves as a leader and retailer behaves as a follower

In this case, we first need to estimate the first order conditions of the follower, which is written as

$$P_{PLst} = \left(-\frac{a_2 + b_2}{2a_1} \right) P_{NBst} - \frac{1}{2a_1} \left(a_0 - b_2 W_{NBst} - a_1 W_{PLst} + a_4 S_{NBst} + a_3 S_{PLst} \right) + \upsilon_{3st} \quad (3.26)$$

$$P_{NBst} = \left(-\frac{a_2 + b_2}{2b_1} \right) P_{PLst} - \frac{1}{2b_1} \left(b_0 - b_1 W_{NBst} - a_2 W_{PLst} + b_3 S_{NBst} + b_4 S_{PLst} \right) + \upsilon_{4st} \quad (3.27)$$

By solving equation (3.26) and (3.27) in terms of W_{NBst} and other exogenous variables, we substitute these expressions into the NB manufacturer maximization problem. The first order conditions of the NB manufacturer can be written as

$$W_{PLst} = -\frac{a_2 + b_2}{2a_1} W_{NBst} + \frac{a_2 + b_2}{4a_1} C_{NBst} + \left(\frac{\begin{matrix} a_4 b_2^2 + a_1 a_2 b_3 - 2a_1 b_1 a_4 \\ - a_1 b_2 b_3 + a_2 a_4 b_2 \end{matrix}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) S_{NBst}$$

$$+ \left(\frac{\begin{matrix} a_3 b_2^2 - 2a_1 a_3 b_1 + a_1 a_2 b_4 \\ + a_2 a_3 b_2 - a_1 b_2 b_4 \end{matrix}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst} + \frac{C_{PLst}}{2} - \frac{\begin{matrix} 2a_0 a_1 b_1 - a_0 b_2^2 - a_1 a_2 b_0 \\ - a_0 a_2 b_2 + a_1 b_0 b_2 \end{matrix}}{4a_1 (a_1 b_1 - a_2 b_2)} + \upsilon_{5st} \quad (3.28)$$

$$W_{NBst} = -\frac{a_2 + b_2}{2b_1} W_{PLst} + \frac{a_2 + b_2}{4b_1} C_{PLst} + \left(\frac{\begin{array}{l} a_2^2 b_4 - a_2 a_3 b_1 - 2a_1 b_1 b_4 \\ + a_3 b_1 b_2 + a_2 b_2 b_4 \end{array}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst}$$

$$+ \left(\frac{\begin{array}{l} a_2^2 b_3 - 2a_1 b_1 b_3 - a_2 a_4 b_1 \\ + a_2 b_2 b_3 + a_4 b_1 b_2 \end{array}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{NBst} + \frac{C_{NBst}}{2} - \left(\frac{\begin{array}{l} 2a_1 b_0 b_1 - a_2^2 b_0 + a_0 a_2 b_1 \\ - a_0 b_1 b_2 - a_2 b_0 b_2 \end{array}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) + \upsilon_{6st} \quad (3.29)$$

To estimate the model properly, we need to estimate equations (3.20), (3.21), (3.26)-(3.29) as a system. The endogenous variables in this system are the wholesale price of the NB and PL products, the retail price of the PL and NB products, and the quantity demanded of the NB and PL products and the remaining variables are all exogenous. Appendix B lists the econometric specifications of the retailer, who behaves as a leader, and the NB manufacturer, who behaves as the follower.

3.4: DATA

For the purpose of analysis, we chose a product category and product pairings in which the regular and healthy PL and NB products were so similar that they could easily be substituted for each other. The matching criterion is based on the fact that products are direct, close substitutes within the same product category, and that both products (PL, NB) carry close to identical characteristics as identified from the product description. The analysis in this study is based on a set of proprietary scanner panel data made available through the SIEPR-Giannini Data Center (SIEPR-Giannini Data Center 2012). The data provide retail sales information for 200 UPC product categories for a major North American retail

chain with stores in Canada. Aggregate weekly store level sales data are used from all retailer operational regions. The data include information at the individual UPC level for price, applicable discounts, sales quantity, and retail gross and net margin for week 1-2004 to week 27-2007.

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

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

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

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

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

Table 3.5 shows the descriptive statistics of NB and PL regular and healthy bacon. In the present study we deflated the retail price using a consumer price index, the wholesale price using an industry price index, and the input cost using a farm price index (Statistics Canada 2012). Table 3.5 provides average values of shelf price, promotional price, wholesale price, average quantity of PL and NB. Table 3.6 compares average retail and promotional prices etc. This comparison helps us to understand how retailer and NB manufacturer price their regular and vertical differentiated bacon products. Tables 3.7 and 3.8 compare

how retailer and NB manufacturer using promotional activities against the rival brand.

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

Table 3.5: Descriptive Statistics for NB and PL Regular and Healthy Bacon

Particulars	Mean	Std. Dev.	Minimum	Maximum
	Regular Bacon			
NB Shelf Price [a]	6.39	0.34	4.57	8.04
NB Promotional Price [b]	5.45	0.91	4.05	8.04
NB Wholesale Price	3.53	0.16	2.33	4.26
PL Shelf Price [a]	3.16	0.18	2.80	3.49
PL Promotional Price [b]	3.06	0.24	2.58	3.49
PL Wholesale Price	1.92	0.06	1.29	1.99
NB Quantity	38.15	32.79	1	247
PL Quantity	9.06	6.26	1	63
	Healthy Bacon			
NB Shelf Price [a]	6.39	0.35	4.57	8.04
NB Promotional Price [b]	5.45	0.91	4.43	8.04
NB Wholesale Price	3.54	0.17	1.18	4.28
PL Shelf Price [a]	5.38	0.36	3.68	6.15
PL Promotional Price [b]	4.86	0.74	2.89	5.97
PL Wholesale Price	2.77	0.22	1.30	3.35
NB Quantity	14.99	13.78	1	95
PL Quantity	16.00	16.23	1	209

All prices are in Canadian $ and quantity is measured in number of package of 500g each. [a] Shelf price: Price printed on the shelf of the product at the retail store. [b] Promotional price: Price accounting for the promotional discounts, coupons and saving through membership cards

The average sales quantity of the NB is higher for regular bacon while this relationship is reverse for PL healthy bacon. The share of PL healthy bacon is 49.7 percent, which is significantly higher than PL regular bacon share of 18.2 percent. These statistics show that retailers focus more on health differentiation.

Table 3.6 shows the average price difference between NBs and PLs, retail margins, promotional frequency and promotional depth for selected NB and PL products at the Canadian retail level. The second and third rows of table 3.6 show the difference between the average shelf and promotional prices of NB and PL products. The next two rows show the retailer margin (difference between shelf price and wholesale price) for PL and NB healthy and regular bacon. We study the promotional activities of PLs and NBs where the main variables of interest are promotional frequency and promotional depth. The promotional frequency shows the number of times a given product remains on promotion and the promotional depth measures the extent of the shelf price reduction during the promotion (Volpe 2010). The last two rows show the percentage difference between NB and PL promotional frequency and the difference between NB and PL promotional depth, respectively.

The differences between NB and PL shelf prices vary considerably between healthy and regular bacon. These values show that the NB is more expensive than the respective PL product. The highest price difference exists for regular bacon at $3.23 a package. Previous literature concluded that the price of a NB can be expected to be higher than its PL counterpart (Dhar and Hoch, 1997; Ailawadi et al. 2001; Volpe, 2010). The difference between the promotional price

of NB and PL products shows that promotional price difference is higher in the regular bacon category (i.e., $2.39) as compared to healthy bacon (i.e., $0.59). This shows that the NB producers are offering more discounts on their products than the retailers do on PL products. Retailer margins for PL and NB products vary between healthy and regular bacon, as shown in table 3.6. Hoch and Banerji (1993) and Steiner (2004) stated that PL products are expected to be less expensive than their NB substitutes and yield higher retail margins. The data show that the dollar retail margin of NB bacon is higher than PL bacon but the percentage retail margin of PL is higher than NB healthy bacon. The reason for the higher dollar retail margin for NBs is that the NB has a higher NB shelf price than the PL.

Table 3.6: Price Difference, Retail Margin, Promotional Frequency and Promotional Depth for NB and PL Bacon Products

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

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

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

Since, we only chose PL and NB products that were so similar they could easily be substituted for each other. This imposes the implicit assumption that promotional interactions affect only a single category – in other words, when a store's PL bacon goes on sale, it affects only the NB bacon.

Table 3.7: Contingency Table of Healthy Bacon Promotion

		Private Label		
		Promotion [a]	No promotion	Total
National Brand	Promotion [a]	24.84	27.95	52.80
	No Promotion	14.91	32.30	47.20
	Total	39.75	60.25	100

All the values in this table are in percentage. [a] Promotional price: Price accounting for the promotional discounts, coupons and saving through membership cards.

Tables 3.7 and 3.8 address the issues of overall promotional activity between competing PLs and NBs and use contingency tables to address the products' promotional interactions. The contingency tables cover all possible promotional outcomes (i.e., only PL (NB) on promotion, both PL (NB) are on promotion or none are on promotion).

Table 3.8: Contingency Table of Regular Bacon Promotion

		Private Label		
		Promotion [a]	No promotion	Total
National Brand	Promotion [a]	14.91	38.51	53.42
	No Promotion	9.32	37.27	46.58
	Total	24.22	75.78	100

All the values in this table are in percentage. [a] Promotional price: Price accounting for the promotional discounts, coupons and saving through membership cards

The contingency table for health differentiated sliced bacon shows that the NB remains on promotion about 52.80% of the time, while the competing PL remains on promotion 39.75% of the time, and both the NB and PL remain on promotion 24.84% of the time. The table shows that 32.30% of the time neither of the two competing brands is sold at a discount at any of the retailer's stores in Canada. Furthermore, the PL remains on promotion only 14.91 percent of the time, while the NB is also on promotion. Moreover, the chi-square statistics[13] reveal a significant association between NB-PL promotional activities. A χ^2 test

[13] For calculating χ^2 statistic we used following formula:

$$\chi^2 = \sum \frac{(Observed \quad value - \exp ected \quad value)^2}{\exp ected \quad value}$$

statistic value of 37.03 is significant at the 1 percent level of significance. In the regular sliced bacon category, the NB remains on promotion 53.42% of the time compared to 24.22% for the PL product (as shown in table 3.8).

3.5: RESULTS AND DISCUSSION

Table 3.9 summarizes the results of the hypothesis tests of whether price competition differs for different product categories under different PL production arrangements. For the analysis purpose, demand and price reaction equations are estimated as a system. In this regard the Full Information Maximum Likelihood (FIML) method is applied and the model which gives lowest values for Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) is considered as the best model (Gujarati and Sangeetha 2007; Greene 2008). Table 3.9 shows considerable variations in the competitive behavior of PL and NB for regular and the healthy bacon products. Similar results are reported by Putsis and Dhar (1998); however, they used horizontal price competition between PL and NB without considering the production arrangements of the retailer's brand.

The study shows leader follower competitive behavior for healthy bacon. Kadiyali et al. (1996) state that there is a greater likelihood of leader follower behavior when firms interact repeatedly. An interesting question is which firm behaves as a leader and which as a follower. In this regard, the lowest values of AIC and SIC show that the retailer behaves as a leader and the NB manufacturer as a follower for healthy bacon when the retailer owns the production facility.

Table 3.9: Values of SIC and AIC for Testing Competitive Games of Regular and Healthy Bacon

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

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

Kadiyali et al. (1996) report that the leader-follower behavior is more profit-enhancing for the leader than Bertrand Nash price behavior. Theoretical models also show that the retailer earns the highest profit when it behaves as a

leader and the lowest when it behaves as a follower. The total industry earns less profit in leader-follower than in Bertrand behavior. Results of the study indicate Bertrand Nash competition for regular bacon when the retailer outsources PL production.

We selected the best representation of the market by using the information criteria which gives us the lowest value. The estimates for these games, for the healthy and the regular bacon cases are given in tables 3.10. Appendix C shows the remaining game results. A Wald test is applied to determine how NB and PL promotion dummies[14] jointly affect the demand. The test statistic shows that all the promotional dummy variables have jointly significant impact on the demand for NBs and PLs regardless of how the PLs are produced.

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

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

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

promotion, consumers perceive that the product is of poor quality or may be close to expire. In the case of healthy bacon, both promotional dummy variables (own promotional dummy and cross promotional dummy variable) show negative impacts on the demand of NB and PL. There can be various reasons for such a relationship. Firstly, it may be due to strong association in the promotional activity between NB and PL as shown in contingency table.

Table 3.10: Best Fitted Game of Healthy and Regular Bacon

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

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

So whenever, PL is on promotion then NB is also on promotion and vice versa. Secondly, consumers may perceive negatively between the quality of the product and promotional activity and whenever the product is on promotion then the quality may be poor. Thirdly, the promotional benefits may be available to only those consumers who buy large quantity of the product, for example, get one

free with a pack of four. The consumer may not be willing to buy four units in order to get benefit of an additional unit. In this case, promotional activity does not have the desirable effect on the demand of the product. Finally, since we do not have detailed information of promotion (promotional expenditure, promotional instruments) and other marketing instruments that are used simultaneously, it is quite possible that the marketing instruments (advertising) used by the rival brand has bigger effect relative to the product promotion and as a result promotion has a negative impact on the demand of the product.

3.5.1: Elasticity Results

The own price elasticity shows that consumers are more responsive to the NB price change as compared to the PL price change in a healthy bacon when the retailer owns the production facility (see table 3.11). The consumers perceive that the NB product quality is higher, as NB products are more expensive than the PL products. Previous literature shows that price reduction benefits high quality brands more than low quality brands (Sivakumar and Raj 1997; Huang et al. 2010).

A PL's cross price has a positive impact on the NB demand for regular bacon when retailer outsources PL product. This positive sign is as expected, based on economic theory (Cotterill and Putsis 2000; Huang et al. 2003; Akbay and Jones 2005), and shows that the products are substitutes. However, the other cross price elasticities are negative, showing that the NB and PL healthy bacon are complementary in nature (as shown in table 3.11). Deaton (1987) also reports

complementary relationship between dry fish and fresh fish. A number of other studies found similar behavior (Kadiyali et al. 1996; Guo et al. 1999).

Table 3.11: Estimated Own and Cross Price Elasticities of Regular and Healthy Bacon

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

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

These cross price elasticities demonstrate that an increase in the NB price will decrease demand for the PL product. These estimates indicate that whenever consumers buy PL healthy bacon, they also buy the NB. This behavior is consistent for both products (regular bacon and healthy bacon). A plausible explanation can be that as the price of NB goes up, it results in an increase in the price gap between NB and PL. Sethuraman (2009) also finds a negative relationship between PL demand and the price gap between NB and PL.

3.6: CONCLUSIONS

The present study develops a theoretical model of PL and NB competition by assuming different production arrangements for the retailer's brand (PL). Furthermore, this study develops and estimates different models to understand the

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

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

The empirical results of the present study show that there is no consistent pattern of competition between PLs and NBs across different food product categories. The pattern of competition also varies depending on how the PL product is produced. The present study concludes that the retailer behaves as a price leader and the NB manufacturer as a follower for healthy bacon products when the retailer owns the production facility, while the competitive behavior is different for regular bacon. PL and NB products compete in a Bertrand fashion for regular bacon when the retailer outsources the PL product. These different competitive interactions are consistent with the findings of previous economic

studies. The results of the study suggest that researchers should not assume arbitrary a type of competitive interaction while doing the analysis and making conclusions. If the assumptions regarding the competitive interaction are wrong, it will result in wrong conclusions. The conclusions from these studies should be evaluated considering the assumptions that the studies make regarding the strategic competitive interaction between manufacturer and retailer.

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

This study has some limitations. First, it uses scanner data, which provide product level information, but this dataset lacks consumers' demographic information. If the focus is to better understand consumer preferences for PL and NB products, and how demographic information affects the competitive pricing strategy between PLs and NBs across different product categories, then demographic information should be incorporated in the demand specifications for

PLs and NBs. Another limitation of the present study is the use of linear demand model. It could be argued that other, nonlinear demand models are more appropriate than the linear specification we used, but it may be impossible to solve the related brand competition model. However, linear model specifications are widely accepted in the economic literature due to their superior tractability (Kadiyali et al. 1996), as has been previously discussed by Roy et al. (2006). The present study analyzed competition between the PL and NB for two products, not for the entire product line, while at the retail level each competing firm supplies a complete product line. Due to the non-availability of data for other products offered by the same producer in its product line we used only one product from its entire product line. The same holds for the retailer, so the competitive behavior analyzed is based on only one NB and PL product from an entire NB and PL product line. In other words, the conclusions and implications drawn from this study are based on only two products, not on a complete product line.

3.7: REFERENCES

Agriculture and Agri Food Canada (AAFC). 2010. Global Private Label Trends Market Analysis Report Agriculture and Agri-Food Canada 1341 Baseline Road, Tower 5 4th Floor Ottawa, ON Canada K1A 0C5.

Ailawadi, K. L., S. A. Neslin and K. Gedenk. 2001. Pursuing The Value-Conscious Consumer: Store Brands Versus National Brand Promotions. *Journal of Marketing* 65: 71-89.

Akbay, C. and E. Jones. 2005. Food Consumption Behavior of Socioeconomic Groups for Private Labels and National Brands. *Food Quality and Preference* 16: 621-631.

che, N., G. Martin-Herran and G. Zaccour. 2008. Pricing and Advertising of Private and National Brands in a Dynamic Marketing Channel. *Journal of Optimization Theory and Applications* 137(3): 465-483.

Anders, S. and A. Moeser. 2010. Consumer Choice and Health: The Importance of Health Attributes for Retail Meat Demand in Canada. *Canadian Journal of Agricultural Economics* 58(2): 249-271.

Anderson, E. T. and D. I. Simester. 2004. Long Run Effects of Promotional Depth on New Versus Established Customers: Three Field Studies. *Marketing Science* 23(1): 2-20.

Berges, F. and Z. Bouamra-Mechemache. 2011. Is Producing a Private Label Counterproductive for a Branded Manufacturer? *European Review of Agricultural Economics*: 1-27.

Berges-Sennou, F. 2006. Store Loyalty, Bargaining Power and the Private Label Production Issue. *European Review of Agricultural Economics* 33(3): 315-335

Berges-Sennou, F., P. Bontems and V. Requillart. 2004. Economics of Private Labels: A Survey of Literature. *Journal of Agricultural and Food Industrial Organization* 2(3): 1-23.

Chen, J., O. Narasimhan, G. John and R. Dhar. 2010. An Empirical Investigation of Private Label Supply by National Label Producers. *Marketing Science* 29(4): 738-755.

Choi, S. C. 1991. Price Competition in a Channel Structure with a Common Retailer. Marketing *Science* 10(4): 271-296.

Corstjens, M and R. Lal. 2000. Building Store Loyalty Through Store Brands. *Journal of Marketing Research* 37(3): 281-291.

Cotterill, R. W. and W. P. Putsis, Jr. 2001. Do Models of Vertical Strategic Interaction for National and Store Brands Meet the Market Test? *Journal of Retailing* 77: 83-109.

Cotterill, R. W. and W. P. Putsis, Jr. 2000. Market Share and Price Setting Behavior for Private Labels and National Brands. *Review of Industrial Organization* 17: 17-39.

Cotterill, R. W., W. P. Putsis, Jr and R. Dhar. 2000. Assessing The Competitive Interaction Between Private Labels and National Brands. *The Journal of Business* 73(1): 109-137.

Cotterill, R. W. and P. O. Samson. 2002. Estimating A Brand Level Demand System For American Cheese Products to Evaluate Unilateral and Coordinated Market Power Strategies. *American Journal of Agricultural Economics* 84(3): 817-823.

Deaton, A. 1987. Estimation of Own and Cross Price Elasticities from Household Survey Data. *Journal of Econometric* 36: 7-30.

Dhar, S. K and S. J. Hoch. 1997. Why Store Brand Penetration Varies By Retailer" *Marketing Science* 16(3): 208-227.

Ezrachi, A and U. Bernitz. 2009. Private Labels, Brands, and Competition Policy The Changing Landscape of Retail Competition. Oxford University Press.

Gomez, M. and N. R. Benito. 2008. Manufacturer's Characteristics that Determine the Choice of Producing Store Brands. *European Journal of Marketing* 42(1/2): 154-177.

Greene, W. H. 2008. Econometric Analysis. Sixth Edition. Pearson Education, Inc. Upper Saddle River, New Jersey, 07458.

Gujarati, D. N. and Sangeetha. 2007. Basic Econometrics. Fourth Edition. Tata McGraw Hill Publishing Company Limited New Delhi.

Guo, X., B. M. Popkin, T. A. Mroz and F. Zhai. 1999. Food Price Policy Can Favorably Alter Macronutrient Intake in China. *American Society of Nutritional Sciences*. 994-1001.

Hoch, S. J. and S. Banerji. 1993. When Do Private Labels Succeed? *Sloan Management Review* 34(4): 57-67

Huang, M. H., D. E. Hahn and E. Jones. 2003. A Socioeconomic Approach to Assessing Price Competition Between Private Labels and National Brands: The

Case of Shredded Cheese. Presented at the American Agricultural Economics Association Annual Meeting, Montreal, Canada July 27-30, 2003.

Huang, M. H., E. Jones, D. E. Hahn and R. P. Leone. 2010. Assessing Price Elasticity for Private Labels and National Brands by Store Locations. *Journal of Revenue and Pricing Management* 9: 1-16.

Iwata, G. 1974. Measurement of Conjectural Variations in Oligopoly. *Econometrica* 42 (5): 947-966.

Kadiyali, V. 1996. Entry, Its Deterrence, and its Accommodation: A Study of the U.S. Photographic Film Industry. *The Rand Journal of Economics* 27(3): 452-478.

Kadiyali, V., N. J. Vilcassim and P. K. Chintagunta. 1996. Empirical Analysis of Competitive Product Line Pricing Decisions: Lead, Follow or Move Together? *The Journal of Business* 69(4): 459-487.

Kadiyali, V., K. Sudhir and V. R. Rao. 2001. Structural Analysis of Competitive Behavior: New Empirical Industrial Organization Methods in Marketing. *International Journal of Research in Marketing* 18: 161-186.

Karray, S and G. M. Herran. 2009. A Dynamic Model For Advertising and Pricing Competition Between National and Store Brands. *European Journal of Operational Research* 193: 451-467.

Kumar, N. and J. B. E. M. Steenkamp. 2007. Private Label Strategy How to Meet the Store Brand Challenge. Harvard Business School Press Boston Massachusetts.

Marsden, P and P. Whelan. 2009. The Consumer Welfare Standard As a Form of Substantive Protection for Consumer Under European Competition Law. In Ezrachi, A and U. Bernitz (Eds.), Private Labels, Brands, And Competition Policy The Changing Landscape of Retail Competition (PP. 353-378) Oxford University Press Inc., New York.

Meza, S. and K. Sudhir. 2010. Do Private Labels Increase Retailer Bargaining Power? *Quantitative Marketing Economics* 8: 333-363.

Narasimhan, C and R. T. Wilcox. 1998. Private Labels and the Channel Relationship: A Cross Category Analysis. *The Journal of Business* 71(4): 573-600.

Nielsen. 2010. U.S. Healthy Eating Trends Part 1: Commitment Trumps the Economic Pinch. http://blog.nielsen.com/nielsenwire/consumer/healthy-eating-trends-pt-1-commitment-trumps-the-economic-pinch (accessed October 29, 2010).

Putsis, Jr, W. P. and R. Dhar. 1998. The Many Faces of Competition. *Marketing Letters* 9(3): 269-284.

Quelch, J. A. and D. Harding. 1996. Brands Versus Private Labels: Fighting to Win. *Harvard Business Review* 74(1): 99-109.

Raju, J. S., R. Sethuraman and S. K. Dhar. 1995. The Introduction and Performance of Store Brands. *Management Science* 41(6): 957-978.

Rao, R. C. 1991. Pricing and Promotions in Asymmetric Duopolies. *Marketing Science* 10(2): 131-144.

Roy, A., N. Kim and J. S. Raju. 2006. Assessing New Empirical Industrial Organization (NEIO) Methods: The Cases of Five Industries. *International Journal of Research in Marketing* 23: 369-383.

Safeway. 2011. Fact book. Safeway Inc. 5918 Stoneridge Mall Road Pleasanton, CA 94588-3229.

Salvage. B. 2011. Bacon's on Fire! Consumers are Buying More Bacon and Products Containing this Protein, Despite Tightening Their Food Budgets. Available at www.meatpoultry.com (accessed on January 19, 2013).

Salvage, B. 2012. A Passion for Bacon: Tyson Foods' Omaha Bacon Complex Satisfies the Guilty Pleasures of Millions. http://www.meatpoultry.com/News/News%20Home/Features/2012/10/A%20passion%20for%20bacon.aspx?cck=1 (accessed February 5, 2013)

Sayman, S., S. J. Hoch and J. S. Raju. 2002. Positing of Store Brands. *Marketing Science* 21(4): 387-397.

Sethuraman, R. 2009. Assessing the External Validity of Analytical Results from National Brand and Store Brand Competition Models. *Marketing Science* 28(4): 759-781.

Stanford Institute for Economic Policy Research (SIEPR)-Giannini Data Center. 2012. http://are.berkeley.edu/SGDC.

Sivakumar, K and S. P. Raj. 1997. Quality Tier Competition: How Price Change Influences Brand Choice and Category Choice. *The Journal of Marketing* 61(3): 71-84.

Statistics Canada. 2012. Prices and Price Indexes. http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&ResultTemplate=/Stu-Etu/Stu-Etu3&ChunkSize=25&AS_Theme=3956&ChunkStart=1&AS_Date=

.&AS_Ser=.&AS_Auth=.&AS_Srch=&AS_SORT=0&AS_UNIV=3&Version=2&AS_Mode=2 (accessed November 15, 2012)

Steiner, B. 2004. French Wines on the Decline? Econometric Evidence from Britain. *Journal of Agricultural Economics* 55(2): 267-288.

Verhoef, P. C., E. J. Nijssen and L. M. Sloot. 2002. Strategic Reactions of National Brand Manufacturers towards Private Labels: An Empirical Study in the Netherlands. *European Journal of Marketing* 36(11): 1309-1326.

Vilcassim. N. J., V. Kadiyali and P. K. Chintagunta. 1999. Investigating Dynamic Multi-firm Market Interactions in Price and Advertising. *Management Science* 45(4): 499-518.

Volpe, R. J. 2010. NB and PL Pricing and Promotional Strategy. presented at the Agricultural and Applied Economics Association, AAEA, CAES and WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010.

Wu, C. C. and C. J. Wang. 2005. A Positive Theory of Private Label: A Strategic Role of Private Label in a Duopoly NB Market. *Marketing Letters* 16(2): 143-161

Chapter 4: Store Level Competition between Private Labels and National Brands: The Role of Consumer Profiles

4.1: INTRODUCTION

With the growing unemployment and economic recession, many consumers have been forced to reduce or at least adjust their spending on grocery shopping (Lamey et al 2007). This behavior helps retailers strengthen their own brand (PL) (Symphony IRI Group 2011). The share of PL products has shown a boost in sales in the period of economic contraction. Much of these gains persist in times of economic prosperity. However, while the national brand (NB) recovers from part of its losses in economic expansion, the recovery is not complete (Lamey et al. 2012). This behavior shows that during economic distress consumers are more receptive to PL products.

PLs help retailers in strengthening their market share against major competing manufacturer brands (NB). In 1998, PLs were among the top three brands in 70 percent of all superstore product categories (Wu and Wang 2005), and by 2010, PL sales totaled $11.4 billion in Canada (Nielsen-wire 2010). Retailers aim to further increase the share of PLs as these products provide several benefits to retailers: they strengthen the bargaining position against brand manufacturers, which leads to higher retail margins (Hoch and Banerji 1993; Sayman et al. 2002); and they provide potential increases in store traffic, and greater store (retail chain) loyalty (Ailawadi et al. 2008; Meza and Sudhir 2010). In turn, higher consumer loyalty may positively affect a retailer's PL market share within a product category. PL products also strengthen a retailer's promotional

strategy, attracting additional consumers to their stores, thereby increasing the overall demand for their PL products (Volpe 2010).

Several large retail chains have developed differentiated PL "good for you" product lines and labeling schemes around their health-differentiated product options. For example, the Canadian Loblaws has developed the "President's Choice Blue Menu" and Safeway has developed the "Eating Right" healthy product line. These product lines focus on reducing the levels or removing unfavorable ingredients (e.g., fat, sodium, sugar, salt, etc.) (Anders and Moeser 2010). According to Agriculture and Agri-Food Canada (2009), 32% of PLs and NBs available in Canadian retail stores carry at least one health-related product attribute. As a result of PL vertical differentiated product development, products differentiated by the level of quality (Pepall et al. 2011), there is an increase in the competition between NB and PL products. Consequently, manufacturers and retailers are paying more attention in order to enhance their market share (Akbay and Jones 2005).

Retailers and NB manufacturers use different marketing instruments (price, promotion, etc.) to enhance product market shares and profits. Economic theory shows that an increase in market share (increase in concentration and market power) reduces competition and increases prices at the retail level (Cotterill et al. 2000), which ultimately reduces consumer welfare. Therefore, it is important to determine market share and factors affecting PL and NB market share.

The economic literature also indicates that the socioeconomic characteristics of shoppers significantly impact the store level price elasticity within a retail trading area (Huang et al. 2010). Some studies have shown a significant difference in consumer purchasing behavior among shoppers of different socioeconomic characteristics (Jones 1997; Jones and Mustiful 1996), as lower income consumers have greater budgetary constraints compared to high-income consumer groups (Huang et al. 2010). Furthermore, the brand price elasticity relates directly to household income in the market (Mulhern et al. 1998). Differences in consumer preferences for PL and NB products based on their socioeconomic profiles (different income levels) motivate us to investigate how increasing vertical product differentiation of PL and NB effects PL competition and their retail market share.

Given the significant increase in the share of PL products at the retail level, competition issues between PL and NB have become an important concern for researchers, marketing managers and policy makers. The previous economic literature has taken great interest in retailers' strategic use of PLs to counter the prior dominance of NB manufacturers (Berges-Sennou et al. 2004). The literature, however, has provided limited insight into the role of how different socioeconomic characteristics of shoppers have an impact on the PL-NB competitive relationship in vertically differentiated product categories. The primary objectives of this study are: (a) to investigate different factors affecting market share of PLs and their NB product counterparts in vertically differentiated

product categories and (b) to estimate the price elasticity for PL and NB products for consumers in different socioeconomic neighborhoods.

The present study contributes to the state of knowledge in this area by estimating the shares of vertically differentiated food product categories as a function of price, promotion, expenditure, etc. To the best of our knowledge, it is the first empirical application of its kind taking into consideration the PL and NB competition, and its impact on the varying socioeconomic consumer profiles at the Canadian retail level. Another contribution is the assessment of different factors on the demand and supply sides of two selected fast moving consumer product categories. This study identifies the factors which influence the consumer's price elasticity of demand for varying socioeconomic characteristics of shoppers, as these factors are critical for decision making for retailers and marketing managers. Retailers and NB manufacturers have to make pricing and promotional decisions on the regular basis (Huang et al. 2007). These decisions depend on the price elasticity of brands and their interrelationships. For example, the objective of brand managers is to maximize profit, so they need to know whether the demand is inelastic or elastic. These elasticities provide guidance to help them increase the price or offer the product at a discounted price.

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

4.2: REVIEW OF LITERATURE

Economic studies have developed the relationship between economic conditions and PL share. Lamey et al. (2007); Quelch and Harding (1996) and Lamey et al. (2012) conclude that the PL share increases during economic downturn and PL share decreases when the economy is flourishing. These studies further show that some consumers not only buy PLs in economic downturns but they also keep buying PL products in times of economic prosperity. Lamey et al. (2012) indicate that retailers focus more on marketing instruments in periods of economic contraction than in periods of economic expansion. This is because PL products cost less, making them more attractive to consumers whose disposable incomes have been reduced.

Brand loyalty shows customers' attitudes and behavior that affect consumption decisions (Empen et al. 2011). It plays an important role in a brand's growth and profit. Economic studies show mixed behavior of consumer loyalty for NBs and PLs. Wettstein et al. (2009) conclude that consumers are more loyal to branded products than to PLs, while Wulf et al. (2005) and Berges-Sennou et al. (2009) show that consumers' loyalty decreases for branded products (NBs) over time. Huang et al. (2006); Huang et al. (2007) and Huang et al. (2010) further show that high-income consumers are more loyal to NBs than to PLs.

Earlier economic studies have found a different buying behavior for consumers of varying socioeconomic shopper profiles. In this regard, Sethuraman and Cole (1999) show that different socioeconomic shopper classes are willing to pay higher premiums for NB products. Hoch (1996) concludes that demand of PL

product is less price elastic in high-income neighborhoods, while shoppers in low-income neighborhoods show higher price elasticity for NB and PL products than consumers in high-income neighborhoods (Akbay and Jones 2005; Huang et al. 2007; Huang et al. 2006; Huang et al. 2010). Jones et al. (1994a) conclude that the average price elasticity of PLs is higher than NBs in low-income neighborhoods compared to high-income areas. The low-income consumers have higher price elasticity for NBs than PLs for some product categories (cooking oil, mayonnaise) (Akbay and Jones 2005), while price does not have significant impact on the consumption of other PL products (cereal) (Jones et al. 1994[a]). Huang et al. (2003) show that PL products are cheaper than NB substitutes and these products have a greater market share in neighborhoods of differing socioeconomic characteristics. Consumers in low-income neighborhoods are more likely to engage in brand substitution than are consumers in high-income neighborhoods.

Expenditure elasticity shows different behavior for NB and PL demand, e.g., Cotterill and Putsis (2000). Cotterill et al. (2000a) and Cotterill et al. (2000) categorize NBs as luxury and PLs as necessity products. Akbay and Jones (2005) conclude that the expenditure elasticity of demand is higher for the NB than the PL products in low-income neighborhoods and the reverse is true for high-income neighborhoods. They further conclude that expenditure elasticity of demand also varies across different product categories.

Vertical differentiation has a significant impact on demand. Delvecchio (2001) states that quality perceptions vary across different consumer segments. Consumers are willing to pay a price premium for branded products as they

perceive the quality of NBs to be higher than their PL counterparts (Sethuraman and Cole 1999). Quality perception also varies among shoppers of different socioeconomic characteristics; Jones et al. (1994a) conclude that consumers in low-income neighborhoods find no difference in NB and PL quality attributes. Low income consumers perceive that the price difference between the PL and NB is sufficient to compensate for the quality difference. Consumers in high-income areas perceive that the quality of NBs is higher (Akbay and Jones 2005) and are therefore willing to pay a premium price for NBs.

The economic literature found that promotion has a greater impact on NBs than PLs products in vertical differentiated product categories. Lemon and Nowlis (2002) and Sivakumar and Raj (1997) conclude that promotion has greater impact on the consumption of high quality (NB) brands as compared to low quality PL products. The study also concludes that the high quality products are less vulnerable to losses if the price of the product is increased (Sivakumar and Raj 1997). Du and Stiegert's (2009) findings show that cross-promotion of PLs has less impact on the sales of NBs, while cross-promotion of leading NBs has a greater effect on PLs than on other NBs. Promotion has a mixed impact on the demand for NB and PL products for shoppers of different socioeconomic characteristics (Akbay and Jones 2005).

Based on the literature discussed above, it is clear that factors such as price, expenditure, promotional expenditure and quality attributes of PLs and NBs have different impacts on the demand of consumers located in neighborhoods with different socioeconomic characteristics. Mulhern et al. (1998) showed that

the price elasticity of a brand relates directly to the household income in the retail trading area. For making pricing and promotional decisions, for vertically differentiated PL and NB food products, manufacturers and retailers should consider socioeconomic characteristics of consumers in the retail trading area (Akbay and Jones 2005; Huang et al. 2006; Huang et al. 2010).

4.3: DATA

For the purpose of the present study, we use a set of proprietary scanner data made available through the SIEPR-Giannini Data Center (SIEPR-Giannini Data Center 2012). The data provide retail sales information for 200 Universal Product Code (UPC) product categories across stores for a major North American retail chain with stores in Canada. Aggregate weekly store level sales are selected from all retailer operational regions. The data include information at the individual UPC level about price, applicable discounts, sales quantity, and retailer gross and net margins for the period week 1-2004 to week 27-2007.

The study utilizes data from stores in four Canadian regions (Vancouver, Calgary, Edmonton and Winnipeg), which were selected on the basis of their location in city neighborhoods with distinct underlying socio-economic characteristics. These regions are defined as distribution regions of the retail chain. This study assumes that management is making decisions for marketing instruments at a regional level. Given the focus of this study, these management regions are further divided into two groups on the basis of socioeconomic characteristics of the consumers. These consumer groups are identified based on

the socioeconomic information (i.e., income level) (Huang et al. 2003; Huang et al. 2010) of all residents living within 13 minutes of travel time from the shopping center; Master Card Worldwide (2008) states that on average, Canadian consumers travel about 13 minutes for grocery shopping. Huang et al. (2003) and Huang et al. (2010) used information about all residents living within three-mile of radius, but this approach is flawed in the sense that the consumer shopping at a particular store depends on travel time. The travel time varies; it could take more or less time for consumers living within three-mile radius for shopping. To account for travel time, the present study uses "MAPNIFICENT" software. This software helps us to draw a boundary line for 13 minutes of travel distance. Within this area, we compute an average income of all residing communities and further divide the stores into two groups (low and high income groups). We obtained community income from the city websites. If the average income of shoppers of the locality is less than \$66,343[15], then the store is placed in the lower income consumers' stores category, whereas if the average income of shoppers is greater than \$66,343, the store is placed in the high-income consumers' stores category. Thus, the low-income store localities cater to a larger proportion of the low-income population while high-income stores are in areas with a larger proportion of the high-income level population.

The present study uses two different product categories (i.e., bread and salad dressing). We select these two product categories based on the differences in their usage characteristics, price levels, shelf-life and the fact that both

[15] The median income in Canada was \$66,343 in 2005 (Statistics Canada, 2006)

categories contain NB and PL products that are quality differentiated by health attributes. Bread has an important place in people's diets as it is a staple food, less expensive, and has a relatively low degree of differentiation. Products in this category (bread) have a shorter shelf life compared to other products (e.g., salad dressing). Salad dressings like many other products are classified as convenient products and are an easy solution for meal preparation for consumers who have high opportunity cost of time (Bocionek 2012). Salad dressing has a comparatively longer shelf life than bread. Products in this category (salad dressing) are highly differentiated and more expensive than other products (bread).

Descriptive statistics of the PLs and NBs of bread and salad dressing are given in tables 4.1, 4.2 and 4.3. These tables show the descriptive statistics of NB and PL[16] regular and health differentiated bread, as well as salad dressings for consumers located in neighborhoods with different socioeconomic characteristics. Furthermore, these tables show the average values of shelf, promotional and wholesale price, and quantity. Promotional price accounts for any promotional discounts, coupons and savings through a membership card, while the shelf price is defined as the price printed on the shelf. When a product is not on promotion, the shelf price and the promotional price are the same.

Table 4.3 shows the average price difference between the NB and PL, the retail margins, promotional frequency, promotional depth, and the differences between average shelf of NB and promotional prices of PL for selected NB and

[16] Present study uses one NB and one PL brand; due to confidentiality I did not report the names of brands.

PL products for consumers located in neighborhoods with different socioeconomic characteristics.

Table 4.1: Descriptive Statistics for Bread for Stores Located in Different Neighborhoods

Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Stores Located in High Income Neighborhoods (number of stores = 22)								
n = 3708	**Regular Bread**				**Health Differentiated Bread**			
NB SP [a]	2.54	0.26	2.19	2.99	2.54	0.26	2.19	2.99
NB PP [b]	2.30	0.47	1.31	2.99	2.30	0.47	1.32	2.99
NB WP	1.25	0.08	0.94	1.38	1.25	0.08	0.83	1.38
NB Q	42.20	35.54	1	243	36.73	34.50	1	223
PL SP [a]	2.00	0.06	1.15	2.19	1.90	0.14	1.69	2.19
PL PP [b]	1.78	0.25	1.15	2.19	1.77	0.24	0.99	2.19
PL WP	0.83	0.03	0.59	0.91	0.85	0.11	0.69	1.07
PL Q	149.77	105.10	1	577	79.93	57.13	5	466
Stores Located in Low Income Neighborhoods (number of stores = 20)								
n= 3479	**Regular Bread**				**Health Differentiated Bread**			
NB SP [a]	2.55	0.27	1.54	3.09	2.55	0.27	2.19	3.09
NB PP [b]	2.30	0.47	1.32	3.09	2.30	0.48	1.31	3.09
NB WP	1.26	0.08	1.12	1.38	1.26	0.08	1.12	1.38
NB Q	38.82	43.02	1	321	32.03	39.08	1	297
PL SP [a]	2.00	0.06	1.18	2.19	1.91	0.14	1.39	2.19
PL PP [b]	1.78	0.25	1.18	2.19	1.77	0.24	0.99	2.19
PL WP	0.83	0.03	0.79	0.91	0.86	0.11	0.69	1.07
PL Q	170.64	129.33	6	720	76.78	61.42	1	389

SP = Shelf Price, PP = Promotional Price, WP = Wholesale Price, Q = Quantity, NB = National Brand, PL = Private Label. All prices are in Canadian $ and quantity is measured per package of 450g. [a] Shelf price: Price printed on the shelf of the product at the retail store. [b] Promotional price: Price accounting for the promotional discounts, coupons and saving through membership cards.

Positive values indicate that the NB is more expensive than the respective PL product. The differences between NB and PL shelf prices vary considerably among different products (bread and salad dressing) as well as among vertically differentiated products.

Table 4.2: Descriptive Statistics for Salad Dressing for Stores Located in Different Neighborhoods

Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Stores Located in High Income Neighborhoods (number of stores = 22)								
n = 2961	**Regular Salad Dressing**				**Healthy Salad Dressing**			
NB SP [a]	2.53	0.15	1.77	2.79	3.77	0.26	2.61	4.44
NB PP [b]	2.35	0.32	0.64	2.79	3.25	0.69	0.72	3.99
NB WP	1.54	0.05	0.51	1.61	2.40	0.01	2.40	2.45
NB Q	7.47	6.85	1	69	6.55	6.38	1	48
PL SP [a]	2.72	0.17	1.99	2.99	2.72	0.17	1.99	2.99
PL PP [b]	2.61	0.22	1.73	2.99	2.61	0.22	1.73	2.99
PL WP	1.20	0.01	1.18	1.21	1.20	0.01	1.18	1.21
PL Q	5.13	3.75	1	28	3.75	2.76	1	22
Stores Located in Low Income Neighborhoods (number of stores = 20)								
n = 2301	**Regular Salad Dressing**				**Healthy Salad Dressing**			
NB SP [a]	2.53	0.15	1.67	3	3.70	0.30	2.89	4
NB PP [b]	2.35	0.32	0.97	3	3.20	0.69	0.57	4
NB WP	1.54	0.02	1.53	2	2.40	0.04	0.8	2
NB Q	6.28	6.00	1	47	5.27	5.18	1.00	50
PL SP [a]	2.68	0.20	1.99	3	2.68	0.20	1.99	3
PL PP [b]	2.57	0.25	1.25	3	2.57	0.25	1.25	3
PL WP	1.20	0.02	0.60	1	1.20	0.02	0.40	1
PL Q	4.97	3.37	1	30	3.41	2.35	1	18

SP = Shelf Price, PP = Promotional Price, WP = Wholesale Price, Q = Quantity, NB = National Brand, PL = Private Label. All prices are in Canadian $ and salad dressing are measured per package of 475ml. [a] Shelf price: Price printed on the shelf of the product at the retail store. [b] Promotional price: Price accounting for the promotional discounts, coupons and saving through membership cards.

The shelf price difference between regular NB and PL salad dressing shows negative values, which indicates that PL salad dressing is more expensive than NB dressing. Karp (2012) discusses that retailers raise the prices of PL products faster than NB products. On average, PL prices increased by 5.3 percent as compared to the industry average price increase, which was 1.9 percent from 2011 to 2012.

Table 4.3: Price Difference, Retail Margin, Promotional Frequency and Promotional Depth for Selected NB and PL Products for Different Neighborhoods

Particular	Item	High Income		Low Income	
		Regular	Healthy	Regular	Healthy
Bread					
Price Difference Between NB and PL	Shelf Price ($)[a]	0.546	0.639	0.549	0.639
	Promotional Price ($) [b]	0.523	0.533	0.521	0.528
% difference between NB promotional price and PL shelf price		13.29	17.29	13.24	17.03
Retailer Margin	PL ($)	1.17	1.05	1.17	1.05
	NB ($)	1.29	1.29	1.29	1.29
Difference Between NB and PL promotional Frequency and Depth	Promotional Frequency [c]	-46.07	-34.27	-50.56	-38.76
	Promotional Depth ($) [d]	0.023	0.106	0.029	0.111
Salad Dressing					
Difference between NB and PL Price	Shelf Price ($)[a]	-0.186	1.049	-0.156	1.016
	Promotional Price ($) [b]	-0.259	0.637	-0.219	0.633
% difference between NB promotional price and PL shelf price		-15.65	16.28	-14.04	16.28
Retail Margin	PL ($)	1.514	1.514	1.479	1.479
	NB ($)	0.993	1.362	0.986	1.296
Difference Between NB and PL promotional Frequency and Depth	Promotional Frequency [c]	20.79	16.85	14.61	16.85
	Promotional Depth ($) [d]	0.073	0.412	0.063	0.383

White bread is considered as regular bread; bread with 100 % whole wheat ingredients is considered as health differentiated bread. Light salad dressing (less fat) is considered as a health differentiated dressing and other is considered as a regular salad dressing. [a] Shelf price: Price printed on the shelf of the product at the retail store. [b] Promotional price: Price accounting for the promotional discounts, coupons and saving through membership cards. [c] Promotional frequency: It shows the number of times a given product remains on promotion. [d] Promotion depth: It measures the extent of the shelf price reduction during the promotion.

The price of perishable PL products rose approximately 12 percent, while the price of NB products increased by about 8 percent during this period. Berges-Sennou et al. (2007) and Clarkston Consulting (2012) found that PL products are more expensive than their NB counterparts. The difference between the promotional price of NB and PL products shows that the promotional price for NBs is higher than for their PL counterparts in case of bread and healthy salad dressing. Previous literature concludes that the promotional price of NBs is higher than their PL counterparts (Dhar and Hoch 1997; Ailawadi et al. 2001; Volpe 2010).

The difference between the NB promotional price and PL shelf price shows mixed behavior. For example, the difference is positive for vertically differentiated bread and salad dressing, while it is negative for regular salad dressing for consumers with different socioeconomic profiles. Positive (negative) values show that NB promotional prices are more (less) than the PL shelf prices. These results are consistent with Volpe (2010), who also found a considerable variation in the percentage differences between the NB promotional price and PL shelf price.

Retailer margins for PLs and NBs remain the same for PL and NB products across neighborhoods with different socioeconomic characteristics for bread. However, they vary for salad dressing. The PL retail margin is higher than its NB counterpart for salad dressing, while the NB retail margin is higher than PL for bread in different neighborhoods. The higher PL retail margin is one of the most important reasons to introduce PL products at the retail level (Kumar and

Steenkamp 2007) and the higher PL retail margin for salad dressing is consistent with the findings of Hoch and Banerji (1993) and Steiner (2004). Sayman et al. (2002) stated that PLs tend to have high retail margins because of vertical integration; this is because they can reduce the double marginalization problem. The dollar retail margin for NBs is higher than for PL for bread, but the percent retail margin for PLs is higher. The reason for the higher dollar retail margins for NB is that NBs have a higher shelf price than PL products, which is consistent with the findings of Ailawadi and Harlam (2004).

Promotional decisions in grocery retailing have two dimensions: promotional depth and promotional frequency (Rao 1991). Promotional frequency measures the number of times a given product remains on promotion over the range of available data. Promotional depth measures the extent of the shelf price reduction of the product during the promotion. Promotional frequency varies considerably between different product categories and vertical differentiated products for consumers in different socioeconomic neighborhoods. Promotional frequency shows negative values for bread, which indicates that PLs are more frequently promoted relative to their NB counterparts. The promotional frequency also differed for different socioeconomic neighborhoods. Promotional frequency shows positive values of salad dressing, which indicates that NB dressing remains on promotion more than its PL counterpart. The reason for this behavior could be that NB manufacturers want to create brand loyalty, do not want consumers to try the PL brand and want to increase the NB market share. Overall, these findings

are largely consistent with the findings reported by Volpe (2010) and Rao (1991) for product categories and retail markets in North America.

Promotional depth has a significant impact on the sales of both NB and PL products at the retail level (Huang et al. 2003). Anderson and Simester (2004) stated that increases in the promotional depth of a product can result in repeated purchasing probability and generate a positive long-run effect on prospective consumer loyalty. Our data reveal that the highest promotional depth can be found in the vertical differentiated product categories in neighborhoods with different socioeconomic characteristics. The data show that promotional depth is the highest for vertically differentiated dressing in high-income neighborhoods. It further indicates that NBs provide roughly $ 0.41 more promotional discount than the competing PL brand. Positive values of promotional depth also suggest that NB manufacturers tend to offer higher degrees of promotional depth than the substitute PL product. Overall, our results for the analysis of retailer promotional activities are consistent with the findings of Rao (1991); Volpe (2010) and Volpe (2011).

4.4: MODEL DEVELOPMENT

To demonstrate the difference between the competitive interaction and pricing strategies of the NB manufacturer and the retailer in vertically differentiated product categories, and the difference in price elasticity for stores in neighborhoods with different socioeconomic characteristics, the present study builds on the Cotterill and Putsis (2000) method and applies the new empirical

industrial organization (NEIO) approach. The approach is based on the development and estimation of structural strategic econometric models and the competitive behavior of NB manufacturers and retailers (Kadiyali et al. 2001) in which both competitors optimize their behavior with a goal of profit maximization. In NEIO model, the NB manufacturer and retailer also consider the reaction of their competitors while making decisions. The empirical application of this model is in line with the discussion in the previous paper and it is done in a way that is general enough to not impose any assumptions about the competitive relationship.

In this section, a model comprising of two manufacturers is developed. Each manufacturer produces vertical differentiated NB and PL products. The study assumes that both manufactures compete at the Canadian retail level and produce differentiated products. The quantity demanded of a particular brand (NB/PL) depends on its own price, the competitor's price and a vector of demand shift variables (distributional regions, time, promotional expenditure and price difference between NB and PL).

The NB and PL demand can be written as

$$Q_{NB}=f\ (P_{NB}, P_{PL}, D) \qquad (4.1)$$

$$Q_{PL}=g\ (P_{PL}, P_{NB}, D) \qquad (4.2)$$

where Q_{NB} is the quantity of NB sold in Canadian retail stores, Q_{PL} is the quantity of PL sold, P_{NB} is the price of the NB, P_{PL} is the price of the PL product and D is the vector of demand shift variables as explained above.

The objective functions of the NB and PL manufacturers can be specified as

$$\text{Max } \pi_{NB} = \left(w_{NB}Q_{NB} - C\left(Q_{NB}\right)\right) \tag{4.3}$$

$$\text{Max } \pi_{PL} = \left(w_{PL}Q_{PL} - C\left(Q_{PL}\right)\right) \tag{4.4}$$

Where π_{NB}, π_{PL} denotes the profit of the NB/PL manufacturer, C is the cost function and w is the wholesale price. NB and PL manufacturers maximize their profit by setting the wholesale price.

Based on wholesale prices, the retailer's profit maximization can be given as

$$\text{Max } \pi_R = \left(P_{NB} - w_{NB}\right)Q_{NB} + \left(P_{PL} - w_{PL}\right)Q_{PL} \tag{4.5}$$

The retailer maximizes its profit by setting the retail price of PLs and NBs.

In this study, we use the Almost Ideal Demand System (AIDS) model (Deaton and Muellbauer 1980). The AIDS model is derived using a duality approach. In this approach, the consumer's expenditure is minimized subject to a particular level of utility. For this purpose, a price independent generalized logarithmic (PIGLOG) form of expenditure function is used. By differentiating this function with respect to price, the demand function from the AIDS model can be obtained in the budget share form. The detailed derivation can be found in Deaton and Muellbauer (1980). The AIDS model in terms of budget shares is given as:

$$s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \log P_j + \beta_i (\log E - \log P) \tag{4.6}$$

Where the s_i is the share of expenditure on good i (PL or NB).

α_i, γ_{ij} and β_i are parameters, E is the total expenditure and P is a price index defined as

$$\log P = \sum_{i=1}^{n} s_i \log P_i \qquad (4.7)$$

In case of the AIDS model, Cotterill and Putsis (2000), Cotterill, et al. (2000a), and Cotterill and Samson (2002) use first-order Taylor series approximations to obtain reaction functions for the model estimation. These functions are sufficiently general and do not restrict vertical interaction to be Stackelberg leader follower or Vertical Nash (Cotterill and Putsis 2001).

$$\log P_i = \varepsilon_0 + \varepsilon_1 \log P_j + \varepsilon_2 D_i + \varepsilon_3 W_i \qquad (4.8)$$

Equation 4.8 shows the price reaction equation of brand (NB/PL), where $\varepsilon' S$ are the parameters to be estimated, and D_i is ith demand shifters and W_i ith supply shifter variables. In order to measure the oligopolistic price interdependence relation, brand share is used in the price reaction function. Cotterill and Putsis (2000) state that a positive relationship between brand share and price shows the existence of market power. For example, if the PL product's market share has a positive relationship with its own price, the share of the PL increases and indicates the existence of the PL market power. As a result, the PL reduces the NB product's presence in the category at the retail store. We also used a brand level Herfindahl index[17] to measure the size of the brand's dispersion on

[17] In this study we used the brand level Herfindahl index; it is defined as the sum of squares of brand shares (Cotterill and Putsis 2000; Cotterill et al. 2000).

the profit maximizing price (Cotterill and Putsis 2000). With the incorporation of the PL share and Herfindahl index in the reaction function, the equation (4.8) becomes as follows

$$\log P_i = \varepsilon_0 + \varepsilon_1 \log P_j + \varepsilon_2 D_i + \varepsilon_3 PLshare_i + \varepsilon_4 HHI_i \quad (4.9)$$

4.4.1: Econometric Model Specification

For the empirical model, the demand system for vertically differentiated products is implicitly derived from the above model and can be specified as

$$Share_{ist} = \alpha_i + \sum_{j=1}^{4} \alpha_{ij} P_{jst} + \beta_i Expend_{ist} + \sum_{j=1}^{4} \lambda_{ij} D\mathrm{Pr}_{jst} + \sum_{j=1}^{3} \phi_{ij} DYear_t + \sum_{j=1}^{3} \varphi_{ij} D\mathrm{Re}gion_{jst} + \delta_i PdiffNBPLR_{st} + \gamma_i PdiffNBPLH_{st} + \varepsilon_{ist} \quad (4.10)$$

The econometric specification of the price reaction function can be written as

$$P_{jst} = \nu_j + \sum_{z=1}^{4} \nu_{jz} P_{zst} + \sum_{l=1}^{4} \theta_{jl} D\,\mathrm{Pr}_{lst} + \sum_{l=1}^{3} \omega_{jl} DYear_t + \sum_{l=1}^{3} \psi_{jl} D\,\mathrm{Re}\,gion_{lst} + \kappa_j Expend_{jst} + \vartheta_j HHI_{jst} + \tau_j PdiffNBPLR_{st} + \xi_j PdiffNBPLH_{st} + \Omega\rho_j PLHSh_{st} + (1-\Omega)\Phi_j PLRSh_{st} + \mu_{jst} \quad (4.11)$$

Where j≠z, j varies from 1-4 (j=1, NB Regular; j=2, NB Healthy; j=3, PL Regular; j=4, PL Healthy), Ω=0 if the dependent variable is NB or PL regular price; otherwise Ω=1.

$Share_{ist}$ denotes the average expenditure share of good i in store s at time t, $\varepsilon_{ist}, \mu_{jst}$ denotes error terms. Since the demand systems and reaction functions are estimated at the retail level, it is expected that error terms are correlated across

equations (Huang et al. 2010). This type of correlation is called contemporaneously correlated random errors. Economic literature shows that when the error terms are contemporaneously correlated, the joint estimation of all equations will increase the model's efficiency (Huang et al. 2006; Huang et al. 2010). For this purpose, the linear AIDS model and reaction functions (four demand equations and four reaction functions) are used as a system (variable definition can be seen in table 4.4).

Table 4.4: Definition of Variables Used in the Analysis

Variable	Definition of the Variable
$Share_{ist}$	Aggregate share of category expenditure for product i* in store s at time t
P_{jst}	Natural log of price for product j* in store s at time t
HHI_{jst}	Herfindhal index of brand concentration for product j* in store s at time t
DPr_{jst}	DPr=1 if product j* is on promotion in store s at time t, 0 otherwise
$DYear_{jst}$	DYear =1, if product is sold in year** at store s at time t, 0 otherwise
$DRegion_{jst}$	DRegion =1, if the product is supplied to retail store s from a distribution region*** at time t, 0 otherwise
$PdiffNBPLR_{st}$	Price difference between NB and PL regular product at store s at time t
$PdiffNBPLH_{st}$	Price difference between NB and PL health differentiated product at store s at time t
$PLRSh_{st}$	Aggregate share of category expenditure for PL regular product in store s at time t
$PLHSh_{st}$	Aggregate share of category expenditure of PL health differentiated product in store s at time t

i and J varies NBR, PLR, NBH, PLH. *Product include the information of NB regular, NB healthy, PL regular and PL healthy. **DYear: Dummy variables for year 2004, 2005, 2006 and 2007 were included in the model. ***DRegion: Dummy variables for production region Calgary, Edmonton, Vancouver and Winnipeg were used in the model.

In this present study, the AIDS model with the reaction function is estimated for each product category independently for each neighborhood with

different socioeconomic characteristics. In the LA/AIDS model, one of the demand equations is redundant (as the sum of the market shares of PL and NB healthy and regular product equals 1) so we drop one demand equation and estimate the rest of the model as a system. The parameters of the omitted equation can be found by adding up property. Since we use a Taylor series approximation to compute reaction functions, we cannot impose the typical cross equation restrictions of homogeneity and symmetry on the demand and price reaction equations. It implies that we cannot estimate the conjectural variation parameter that is embedded in the price reaction equations, but this is not the focus of this study (Cotterill and Putsis 2000).

After estimating parameter values, the expenditure, own and cross price elasticities can be computed using the Green and Alston (1990) procedure.

$$e_{ii} = -1 + \left(\frac{\alpha_{ii}}{Share_i}\right) - \beta_i,\ e_{ij} = \left(\frac{\alpha_{ij}}{Share_i}\right) - \left(\frac{\beta_i}{Share_i}\right) Share_j,$$

$$e_i = 1 + \frac{\beta_i}{Share_i}$$

e_{ii}, e_{ij} and e_i denote own price, cross price and expenditure elasticity, respectively. $Share_i$ is the market share of the product.

$$e_{pdiffR} = \frac{\delta_i}{Share_i}\overline{PdiffNBPLR_i},\ e_{pdiffH} = \frac{\gamma_i}{Share_i}\overline{PdiffNBPLH_i}$$

where e_{pdiffR}, e_{pdiffH} is the demand shifter elasticity;

$\overline{PdiffNBPLR_i}, \overline{PdiffNBPLH_i}$ is the average value of demand shifter variables

(price difference between NB and PL) and $\overline{Share_i}$ is the average value of the share.

4.5: RESULTS AND DISCUSSION

The present study uses the generalized method of moments (GMM) for estimation. This approach provides efficient estimates even in the presence of heteroskedasticity and autocorrelation (Greene 2008). In this analysis, we apply a likelihood ratio (LR) test to compare nested (we drop year and regional dummies and price difference between NB and PL)[18] models. Further a Wald test is used to determine the joint significance of promotional dummies, year dummies, regional dummies and price differences between NB and PL on the demand for two selected fast moving consumer goods (FMCG) categories. LR test statistics reject the null hypothesis of the nested model; which shows that the general model performs better than the nested model (as shown in table 4.5). The results of the Wald test show that all the variables have a jointly significant impact on the model for consumers located in different socioeconomic neighborhoods, except for the price difference between NBs and PLs of salad dressing for consumers located in high-income areas. This difference is significant for low-income neighborhoods for the salad dressing.

[18] With the nested model, we want to test the impact of price difference on the demand, whether consumption behavior for PLs and NBs has changed over time, and whether decisions of different management regions significantly impact the demand for PLs and NBs.

Table 4.5: Values of LR and Wald Tests for Stores Located in Different Neighborhoods

Particulars	Bread		Salad Dressing	
	Low Income	**High Income**	**Low Income**	**High Income**
LR test	60315.86**	34620.86**	12463.27**	21858.56**
Wald test for Promotional dummies	19.55**	76.54**	55.62**	38.58**
Wald test for Year dummies	24.69**	38.24**	32.15**	34.06**
Wald test for Regional dummies	85.77**	189.16**	28.53**	20.05**
Wald test for Price differences between NB and PL	8.97**	38.52**	20.09**	2.05

** and * represent statistical significance at 1% and 10 % level respectively.

Appendix D, tables 1 - 4 show results of the AIDS model for stores located in neighborhoods with different socioeconomic characteristics for bread and salad dressing demand. The elasticity estimates of different models are reported in tables 4.6 and 4.7. We divide the rest of the results' section into two sub sections. The first section deals with the interpretation of demand estimates for both study products, and the second section is concerned with the discussion of reaction functions.

4.5.1: Demand Estimates

4.5.1.1: Price and Expenditure Effects

The own price signs in different neighborhoods for both product categories are as expected based on economic theory (Cotterill and Samson 2002; Cotterill and Putsis 2001; Akbay and Jones 2005; Huang et al. 2003). The

exception is for the own price of PL health-differentiated salad dressing. This behavior does not meet our expectation; it may due to the fact that when the retailer increases the product price, he may also increase the advertising or promotional expenditure at the same time. The advertising or promotional expenditure may result in an increase in the demand of healthy salad dressing in low income neighborhoods and this expenditure may over compensate the negative price effect on the demand. Unfortunately, we do not have sufficient and detailed enough advertising or promotional expenditure data to model this aspect with greater certainly. All the cross prices show positive relationships except for the cross prices of NB regular bread and salad dressing in high-income neighborhoods. These results reveal that a decrease in the PL price will not cause any decrease in the sales of NB regular bread. These cross prices show complementary behavior. Thus, when consumers do not buy PL they also do not prefer to buy NB. Deaton (1987); Kadiyali et al. (1996); Guo et al. (1999) also found similar behavior for cross prices.

Demand elasticity varies for both product categories and consumers located in different neighborhoods. Results of the own and cross price elasticities of PLs and NBs reveal that for bread, consumers residing in low-income neighborhoods show a higher price elasticity than consumers residing in high-income neighborhoods (see table 4.6). These results are consistent with the findings of previous economic literature (Hoch et al. 1995; Jones et al. 1994; Jones and Mustiful 1996; Huang et al. 2006; Huang et al. 2010). The reason for

this behavior is that low-income consumers have lower opportunity costs of time, which results in lower search and transaction costs (Blattberg et al. 1978).

Table 4.6: Elasticity Estimates of Bread by Store Location

	PLRQ	NBRQ	PLHQ	NBHQ	PPLR	PNBR	PPLH	PNBH
Stores Located in Low Income Neighborhoods								
PPLR	-45.16**	22.85**	60.09**	38.36		0.52**	0.94**	-0.50**
PNBR	79.83**	-82.64*	-79.74**	-83.60	1.79**		-1.66**	0.97**
PPLH	44.93**	-21.87*	-63.74**	-37.21	1.06**	-0.53**		0.52**
PNBH	-81.16**	83.22**	81.95**	81.78	-1.88**	1.03**	1.76**	
PLRS					-0.01**	0.003**		
PLHS							-0.002**	0.001**
HHI					-0.01**	0.01**	0.02**	-0.01**
Expend	1.19**	1.02	0.69**	0.82	0.02**	-0.01**	-0.02**	0.01**
PdiffR	-13.62**	6.88**	18.61**	11.89	-0.31**	0.16**	0.29**	-0.16**
PdiffH	14.24**	-7.40**	-19.53**	-12.01	0.34**	-0.17**	-0.32**	0.17**
Stores Located in High Income Neighborhoods								
PPLR	-20.67**	-12.39**	45.49**	-10.60		-0.11*	0.91**	0.08*
PNBR	1.22	-23.78*	-18.65	57.03	0.47		-1.46**	0.91**
PPLH	19.71**	8.40**	-45.82**	13.67	1.01**	0.03		-0.01
PNBH	-0.85	29.85**	16.05	-62.15	-0.46	1.10**	1.56**	
PLRS					-0.01**	0.001**		
PLHS							-0.01**	0.0002**
HHI					-0.01	-0.01**	0.01**	0.01**
Expend	1.21**	1.01	0.76**	0.78	0.01**	0.01**	-0.01**	-0.01**
PdiffR	-5.91**	-4.02**	14.02**	-3.52	-0.31**	-0.03*	0.28**	0.02
PdiffH	6.01**	2.57*	-13.87**	4.52	0.32**	0.01	-0.32**	0.001

** and * represents statistical significance at 1 % and 10 % level of significance respectively
PNBR = price NB regular, PPLR = price PL regular, PPLH = price PL healthy, PNBH = price NB healthy, HHI= Herfindahl index, Expend = Expenditure, PdiffR = Price difference between NB and PL regular, PdiffH = Price difference between NB and PL healthy, NBRQ = Quantity demanded of NB regular bread, PLRQ = Quantity demanded of PL regular bread, PLHQ = Quantity demanded of PL healthy bread, NBHQ = Quantity demanded of NB healthy bread.

The consumers located in high-income neighborhoods show a higher elasticity than the low-income consumer group for regular PL salad dressing (as shown in table 4.7). The reason for this behavior could be that since, in case of salad dressing, the store brand is more expensive than the NB; consumers might think these products are of superior quality and they are more responsive to price changes in a high quality brand (Sivakumar and Raj 1997). Another plausible explanation is that salad dressing has a longer shelf life and consumers located in high-income neighborhoods may take advantage of a price deal.

Consumers' price elasticity also differs for both brands (NB and PL) for consumers residing in different neighborhoods. Consumers in low-income neighborhoods show higher price elasticity for branded bread than for PL bread. A plausible reason for this behavior could be the consumer perception regarding quality. Consumers in different neighborhoods believe that NB products offer better quality than the store brand (Quelch and Harding 1996). Woodside and Ozcan (2009) and Huang et al. (2010) found similar results. For the salad dressing case, however, consumers have higher price elasticity for the store brand than for the NB. Consumer price elasticity also differs for vertically differentiated products. Our results show that consumers have higher price elasticity for vertically differentiated bread than for regular bread (table 4.6). This shows that consumers are more inclined to buy health-differentiated products. This behavior indicates that retailers and NB manufacturers could enhance their profits by focusing more on product differentiation.

Table 4.7: Elasticity Estimates of Salad Dressing by Store Location

	PLRQ	NBRQ	PLHQ	NBHQ	PPLR	PNBR	PPLH	PNBH
Stores Located in Low Income Neighborhoods								
PPLR	-8.92	14.74**	-21.13**	6.53		0.37*	1.08**	0.64
PNBR	27.14**	-12.08**	-11.69**	-6.57	0.71**		0.17	1.03**
PPLH	-16.52**	-0.34	23.02**	0.05	0.35*	0.50**		-1.05**
PNBH	-9.52**	-3.00	13.98**	1.51	-0.24*	0.40**	-0.35**	
PLRS					-0.01**	0.03**		
PLHS							0.03**	0.06**
HHI					0.01	0.01	0.01	0.03
Expend	0.92	1.03	0.82**	1.15	-0.003	0.004	0.01	0.02*
PdiffR	2.76**	-1.01*	-1.23**	-0.75	0.08**	-0.11**	0.02	0.12**
PdiffH	2.22**	0.74	-3.11**	-0.72	0.06**	-0.10**	0.08**	0.24**
Stores Located in High Income Neighborhoods								
PPLR	-33.37**	-13.57*	-4.56	38.15		1.97**	1.28**	-0.68*
PNBR	22.56**	-6.15*	-3.68	-9.79	0.31**		-0.49**	0.46**
PPLH	41.12**	18.40**	-15.16*	-38.73	0.60**	-1.75**		0.99**
PNBH	-38.85**	-0.77	28.14**	12.73	0.06	1.04**	0.33*	
PLRS					-0.001	0.02**		
PLHS							-0.01**	0.02**
HHI					0.06**	-0.06*	-0.08**	0.05**
Expend	0.95	0.90**	0.99	1.13	-0.02**	0.02**	0.03**	-0.02*
PdiffR	2.81**	-0.39	-0.56	-1.39	0.04**	-0.13**	-0.07**	0.06**
PdiffH	9.09**	0.30	-6.29**	-3.48	-0.01	-0.27**	-0.09**	0.25**

** and * represents statistical significance at 1% and 10% level respectively. PNBR = price NB regular, PPLR = price PL regular, PPLH = price PL healthy, PNBH = price NB healthy, HHI= Herfindahl index, Expend = Expenditure, PdiffR = Price difference between NB and PL regular, PdiffH = Price difference between NB and PL healthy, NBRQ = Quantity demanded of NB regular salad dressing, PLRQ = Quantity demanded of PL regular salad dressing, PLHQ = Quantity demanded of PL healthy salad dressing, NBHQ = Quantity demanded of NB healthy salad dressing.

The expenditure elasticity is 1.19, which reveals that PL regular bread is a luxury product. This shows that as consumer expenditures increases, consumers spend more on the store brand as compared to the branded bread. The expenditure elasticities of NB and PL regular salad dressing in low-income consumer neighborhoods are not significant, so an income increase does not have any

impact on the demand. Akbay and Jones (2005) found similar behavior for pasta, frozen yogurt and salad dressing.

4.5.1.2: Promotional Effect

Promotional dummy variables show mixed behavior for different product categories for consumers residing in different neighborhoods. These variables have a significant positive impact on the demand of PL for both FMCG product categories. Similar results have been reported by Cotterill et al. (2000) and Meza and Sudhir (2010). The promotion does not have a significant impact on the demand of branded products (as shown in tables 1, 2, 3 and 4 in Appendix D). Akbay and Jones (2005) and Ailawadi et al. (2001) found similar behavior. The PL and NB product promotion shows strong association, so whenever NB products is available on promotion then the retailer also offers the PL brand on promotion and these promotional behaviors nullify each other promotional effects. The coefficient of the PL promotional dummy further reveals that promotion has a higher impact on the demand of low-income consumers as compared to high-income consumers for bread product; while this relationship does not hold for salad dressing.

4.5.1.3: Time Effect

Different yearly dummies are used to capture the consumption behavior over time of different product categories for consumers of varying socioeconomic characteristics. Yearly dummy coefficients show mixed behavior for different

product categories. For example, these coefficients have positive impact on the health-differentiated PL bread relative to 2004 for both income neighborhoods. This indicates that consumers have a higher preference for health-differentiated products. These results are consistent with previous economic studies (Soberman and Parker 2004; Wu and Wang 2005; Meza and Sudhir 2010). This consumer behavior could be one of the reasons that retailers and manufacturers have developed a complete product line for health-differentiated product categories. Furthermore, the yearly dummy variable shows that consumers in both income groups are moving away from PL salad dressing and consuming more of the NB product. A plausible reason for this behavior could be that the PL brand is more expensive than its NB counterpart.

4.5.1.4: Regional Effect

Regional dummy variables reveal mixed consumption patterns for NBs and PLs for vertically differentiated product categories. Different neighborhoods in different management regions (Calgary, Edmonton and Winnipeg) show preferences for PL regular products (bread and salad dressing) relative to the base region (i.e., Vancouver). For healthy bread, different regions show a negative relationship relative to the base region (see tables 1, 2, 3, 4 in appendix D). These results show that consumers in Vancouver are more health conscious than consumers in Edmonton and Winnipeg. Lee et al. (1986) also concludes that consumer preference varies for different regions. In order to enhance the profits

and optimal allocation of resources, NB manufacturers and retailers should focus separately on each region.

4.5.1.5: Price Difference Effect

Study results show that the price difference between NB and PL has a positive impact on the demand elasticity (i.e. 6.88 as shown in table 4.6) for NB regular bread in low-income neighborhood, which indicates that as the price difference between NBs and PLs increases, so does demand for the NB product. A plausible reason for this is that as the price difference grows, consumers of low-income neighborhoods perceive that the NB is of superior quality. This reflects the reality that consumers use price as a signal to assess a product's quality (Verma and Gupta 2004). The price difference between NBs and PLs variable has a negative relationship with the PL regular bread demand elasticity for low (i.e. 13.62) and high-income neighborhoods (i.e. 5.91). Sethuraman (2009) found similar behavior between the NB and PL price differential and PL share. However, the price difference between NBs and PLs shows a negative impact on the demand of NB bread and salad dressing in high-income store neighborhoods. This relationship is contrary to our expectation. In this relationship, the NB manufacturer should focus less on price and more on diversification.

4.5.2: Reaction Function

All cross-price coefficients have positive relationships in the reaction functions for different product categories, except the cross price of salad dressing

in the health-differentiated product category in low-income neighborhoods. The positive relationship of cross price in reaction function is consistent with previous economic studies, Putsis (1997) and Deneckere and Davidson (1985). Deneckere and Davidson (1985) showed that price reaction equations are positively sloped in the price game and negatively sloped in the quantity game. The positive slopes of the reaction function show that products are strategic complements. The price-reaction elasticities show that the retailer is responding more severely to the price change of the NB bread for consumers in different neighborhoods. These results are consistent with the findings of Cotterill and Putsis (2000). For regular dressing, the NB manufacturer responds more severely to a PL price change. A plausible explanation for this behavior could be that the NB manufacturer doesn't want consumers to try the store brand.

The expenditure elasticity in the price reaction equation has a positive impact on the price of PL regular bread for stores located in low- and high-income neighborhoods. It shows that as expenditure increases, the retailer will increase the price of PL regular bread. These results are consistent with the findings of Cotterill et al. (2000). The reason for this behavior could be that retailers try to convey the message that the PL product is of superior quality, and as a result the retailer can enhance profits.

The own promotional dummy variable has a varying impact on the demand of NBs and PLs for different product categories (as shown in appendix D table 1-4). The own promotional dummy variable has a positive impact on the demand of PL bread, but a negative relationship with the PL demand for salad

dressing. Cross-price promotion negatively impacts the competitor's price except for the NB promotion, which does not significantly influence the price of PL. This relationship shows that when the PL brand is on promotion, the NB manufacturer responds to this behavior by lowering the NB price. The non-significance of NB promotion on PL reaction function indicates that NB promotion does not change the price of PL bread. These findings conclude that consumers are not brand loyal; rather they consume more PL products, and retailer strategies have significant influence on the consumption behavior of consumers in neighborhoods with different socioeconomic characteristics. These results are consistent with the findings of Cotterill et al. (2000).

The reaction function indicates that the price of NB health-differentiated product categories goes up relative to 2004. However, this relationship differs for consumers located in neighborhoods with different socioeconomic characteristics. Regional dummy variables show mixed behavior of price for different neighborhoods (as shown in tables 1, 2, 3, and 4 in appendix D). For example, regional dummies show a positive impact on the PL price of regular bread, while the reverse is true for salad dressing. The negative coefficients indicate a lower price of PL salad dressing in Calgary and Winnipeg relative to the Vancouver region.

PL share has a negative relationship with the PL bread price in low-income consumer neighborhoods, which shows that if retailers want to increase the share of their product (i.e., bread) they need to decrease the price. The PL share has a positive relationship with the price of the NB product, which indicates

that the NB manufacturer will increase the price of the product as the PL share increases. The reason the NB manufacturer is behaving this way is to target quality conscious customers. The PL share has a positive impact on the price of PLs and NBs for health-differentiated salad dressing in low-income neighborhoods and regular dressing in high-income neighborhoods. In this scenario, to target quality-conscious customers, the NB manufacturer may increase its price as the PL share goes up.

A brand-level Herfindahl index has been used to measure the size of brand dispersion (using brand proliferation). The brand Herfindahl index shows a positive impact on the PL price and it has a negative relationship with the NB in high-income consumer neighborhoods for regular brands in both product categories (as shown in tables 4.6 and 4.7). Putsis (1997) showed that when the brand Herfindahl index has a positive impact on the PL product and a negative impact on the NB, the price of NB products will increase. These coefficients indicate that the NB manufacturer will increase the NB price to differentiate its product from the store brand, to enhance profits and the share of the branded product. These results are consistent with the findings of Cotterill and Putsis (2000).

The present study shows that consumer responsiveness varies for stores in different socioeconomic neighborhoods, vertical differentiated products and different product categories. Promotion has a bigger effect on low-income consumers, which suggests that high-income consumers may behave less price conscious. When the price difference between a NB and PL gets bigger,

consumers perceive that the NB is of better quality than the PL. Further PL and NB products are strategic complements and the negative relationship of the PL share and PL price indicates that retailer does not gain market power by increasing the PL share.

4.6: CONCLUSIONS

This study uses two study examples (bread and salad dressing) of vertically differentiated product categories to examine the competitive interactions and pricing strategies of PL and NB products for stores in neighborhoods with different socioeconomic characteristics. By utilizing proprietary scanner data, the present study uses the LA/AIDS model, along with its reaction functions, to study how the demand and supply side factors impact the competitive behavior of NB and PL products. Brand level price elasticities were derived for vertically differentiated product category examples at the Canadian retail level. The present study extends the economic literature by estimating the demand and supply side impact on the PL and NB competitive behavior using Canadian retail level data. This study incorporates the aspect of vertical differentiation of products for consumers residing in different socioeconomic neighborhoods.

On the basis of the results of the study, one can conclude that both supply and demand side behavior differs for different product categories and for consumers located in different socioeconomic neighborhoods. It highlights that for studying the competition and demand response, it is important to consider

different product categories for various socioeconomic neighborhoods. The study further concludes that consumer behavior differs for stores in different neighborhoods for both bread and salad dressing. The results of the study reveal that low-income consumers have higher price elasticity than consumers in high-income neighborhoods. These results indicate that promotional discounts have a bigger effect in low-income neighborhoods. Furthermore, different regional dummy variables also indicate that consumer behavior differs across regions.

Stores in different socioeconomic regions have varying price elasticities for NB, PL and vertically differentiated products. Higher NB elasticity shows that consumers are less loyal to the branded product. To enhance the loyalty, NB manufacturers should diversify their products to convey the message of a premium quality of their brand and obtain a premium price (Quelch and Harding 1996). Higher NB price elasticity also indicates that consumers in different neighborhoods pay more attention to possible tradeoffs for brand loyalty, quality and price. These high-price elasticities show that the NB manufacturer can enhance profit through promotional discounts (as this will generate greater response), persuasive advertising and by using micro-marketing strategies (price, promotion, etc.) (Mulhern et al. 1998). Consumers in both high and low-income groups have higher elasticity for vertically differentiated product categories. This behavior concludes that the manufacturer will gain more by reducing the price of vertically differentiated products. To enhance the profit, retailers and manufacturers should use more promotional strategies for these products.

The present study helps to clarify the effectiveness of various marketing strategies on the demand side and the competitive interaction between NBs and PLs on the supply side. We used information about two products, not the entire product line, while at the retail level each competing firm supplies the complete product line. So our results need to be understood as being limited in terms not including all the product categories. So in this sense we may be under or overestimating certain effects. The analysis can be further extended to include the complete product line. The present study uses scanner data information, which lacks consumer demographic information. To understand how consumer demographics influence the competitive interaction between the PL and NB, such information needs to be incorporated in the demand specification.

4.7: REFERENCES

Agriculture and Agri-Food Canada (AAFC). 2009. Grocery Innovations Trade Show Trend Highlights http://www.ats.agr.gc.ca/eve/5305-eng.htm (accessed December 1, 2010).

Ailawadi, K. L. and B. Harlam. 2004. An Empirical Analysis of the Determinants of Retail Margins: The Role of Store Brand Share. *The Journal of Marketing* 68(1): 147-165.

Ailawadi, K. L., K. Pauwels and J. B. E. M. Steenkamp. 2008. Private Label Use and Store Loyalty. *Journal of Marketing* 72: 19-30.

Ailawadi, K. L., S. A. Neslin and K. Gedenk. 2001. Pursuing The Value-Conscious Consumer: Store Brands Versus National Brand Promotions. *Journal of Marketing* 65: 71-89.

Akbay, C. and E. Jones. 2005. Food Consumption Behavior of Socioeconomic Groups for Private Labels and National Brands. *Food Quality and Preference* 16: 621-631.

Anders, S. and A. Moeser. 2010. Consumer Choice and Health: The Importance of Health Attributes for Retail Meat Demand in Canada. *Canadian Journal of Agricultural Economics* 58(2): 249-271.

Anderson, E. T. and D. I. Simester. 2004. Long Run Effects of Promotional Depth on New Versus Established Customers: Three Field Studies. *Marketing Science* 23(1): 2-20.

Berges-Sennou, F., D. Hassan and S. M. Dilhan. 2009. Are Consumers More Loyal to National Brands than to Private Labels? Toulouse School of Economics Working Paper Series 09-131.

Berges-Sennou, F., D. Hassan, S. M. Dilhan and H. Raynal. 2007. Consumers' Decision between Private Labels and National Brands in a Retailer's Store: A Mixed Multinomial Logit Application. Paper presented at Mediterranean Conference of Agro Food Social Scientists. 103rd EAAE Seminar "Adding Value to the Agro Food Supply Chain in the Future Euromediterranean Space". Barcelona, Spain, April 23rd – 25th, 2007.

Berges-Sennou, F., P. Bontems, V. Requillart. 2004. Economics of private labels: A survey of the literature. *Journal of Agricultural and Food Industrial Organization* 2 Article 3.

Blattberg, R., T. Buesing, P. Peacock and S. Sen. 1978. Identifying the Deal Prone Segment. *Journal of Marketing Research* 15(3): 369-377.

Bocionek. M. 2012. Price Rigidity in the Context of Private Label National Brand Competition in Canadian Retailing. Unpublished MSc thesis, Institute of Agricultural Policy and Market Research, Justus Liebig University Giessen, Germany.

Clarkston Consulting. 2012. Retail Experience: How is the Private Label Evolving? Clarkston Consulting 1007 Slater Road, Suite 400 Durham, NC 27703 http://www.clarkstonconsulting.com/publication/retail-experience-how-is-the-private-label-evolving (accessed August 30, 2012).

Cotterill, R. W. and P. O. Samson. 2002. Estimating A Brand Level Demand System For American Cheese Products to Evaluate Unilateral and Coordinated Market Power Strategies. *American Journal of Agricultural Economics* 84(3): 817-823.

Cotterill, R. W. and W. P. Putsis, Jr. 2000. Market Share and Price Setting Behavior for Private Labels and National Brands. *Review of Industrial Organization* 17: 17-39.

Cotterill, R. W. and W. P. Putsis, Jr. 2001. Do Models of Vertical strategic Interaction for National and Store Brands Meet the Market Test? *Journal of retailing* 77: 83-109.

Cotterill, R. W., W. P. Putsis, Jr. and R. Dhar. 2000. Market Share and Price Setting Behavior for Private Labels and National Brands. Food Marketing Policy Center, Research Report No. 51 Department of Agricultural and Resource Economics, University of Connecticut.

Cotterill, R. W., W. P. Putsis, Jr. and R. Dhar. 2000a. Assessing The Competitive Interaction Between Private Labels and National Brands. *The Journal of Business* 73(1): 109-137.

Deaton, A. 1987. Estimation of Own and Cross Price Elasticities From Household Survey Data. *Journal of Econometrics* 36: 7-30.

Deaton, A. and J. Muellbauer. 1980. An Almost Demand System. *The American Economic Review* 70(3): 312-326.

DelVecchio, D. 2001. Consumer Perceptions of Private Label Quality: The Roe of Product Category Characteristics and Consumer Use of Heuristics. *Journal of Retailing and Consumer Services* 8: 239-249.

Deneckere, R and C. Davidson. 1985. Incentives to Form Coalitions with Bertrand Competition. *The Rand Journal of Economics* 16(4): 473-486.

Dhar, S. K and S. J. Hoch. 1997. Why Store Brand Penetration Varies By Retailer. *Marketing Science* 16(3): 208-227.

Du, Y. and K. W. Stiegert. 2009. Strategic Vertical Pricing in the U.S. Butter Market. Paper presented at the Agricultural and Applied Economics Association 2009 AAEA & ACCI Joint Annual Meeting, Milwaukee, Wisconsin, July 26-29, 2009.

Empen, J., J. P. Loy and C. Weiss. 2011. Price Promotion and Brand Loyalty: Empirical Evidence for the German Ready to Eat Cereal Market. Paper presented at the Inra-IDEI Seminar on Competition and Strategies in the Retailing Industry in Toulouse, May 16-17, 2011.

Green, R and J. M. Alston. 1990. Elasticities in AIDS models. *American Journal of Agricultural Economics* 72(2): 442-445.

Greene, W. H. 2008. Econometric Analysis. 6th Edition. Pearson Education, Inc. Upper Saddle River, New Jersey, 07458.

Guo, X., B. M. Popkin, T. A. Mroz and F. Zhai. 1999. Food Price Policy Can Favorably Alter Macronutrient Intake in China. *The Journal of Nutrition* 129(5): 994-1001.

Hoch, S. J. 1996. How Should National Brands Think About Store Brands? *Sloan Management Review* 37(2): 89-102.

Hoch, S. J. and S. Banerji. 1993. When Do Private Labels Succeed? *Sloan Management Review* 34(4): 57-67

Hoch, S. J., B. D. Kim, A. L. Montgomery and P. E. Rossi. 1995. Determinants of Store Level Price Elasticity. *Journal of Marketing Research* 32(1): 17-29.

Huang, M. H., D. E. Hahn and E. Jones. 2003. A Socioeconomic Approach to Assessing Price Competition Between Private Labels and National Brands: The Case of Shredded Cheese. Presented at the American Agricultural Economics Association Annual Meeting, Montreal, Canada July 27-30, 2003.

Huang, M. H., E. Jones and D. E. Hahn. 2007. Determinants of Price Elasticities for Private Labels and National Brands of Cheese. *Applied Economics* 39: 553-563.

Huang, M. H., E. Jones, D. E. Hahn and R. P. Leone. 2006. Assessing Price Elasticity for Private Labels and National Brands: Difference by Income and

Store Location. Working paper 2006-01-004, Fisher College of Business, The Ohio State University.

Huang, M. H., E. Jones, D. E. Hahn and R. P. Leone. 2010. Assessing Price Elasticity for Private Labels and National Brands by Store Locations. *Journal of Revenue and Pricing Management* 9: 1-16.

Jones, E. 1997. An Analysis of Consumer Food Shopping Behavior Using Supermarket Scanner Data: Differences by Income and Location. *American Journal of Agricultural Economics* 79(5): 1437-1143.

Jones, E. and B. W. Mustiful. 1996. Purchasing Behavior of Higher and Lower Income Shoppers: A Look at Breakfast Cereal. *Applied Economics* 28: 131-137.

Jones, E., W. S. Chern and B. K. Mustiful. 1994. Are Lower Income Shoppers as Price Sensitive as Higher Income Ones? A Look at Breakfast Cereals. *Journal of Food Distribution Research* 25(1): 82-92.

Jones, E., B. W. Mustiful and W. S. Chern. 1994a. Estimating Demand Elasticities for Cereal Products: A Socioeconomic Approach Using Scanner Data. *Agribusiness* 10(4): 325-339.

Kadiayali, V., N. J. Vilcassim and P. K. Chintagunta. 1996. Empirical Analysis of Competitive Product Line Pricing Decisions: Lead, Follow, or Move Together? *The Journal of Business* 69(4): 459-487.

Kadiyali, V., K. Sudhir and V. R. Rao. 2001. Structural Analysis of Competitive Behavior: New Empirical Industrial Organization Methods in Marketing. *International Journal of Research in Marketing* 18: 161-186.

Karp, H. 2012. Store Brands Step up Their Game, and Prices. The Wall Street Journal January 31, 2012. http://online.wsj.com/article/SB10001424052970204624204577179193540556620.html (accessed August 30, 2012).

Kumar, N and J. B. E. M. Steenkamp. 2007. Private Label Strategy: How to Meet the Store Brand Challenge. Harvard Business School Press, Boston, Massachusetts

Lamey, L., B. Deleersnyder, J. Benedict, E. M. Steenkamp and M. G. Dekimpe. 2012. The Effect of Business Cycle Fluctuations on Private Label Share: What Has Marketing Conduct Got to Do with it? *Journal of Marketing* 76: 1-19.

Lamey, L., B. Deleersnyder, M. G. Dekimpe, J. Benedict and E. M. Steenkamp. 2007. How Business Cycles Contribute to Private Label Success: Evidence from the United States and Europe. *Journal of Marketing* 71: 1-15.

Lee, J. Y., M. G. Brown and B. Schwartz. 1986. The Demand for National Brand and Private Label Frozen Concentrated Orange Juice: A Switching Regression Analysis. *Western Journal of Agricultural Economics* 11(1): 1-7.

Lemon, K. N. and S. M. Nowlis. 2002. Developing Synergies Between Promotions and Brands in Different Price Quality Tiers. *Journal of Marketing Research* 39(2): 171-185.

Master Card Worldwide. 2008. Checking Out the Canadian Grocery Shopping Experience. Master Index Report. http://www.mastercard.com/ca/company/en/press/masterindex2008.html (accessed December 5, 2011).

Meza, S. and K. Sudhir. 2010. Do Private Labels Increase Retailer Bargaining Power? *Quantitative Marketing Economics* 8: 333-363.

Mulhern, F. J., J. D. Williams and R. P. Leone. 1998. Variability of Brand Price Elasticities Across Retail Stores: Ethnic, Income and Brand Determinants. *Journal of Retailing* 74(3): 427-446.

Nielsen-Wire. 2010. The Global Staying Power of Private Label. http://blog.nielsen.com/nielsenwire/consumer/the-global-staying-power-of-private-label/ (accessed January 9, 2011).

Pepall, L., D. Richards and G. Norman. 2011. Contemporary Industrial Organization: A Quantitative Approach. John Wiley and Sons Inc. 111 River Street, Hoboken, NJ 07030-5774.

Putsis, Jr. W. P. 1997. An Empirical Study of the Effect of Brand Proliferation on Private Label-National Brand Pricing Behavior. *Review of Industrial Organization* 12: 355-371.

Quelch, J. A. and D. Harding. 1996. Brands versus Private Labels: Fighting to Win. Harvard Business Review 37: 99-109.

Rao, R. C. 1991. Pricing and Promotions in Asymmetric Duopolies. *Marketing Science* 10(2): 131-144.

Sayman, S., S. J. Hoch and J. S. Raju. 2002. Positing of Store Brands. *Marketing Science* 21(4): 387-397.

Sethuraman, R and C. Cole. 1999. Factors Influencing the Price Premiums that Consumers Pay for National Brands Over Store Brands. *Journal of Product and Brand Management* 8(4): 340-351.

Sethuraman, R. 2009. Assessing the External Validity of Analytical Results from National Brand and Store Brand Competition Models. *Marketing Science* 28(4): 759-781.

Sivakumar, K and S. P. Raj. 1997. Quality Tier Competition: How Price Change Influences Brand Choice and Category Choice. *The Journal of Marketing* 61(3): 71-84.

Soberman, D. A and P. M. Parker. 2004. Private Labels: Psychological Versioning of Typical Consumer Products. *International Journal of Industrial Organization* 22: 849-861.

Stanford Institute for Economic Policy Research (SIEPR)-Giannini Data Center. 2012. http://are.berkeley.edu/SGDC.

Statistics Canada. 2006. http://www12.statcan.gc.ca/census-recensement/index-eng.cfm (accessed on January 5, 2012)

Steiner, R. L. 2004. The Nature and Benefits of National Brand/Private Label Competition. *Review of Industrial Organization* 24: 105-127.

Symphony IRI Group. 2011. Retail Private Label Brands in Europe: Current and Emerging Trends. www.SymphonyIRI.eu (accessed January 13, 2011).

Verma, D. P. S., and S. S. Gupta. 2004. Does Higher Price Signal Better Quality? *Vikalpa* 29(2): 67-77.

Volpe, R. J. 2010. NB and PL Pricing and Promotional Strategy. presented at the Agricultural and Applied Economics Association, AAEA, CAES and WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010.

Volpe, R. 2011. The Relationship between National Brand and Private Label Food Products: Prices, Promotions, Recessions and Recoveries. Economic Research Report Number 129 United States Department of Agriculture, Economic Research Services.

Wettstein, N., S. Brosig, T. Glauben, J. H. Hanf and J. P. Loy. 2009. Do Private Labels Generate Customer Loyalty in Food Retailing? Paper presented at the 49th Annual Meeting of the Gewisola, Agri-Food Markets after the Boom, Kiel, September 30 – October 2, 2009.

Woodside, A. G and T. Ozcan. 2009. Customer Choices of Manufacturer Versus Retailer Brands in Alternative Price and Usage Contexts. *Journal of Retailing and Consumer Services* 16: 100-108.

Wu, C. C. and C. J. Wang. 2005. A Positive Theory of Private Label: A Strategic Role of Private Label in a Duopoly NB Market. *Marketing Letters* 16(2): 143-161.

Wulf, K. D., G. O. Schroder, F. Goedertier and G. V. Ossel. 2005. Consumer Perceptions of Store Brands versus National Brands. 22(4): 223-232.

Chapter 5: SUMMARY AND CONCLUSION

5.1: SUMMARY AND MAIN CONCLUSIONS OF THREE MAIN RESEARCH TOPICS

5.1.1: Paper 1: The Value of Brand and Convenience Attributes in Highly Processed Food Products

This study explores how Canadian consumers value brands, convenience and quality attributes in highly processed fast moving consumer goods (FMCG) product categories. A hedonic price model (HPM) is used to estimate the implicit price of different brands, convenience and quality attributes in highly differentiated FMCG product categories. The study findings show that brand, package size, product form, process form and seafood species significantly impact the retail price. The results show that consumers prefer natural and healthy food product attributes relative to price discount. This study confirms the findings of previous studies that larger package size has a negative relationship with the retail price.

Previous studies have applied the HPM on durable products and less on consumer packaged goods. Using FMCG product categories at the Canadian retail level this study extends previous research and contributes to knowledge about consumer valuation of quality attributes in food products. The study also extends the literature by applying the least-square dummy variable approach to the HPM at the Canadian retail level. This helps to evaluate brand equity and attribute mixes that allow companies to gather additional information about the relative market value of different product attributes. Such information helps retailers and brand manufacturers to learn about the ranking and performance of their brand

relative to other brands. The HPM is a very useful tool to price the new product at the retail level and to understand which attributes are more important than others. Incorporation of the desired attributes in the product is important in order to reduce the changes of product failure as Winger and Wall (2006) reported that only 5 percent of new products achieve sustainable market success. The successful product results in an increase in efficiency by the manufacturer and retailers and provision to the consumers with their preferred combination of characteristics for the product (Lancaster 1966).

5.1.2: Paper 2: Strategic Competition between Private Label and National Brand in a Vertically Linked Market

This paper develops and tests different theoretical models of competition in a vertically linked market, assuming different production arrangements. It shows how this competitive behavior affects pricing strategies of PLs and NBs in the Canadian retail market. The analysis builds on the Non-Nested Model Comparison (NNMC) approach and uses weekly store-level retail scanner data. This study fills the literature gap by developing the theoretical model of PL and NB strategic competition in a vertically linked market, assuming various retailers' production methods (owns the production facility, NB manufacturer produces both NB and PL, and retailer outsources PL product). The study further contributes to the literature by identifying the nature of competition between NBs and PLs in regular and health-differentiated food product categories.

The theoretical model reveals that equilibrium retail price remains the same while the wholesale price varies under different production arrangements.

The model further shows that the leader earns the highest profit and follower earns the lowest profit. Empirical results of the study reveal that there are no consistent patterns of competition between PLs and NBs, regardless of who produces the PLs. The patterns of competition also vary for different food categories. The results show that the assumptions about the type of competition can generate wrong conclusions. In the economic literature, most of the studies assume a particular type of competition and make conclusion on the basis of that assumption, but in reality if the assumed type of competition is not the true representation of the market then the implications drawn will be false. The study shows that the leader follower phenomenon is present in the market. Economic literature shows that Bertrand competition is more welfare-enhancing than leader-follower (Marsden and Whelan 2009). For brands to behave in the Bertrand manner, government must play a role by setting competition standards. Ultimately, this will have a positive effect on society.

5.1.3: Paper 3: Store Level Competition between Private Label and National Brand: The Role of Consumer Profiles

This article examines the competitive relationship between NBs and PLs in a grocery product category in varying socioeconomic environments. A unique contribution of this study is that it looks at the Canadian retail level and empirically estimates the PL and NB share for vertically differentiated products (healthy and regular) in neighborhoods with varying socioeconomic characteristics. Another contribution is to determine the impact of different factors on the demand and supply of PLs and NBs in regular and health-

differentiated food-product categories. The study hypothesizes that low-income consumer neighborhoods are more price responsive than high-income consumer neighborhoods. The present study confirms this hypothesis for bread (healthy and regular) but rejects it for regular salad dressing. On the basis of the study results, marketing managers and retailers can enhance their profitability by using micro-marketing strategies (e.g., region specific pricing, promotions) in different socioeconomic neighborhoods. The study's other empirical hypothesis is to see whether consumers are more responsive to the NB price than the PL price. The study indicates that consumers have higher elasticity for NB bread (regular and health differentiated) and PL regular salad dressing.

PLs tend to differentiate their brands from the competing retailers' and thus increase the competition between stores and within a store (competition between NB and PL). This intra-store competition benefits consumers because it lowers prices, and improves quality, choice and service; as a result it enhances the welfare of the society. PL development could cause some problems as it reduces innovation when retailers introduce PL brands too quickly, as he tries to get a free ride on the manufacturer's investment (Marsden and Whelan 2009). Further compounding the problem, NB manufacturers inevitably increase the price of their brand to differentiate from the PL. These problems have a negative impact on consumer welfare. In this regard, government needs to play its role by protecting the competition process and discouraging free riding.

5.2: EXTENSIONS AND LIMITATIONS

This analysis is based on retail scanner data but has several limitations, as this dataset lacks demographic information (Capps et al. 1985). Including such information can help us to identify the type of consumers (education, income level, race etc.) who are willing to pay premium or discounted prices. This information will be very useful to producers seeking to target proper segments of the market. The other limitation of retail scanner data is its aggregated nature, which does not provide individual consumer preferences. All conclusions and implications should be drawn at the market level, not at the consumer level. To understand the individual consumer's preferences survey, panel and lab experiments should be used (Garmendia 2010). Retail scanner information has some advantages as it provides detailed product level sales information that other data sources do not provide (Ahmad and Anders 2012).

The second and third paper use information pertaining to only two products, not the entire product line, while at the retail level each competing firm supplies a complete product line. The analysis can be further extended to include the complete product line. The present study uses scanner data information, which lacks consumer demographic information. In order to understand how consumer demographics influence competitive interaction between PLs and NBs, this information need to be incorporated in the demand specification.

5.3: REFERENCES

Ahmad, W. and S. Anders. 2012. The Value of Brand and Convenience Attributes in Highly Processed Food Products. *Canadian Journal of Agricultural Economics* 60: 113-133.

Capps, O., J.R. Tedford, and J.Jr. Havlicek. 1985. Household Demand for Convenience and Non-convenience Foods. *American Journal of Agricultural Economics* 67 (4): 862-869.

Garmendia, J.M. 2010. Application of Hedonic Price Modeling to Consumer Packaged Goods Using Store Scanner Data. *Journal of Business Research* 63: 690-696.

Lancaster, K. J. 1966. A New Approach to Consumer Theory. *Journal of Political Economy* 74 (2): 132-157.

Marsden, P and P. Whelan. 2009. The Consumer Welfare Standard As a Form of Substantive Protection for Consumer Under European Competition Law. In Ezrachi, A and U. Bernitz (Eds.), Private Labels, Brands, And Competition Policy The Changing Landscape of Retail Competition (PP. 353-378) Oxford University Press Inc., New York.

Winger, R and G. Wall. 2006. Food Product Innovation A Background Paper. Agriculture and Food Engineering Working Document # 2, Food and Agriculture Organization of The United Nations Rome, 2006.

APPENDIX A: PROFIT FUNCTIONS OF THE RETAILER AND THE NB MANUFACTURER UNDER VARIOUS COMPETITIVE INTERACTIONS

Case 1: NB manufacturer produces both NB and PL products

1.1: Manufacturer of NB behaves as a leader and retailer as follower

1.1.1: Retailer Profit

$$\pi_R = \left(\frac{a_1}{16}\right)C_{NB}^2 - \frac{1}{8}\left(2a_2C_{PL} + \frac{a_0(a_1 - 2a_2)}{(a_1 - a_2)}\right)C_{NB} + \frac{3a_1}{16}C_{PL}^2 - \frac{a_0(3a_1 - 2a_2)}{8(a_1 - a_2)}C_{PL} + \frac{a_0^2}{4(a_1 - a_2)}$$

1.1.2: Profit of NB Manufacturer

$$\pi_{NBM} = \left(\frac{a_1}{8}\right)C_{NB}^2 - \frac{1}{4}(a_2C_{PL} + a_0)C_{NB} + \frac{a_1}{8}C_{PL}^2 - \frac{a_0}{4}C_{PL} + \frac{a_0^2}{4(a_1 - a_2)}$$

1.2: Retailer behaves as a leader and manufacturer of NB as follower

1.2.1: Retailer Profit

$$\pi_R = \left(\frac{a_1}{8}\right)C_{NB}^2 - \frac{1}{16}\left(5a_2C_{PL} + \frac{a_0(4a_1 - 5a_2)}{(a_1 - a_2)}\right)C_{NB} + \frac{3a_1}{16}C_{PL}^2 - \frac{a_0(6a_1 - 5a_2)}{16(a_1 - a_2)}C_{PL} + \frac{5a_0^2}{16(a_1 - a_2)}$$

1.2.2: Profit of NB Manufacturer

$$\pi_{NBM} = \left(\frac{a_1}{16}\right)C_{NB}^2 - \frac{1}{8}(a_2C_{PL} + a_0)C_{NB} + \frac{a_1}{16}C_{PL}^2 - \frac{a_0}{8}C_{PL} + \frac{a_0^2}{8(a_1 - a_2)}$$

1.3: Bertrand Competition between retailer and manufacturer of NB

1.3.1: Retailer Profit

$$\pi_R = \left(\frac{a_1}{9}\right)C_{NB}^2 - \frac{1}{9}\left(3a_2C_{PL} + \frac{a_0(2a_1 - 3a_2)}{(a_1 - a_2)}\right)C_{NB} + \frac{2a_1}{9}C_{PL}^2 - \frac{a_0(4a_1 - 3a_2)}{9(a_1 - a_2)}C_{PL} + \frac{a_0^2}{3(a_1 - a_2)}$$

1.3.2: Profit of NB Manufacturer

$$\pi_{NBM} = \left(\frac{a_1}{9}\right)C_{NB}^2 - \frac{2}{9}(a_2C_{PL} + a_0)C_{NB} + \frac{a_1}{9}C_{PL}^2 - \frac{2a_0}{9}C_{PL} + \frac{2a_0^2}{9(a_1 - a_2)}$$

Case 2: NB manufacturer produces NB product and retailer outsources PL product

2.1: Manufacturer of NB behaves as a leader and retailer as follower

2.1.1: Retailer Profit

$$\pi_R = \left(\frac{a_1^3}{4\left(4a_1^2 - a_2^2\right)}\right)C_{NB}^2 - \frac{1}{2}\left(\frac{a_1^2 a_2}{\left(4a_1^2 - a_2^2\right)}C_{PL} + \frac{a_1^2 a_0}{\left(4a_1^2 - a_2^2\right)}\right)C_{NB} + \frac{a_1\left(3a_1^2 - 2a_2^2\right)}{4\left(4a_1^2 - a_2^2\right)}C_{PL}^2$$
$$- \frac{a_1 a_0\left(3a_1 + 2a_2\right)}{2\left(4a_1^2 - a_2^2\right)}C_{PL} + \frac{a_1 a_0^2}{2\left(a_1 - a_2\right)\left(2a_1 - a_2\right)}$$

2.1.2: Profit of NB Manufacturer

$$\pi_{PLM} = \frac{a_1\left(-2a_1^2 C_{PL} + a_2^2 C_{PL} + 2a_0 a_1 + a_0 a_2 + a_1 a_2 C_{NB}\right)^2}{4\left(a_2^2 - 4a_1^2\right)^2}$$

$$\pi_{NBM} = \frac{a_1\left(-2a_1^2 C_{NB} + a_2^2 C_{NB} + 2a_0 a_1 + a_0 a_2 + a_1 a_2 C_{PL}\right)^2}{4\left(a_2^2 - 4a_1^2\right)^2}$$

2.2: Retailer behaves as a leader and manufacturer of NB as follower

2.2.1: Retailer Profit

$$\pi_R = \left(\frac{a_1\left(8a_1^4 + a_2^4 - 5a_1^2 a_2^2\right)}{4\left(a_2^2 - 4a_1^2\right)^2}\right)C_{NB}^2 + \left(\frac{a_1^2 a_2\left(a_2^2 - 3a_1^2\right)}{\left(a_2^2 - 4a_1^2\right)^2}C_{PL} - \frac{a_1 a_0\left(4a_1^2 - a_2^2 - a_1 a_2\right)}{2\left(2a_1 + a_2\right)\left(2a_1 - a_2\right)^2}\right)C_{NB}$$
$$+ \frac{a_1\left(3a_1^2 - a_2^2\right)\left(2a_1^2 - a_2^2\right)}{2\left(a_2^2 - 4a_1^2\right)^2}C_{PL}^2 + \frac{a_1 a_0\left(-3a_1^2 + a_2^2\right)}{\left(2a_1 + a_2\right)\left(2a_1 - a_2\right)^2}C_{PL} + \frac{a_1 a_0^2\left(5a_1 - 3a_2\right)}{4\left(2a_1 + a_2\right)\left(2a_1 - a_2\right)^2}$$

2.2.2: Profit of NB Manufacturer

$$\pi_{PLM} = \frac{a_1\left(-2a_1^2 C_{PL} + a_2^2 C_{PL} + 2a_0 a_1 + a_0 a_2 + a_1 a_2 C_{NB}\right)^2}{2\left(a_2^2 - 4a_1^2\right)^2}$$

$$\pi_{NBM} = \frac{a_1\left(-2a_1^2 C_{NB} + a_2^2 C_{NB} + 2a_0 a_1 + a_0 a_2 + a_1 a_2 C_{PL}\right)^2}{2\left(a_2^2 - 4a_1^2\right)^2}$$

2.3: Bertrand Competition between retailer and manufacturer of NB

2.3.1: Retailer Profit

$$\pi_R = \left(\frac{a_1^3}{9a_1^2 - a_2^2}\right)C_{NB}^2 - 2a_1^2\left(\frac{a_2}{9a_1^2 - a_2^2}C_{PL} + \frac{a_0}{9a_1^2 - a_2^2}\right)C_{NB} + \frac{a_1\left(2a_1^2 - a_2^2\right)}{9a_1^2 - a_2^2}C_{PL}^2$$
$$- \frac{2a_1a_0\left(2a_1 + a_2\right)}{9a_1^2 - a_2^2}C_{PL} + \frac{a_1a_0^2}{\left(a_1 - a_2\right)\left(3a_1 - a_2\right)}$$

2.3.2: Profit of NB Manufacturer

$$\pi_{PLM} = \frac{a_1\left(-3a_1^2C_{PL} + a_2^2C_{PL} + 3a_0a_1 + a_0a_2 + 2a_1a_2C_{NB}\right)^2}{\left(a_2^2 - 9a_1^2\right)^2}$$

$$\pi_{NBM} = \frac{a_1\left(-3a_1^2C_{NB} + a_2^2C_{NB} + 3a_0a_1 + a_0a_2 + 2a_1a_2C_{PL}\right)^2}{\left(a_2^2 - 9a_1^2\right)^2}$$

Case 3: NB manufacturer produces NB product and retailer owns PL production

3.1: Manufacturer of NB behaves as a leader and retailer as follower

3.1.1: Retailer Profit

$$\pi_R = \left(\frac{a_1}{16}\right)C_{NB}^2 - \frac{1}{8}\left(a_2 C_{PL} + a_0\right)C_{NB} + \frac{4a_1^2 - 3a_2^2}{16a_1}C_{PL}^2 - \frac{a_0\left(4a_1 + 3a_2\right)}{8a_1}C_{PL} + \frac{a_0^2\left(5a_1 + 3a_2\right)}{16a_1\left(a_1 - a_2\right)}$$

3.1.2: Profit of NB Manufacturer

$$\pi_{NBM} = \frac{\left(a_0 - a_1 C_{NB} + a_2 C_{PL}\right)^2}{8a_1}$$

3.2: Retailer behaves as a leader and manufacturer of NB as follower

3.2.1: Retailer Profit

$$\pi_R = \left(\frac{a_1}{8}\right)C_{NB}^2 - \frac{1}{4}\left(a_2 C_{PL} + a_0\right)C_{NB} + \frac{2a_1^2 - a_2^2}{8a_1}C_{PL}^2 - \frac{a_0\left(2a_1 + a_2\right)}{4a_1}C_{PL} + \frac{a_0^2\left(3a_1 + a_2\right)}{8a_1\left(a_1 - a_2\right)}$$

3.2.2: Profit of NB Manufacturer

$$\pi_{NBM} = \frac{\left(a_0 - a_1 C_{NB} + a_2 C_{PL}\right)^2}{16a_1}$$

3.3: Bertrand Competition between retailer & manufacturer of NB

3.3.1: Retailer Profit

$$\pi_R = \left(\frac{a_1}{9}\right)C_{NB}^2 - \frac{2}{9}\left(a_2 C_{PL} + a_0\right)C_{NB} + \frac{9a_1^2 - 5a_2^2}{36a_1}C_{PL}^2 - \frac{a_0\left(9a_1 + 5a_2\right)}{18a_1}C_{PL} + \frac{a_0^2\left(13a_1 + 5a_2\right)}{36a_1\left(a_1 - a_2\right)}$$

3.3.2: Profit of NB Manufacturer

$$\pi_{NBM} = \frac{\left(a_0 - a_1 C_{NB} + a_2 C_{PL}\right)^2}{9a_1}$$

APPENDIX B: ECONOMETRIC MODEL SPECIFICATIONS

Case 1: Manufacturer of NB produces both NB and PL products

1.1: Retailer behaves as a leader and manufacturer of NB behaves as a follower

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

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

$$W_{PLst} = \frac{1}{a_1}\left(a_1 C_{PLst} + b_2 C_{NBst} - b_2 W_{NBst} - a_0 - a_1 P_{PLst} - a_2 P_{NBst} - a_3 S_{PLst} - a_4 S_{NBst}\right) + \upsilon_{3st}$$

$$W_{NBst} = \frac{1}{b_1}\left(b_1 C_{NBst} + a_2 C_{PLst} - a_2 W_{PLst} - b_0 - b_1 P_{NBst} - b_2 P_{PLst} - b_3 S_{NBst} - b_4 S_{PLst}\right) + \upsilon_{4st}$$

$$P_{PLst} = \frac{1}{4} C_{PLst} - \frac{a_2 + b_2}{2a_1} P_{NBst} + \frac{b_2}{4a_1} C_{NBst} + \left(\frac{\begin{array}{l} a_4 b_2^2 + a_1 a_2 b_3 - 3a_1 b_1 a_4 \\ - a_1 b_2 b_3 + 2a_2 a_4 b_2 \end{array}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) S_{NBst}$$

$$+ \left(\frac{\begin{array}{l} a_3 b_2^2 - 3a_1 a_3 b_1 + a_1 a_2 b_4 \\ + 2a_2 a_3 b_2 - a_1 b_2 b_4 \end{array}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst} - \left(\frac{\begin{array}{l} 3a_0 a_1 b_1 - a_0 b_2^2 - a_1 a_2 b_0 \\ - 2a_0 a_2 b_2 + a_1 b_0 b_2 \end{array}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) + \upsilon_{5st}$$

$$P_{NBst} = \frac{1}{4} C_{NBst} - \frac{a_2 + b_2}{2b_1} P_{PLst} + \frac{a_2}{4b_1} C_{PLst} + \left(\frac{\begin{array}{l} a_2^2 b_4 - a_2 a_3 b_1 - 3a_1 b_1 b_4 \\ + a_3 b_1 b_2 + 2a_2 b_2 b_4 \end{array}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst}$$

$$+ \left(\frac{\begin{array}{l} a_2^2 b_3 - 3a_1 b_1 b_3 - a_2 a_4 b_1 \\ + 2a_2 b_2 b_3 + b_1 a_4 b_2 \end{array}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst} - \left(\frac{\begin{array}{l} 3a_1 b_0 b_1 - a_2^2 b_0 + a_0 a_2 b_1 \\ - a_0 b_1 b_2 - 2a_2 b_0 b_2 \end{array}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) + \upsilon_{6st}$$

Case 2: Retailer outsources PL products

2.1: Bertrand Competition

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

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

$$P_{PLst} = \left(-\frac{a_2 + b_2}{2a_1} \right) P_{NBst} - \frac{1}{2a_1} \left(a_0 - b_2 W_{NBst} - a_1 W_{PLst} + a_4 S_{NBst} + a_3 S_{PLst} \right) + \upsilon_{3st}$$

$$P_{NBst} = \left(-\frac{a_2 + b_2}{2b_1} \right) P_{PLst} - \frac{1}{2b_1} \left(b_0 - b_1 W_{NBst} - a_2 W_{PLst} + b_3 S_{NBst} + b_4 S_{PLst} \right) + \upsilon_{4st}$$

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

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

2.2: Manufacturer of NB and PL behave as a leader and retailer behaves as a follower

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

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

$$P_{PLst} = \left(-\frac{a_2 + b_2}{2a_1} \right) P_{NBst} - \frac{1}{2a_1} \left(a_0 - b_2 W_{NBst} - a_1 W_{PLst} + a_4 S_{NBst} + a_3 S_{PLst} \right) + \upsilon_{3st}$$

$$P_{NBst} = \left(-\frac{a_2 + b_2}{2b_1} \right) P_{PLst} - \frac{1}{2b_1} \left(b_0 - b_1 W_{NBst} - a_2 W_{PLst} + b_3 S_{NBst} + b_4 S_{PLst} \right) + \upsilon_{4st}$$

$$W_{PLst} = \left(-\frac{a_2 + b_2}{4a_1} \right) W_{NBst} + \left(\frac{\begin{matrix} a_3 b_2^2 - 2a_1 a_3 b_1 + a_1 a_2 b_4 \\ + a_2 a_3 b_2 - a_1 b_2 b_4 \end{matrix}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst}$$

$$+ \left(\frac{\begin{matrix} a_4 b_2^2 + a_1 a_2 b_3 - 2a_1 b_1 a_4 \\ - a_1 b_2 b_3 + a_2 a_4 b_2 \end{matrix}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) S_{NBst} + \frac{1}{2} C_{PLst} - \left(\frac{\begin{matrix} 2a_0 a_1 b_1 - a_0 b_2^2 - a_1 a_2 b_0 \\ - a_0 a_2 b_2 + a_1 b_0 b_2 \end{matrix}}{4a_1 (a_1 b_1 - a_2 b_2)} \right) + \upsilon_{5st}$$

$$W_{NBst} = \left(-\frac{a_2 + b_2}{4b_1} \right) W_{PLst} + \left(\frac{\begin{matrix} a_2^2 b_4 - a_2 a_3 b_1 - 2a_1 b_1 b_4 \\ + a_3 b_1 b_2 + a_2 b_2 b_4 \end{matrix}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst}$$

$$+ \left(\frac{\begin{matrix} a_2^2 b_3 - 2a_1 b_1 b_3 - a_2 a_4 b_1 \\ + a_2 b_2 b_3 + a_4 b_1 b_4 \end{matrix}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{NBst} + \frac{1}{2} C_{NBst} + \left(\frac{\begin{matrix} a_2^2 b_0 - a_0 a_2 b_1 - 2a_1 b_0 b_1 \\ + a_0 b_1 b_2 + a_2 b_0 b_2 \end{matrix}}{4b_1 (a_1 b_1 - a_2 b_2)} \right) + \upsilon_{6st}$$

2.3: Retailer behaves as a leader and manufacturer of NB behaves as a follower

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

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

$$W_{PLst} = \frac{1}{a_1} (a_1 C_{PLst} - a_0 - a_1 P_{PLst} - a_2 P_{NBst} - a_3 S_{PLst} - a_4 S_{NBst}) + \upsilon_{3st}$$

$$W_{NBst} = \frac{1}{b_1} (b_1 C_{NBst} - b_0 - b_1 P_{NBst} - b_2 P_{PLst} - b_3 S_{NBst} - b_4 S_{PLst}) + \upsilon_{4st}$$

$$P_{PLst} = \frac{b_1 b_2}{2b_2^2 + 4a_1 b_1} C_{NBts} - \left(\frac{3a_2 b_1 + 3b_1 b_2}{2b_2^2 + 4a_1 b_1} \right) P_{NBst} - \left(\frac{3b_1 a_4 + 2b_2 b_3}{2b_2^2 + 4a_1 b_1} \right) S_{NBts}$$
$$- \left(\frac{3a_3 b_1 + 2b_2 b_4}{2b_2^2 + 4a_1 b_1} \right) S_{PLst} + \frac{a_1 b_1}{2b_2^2 + 4a_1 b_1} C_{PLst} - \frac{3a_0 b_1 + 2b_0 b_2}{2b_2^2 + 4a_1 b_1} + \upsilon_{5st}$$
$$P_{NBst} = \frac{a_1 b_1}{2a_2^2 + 4a_1 b_1} C_{NBts} - \left(\frac{3a_1 a_2 + 3a_1 b_2}{2a_2^2 + 4a_1 b_1} \right) P_{PLst} - \left(\frac{3b_3 a_1 + 2a_2 a_4}{2a_2^2 + 4a_1 b_1} \right) S_{NBts}$$
$$- \left(\frac{2a_2 a_3 + 3a_1 b_4}{2a_2^2 + 4a_1 b_1} \right) S_{PLst} + \frac{a_1 a_2}{2a_2^2 + 4a_1 b_1} C_{PLst} - \frac{2a_0 a_2 + 3a_1 b_0}{2a_2^2 + 4a_1 b_1} + \upsilon_{6st}$$

Case 3: Retailer owns the production facility

3.1: Bertrand Competition

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

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

$$P_{PLst} = \left(-\frac{(a_2 + b_2)}{2a_1} \right) P_{NBst} - \frac{1}{2a_1} (a_0 - b_2 W_{NBst} - a_1 C_{PLst} + a_4 S_{NBst} + a_3 S_{PLst}) + \upsilon_{3st}$$

$$P_{NBst} = \left(-\frac{(a_2 + b_2)}{2b_1} \right) P_{PLst} - \frac{1}{2b_1} (b_0 - b_1 W_{NBst} - a_2 C_{PLst} + b_3 S_{NBst} + b_4 S_{PLst}) + \upsilon_{4st}$$

$$W_{NBst} = \frac{1}{b_1} (b_1 C_{NBst} - b_0 - b_1 P_{NBst} - b_2 P_{PLst} - b_3 S_{NBst} - b_4 S_{PLst}) + \upsilon_{5st}$$

3.2: Retailer's brand (PL) behaves as a leader and manufacturer's brand as a follower

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

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

$$P_{PLst} = \left(-\frac{a_2 b_1 + 3 b_1 b_2}{2 b_2^2 + 2 a_1 b_1} \right) P_{NBst} - \left(\frac{b_1 a_4 + 2 b_2 b_3}{2 b_2^2 + 2 a_1 b_1} \right) S_{NBst} - \left(\frac{a_3 b_1 + 2 b_2 b_4}{2 b_2^2 + 2 a_1 b_1} \right) S_{PLst}$$

$$+ \frac{a_1 b_1}{2 b_2^2 + 2 a_1 b_1} C_{PLst} + \frac{b_1 b_2}{2 b_2^2 + 2 a_1 b_1} C_{NBst} - \frac{a_0 b_1 + 2 b_0 b_2}{2 b_2^2 + 2 a_1 b_1} + \upsilon_{3st}$$

$$P_{NBst} = \left(-\frac{(a_2 + 3 b_2)}{4 b_1} \right) P_{PLst} + \frac{a_2}{4 b_1} C_{PLst} - \frac{3 b_4}{4 b_1} S_{PLst} - \frac{3 b_3}{4 b_1} S_{NBst} + \frac{1}{4} C_{NBst} - \frac{3 b_0}{4 b_1} + \upsilon_{4st}$$

$$W_{NBst} = \frac{1}{b_1} (b_1 C_{NBst} - b_0 - b_1 P_{NBst} - b_2 P_{PLst} - b_3 S_{NBst} - b_4 S_{PLst}) + \upsilon_{5st}$$

3.3: NB manufacturer behaves as a leader and retailer's brand as a follower

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

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

$$P_{PLst} = \left(-\frac{(a_2 + b_2)}{2a_1} \right) P_{NBst} - \frac{1}{2a_1} (a_0 - b_2 W_{NBst} - a_1 C_{PLst} + a_4 S_{NBst} + a_3 S_{PLst}) + \upsilon_{3st}$$

$$P_{NBst} = \left(-\frac{(a_2 + b_2)}{2b_1} \right) P_{PLst} - \frac{1}{2b_1} (b_0 - b_1 W_{NBst} - a_2 C_{PLst} + b_3 S_{NBst} + b_4 S_{PLst}) + \upsilon_{4st}$$

$$W_{NBst} = \frac{1}{2} C_{NBst} - \frac{(a_2 + b_2)}{4b_1} C_{PLst} - \left(\frac{a_2 a_3 b_1 - a_2^2 b_4 + 2a_1 b_1 b_4 - a_3 b_1 b_2 - a_2 b_2 b_4}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{PLst}$$

$$- \left(\frac{2a_1 b_1 b_3 - a_2^2 b_3 + a_2 b_1 a_4 - a_2 b_2 b_3 - b_1 a_4 b_2}{4b_1 (a_1 b_1 - a_2 b_2)} \right) S_{NBst} - \left(\frac{a_0 a_2 b_1 - a_2^2 b_0 + 2a_1 b_0 b_1 - a_0 b_1 b_2 - a_2 b_0 b_2}{4b_1 (a_1 b_1 - a_2 b_2)} \right) + \upsilon_{5st}$$

APPENDIX C: RESULTS FOR VARIOUS COMPETITIVE GAMES FOR HEALTHY AND REGULAR BACON

Table C-1: Results of a Competitive Game for Healthy and Regular Bacon When the NB Manufacturer Produces NB and Retailer Owns the Production Facility of PL (NB Manufacturer Behaves as a Leader)

Variable	Healthy Bacon		Regular Bacon	
	NB Manufacturer Behaves as a Leader		NB Manufacturer Behaves as a Leader	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	77.005 (5.364)**	192.363 (9.743) **	11.905 (0.105)**	24.847 (0.147) **
Price NB	-12.922 (0.652) **	-31.616 (1.203) **	-1.697 (0.007) **	-3.743 (0.039) **
Price PL	3.699 (0.455) **	4.708 (0.281) **	-0.540 (0.069) **	2.443 (0.029) **
Sales Promotion Dummy (NB)	-20.912 (1.592) **	-45.799 (4.033) **	-1.676 (0.026) **	-7.219 (0.095) **
Sales Promotion Dummy (PL)	-0.251 (0.443)	-1.266 (0.933)	-0.266 (0.021) **	0.251 (0.047) **

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

Table C-2: Results of a Competitive Game for Healthy and Regular Bacon When the NB Manufacturer Produces NB and Retailer Owns the Production Facility of PL (Bertrand Behavior)

Variable	Healthy Bacon		Regular Bacon	
	Bertrand Behavior		Bertrand Behavior	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	96.969 (0.865) **	124.009 (1.125) **	-6.322 (0.018) **	9.976 (0.028) **
Price NB	-5.281 (0.023) **	-14.640 (0.103) **	-1.027 (0.000) **	-0.423 (0.000) **
Price PL	-9.373 (0.143) **	-1.538 (0.018) **	5.044 (0.000) **	-0.303 (0.000) **
Sales Promotion Dummy (NB)	-13.138 (0.224) **	-40.627 (0.763) **	-2.052 (0.023) **	3.256 (0.036) **
Sales Promotion Dummy (PL)	-1.823 (0.148) **	2.276 (0.278) **	1.476 (0.030) **	-2.335 (0.048) **

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

Table C-3: Results of Various Competitive Games for Healthy and Regular Bacon When the NB Manufacturer Produces NB & Retailer Owns PL Production Facility for Regular Bacon and Retailer Outsources PL Healthy Bacon

	Retailer Outsources PL Product		**Retailer Owns PL Production Facility**	
Variable	Healthy Bacon		Regular Bacon	
	Bertrand Behavior		Retailer behave as a leader	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	10.705 (0.029) **	6.854 (0.100) **	92.077 (1.033) **	122.392 (1.289) **
Price NB	-1.246 (0.002) **	-2.306 (0.015) **	-11.366 (0.141) **	-17.197 (0.244) **
Price PL	0.134 (0.004) **	1.039 (0.001) **	3.870 (0.090) **	-2.686 (0.073) **
Sales Promotion Dummy (NB)	-2.089 (0.013) **	-3.725 (0.028) **	-18.602 (0.255)**	-18.040 (0.305) **
Sales Promotion Dummy (PL)	0.198 (0.014) **	1.343 (0.023) **	-0.155 (0.149)	-2.168 (0.166) **
Wald Test for all promotional dummies	37471.5**		8434.2**	

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

Table C-4: Results of Various Competitive Games for Healthy and Regular Bacon When the NB Manufacturer Produces both NB and PL Products – NB Manufacturer Behaves as a Leader for Healthy Bacon and Retailer Behaves as a Leader for Regular Bacon

Variable	Healthy Bacon		Regular Bacon	
	NB Manufacturer behaves as a Leader		Retailer Behave as a Leader	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	66.549 (0.154) **	-28.709 (0.091) **	2.341 (0.027) **	41.572 (0.881) **
Price NB	-0.299 (0.001) **	8.446 (0.021) **	-0.643 (0.020) **	-0.348 (0.014) **
Price PL	-8.944 (0.020) **	-1.705 (0.002) **	1.295 (0.050) **	-10.167 (0.259) **
Sales Promotion Dummy (NB)	-7.528 (0.070) **	3.406 (0.033) **	-1.147 (0.038) **	1.056 (0.079) **
Sales Promotion Dummy (PL)	-2.336 (0.069) **	-1.905 (0.030) **	0.041 (0.016) **	-0.897 (0.119) **

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

Table C-5: Results of a Competitive Game for Healthy and Regular Bacon When the NB Manufacturer Produces both NB and PL Products (Bertrand Behavior)

Variable	Healthy Bacon		Regular Bacon	
	Bertrand Behavior		Bertrand Behavior	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	14.795 (0.013) **	18.006 (0.019) **	72.321 (1.459) **	263.735 (7.004) **
Price NB	-1.045 (0.001) **	-1.411 (0.002) **	-0.912 (0.010) **	-43.923 (1.128) **
Price PL	-0.433 (0.001) **	-1.039 (0.001) **	-4.128 (0.034) **	1.436 (0.002) **
Sales Promotion Dummy (NB)	-1.543 (0.015) **	-1.631 (0.018) **	-1.544 (0.117) **	-43.853 (1.017) **
Sales Promotion Dummy (PL)	-0.519 (0.016) **	-0.754 (0.019) **	-1.345 (0.145) **	-0.224 (0.447)

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

Table C-6: Results of a Competitive Game for Healthy and Regular Bacon When the NB Manufacturer Produces Both NB and PL Products – Retailer Behaves as a Leader for Healthy Bacon and NB Manufacturer Behaves as a Leader for Regular Bacon

Variable	Healthy Bacon		Regular Bacon	
	Retailer behave as a leader		Manufacturer of NB behave as a leader	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	42.419 (0.530) **	0.510 (0.007) **	43.054 (0.105) **	-26.218 (0.054) **
Price NB	-4.684 (0.060) **	-0.056 (0.001) **	-0.405 (0.001) **	7.133 (0.016) **
Price PL	-0.021 (0.000) **	-0.015 (0.000) **	-7.525 (0.017) **	-2.191 (0.004) **
Sales Promotion Dummy (NB)	-6.595 (0.095) **	-0.066 (0.001) **	-2.724 (0.031) **	1.735 (0.020) **
Sales Promotion Dummy (PL)	0.201 (0.015) **	-0.010 (0.000) **	0.327 (0.040) **	-0.907 (0.022) **
Wald Test for all promotional dummies	37425.7**		12636.3**	

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

Table C-7: Results of a Competitive Game for Healthy and Regular Bacon When the NB Manufacturer Produces NB and the Retailer Outsources PL Products (NB Manufacturer Behaves as a Leader)

Variable	Healthy Bacon		Regular Bacon	
	NB Manufacturer behaves as a Leader		NB Manufacturer behaves as a Leader	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	3.823 (0.025) **	-1.153 (0.027) **	7.695 (0.106) **	-455.309 (6.521) **
Price NB	-0.768 (0.000) **	0.871 (0.002) **	-0.152 (0.001) **	73.243 (1.029) **
Price PL	1.231 (0.003) **	-1.086 (0.002) **	-3.532 (0.062) **	-1.322 (0.001) **
Sales Promotion Dummy (NB)	-0.439 (0.008) **	0.136 (0.005) **	-0.225 (0.006) **	57.053 (0.606) **
Sales Promotion Dummy (PL)	0.356 (0.008) **	-0.283 (0.004) **	0.084 (0.010) **	9.478 (0.645) **

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

Table C-8: Results of a Competitive Game for Healthy and Regular Bacon When the NB Manufacturer Produces NB and the Retailer Outsources PL Products (Retailer Behaves as a Leader)

Variable	Healthy Bacon		Regular Bacon	
	Retailer Behaves as a Leader		Retailer Behaves as a Leader	
	Q_{NB} [a]	Q_{PL} [b]	Q_{NB} [a]	Q_{PL} [b]
Intercept	12.968 (1.523) **	12.292 (1.438) **	-10.484 (0.164) **	-5.315 (0.101) **
Price NB	-1.612 (0.190) **	-2.435 (0.286) **	2.112 (0.031) **	5.166 (0.075) **
Price PL	0.356 (0.043) **	0.506 (0.060) **	-2.844 (0.042) **	-6.943 (0.101) **
Sales Promotion Dummy (NB)	-2.657 (0.307) **	-3.474 (0.400) **	3.557 (0.055) **	7.494 (0.117) **
Sales Promotion Dummy (PL)	0.392 (0.050) **	1.116 (0.132) **	-0.948 (0.028) **	-3.120 (0.074) **

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

APPENDIX D: RESULTS OBTAINED FOR NB AND PL COMPETITIVE INTERACTIONS IN DIFFERENT SOCIO-ECONOMIC NEIGHBORHOODS

Table D-1: Results of Bread for Stores Located in Low Income Neighborhoods

	PLRS	NBRS	PLHS	NBHS	PPLR	PNBR	PPLH	PNBH
Constant	-0.236 (0.331) **	-0.017 (0.128)	0.918 (0.218) **	0.336	0.010 (0.015) **	-0.0004 (0.008)	-0.006 (0.014) **	0.000 (0.007) **
PPLR	-22.212 (1.836) **	3.124 (1.032)**	14.774 (1.159) **	4.314		0.517 (0.034) **	0.936 (0.018) **	-0.505 (0.029) **
PNBR	40.252 (2.442) **	-11.157 (1.329) **	-19.667 (2.385) **	-9.428	1.785 (0.113) **		-1.664 (0.117) **	0.969 (0.017) **
PPLH	22.674 (2.201) **	-2.988 (1.173) **	-15.485 (1.364) **	-4.200	1.063 (0.022) **	-0.531 (0.042) **		0.522 (0.034) **
PNBH	-40.900 (2.817) **	11.374 (1.525) **	20.195 (2.605) **	9.331	-1.882 (0.111) **	1.027 (0.019) **	1.763 (0.109) **	
PLRS					-0.020 (0.002) **	0.006 (0.001) **		
PLHS							-0.010 (0.001) **	0.003 (0.001) **
HHI					-0.023 (0.004) **	0.022 (0.001) **	0.039 (0.003) **	-0.026 (0.001) **
Expend	0.095 (0.021) **	0.002 (0.008)	-0.076 (0.011) **	-0.021	0.003 (0.001) **	-0.002 (0.001) **	-0.003 (0.001) **	0.002 (0.000) **
DPrPLR	0.251 (0.030) **	-0.040 (0.013) **	-0.161 (0.017) **	-0.050	0.011 (0.001) **	-0.006 (0.001) **	-0.010 (0.001) **	0.005 (0.001) **
DPrNBR	-0.571 (0.434) **	-0.069 (0.162)	0.609 (0.226) **	0.031	-0.023 (0.019)	0.009 (0.011)	0.020 (0.017)	-0.009 (0.010)
DPrPLH	-0.120 (0.027)	0.023 (0.010) *	0.084 (0.016) **	0.013	-0.005 (0.001) **	0.003 (0.001) **	0.005 (0.001) **	-0.003 (0.001) **
DPrNBH	0.482 (0.443)	0.179 (0.166)	-0.697 (0.233) **	0.036	0.015 (0.019)	-0.006 (0.011)	-0.014 (0.017)	0.006 (0.010)
D2005	0.049 (0.024) *	-0.041 (0.009) **	0.034 (0.013) **	-0.041	0.003 (0.001) **	-0.002 (0.001) **	-0.003 (0.001) **	0.002 (0.001) **
D2006	0.050 (0.048)	-0.075 (0.019) **	0.084 (0.028) **	-0.060	0.004 (0.002) *	-0.002 (0.001) *	-0.004 (0.002) *	0.002 (0.001) *
D2007	0.016 (0.068)	-0.078 (0.026) **	0.102 (0.037) **	-0.040	0.003 (0.003)	-0.002 (0.002)	-0.003 (0.003)	0.002 (0.002)
DCal	0.074 (0.021) **	-0.036 (0.008) **	0.029 (0.011) **	-0.067	0.002 (0.001) **	-0.001 (0.001) **	-0.001 (0.001)	0.001 (0.000) *
DEdm	0.020 (0.027)	0.056 (0.010) **	-0.078 (0.014) **	0.001	-0.001 (0.001)	0.001 (0.001) *	0.002 (0.001)	-0.001 (0.001) *
DWin	0.228 (0.019) **	-0.019 (0.007) **	-0.131 (0.010) **	-0.078	0.007 (0.001) **	-0.004 (0.001) **	-0.006 (0.001) **	0.004 (0.000) **
PdiffR	-13.186 (1.093) **	1.805 (0.614) **	8.807 (0.692) **	2.574	-0.595 (0.003) **	0.308 (0.020) **	0.557 (0.011) **	-0.301 (0.017) **
PdiffH	13.591 (1.311) **	-1.915 (0.702) **	-9.112 (0.826) **	-2.563	0.641 (0.013) **	-0.322 (0.025) **	-0.604 (0.003) **	0.317 (0.020) **

** and * represent statistical significance at 1% and 10% respectively. Standard errors are given in the parentheses. PNBR = price NB regular, PPLR = price PL regular, PPLH = price PL healthy, PNBH = price NB healthy, HHI= Herfindahl index, Expend = Expenditure, PdiffR = Price difference between NB and PL regular, PdiffH = Price difference between NB and PL healthy, DPrNBR = Dummy for NB regular promotion, DPrPLR = Dummy for PL regular promotion, DPrPLH = Dummy for PL healthy promotion, DPrNBH = Dummy for NB healthy promotion, D2005 = Dummy for 2005, D2006 = Dummy for 2006, D2007 = Dummy for 2007, Dcal = Dummy for Calgary, DEdm = Dummy for Edmonton, DWin = Dummy for Winnipeg, NBRS = NB regular share, PLRS = PL regular share, PLHS = PL healthy share, NBHS = NB healthy share.

Table D-2: Results of Bread for Stores Located in High Income Neighborhoods

	PLRS	NBRS	PLHS	NBHS	PPLR	PNBR	PPLH	PNBH
Constant	1.207 (0.206)**	-0.201 (0.081)**	1.107 (0.202)**	-1.113	-0.016 (0.024)	-0.015 (0.007)*	0.019 (0.019)	0.014 (0.006)**
PPLR	-8.610 (0.773)**	-1.928 (0.419)**	12.029 (0.763)**	-1.492		-0.107 (0.048)*	0.910 (0.042)**	0.076 (0.042)**
PNBR	0.549 (3.717)	-3.545 (1.572)*	-4.953 (4.030)	7.948	0.470 (0.442)		-1.460 (0.355)**	0.905 (0.011)**
PPLH	8.692 (0.918)	1.307 (0.485)**	-11.898 (0.890)**	1.898	1.011 (0.056)**	0.030 (0.051)		-0.006 (0.044)
PNBH	-0.361 (4.154)	4.646 (1.765)**	4.246 (4.480)	-8.532	-0.462 (0.491)	1.103 (0.014)	1.560 (0.385)**	
PLRS					-0.029 (0.008)**	0.002 (0.001)**		
PLHS							-0.038 (0.002)**	0.001 (0.000)**
HHI					-0.023 (0.020)	-0.041 (0.005)**	0.019 (0.007)**	0.031 (0.004)**
Expend	0.092 (0.006)**	0.002 (0.003)	-0.063 (0.007)**	-0.031	0.002 (0.001)**	0.002 (0.000)**	-0.002 (0.001)**	-0.001 (0.000)
DPrPLR	0.091 (0.013)**	0.009 (0.006)	-0.128 (0.013)**	0.028	0.009 (0.001)**	-0.001 (0.001)*	-0.011 (0.001)**	0.001 (0.001)*
DPrNBR	-0.195 (0.140)	-0.048 (0.063)	0.241 (0.153)	0.001	-0.025 (0.017)	-0.012 (0.010)	0.013 (0.017)	0.010 (0.009)
DPrPLH	-0.018 (0.011)	0.001 (0.005)	0.038 (0.012)**	-0.022	0.000 (0.001)	0.002 (0.001)**	0.003 (0.001)**	-0.002 (0.001)**
DPrNBH	0.201 (0.160)	0.237 (0.071)**	-0.462 (0.175)**	0.025	0.032 (0.019)*	0.021 (0.010)**	-0.013 (0.018)	-0.018 (0.009)*
D2005	-0.011 (0.008)	-0.011 (0.004)**	0.033 (0.008)**	-0.010	0.002 (0.001)*	0.000 (0.001)	0.000 (0.001)	0.000 (0.000)
D2006	-0.037 (0.018)*	-0.043 (0.008)**	0.101 (0.020)**	-0.022	-0.001 (0.002)	0.000 (0.001)	0.003 (0.002)	0.000 (0.001)
D2007	-0.083 (0.025)**	-0.037 (0.011)**	0.123 (0.027)**	-0.003	-0.002 (0.003)	0.000 (0.002)	0.005 (0.003)	0.000 (0.002)
DCal	0.140 (0.011)**	-0.033 (0.005)**	-0.032 (0.012)**	-0.074	0.006 (0.001)**	0.004 (0.001)**	-0.001 (0.001)	-0.004 (0.001)**
DEdm	0.027 (0.006)**	0.020 (0.003)**	-0.022 (0.007)**	-0.025	0.000 (0.001)	0.000 (0.000)	0.000 (0.001)	0.000 (0.000)
DWin	0.131 (0.006)**	0.017 (0.003)**	-0.073 (0.006)**	-0.075	0.004 (0.001)**	0.001 (0.000)**	-0.003 (0.001)**	-0.001 (0.000)**
PdiffR	-4.967 (0.462)**	-1.197 (0.250)**	7.104 (0.456)**	-0.939	-0.590 (0.004)**	-0.056 (0.028)*	0.542 (0.024)**	0.039 (0.025)
PdiffH	4.960 (0.553)**	0.750 (0.291)**	-6.892 (0.536)**	1.182	0.595 (0.035)**	0.013 (0.030)	-0.591 (0.004)**	0.001 (0.026)

** and * represent statistical significance at 1% and 10% level respectively. Standard errors are given in the parentheses. PNBR = price NB regular, PPLR = price PL regular, PPLH = price PL healthy, PNBH = price NB healthy, HHI= Herfindahl index, Expend = Expenditure, PdiffR = Price difference between NB and PL regular, PdiffH = Price difference between NB and PL healthy, DPrNBR = Dummy for NB regular promotion, DPrPLR = Dummy for PL regular promotion, DPrPLH = Dummy for PL healthy promotion, DPrNBH = Dummy for NB healthy promotion, D2005 = Dummy for 2005, D2006 = Dummy for 2006, D2007 = Dummy for 2007, Dcal = Dummy for Calgary, DEdm = Dummy for Edmonton, DWin = Dummy for Winnipeg, NBRS = NB regular share, PLRS = PL regular share, PLHS = PL healthy share, NBHS = NB healthy share.

Table D-3: Results of Salad Dressing for Stores Located in Low Income Neighborhoods

	PLRS	NBRS	PLHS	NBHS	PPLR	PNBR	PPLH	PNBH
Constant	1.828 (0.267)**	0.080 (0.256)	-0.433 (0.212)*	-0.475	0.152 (0.047)**	-0.271 (0.035)**	0.034 (0.050)	0.172 (0.078)*
PPLR	-2.051 (1.416)	3.953 (1.230)**	-3.827 (1.106)**	1.925		0.371 (0.206)*	1.077 (0.203)**	0.635 (0.418)
PNBR	7.000 (0.899)**	-2.967 (1.103)**	-2.121 (0.908)*	-1.912	0.712 (0.157)**		0.168 (0.189)	1.030 (0.310)**
PPLH	-4.268 (1.246)**	-0.090 (1.180)	4.335 (0.623)**	0.024	0.348 (0.144)**	0.498 (0.193)**		-1.050 (0.284)**
PNBH	-2.464 (0.799)**	-0.801 (0.680)	2.517 (0.370)**	0.749	-0.237 (0.096)**	0.398 (0.105)**	-0.345 (0.105)**	
PLRS					-0.057 (0.014)**	0.123 (0.016)**		
PLHS							0.156 (0.023)	0.357 (0.050)**
HHI					0.022 (0.048)	0.040 (0.032)	0.019 (0.040)	0.105 (0.073)
Expend	-0.021 (0.014)	0.009 (0.008)	-0.032 (0.010)**	0.044	-0.001 (0.002)	0.001 (0.002)	0.004 (0.003)	0.008 (0.005)*
DPrPLR	0.527 (0.093)**	0.013 (0.090)	-0.447 (0.051)**	-0.093	-0.001 (0.014)	-0.068 (0.014)**	0.087 (0.007)**	0.136 (0.021)**
DPrNBR	-0.151 (0.028)**	0.067 (0.028)**	0.047 (0.022)*	0.038	-0.018 (0.004)**	0.023 (0.003)**	-0.002 (0.005)**	-0.024 (0.007)**
DPrPLH	-0.465 (0.097)**	-0.093 (0.090)	0.511 (0.051)**	0.046	0.007 (0.013)	0.061 (0.015)**	-0.099 (0.008)	-0.155 (0.021)**
DPrNBH	0.065 (0.058)	0.038 (0.048)	-0.168 (0.029)**	0.066	0.016 (0.006)**	-0.015 (0.008)*	0.019 (0.008)**	0.070 (0.006)**
D2005	0.000 (0.015)	-0.020 (0.010)*	0.037 (0.011)**	-0.017	-0.001 (0.002)	0.001 (0.002)	-0.005 (0.003)*	-0.014 (0.004)**
D2006	-0.023 (0.015)	0.022 (0.010)*	0.012 (0.012)	-0.012	-0.004 (0.001)**	0.004 (0.002)	-0.001 (0.003)	-0.006 (0.005)
D2007	-0.043 (0.019)*	0.018 (0.011)	-0.011 (0.014)	0.036	-0.002 (0.002)	0.005 (0.003)*	0.002 (0.003)	0.005 (0.006)
DCal	-0.056 (0.024)**	0.038 (0.015)**	0.012 (0.018)	0.007	-0.003 (0.002)	0.007 (0.004)*	-0.002 (0.004)	-0.003 (0.007)
DEdm	-0.047 (0.019)**	0.052 (0.011)**	-0.034 (0.014)**	0.029	-0.006 (0.001)**	0.006 (0.003)*	0.007 (0.003)*	0.009 (0.005)*
DWin	-0.090 (0.022)**	-0.026 (0.018)	0.060 (0.015)**	0.056	-0.010 (0.002)**	0.013 (0.003)**	-0.007 (0.003)*	-0.027 (0.005)**
PdiffR	-3.506 (0.462)**	1.328 (0.564)**	1.091 (0.464)**	1.087	-0.367 (0.079)**	0.505 (0.005)**	-0.082 (0.097)	-0.532 (0.157)**
PdiffH	0.969 (0.316)**	0.337 (0.270)	-0.948 (0.147)**	-0.358	0.100 (0.037)**	-0.156 (0.041)**	0.126 (0.041)**	0.385 (0.005)**

** and * represent statistical significance at 1% and 10% level respectively. Standard errors are given in the parentheses. PNBR = price NB regular, PPLR = price PL regular, PPLH = price PL healthy, PNBH = price NB healthy, HHI= Herfindahl index, Expend = Expenditure, PdiffR = Price difference between NB and PL regular, PdiffH = Price difference between NB and PL healthy, DPrNBR = Dummy for NB regular promotion, DPrPLR = Dummy for PL regular promotion, DPrPLH = Dummy for PL healthy promotion, DPrNBH = Dummy for NB healthy promotion, D2005 = Dummy for 2005, D2006 = Dummy for 2006, D2007 = Dummy for 2007, Dcal = Dummy for Calgary, DEdm = Dummy for Edmonton, DWin = Dummy for Winnipeg, NBRS = NB regular share, PLRS = PL regular share, PLHS = PL healthy share, NBHS = NB healthy share.

Table D-4: Results of Salad Dressing for Stores Located in High Income Neighborhoods

	PLRS	NBRS	PLHS	NBHS	PPLR	PNBR	PPLH	PNBH
Constant	1.207 (0.206)**	0.622 (0.218)**	-0.427 (0.169)**	-0.403	-0.017 (0.034)	-0.136 (0.047)**	-0.010 (0.032)	0.081 (0.041)*
PPLR	-7.440 (1.979)**	-3.854 (1.852)*	-0.778 (1.427)	12.072		1.965 (0.301)**	1.276 (0.130)**	-0.679 (0.296)*
PNBR	5.180 (0.618)**	-1.467 (0.760)*	-0.629 (0.607)	-3.084	0.313 (0.079)**		-0.488 (0.074)**	0.463 (0.131)**
PPLH	9.446 (1.892)**	5.212 (1.746)**	-2.416 (1.384)*	-12.241	0.599 (0.116)**	-1.748 (0.280)**		0.989 (0.278)**
PNBH	-8.928 (1.019)	-0.227 (1.185)	4.800 (0.646)**	4.355	0.060 (0.141)	1.041 (0.241)**	0.326 (0.141)*	
PLRS					-0.002 (0.006)	0.104 (0.021)**		
PLHS							-0.054 (0.011)**	0.135 (0.020)**
HHI					0.166 (0.045)**	-0.190 (0.074)**	-0.233 (0.044)**	0.148 (0.049)**
Expend	-0.011 (0.011)	-0.028 (0.010)**	-0.003 (0.008)	0.042	-0.006 (0.002)**	0.008 (0.003)**	0.008 (0.002)**	-0.005 (0.002)*
DPrPLR	-0.011 (0.108)	-0.322 (0.090)**	-0.103 (0.074)	0.436	-0.033 (0.006)**	0.034 (0.018)*	0.035 (0.007)**	-0.003 (0.017)
DPrNBR	-0.212 (0.022)**	0.025 (0.027)	0.056 (0.019)**	0.130	-0.005 (0.003)*	0.032 (0.004)**	0.012 (0.003)**	-0.018 (0.003)**
DPrPLH	0.018 (0.117)	0.280 (0.098)**	0.197 (0.079)**	-0.495	0.043 (0.007)**	-0.045 (0.020)*	-0.042 (0.009)**	-0.006 (0.018)
DPrNBH	0.546 (0.066)**	0.024 (0.076)	-0.305 (0.044)**	-0.264	0.000 (0.009)	-0.069 (0.014)**	-0.026 (0.008)**	0.066 (0.003)**
D2005	0.019 (0.014)	-0.031 (0.012)**	-0.001 (0.010)	0.012	-0.003 (0.001)*	0.002 (0.002)	0.004 (0.001)**	-0.002 (0.002)
D2006	-0.083 (0.016)**	0.008 (0.015)	0.004 (0.012)	0.072	-0.005 (0.001)**	0.015 (0.002)**	0.007 (0.001)**	-0.006 (0.003)*
D2007	0.028 (0.018)	0.014 (0.017)	-0.063 (0.012)**	0.021	-0.004 (0.002)*	-0.001 (0.003)	0.000 (0.002)	0.010 (0.003)**
DCal	0.186 (0.032)**	-0.017 (0.030)	-0.078 (0.021)**	-0.092	-0.002 (0.004)	-0.020 (0.007)**	-0.005 (0.004)	0.017 (0.004)**
DEdm	0.070 (0.018)**	0.000 (0.017)	-0.057 (0.011)**	-0.013	-0.004 (0.002)*	-0.005 (0.004)	0.000 (0.002)	0.009 (0.002)**
DWin	-0.078 (0.013)**	-0.055 (0.013)**	0.030 (0.010)**	0.103	-0.005 (0.001)**	0.015 (0.002)**	0.008 (0.001)**	-0.009 (0.002)**
PdiffR	-2.681 (0.321)**	0.461 (0.398)	0.399 (0.314)	1.821	-0.161 (0.040)**	0.516 (0.006)**	0.255 (0.038)**	-0.249 (0.066)**
PdiffH	3.499 (0.389)**	0.143 (0.454)	-1.797 (0.249)**	-1.844	-0.012 (0.054)	-0.419 (0.091)**	-0.137 (0.053)**	0.386 (0.003)**

** and * represent statistical significance at 1% and 10% level respectively. Standard errors are given in the parentheses. PNBR = price NB regular, PPLR = price PL regular, PPLH = price PL healthy, PNBH = price NB healthy, HHI= Herfindahl index, Expend = Expenditure, PdiffR = Price difference between NB and PL regular, PdiffH = Price difference between NB and PL healthy, DPrNBR = Dummy for NB regular promotion, DPrPLR = Dummy for PL regular promotion, DPrPLH = Dummy for PL healthy promotion, DPrNBH = Dummy for NB healthy promotion, D2005 = Dummy for 2005, D2006 = Dummy for 2006, D2007 = Dummy for 2007, Dcal = Dummy for Calgary, DEdm = Dummy for Edmonton, DWin = Dummy for Winnipeg, NBRS = NB regular share, PLRS = PL regular share, PLHS = PL healthy share, NBHS = NB healthy share.