MODELING AND TESTING STRATEGIC PRICING, PRODUCT POSITIONING, AND COUPONING BEHAVIOR BY FOOD MANUFACTURERS AND RETAILERS

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by

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Abstract

This research explores the competition between a food manufacturer and a retailer through the use of pricing, positioning, and couponing behavior. Both cooperative and non-cooperative strategies are examined. The demand side of the market is composed by two representative consumers, one who is relatively insensitive to price, and the other who is relatively sensitive. A series of specific retailer decisions are examined, including the following: offering a private label (store brand) product or not, positioning the private label in terms of quality (vertical) and feature (horizontal) differentiation relative to the manufacturer’s national brand product, and setting the retail prices and offering cents-off coupons for both products.

As current literature focuses on the pricing strategies taken by the incumbent manufacturer(s) and retailer(s), their couponing strategies haven’t been formally modeled and clarified. In particular, how their couponing strategies are impacted by the threat of private label and the private label offering hasn’t been addressed before. Besides, given the relationship between private label expansion and couponing activities found in the existing empirical literature, no formal analysis and re-examination of the relationship has been presented. Meanwhile, the issue whether the private label customers are all price-sensitive hasn’t been confirmed, and therefore becomes one of the targets of this research. By considering both non-cooperative
strategies and cooperative strategies, the research intends to provide a more thorough picture of the interaction between the incumbent manufacturer(s) and retailer(s).

This research shows that when the manufacturer and the retailer take non-cooperative strategies, the private label’s retail price is related only to its quality level, and the retailer’s coupons for the private label are simply determined by the difference between consumer types: greater consumer difference in willingness to pay brings higher coupon values. Similar patterns of the private label’s price and coupon value hold when the retailer cooperates with the manufacturer.

However, the national brand’s prices (wholesale price and retail price) and coupon values (manufacturer’s coupon and retailer’s national brand coupon) are conditional on a number of factors, including whether or not the manufacturer and the retailer cooperate or not. When the manufacturer and the retailer take cooperative strategies, the national brand retail price reflects only its own quality level no matter whether the private label is introduced or not, and the national brand’s total coupon value determined jointly by the manufacturer and the retailer is equal to the consumer type difference.

Alternatively, when the manufacturer and the retailer take non-cooperative strategies, the threat of the private label’s entry always drives the national brand’s wholesale price and retail price down, no matter the threat comes from either higher
private label quality or larger feature differentiation. However, with the presence of
the private label, the national brand’s wholesale price and retail price basically
decrease with the quality for the private label but increase with feature differentiation.
The retailer’s national brand coupon value is based on the value of the manufacturer’s
coupon: as the manufacturer increases (decreases) the coupon value, the retailer
decreases (increases) its own national brand coupon.

No matter what strategies are taken, the research points out the emergence of three
scenarios depending on the positioning of the private label. First, it is possible that the
private label product is not offered. Second, the private label product might be offered
but targeted to and consumed only by the consumer with higher willingness to pay,
rather than the price-sensitive consumer. And third, the private label product is
offered to and consumed by both types of consumers. In other words, (i) the target
customer of the private label product is therefore not necessarily the price-sensitive
consumer, and (ii) store coupons for the private label product are offered to the
price-sensitive consumer only in the third scenario but not the second.

The research shows that if the retailer offers the private label, it is always
positioned at the highest possible quality (vertical differentiation) no matter what
strategies are taken by the retailer and the manufacturer. However, while a very
different feature strategy (horizontal differentiation) is always the best under
cooperative strategies, the retailer under non-cooperative strategies may choose similar features thereby imitating the national brand to a degree such that the price-insensitive consumer is the target customer of the private label product and the second scenario therefore emerges.

Focusing on the relationship between the private label expansion and non-cooperative couponing strategies in Sethurman and Mittelstaedt (1992), this research shows that the private label value market share and volume market share are irrelevant to the retailer’s private label coupons, which coincides with the finding in Sethurman and Mittelstaedt (1992).

However, while Sethurman and Mittelstaedt (1992) find that manufacturer’s coupons (store coupons for the national brand) curb (contribute to) the private label value market share and the private label volume market share, this research shows that when the private label expansion is primarily driven by the degree of feature differentiation, manufacturer’s coupons (store coupons for the national brand) decrease (increase) the private label value market share only in the private label position with very high quality relative to the national brand and very large feature differentiation from the national brand. Moreover, either when the private label expansion is driven by an increase in the private label quality or an increase in its feature differentiation from the national brand, the manufacturer’s coupons (store
coupons for the national brand) always increase (decrease) private label volume market share. This research therefore suggests that the private label quality or the degree of feature differentiation alone can’t fully explain the relationship between the private label expansion and non-cooperative national brand couponing strategies.

Finally, this research empirically tests the retailer’s couponing strategy and shows that an increase in horizontal feature differentiation lowers the leading retailers’ coupon values of store-level leading national brand products. This result confirms the theoretical prediction. On the other hand, an increase in feature differentiation has no impact on coupon values of leading private label products. Both results are supported by a robustness check.
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Chapter 1 Introduction

1.1 Overview

Private label (PL) food products, also called store brands, are gaining more interest than ever. Zumburn (Forbes.com, Nov. 11, 2008) indicates that consumers tend to spend more on generic, PL food products especially in a stalled economy. Retailers are thus inclined to manufacture PL products. According to Zumburn, “Kroger reported its brands had their best-ever quarter, accounting for 26% of sales. Wal-Mart, responding to the trend, is relaunching its own lines.”

In Europe, PL market share has already been high among food categories. Take frozen food for example. Bergès-Sennou et al. (2004) document that the value market share is especially high in some European countries such as Spain (33.9%), Germany (36%), France (36.3%), UK (45.4%), and Belgium (49%). In Belgium, the volume market share is even close to 60%. In France, an upward trend of PL penetration is obvious in all food categories.

An increase in PL penetration reflects retailers’ power. Retailers nowadays are no longer distributors of national brand (NB) products only. Retailers carry NB products on shelves while simultaneously offering consumers PL products and functioning as manufacturers. Within the same product category, PL products are increasingly
considered as competitors to NBs. Retailers’ dual role therefore intrigues us to ask the foremost question: How does a retailer maximize its profit when carrying both a NB product and a PL product? In particular, in its own distribution channel, how does a retailer position the PL product, set prices on both the NB and the PL, and promote one product or both?

Product positioning comprises two dimensions, vertical and horizontal. While the former refers to quality differentiation, the latter refers to feature differentiation. Consumers are assumed to always prefer higher quality, but their preferences for features such as flavor, package size, and color are finitely varied. In other words, for the feature differentiation, more doesn’t mean better. While it thus may be reasonable for the retailer to always produce the PL with the same high quality as the NB, such ideal vertical positioning may not be reached when the retailer is constrained by its present technology. Moreover, consumers may not appreciate a very horizontally distinctive PL product because their ideal points of product features are finite. These logical conclusions imply that the PL positioning is bounded by a constraint on quality as well as a constraint on feature differentiation, and the retailer therefore has to decide in what degree the PL should be positioned differently from the NB.

The PL positioning decision determines the retailer’s pricing strategy for both the NB and the PL. Suppose the PL is positioned as a close substitute to the NB. A very
competitive PL price is expected to depress the NB’s sales. To the retailer, its total profit will be harmed if the loss from the NB can’t be covered by the gain from selling the PL. In contrast, suppose the PL is positioned differently from the NB and consumers are willing to purchase both products for diversity, then the retailer may increase its profit by charging higher PL price.

The PL positioning decision also affects the retailer’s promotions in terms of store coupon offerings. If the NB can be substituted by the PL and either (1) the retailer avoids offering store coupons for the NB entirely, or (2) it offers store coupons for the PL with high face value and store coupons for the NB with low face value, then consumers are encouraged to purchase more of the PL and less of the NB due to a change in relative net prices between the PL and the NB. However, such couponing strategy won’t work well when the PL is a poor substitute for the NB.

Of course, not all consumers search for and use coupons.¹ When consumers are divided into coupon users and non-coupon users, the retailer’s decisions on coupon offerings become more complicated. Given possible constraints on the PL quality and on feature differentiation, the retailer could position the PL where one type of consumers always declines to purchase the PL product. If this non-purchasing

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¹ According to an industry group, coupon redemption volume for grocery stores and mass merchandisers has increased 16.7 and 30.2 percent, respectively, from the first half of 2008 to the first half of 2009 (NCH Marketing Services, 2009).
consumer type was generally a coupon user, then for this scenario, the retailer would naturally avoid offering coupons. In other words, the retailer decides to offer coupons or not according to its anticipation of the target customers of each product. Intuitively, the retailer’s pricing strategies on the NB and the PL should be set to cater to the target customers.

In the real world, some retailers offer PL products, while others do not. Retailers who chose not to offer PL products must have anticipated the total profit from selling NBs only would be greater than selling both products. This implies that the retailer’s profit maximization problem cannot be fully characterized without tracing back to its first decision: whether or not the PL should be offered.

Modeling the retailer’s decisions also takes account of the manufacturer’s pricing and couponing strategies, because the NB wholesale price and manufacturer’s coupon value are set based on the manufacturer’s anticipation of a series of the retailer’s decisions. A more complete picture of the interaction between the retailer and the manufacturer is drawn by further considering the case in which the retailer colludes with the manufacturer and they cooperatively make the following decisions: offering a PL product or not, positioning the PL in terms of quality and feature differentiation relative to the NB, and setting the retail price(s) and offering coupons for the PL or the NB or both.
1.2 Research Objectives

Focusing on food retailers with market power, my research plans to accomplish the following objectives and sub-objectives:

1. Develop a theoretical model in which a retailer carries a NB product produced by a manufacturer. The model must account for the following potential decisions: the retailer is allowed to offer a PL to consumers; the retailer is allowed to vertically and horizontally position the PL product subject to possible restrictions; the retailer is allowed to set the retail price of both NB and PL product; the retailer is allowed to promote both products with cents-off coupons; and finally, the manufacturer is allowed to set the NB wholesale price and promote the NB with its own coupons. The manufacturer and the retailer may take non-cooperative strategies or cooperate with each other.

1.1 Derive the conditions under which the PL attracts all consumers, the conditions under which the PL is introduced to attract only one type of consumers, and the conditions under which the PL is not introduced at all.

1.2 In different scenarios, conditional on the PL positioning, derive the equilibrium NB wholesale price, the NB retail price, manufacturer’s coupon value, the retailer’s NB coupon value, and the PL retail price as well as the retailer’s PL coupon value.
2. Demonstrate how target customer(s) of the PL, the manufacturer’s strategies, and retail prices and coupon values of both products all might change depending on the PL positioning in terms of quality and feature differentiation relative to the NB. A numerical example is provided.

2.1 For a range of PL positioning, develop a map of target PL customers and a map of the manufacturer’s strategies.

2.2 Given a fixed PL feature differentiation from the NB, investigate the impact of the PL quality on the NB wholesale price, the NB retail price, manufacturer’s coupon value, the retailer’s NB coupon value, and the PL retail price and the retailer’s PL coupon value.

2.3 Given a fixed PL quality, investigate the impact of the PL feature differentiation from the NB on the NB wholesale price, the NB retail price, manufacturer’s coupon value, the retailer’s NB coupon value, and the PL retail price and the retailer’s PL coupon value.

3. Determine the optimal PL positioning in different scenarios with the numerical example.

3.1 Under non-cooperative strategies, explore how the retailer’s profit changes with the PL position.

3.2 Under cooperative strategies, explore how the joint profit changes with the
4. Continuing the example, investigate the relationship between PL expansion and varieties of coupons under non-cooperative strategies.

4.1 Conditional on the optimal PL position, describe the impact of the PL positioning on PL expansion.

4.2 Connect the impact of the PL positioning on PL expansion with the impact of the PL positioning on coupon values to re-examine the findings in Sethurman and Mittelstaedt (1992).

5. Empirically test the response of the retailer’s coupons to the PL feature differentiation from the NB.

5.1 Manipulate household-level purchase data to construct new variables that capture the PL feature differentiation, prices and coupon values, and market structure and store characteristics.

5.2 Test whether the empirical results coincide with the theoretical ones.

5.3 Describe the impact of the control variables on the retailer’s NB and PL coupon values.

5.4 Implement a robustness check (presented in an appendix) to examine the retailer’s couponing strategy.

By the above research objectives, this research intends to bridge some of the
present research gaps in NB vs. PL competition. In particular, while current literature focuses on the pricing strategies taken by the retailer(s) and the incumbent manufacturer(s), this research, on the other hand, considers both the pricing and the promotional strategies and especially turns the spotlight on the couponing strategies by explicitly modeling three different kinds of coupons in a simple environment where one PL competes with one NB. A relationship between PL expansion and varieties of coupons can therefore be formally presented and analyzed, which complements the existing empirical research. With introduction of two consumers with different levels of willingness to pay, this research also is able to answer a long-disputed question: who are the target customers of the private label product? Finally, this research considers the situation in which the retailer may cooperate with the manufacturer, which helps to complete current understanding by showing whether and how different strategies impact on the outcomes.

1.3 The Outline

This research is organized as follows. Starting with economics and marketing literature reviews of PLs and coupons, Chapter 2 proceeds to connect PLs with coupon use by discussing the results of the single existing research paper that is related to this dissertation and identifying the issues which must be re-examined. A model of the competition between one retailer’s PL and one manufacturer’s NB is
constructed in Chapter 3. The key feature of the model is that the retailer chooses the PL’s vertical and horizontal positioning before its decision of offering the PL to consumers or not. In other words, prior to deciding to offer a PL, a retailer asks itself the question: if it were to offer a PL, where would it be positioned? Such a setting magnifies the importance of the PL positioning, which drives the manufacturer’s strategic reaction through its pricing and couponing strategy and therefore impacts on the retailer’s own decision of offering the PL or not. Chapter 4 describes procedures used to solve the model. Because one of the primary objectives is to investigate how the manufacturer reacts to retailer’s PL positioning and how the manufacturer’s reaction affects the retailer’s pricing and couponing, the model is solved conditionally on key product-positioning variables. The equilibrium solutions conditional on the PL positioning are listed in Chapter 4. The properties of the equilibrium solutions are then investigated via a numerical example in Chapter 5. This chapter presents a mapping of sorts, when the manufacturer’s and retailer’s strategic pricing and couponing responses are shown to depend on parameterized values of vertical and horizontal PL positioning. Chapter 6 investigates the optimal PL position based on outright profit maximization and a numerical example. According to the optimal PL position derived in Chapter 6, Chapter 7 proceeds to explore the relationship between PL expansion and varieties of coupons under non-cooperative strategies by using
product-positioning variables as a bridge. Results from this exploration are then compared with findings in the existing empirical literature. Chapter 8 employs an empirical test of retailers’ couponing strategies. Using household-level data, it implements empirical tests on how store coupons for the target NBs and the target PLs are expected to vary with horizontal feature differentiation. Chapter 9 summarizes the findings of this research, compares and contrasts this research with current literature, and concludes this research with limitations of this research and possible future extensions.
Chapter 2 Literature Review

2.1 Private Labels

Cotterill (2001) identifies a channel coordination problem in the food systems of the U.S. and Europe today. The problem arises from the phenomenon that powerful food manufacturers sell national brand products to powerful food retailers, and it can be demonstrated by a successive monopoly model of a distribution channel (Spengler 1950). In the channel framework, an upstream manufacturer sells a product to a downstream retailer at the wholesale price and the downstream retailer re-sells the product to consumers at the retail price. The demand curve faced by the upstream manufacturer is the marginal revenue of the downstream retailer, and the marginal revenue curve faced by the upstream manufacturer shifts further inward. Under linear pricing, the wholesale price equals the manufacturer’s marginal cost plus a markup, and the retail price equals the retailer’s marginal cost, the wholesale price, plus a markup. A sequence of markups leads to a higher retail price and a lower combined profit than would arise if the upstream firm and the downstream firm were vertically integrated. This scenario describes the well-known “double marginalization” problem.

The problem can be reduced when the downstream retailer introduces to consumers the PL, a competing product with the pre-existing NB. The manufacturer’s bargaining
power is limited in a sense that the manufacturer has to decrease the NB wholesale price to compete with the PL. In other words, the downstream retailer increases its bargaining power and therefore its profit by forcing a concession of the NB wholesale price (Mills 1995, Bontems et al. 1999). However, an opposite direction in NB wholesale price is found when taking account of the proportion of loyal customers to switchers (Gabrielsen and Sørgard 2007). Note that a mere threat of the PL always places a downward pressure on the NB wholesale price (Mills 1995, Bontems et al. 1999, Gabrielsen and Sørgard 2007).

The retailer’s profit can also be increased by its strategic choice of product characteristics of the PL. In a market with two pre-existing NBs, Sayman et al. (2002) and Scott-Morton and Zettelmeyer (2004) show that the retailer finds it best to target the leading NB. Alternatively, Choi and Coughlan (2006) and Du et al. (2005) indicate that the retailer might target on the second-tier NB or horizontally position the PL halfway between the two NBs.

show that the pre-existing NBs may be impacted differently by the PL entry or the PL expansion, which confirms the strategic role of PL positioning.

2.1.1 PL entry

Mills (1995) indicates that if the PL quality is too low, the retailer has no incentive to introduce the PL, and the manufacturer sets the NB wholesale price in a position of monopoly. When the PL quality is above a threshold and the PL is substitutable for the NB product, the retailer starts to have incentive to introduce the PL and the NB manufacturer deters the PL entry by decreasing the NB wholesale price. The wholesale price gets lower as the PL quality gets higher. As the PL quality surpasses a certain threshold, it is more profitable for the NB manufacturer to accommodate the PL entry. By taking account of the PL presence, the NB manufacturer proposes an even lower wholesale price to better compete with the PL.

While the production variable costs for the PL and the NB are assumed identical and constant in Mills (1995), Bontems et al. (1999) assume that the production variable costs increase with product quality and the PL has higher marginal cost of production than the NB. They further point out that the retailer sells only the NB if the PL quality is sufficiently close to the NB because the production cost of the high-quality PL makes the PL uncompetitive with the NB. The manufacturer sets the wholesale price as a monopoly price. The retailer sells both the PL and the NB when
the PL quality is really low, because the production cost of the low-quality PL is so low that the NB manufacturer can’t stop its entry. The NB wholesale price goes down due to the PL impact. With the PL quality increases, the production cost of the PL gets higher and the PL gets less and less competitive than the NB, and therefore, above a threshold of PL quality, the NB wholesale price tends to increase with the PL quality.

Gabrielsen and Sørgaard (2007) divide consumers into loyal customers and switchers, where switchers choose between the NB and the PL based on the relative prices. They allow the manufacturer to offer a contract to the retailer specifying that the NB wholesale price is conditioned on whether the PL is introduced or not. Assuming zero production cost, they derive three regimes. First, the retailer sells the NB only when there are few loyal customers. The manufacturer lowers the wholesale price so as to make the retailer reluctant to introduce the PL, because the profit from serving the switchers exceeds the loss of revenue from serving the loyal customers. With the increase of the proportion of loyal customers relative to switchers, the second regime emerges and the NB manufacturer chooses to concentrate on the loyal customers for the competition for the switchers is so intense that serving the loyal customers with high NB retail price is profitable. The NB wholesale price thus increases and the retailer responds by introducing the PL. When the proportion of
loyal customers is sufficiently high, even the manufacturer would serve only the loyal customers without a threat of PL entry. In this case, the third regime, the NB wholesale price is unaffected by the existence of the PL.

2.1.2 PL positioning

Assuming that PL positioning only affects the cross-price sensitivity in demand functions so that brands positioned closer to each other exhibit higher cross-price elasticity, Sayman et al. (2002) show that the PL is positioned to imitate either one of the pre-existing two NBs when the two NBs have equivalent product quality. When one NB is stronger than the other in the product quality, the retailer chooses to imitate the leading NB. Using store-level data on a four-week basis for 19 categories and 122 retailers over 30 periods, Sayman et al. (2002) estimate three demand functions for the leading NB, the second-tier NB, and the PL. They use equivalent units as the basis for demands and retail prices, introduce dummy variables to capture the variation in retailers, and take account of promotional intensities which are represented by the fraction of equivalent unit sales accompanied by retail promotions. Their results show that the PL and the leading NB do compete more intensely with each other than with the secondary NB, but such competition exists only in categories with high-quality PLs but not categories with low-quality PLs. Particularly, based on four different dimensions including package design, labeling/color, shelf placement, and shelf
talkers, they analyze 75 product categories in two grocery chains, and find that the strategy of “targeting on the leading NB” prevails in around 1/3 of the categories.

Choi and Coughlan (2006) indicate that the retailer’s positioning should formally be divided into two dimensions: the PL feature and the PL quality relative to the NBs. More specifically, their definition of feature comprises of both the cross-price sensitivity and the intercept of demand mentioned in Sayman et al. (2002). Starting backwards from consumers’ utility maximization problem of carrying multi brands of products, they show that the retailer always seeks higher PL quality when the PL feature differentiation is fixed. When the PL quality is fixed, a high-quality PL is better off imitating the feature of the stronger NB, while a low-quality private label is better off imitating the weaker national brand. When two NBs are undifferentiated in the feature dimension, the retailer should actively feature-differentiate the PL from the NBs. The higher the private label’s quality, the more it can differentiate. While targeting one of the pre-existing NBs brings a greater competition between the PL and the targeted NB, actively increasing feature differentiation from the two NBs implies less pressure of the PL on the NB prices.

Scott-Morton and Zettelmeyer (2004) consider a situation in which retailer has limited shelf space to carry only two products and therefore makes a choice among the leading NB, the second-tier NB, and its own PL. Both dimensions of product
attributes are addressed. Each NB is positioned to satisfy the tastes of each one of two segments in the market: the NB targeting the larger segment is the leading NB and the NB targeting the smaller segment is the second-tier NB. Both NBs have the same quality. The retailer is allowed to offer its own PL with positioning at either one segment, but to consumers, consumption of the PL always brings lower utility than any of NBs. Furthermore, because the PL can be positioned in only one of two segments, consumers in the other segment will suffer from a positioning mismatch. The retail prices are set with complete channel coordination, and the retailer and the manufacturers divide the channel profits via a bargaining game.

Scott-Morton and Zettelmeyer (2004) point out that if the retailer chooses to introduce the PL, the second-tier NB should be replaced with the PL and the PL is positioned to imitate the leading NB, which allows the retailer to improve the supply terms with the manufacturer. The retailer introduces the PL which is a closer substitute to the leading NB than the second-tier NB. When the two NBs are less differentiated, the PL must be sufficiently high quality for the retailer to carry it instead of the second-tier NB. They also argue that because the second-tier NB can never imitate the first leading NB, the retailer can thus never carry a second-tier NB that targets the larger segment. Using supermarket data containing 5 chains, 9 stores on 82 categories over two years, they use probit models to further confirm that, in
either store level data or chain level data, retailers tend to carry PLs when the share of
the leading NB is higher, which implies that the store brand introductions allow
retailers to enjoy the benefit of negotiating over supply terms.

Du et al. (2005) find that the retailer might position the PL between two NBs.
Different from Scott-Morton and Zettelmeyer (2004), the retailer is allowed to
position the PL anywhere between the two NBs and carry two NBs in addition to the
PL. As the quality of the leading NB is assumed higher than that of the second-tier
NB, the retailer is allowed to position the quality of the PL higher or lower than the
quality of the second-tier NB. Applying variations in horizontal positioning and
vertical positioning and using the percentage of current buyers who receive positive
utilities from both NBs as a measure for competitive intensity between two NBs, they
show that targeting on the leading NB happens only when competitive intensity is
zero and the PL quality is low. When competitive intensity is zero but the PL quality
is sufficiently large, or when competitive intensity is at moderate or high level, it is
optimal to position halfway between two NBs or closer to the second-tier NB.

As the retailer introduces a PL with an optimal positioning strategy, Du et al. (2005)
indicate that the retailer can increase its profit with introducing a PL from three
sources: a higher NB retail margin, an increase in NB sales, and an increase in PL
sales. They show that the NB retail margin is always increased with the PL
introduction no matter the competitive intensity. The NB sales drop dramatically when the competitive intensity is high, but the loss can be compensated by an even higher increase in the PL sales. They further point out that the PL introduction with optimal PL positioning enlarges the total channel profit when the competition between the two NBs is not too intensive, and this generally implies that the PL introduction benefits channel coordination. The retailer finds it most beneficial to introduce the PL especially when the competition between the two NBs is moderate. More importantly, the PL introduction impacts on the wholesale price and the retail price of the second-tier NB more than those of the leading NB in most of scenarios.

2.1.3 Empirical Findings

PL Entry. Typical of several studies where results depend on product category characteristics, both positive and negative price impacts of the PL entry are found in Gabrielsen et al. (2001). Using weekly data on the prices for 83 products in Norwegian food sector over 197 weeks, Gabrielsen et al. (2001) run OLS regressions for each product category with explanatory variables including a consumer price index, the NB price before PL entry and a dummy representing the PL entry. In 17 cases over 83 products, the impact of PL entry is significant, where 15 cases are shown positive. They further estimate price impacts of the PL introduction in different dynamic panel price models, where different combinations of the variables are
introduced: PL rank, PL market share, NB rank, and NB distribution level. Their results also present a picture of mixed price impacts. In addition, the increase in NB prices is larger for highly distributed and ranked NBs, namely the leading NBs.

Chintagunta et al. (2002) use scanner data of one supermarket chain and demonstrate mixed patterns of NB wholesale prices and NB retail prices in the oats category and the frozen pasta category. Focusing on one major incumbent NB in the oats category, they aggregate weekly sales data of one major incumbent NB across sizes and brand variants, take average of prices across all stores, deflate the prices by the monthly CPI index, and demonstrate a pattern of decreasing NB wholesale price and retail price after the PL entry in the oats category. In particular, they allow at least one year of data available prior to and after entry of the PL, and indicate that the decline is 6.2 cents in average NB wholesale price and 6 cents in average NB retail price. On the other hand, for the four major NBs in frozen pasta category, they show that the wholesale prices do not uniformly decrease; the retail prices of the top two NBs increase after the PL entry, while the retail prices of the bottom two NBs decrease after the introduction of the PL.

Pauwels and Srinivasan (2004) proceed to examine the NB price impacts of the PL entry by differentiating the premium-priced NB from the second-tier-priced NB in the oats category. Using the same data source as Chintagunta et al. (2002), they separately
estimate the pre- and post-entry models with multivariate time-series analyses and compare the equilibrium price levels before and after the introduction of the PL. They find that, after the PL entry, both the wholesale price and the retail price of the premium-priced NB go up, while the wholesale price and the retail price of the second-tier-priced NB go down. Though the average price paid by customers is shown lower, their results imply that the PL competes directly with the second-tier-priced NB but not the premium-priced NB.

Bonfrer and Chintagunta (2004) use panel data of 104 categories for 5 retailers in a major US city over 104 weeks to test the impact of the PL entry on average NB price. For each category in each store by each week, they create two indicators: one is to specify the time of PL entry and the other is to specify the launch of a new brand in other stores. Bonfrer and Chintagunta (2004) regress the log of the price of the incumbent brands on the two indicators as well as four dummies capturing store level fixed effects, and find that the incumbent NB retail price increases for the PL entry, but decreases when a new NB is introduced. The incumbent NB retail price gets even lower for the store in which the NB is not introduced but is launched in other competitive stores.

To take account of category specific effects, they further estimate the same model category by category. Their results show that, for the entry of PLs, the NB retail
prices fall in 16 out of 35 categories, whereas for the entry of NBs, the NB retail prices fall in 31 out of 65 categories. This suggests that the effect of PL entry on the NB retail price depends on the product category characteristics.

**PL Expansion.** As opposed to PL entry, expansion of the PL category is often found to have a negative impact on the NB retail prices (Putsis 1997, Cotterill and Putsis 2000). Putsis (1997) identifies a negative impact by using market-level data of 135 food products sold in 59 geographic markets in US from 1991-1992. Controlling other effects such as promotion, brand proliferation and entry deterrence, and local market conditions, Putsis (1997) estimates the NB price reaction and the PL price reaction together via SUR, and shows that a higher PL market share drives the NB price down on average, but the presence of PLs doesn’t generate NB price responses. The PL price is shown to increase with its expansion. Using the same data source and controlling other effects as Putsis (1997), Cotterill and Putsis (2000) apply three stage least squares to estimate one NB demand function as well as two price reaction equations for the NB and the PL. Their result of the NB price reaction to the PL expansion coincides with Putsis (1997), but the PL price is found to decrease with PL expansion. Note that both Putsis (1997) and Cotterill and Putsis (2000) use a first difference model to do estimation, which helps to “control for first order fixed effects due to excluded local market and category variables in level regressions”.
Other empirical studies find support for a positive impact of PL expansion on the NB retail price (Bonanno and Lopez 2005, Ward et al. 2002, Bontemps et al. 2005, Bontemps et al. 2008). Bonanno and Lopez (2005) assess the impact of PL expansion on fluid milk prices by using 2,759 supermarket-level observations in 24 supermarket chains located in 10 US cities. Calculating simple averages of in-store PL shares, PL and NB prices, and price differentials between the PL and the NB, they use scatter plots to show a positive relationship between PL market share and milk prices as well as price differentials in both reduced-fat milk and whole milk. They also offer nonparametric results to demonstrate a nonlinear, increasing relationship between milk prices and PL share. In particular, the expansion of PL share has a clear increasing effect on the NB prices but not PL prices, which suggests that retailers segment the market by offering two products with different price levels.

After performing cross-sectional analyses on the PL and NB price, Bonanno and Lopez (2005) further confirm that PL expansion significantly increases NB prices and the price differential between the two products. Their econometric results also show that PL prices increase with PL expansion once PLs become dominant. In particular, a quadratic form for PL share is specified to capture the nonlinear effect. Time effects, city-specific effects, retailer strategic characteristics, and raw milk price, served as a cost control, are also introduced in their econometric models. A predicted PL share is
used to avoid potential endogeneity problem, which is derived by regressing the PL share on demographic variables as well as retailer specific dummies.

Using monthly US data on 32 product categories over two and one-third years, Ward et al. (2002) examine the effect of PL expansion on NB prices by regressing the log real price of each of the eight largest firms and the log average price of the other branded firms on the log of the PL share in each category. They measure prices as total revenue divided by total quantity for each category, convert them into real prices using the Consumer Price Index, and introduce three dummies to control for seasonality. They find that, for 288 estimated coefficients, every statistically significant coefficient is positive, which suggests that an increase in the PL market share raises or doesn’t affect NB prices. Furthermore, since they fail to find any evidence that the NB prices were impacted in different ways, their results suggest that the price effect is identical no matter whether or not the NB is a market leader.

Ward et al. (2002) also respectively examine the impact of PL market share on the average overall price and the average PL price. They indicate that the PL penetration doesn’t change or lowers down PL prices, but the overall price has significant negative elasticity in 31% of all categories, a positive elasticity in 19% of all categories, and remains unchanged in the rest of categories.

Bontemps et al. (2005) consider different types of retailers’ PL brands: hard
discount products sold by discount stores, private labels developed exclusively by retailers, and first-price products offered by supermarkets and hypermarkets in response to hard discounters. The sum of the market share of the first two brands is considered the typical PL market share, and the last one represents the low-price product.

Since the NB manufacturers may react to PL development by modifying the characteristics of products themselves and targeting the production to the specific subcategory that supports higher prices, Bontemps et al. (2005) use an index of differentiation to reflect the ratio between the NB sales within a specific subcategory over the NB total sales. Quarterly dummies are also introduced.

Selecting 6 French dairy product categories over 39 periods of 4 weeks from 1998 to 2000 and focusing on NBs which are sold over 50% of French region, Bontemps et al. (2005) formulate different settings of models and confirm a positive impact of PL expansion by using reduced-form regressions to test the price responses of NBs on the typical PL market share in volume for each category. The price responses differ with retailer brands: the effect of the development of private labels on NB prices is higher than or equivalent to those of hard discount and first-price products. While an increase in private labels has a positive impact on NB prices in most cases, an increase in hard discount and first-price products have a negative impact in half of the cases. The
manufacturer’s strategy of product differentiation is shown to increase NB prices.

Bontemps et al. (2008) furthermore break the retailers’ brands into finer categories. In particular, the private labels developed exclusively by retailers are divided into private labels at “low price”, “standard” private labels such as “me-too” products, and private labels with “premium” quality. For national brand products which are sold over 50% of French region, Bontemps et al. (2008) also identify the first three leading national brand products by the market share in volume.

Bontemps et al. (2008) control for the change in product characteristics over time by using a Paasche price index to directly adjust the prices. Their data include 218 food products over 52 periods of 4 weeks from 1998 to 2001 in French market. They test different models and derive a positive correlation between the PL market shares and the NB prices, no matter whether the NB price is corrected by the Paasche index or not. This implies that quality changes are not enough to explain the increase of NB prices. They once again confirm that the effect of the development of private labels on NB prices is higher than or equivalent to those of hard discount and first-price products, when quality changes are considered or not. They also indicate that the “standard” private labels and the “low-priced” private labels have a significantly positive impact on NB prices, while no significant price reactions are found from “premium” private labels. Meanwhile, they find that the NB price reactions to the
“standard” private labels are greater than the reactions to the other two types of private labels, which implies that the “standard” private labels are used to compete with NBs. Lastly, using Herfindahl index to identify the seller concentration level, Bontemps et al. (2008) divide the product categories into two clusters and show that when a market is less concentrated and the PL market shares are relatively high, the NB price reaction is larger. Bontemps et al. (2008) also indicate that the leading NB price reactions to the PL development are greater than the second-tier NBs and the third-tier NBs, which implies that retailers may discriminate among consumers by increasing the prices of leading NBs with the PL expansion.

2.2 Coupons

From an individual consumer’s perspective, cents-off coupons represent a simple price discount to induce purchases. However, from a manufacturer’s perspective, coupons can be used to price discriminate between more price elastic and less elastic consumers (Narasimhan 1984, Levedahl 1984, Levedahl 1986, Vilcassim et al. 1987, Gerstner et al. 1994). To a retailer, doubling manufacturers’ coupons is also a means for price discrimination (Hess and Gerstner 1993, Hu et al. 2004).

2.2.1 Coupons as a price discrimination method

Narasimhan (1984) indicates that, before a consumer decides to enjoy the savings
from using the coupons, he/she has to trade off the savings obtained against the cost of using coupons. The cost such as looking for coupons and organizing them is basically the cost of time. Solving a consumer’s utility maximization problem with the constraints of income and time, Narasimhan (1984) shows that as the opportunity cost of time increases, consumers are less inclined to use coupons. In particular, more intense coupon users are more price-elastic than the less intense users. A firm can henceforth price discriminate consumers by selling the product at a coupon-aided lower price to the more price-elastic consumers relative to the consumers who are less price-elastic. Narasimhan (1984) confirms a positive relationship between manufacturers’ coupon values and prices is confirmed by empirically testing four different regression models on 17 product categories, which supports the proposition that coupons are used as a means for price discrimination.

Levedahl (1984) compares the proposition of price discrimination by price sensitive types with an alternative rationale: multipart pricing. Under multipart pricing, coupons are used to induce new consumers, and the marginal price is unchanged to the original customers because the coupon offers apply to the first item purchased. In other words, if multipart pricing holds, the full price will be unaffected by the coupon offer. Focusing on 5 brands of the paper towels, Levedahl (1984) uses survey data with an 18-month sample period and shows that the average full price associated with
the use of a coupon is mostly higher than the average full price when no coupon is used, a result that implies a positive relationship between manufacturer’s coupon value and price. Levedahl (1984) also indicates that the use of multiple coupons is consistent with the price discrimination interpretation because coupon sponsors do not restrict the use of coupons to just the first unit purchased.

To formally differentiate the promotional effect from price discrimination brought by cents-off coupons, Levedahl (1986) builds a two-period, profit maximizing model which allows cents-off coupons offered in the first period to have carry-over effect in the second period. The carry-over effect captures habit formation. With no carry-over effect, offering coupons only brings price discrimination. Consumers can then be divided into three segments: brand loyal non-coupon users, brand loyal coupon-users, and non-loyal coupon users. While the full price paid by the loyal non-coupon users is higher than the price with no coupon offered, both loyal and non-loyal coupon users enjoy the discounts from the coupon offers. With positive carry-over effect, the first-period price incorporates both promotion and price discrimination. Both loyal coupon users and non-loyal coupon users enjoy even more price reductions, but the full price paid by the loyal non-coupon users is determined by two forces. On one hand, coupon offers allow the firm to charge a higher full price to the loyal non-coupon users; on the other hand, a higher price lowers the loyal non-coupon
users’ sales in both periods. Therefore, if price discrimination dominates the promotional effect, a positive relationship between the price and coupon value shall be observed. If the promotional effect dominates the price discrimination, a lower full price shall be set so that greater sales can be brought by the loyal non-coupon users.

Dividing markets by regions and populations, Levedahl (1986) focuses on three nationally distributed paper towels and compares the retail price with coupon value to the retail price without coupon value in each market. The results confirm that price discrimination dominates promotional effect in most of markets.

Especially for mature brands in a stable product category such as coffee, Vilcassim et al. (1987) indicate that the manufacturers' coupons are not used to induce incremental sales but to price discriminate customers. Using a scanner panel data recording coffee purchases by 900 households during a two-year period, they test the hypothesis that the percentage of coupon transactions has a positive effect on the mean brand shelf prices. A brand size variable and its square term are introduced to capture the size effect. An indicator variable to distinguish between the NBs and the store brands is used to capture the quality difference. The percentage of transactions involving store advertising, display activities, and the use of store coupons capturing other marketing aspects are also introduced into the model. Applying an ordinary least squares model, they show a positive coefficient on the percentage of transactions for
the brand involving a manufacturer coupon increases, which supports their idea.

2.2.2 Coupons with non-passive retailers

Price discrimination also happens when retailers double manufacturers’ coupons. Hess and Gerstner (1993) use a generalized least squares model to test the hypothesis that price differences between double and single coupon supermarkets are proportional to the value of the doubleable coupons. If price discrimination happens, the price difference should be positively correlated with the coupon face value. Five supermarkets are chosen, where two supermarkets are double coupon ones and the other three are single coupon ones. The shelf price is averaged across all stores that carry the brand. They show that the corresponding shelf price at double coupon supermarkets are 3.5% higher than shelf prices at single coupon supermarkets, which implies that doubling coupon supermarkets use retail coupons to attract price-sensitive customers and raise shelf prices to insensitive, loyal customers. Moreover, double coupon retailers protect themselves from large numbers of doubleable coupons and consumers’ cherry-picking behavior. They also show that double coupon supermarkets tend to price the non-doubleable brands higher than single coupon supermarkets by 1.1% as their price adjustment strategy.

Within a channel consisting of an upstream manufacturer and a downstream retailer, and two segments of consumers, high willingness to pay (highs) and consumers with
low willingness to pay (lows), Gerstner et al. (1994) assume that the manufacturer uses a pull discount, coupons for example, to price discriminate lows from highs. All lows can use the discount at zero costs, while the highs taking advantage of the discount are those whose transaction costs are lower than the discount. In their model, the manufacturer faces a group of competitive retailers and takes the markup percentage as given. The authors indicate that a higher retail markup percentage reduces the manufacturer’s incentive to use price discrimination. This is because with the increase of markup percentage, the manufacturer needs to offer larger coupon value to keep the consumers with low reservation prices in the market, but such offering induces more non-targeted consumers to use it. Therefore, the manufacturer’s best strategy is to reduce both the coupon value and wholesale price.

Gerstner et al. (1994) test the theoretical results by using samples of manufacturers’ coupons from different US cities and across different product categories between April 1990 and October 1991. The measure of the retail markup percentage for each brand is the average retail markup percentage for its product category. Retail prices are adjusted to reflect the price level by the food-at-home consumer price index. Since a larger coupon face value may be used to induce consumers to try new products, a dummy variable is used to identify new-product coupons. A negative relationship between retail markup percentage and manufacturers’ coupon values is confirmed by
simply regressing manufacturer’s coupon value on retail markup percentage, retail price, and the new product dummy.

Taking account of the possibility that the retail markup percentage could be endogenously determined, Gerstner et al. (1994) use two-stage-least-squares models to re-estimate the coefficients. The instruments to predict the retail markup percentage include the retail price, the new-product dummy, the product’s purchase cycle, and a dummy indicating whether the product needs refrigeration or freezing, where the last two variables are served as proxies of merchandising costs. The coefficients for retail markup percentage under two-stage-least-squares analysis remain negative and even become larger in most cities, which once again support their theoretical results.

Under a similar channel structure, Hu et al. (2004) explicitly model the optimal coupon values by allowing both the manufacturer and the retailer to issue coupons. Analyzing both non-cooperative and cooperative couponing strategies between the manufacturer and the retailer, they show that both the manufacturer and the retailer choose to issue coupons under non-cooperative strategies and only one kind of coupons are observed only if cooperative strategies are taken. By comparing the optimal coupon values, Hu et al. (2004) also show that the manufacturer coupon value is strictly larger than the retailer coupon value when non-cooperative coupon strategies are taken. Under cooperative coupon strategies, the sum of coupon value is
equal to the value with only one coupon issuer when non-cooperation strategies are taken.

More importantly, under non-cooperative couponing, manufacturer’s coupons allow the upstream manufacturer to artificially segment the downstream retailer’s sales into sales to highs and sales to lows, and therefore implicitly charge two wholesale prices according to the segment of consumers to whom the retailer sells. The retailer’s coupons also allow the retailer to charge different prices to consumers. This is what Hu et al. (2004) call “the successive third-degree price discrimination” in the channel framework, which implies a positive relationship between the retail price and manufacturer coupon value.

2.3 Private Labels and Coupons

The literature2 hasn’t drawn much attention on directly linking the private labels with different types of coupons except for Sethurman and Mittelstaedt (1992) who discuss how the PL share is impacted by the NB manufacturer couponing activity, the NB store couponing activity, and the PL store couponing activity. They assume four types of consumers in the market: consumers purchase either the NB or the PL, and their purchasing behavior happens in either the focal store or other stores. Six effects can be triggered by a couponing activity. The regular usage effect occurs when some

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2 1 See the previous section and Bergès-Sennou et al. (2004) for detail reviews of private labels.
consumers who own the coupons purchase only the normal quantities just as they have no coupons in hand. The acceleration effect occurs when some consumers who own the coupons tend to purchase more today but less in the subsequent periods. The primary demand effect occurs when some consumers who own coupons increase their demand for the product, or some consumers who are not currently in the market are induced to step in and purchase the product because they own the coupons. Consumers may also switch brands or stores or both because of coupons, effects denoted as the brand switching effect, store switching effect, and brand and store switching effect.

Sethurman and Mittelstaedt (1992) further assume that the PL customers are price-sensitive and they are attracted to purchase NBs when coupons on NBs are issued, while the NB customers are not price-sensitive and they are reluctant to switch to purchase PLs. Modeling assumptions then dictate the relative strength of the above six effects, and Sethurman and Mittelstaedt (1992) expect a strong negative relationship between NB manufacturer couponing activity and PL share, a weaker negative relationship between NB store couponing activity and PL share, and a weak positive relationship between PL store couponing activity and PL share.

Sethurman and Mittelstaedt (1992) use aggregated scanner panel data on 480 product categories in 1988 to construct three measures which represent couponing
activities: unit volume percentage NB sold with manufacturer coupons, unit volume percentage NB sold with store coupons, and unit volume percentage PL sold with store coupons. Taking account of other covariates such as average price difference between PLs and NBs and other promotional activities involving shelf price reduction, features, and displays, they show that manufacturers’ couponing on NBs decreases the PL value market share, the store coupons on the PLs does not impact on the PL value market share, and the store coupons for NBs contributes to the PL value market share. They derive similar results for PL volume market share.

Sethurman and Mittelstädt (1992) therefore infer that manufacturer coupons are used to deter PL penetration and regular consumers of NBs are declined to switch to purchase PLs even when PLs are promoted with store coupons. Besides, as NB manufacturer’s coupons place a negative impact on the PL market share, this provides evidence that manufacturer coupons do successfully price discriminate consumers by offering discounts to attract the customers who were PL buyers.

Note that a positive relationship between NB store coupons and PL market share is contrast to the prediction in Sethurman and Mittelstädt (1992). While they argue that retailers may develop defensive strategies to guard their PLs and more consumers are attracted to come purchasing PLs so that the PL share increases with NB store coupons, the critical point is that their prediction is based on the key assumption that
PL customers are price sensitive and NB customers are price-insensitive. However, as Hoch and Banerji (1993) indicate, since a price discount on the NBs doesn’t significantly lower down the PL share, the major PL customers are not necessarily price-sensitive. Since Dhar and Hoch (1997) also show mixed signs in different food product categories when regressing PL market share on the average price gap between the PLs and the NBs, whether the PL customers are price-sensitive or not remains unknown. In other words, the patterns of different couponing activities on the PL share shown in Sethurman and Mittelstaedt (1992) henceforth deserve further exploration by explicitly modeling the impact of different kinds of coupons in the competition between one NB and one PL and re-examining how PL share changes with the three kinds of coupons. Finally, it is possible that the NB and the PL collude with each other, and therefore, analyses that address both competition and cooperation between the NB and PL are necessary. Steiner (2004) supports this conclusion using evidence in tortilla industry.
Chapter 3 A Model of Competitive Behavior by Food Manufacturer and Retailer

Consider an economy with one food manufacturer, one retailer, and two representative consumers. The manufacturer produces its NB product and sells it to the retailer at wholesale price \( w \). The retailer then re-sells it to the consumers at retail price \( p_N \). Besides the NB product, the retailer can choose to offer consumers its own PL product. The retail price of the PL product is \( p_P \).

The manufacturer and the retailer are allowed to issue the NB coupons to consumers, denoted by \( m \) and \( s_N \) respectively, which equal the price deductions given to consumers at checkout and charged to either the manufacturer or retailer. If the retailer chooses to offer the PL product to consumers, the store coupon for the PL is denoted by \( s_P \). All variable manufacturing costs are assumed constant and the same for both products.\(^3\) For simplicity, let’s assume them to be zero.\(^4\) Fixed costs such as advertising expenses are not modeled in this research.\(^5\)

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\(^3\) Such setting is the same as Mills (1995).

\(^4\) The assumption can be found in Sayman et al. (2002), Scott-Morton and Zettlemeyer (2004), and Du et al. (2006).

\(^5\) Bergès-Sennou et al. (2004) mention that the NB advertising expenses do not cause a barrier for the PL introduction “because the retailer’s reputation is at stake”.
There are two representative consumers: the high-demander (H) and the low-demander (L). The high-demander has a higher willingness to pay for the NB product and for the PL product than the low-demander. The low-demander always searches for coupons and uses them while the high-demander never searches for nor uses coupons. Therefore, the high-demander and the low-demander pay different net prices in purchasing the NB product and the PL product: the former pays at regular retail prices $p_N$ and $p_p$, while the latter pays at lower prices $p_N - m - s_N$ and $p_p - s_p$.\(^6\)

Consumers’ utility functions are characterized as follows.\(^7\)

\[
U^H(q^H_N, q^H_p) = (\alpha^H_N - p_N)q^H_N + (\alpha^H_p - p_p)q^H_p - \frac{1}{2}(\beta^H_N q^H_N^2 + \beta^H_p q^H_p^2 + 2\gamma^H_N q^H_N q^H_p)
\]

and

\[
U^L(q^L_N, q^L_p) = [\alpha^L_N - (p_N - m - s_N)]q^L_N + [\alpha^L_p - (p_p - s_p)]q^L_p - \frac{1}{2}(\beta^L_N q^L_N^2 + \beta^L_p q^L_p^2 + 2\gamma^L_N q^L_N q^L_p).
\]

The superscript $H$ and $L$ represent different types of consumers and the subscript $N$ and $P$ represent the NB and the PL. $q^H_N$ and $q^L_N$ are the quantities of the NB product consumed by the high-demander and by the low-demander, while $q^H_p$ and

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\(^6\) The setting of the two different demanders is similar to Hu et al. (2004).

\(^7\) The setting of the consumers’ utility functions is similar to Choi and Coughlan (2006).
are the quantities of the PL product consumed by the high-demander and the low-demander.

The parameters \((\alpha^H_N, \alpha^L_N, \alpha^H_P, \alpha^L_P)\) inside the above utility functions represent consumers’ willingness to pay. Since the high demander always has higher willingness to pay than the low demander, \(\alpha^H_N > \alpha^L_N\) and \(\alpha^H_P > \alpha^L_P\). The difference between \(\alpha^H_N\) and \(\alpha^L_N\) represents the difference in consumer type, as does the difference between \(\alpha^H_P\) and \(\alpha^L_P\).

In (3.1), an increase in \(\alpha^H_N\) allows the high-demander to enjoy higher marginal utility of consumption of the NB, and an increase in \(\alpha^H_P\) brings the high-demander higher marginal utility of consumption of the PL. As in Choi and Coughlan (2006), this research infers that \(\alpha^H_N\) can be the high-demander’s perception of the intrinsic quality of the NB product, namely \(\alpha_N\). Similarly, \(\alpha^H_P\) can be the high-demander’s perception of the intrinsic quality of the PL product, \(\alpha_P\). From the low-demander’s perspective, his perception of the intrinsic quality of the NB product and the intrinsic quality of the PL product is respectively \(\alpha^L_N\) and \(\alpha^L_P\). The parameters \((\alpha^H_N, \alpha^L_N, \alpha^H_P, \alpha^L_P)\) therefore reflect the products’ intended quality level, based on consumer perceptions. The NB quality level is assumed always higher than the PL quality level, and henceforth \(\alpha^H_N > \alpha^H_P\) and \(\alpha^L_N > \alpha^L_P\). The difference in product
quality is reflected by the difference between $\alpha_N^H$ and $\alpha_P^H$ as well as the difference between $\alpha_N^L$ and $\alpha_P^L$.

This research further assumes that $\alpha_N^H = \alpha_N$, $\alpha_P^H = \alpha_P$, $\alpha_N^L = \alpha_N - d$, and $\alpha_P^L = \alpha_P - d$, where $\alpha_N > \alpha_P > d > 0$. Here, $d$ refers to the difference between the two types of consumers, since $\alpha_N^H - \alpha_N^L = \alpha_P^H - \alpha_P^L = d$. The strictly positive $d$ implies that, for either product, the low-demanders are always willing to pay a lower amount than the high-demanders. More specifically, $\alpha_N^H - \alpha_P^H = \alpha_N^L - \alpha_P^L = \alpha_N - \alpha_P$ implies that both consumers have the same perception of the quality difference between the two products.

Note that the NB quality is assumed fixed at $\alpha_N$ and $\alpha_P \in [\underline{\alpha}, \overline{\alpha}]$, where $\alpha_N > \overline{\alpha}$ and $\overline{\alpha} > d$. The PL quality is upper-bounded by $\overline{\alpha}$, a lower quality than $\alpha_N$, implying that in the short run, while the manufacturer can’t reposition the NB quality level at all, the retailer’s positioning of the PL quality is constrained perhaps by its present technology and the PL can never catch up with the NB in its quality level. The assumption on the lower bound of the PL quality $\underline{\alpha}$ guarantees that the low-demanders have a strictly positive willingness to pay for the PL.

Both of the high-demanders and the low-demanders share the same parameters $\beta_N$, $\beta_P$, and $\gamma_{NP}$ in the settings of this research. The parameters $\beta_N$ and $\beta_P$ represent the rate of decline in consumers’ own-marginal utilities of consuming the
NB product and the PL product, while $\gamma_{NP}$ represents the rate of decline in consumers’ cross-marginal utilities of consuming one product in substitution for the other. Choi and Coughlan (2006) use $\frac{\gamma_p}{\beta_p}$ as a measure of the degree of feature differentiation between the NB and the PL: the higher (lower) the measure, the more (less) the PL imitates the NB in its feature.

Like Choi and Coughlan (2006), this research assumes that people get satiated much easier when consuming the PL than consuming a NB and when continuing consuming the same product than consuming another product. Therefore, $\beta_P > \beta_N > \gamma_{NP}$, where $\beta_N$, $\beta_P$ are fixed and $\gamma_{NP} \in [\gamma, \bar{\gamma}]$. The upper bound $\bar{\gamma}$ implies that the PL can never perfectly imitate the NB. The lower bound $\gamma$ is set so that the PL can never completely differentiate its features from the NB. These assumptions help us to capture the real world situation in which almost all products within the same category share at least some feature resemblance, but one’s features can’t be exactly the same as the features of another.

The game between the manufacturer and retailer proceeds in three stages. In the first stage, observing the NB quality $\alpha_N$, the retailer makes a decision of positioning the PL product in terms of product quality $\alpha_P$ and its feature differentiation from the NB product $\gamma_{NP}$. In the second stage, the manufacturer chooses the wholesale price

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8 The three-stage game is similar to the setting in Bontems et al. (1999).
and coupon value $m$ for the NB with fixed quality level $\alpha_N$ and makes a take-it or leave-it offer. The manufacturer’s profit stems from selling the NB product alone to two types of consumers via the retailer, and therefore its objective function is

$$\max_{w, m} \Omega = wq^H_N + (w-m)q^L_N, \text{ s.t. } m \geq 0 \quad (3.3)$$

In the third stage, the retailer decides whether or not to accept or reject the manufacturer’s proposal (whether or not to sell the NB) and whether or not to introduce the PL. The retailer makes decisions of pricing and couponing on both products by maximizing its profit from selling two products to two types of consumers:

$$\max_{p, p', s, s'} \pi = (p_N - w)q^H_N + (p_p - w)q^H_p + (p_N - s_N)q^L_N + (p_p - s_p)q^L_p, \quad \text{s.t. } s_N \geq 0, s_p \geq 0 \quad (3.4)$$

One should be aware of the fact that the choice variables in (3.3) and (3.4), namely $w, m, p_N, p_p, s_N, s_p$, are functions of the PL positioning variables, $\alpha_p$ and $\gamma_{NP}$, which are chosen in the first stage. To the retailer, its objective in the first stage is therefore to choose an optimal PL position such that its profit presented in (3.4) can be maximized.

The setting of the above game intends to highlight the retailer’s power through its decision of the PL positioning in the first stage. While Bontems et al. (1999) apply the similar model setting by considering the PL quality only, they indicate that, “the
assumption means that choosing the PL quality is more irreversible than setting wholesale and retail prices”. Here in this model, we assume that choosing the PL quality and the degree of feature differentiation are both irreversible, which forms a valid threat to the manufacturer, and therefore impacts on its pricing and couponing strategy in the second stage. Note that the price competition with possibly promotional coupons offered to consumers in the second and the third stage is similar to a manufacturer-Stackelberg game, in which the manufacturer’s decision of the wholesale price $w$ and the coupon value $m$ for the NB product in the second stage is made by anticipating the retailer’s pricing and couponing reaction in the third stage.

Given the decisions made by the manufacturer and the retailer in the first three stages, both consumers respectively maximize their own utility functions, (3.1) and (3.2), by deciding their optimal quantities of consumption for the NB product and the PL product, namely $q^H_N, q^L_N, q^H_P$, and $q^L_P$.

This research also considers the case in which the manufacturer and the retailer take cooperative strategies. This case has two stages. In the first stage, the manufacturer and the retailer maximize the sum of their profits by together deciding the positioning the PL product. In the second stage, they proceed to make decisions of selling the NB product, offering the PL product or not, and pricing and couponing one product or both products. Note that the total coupon value on the NB product is
determined by both the manufacturer and the retailer now. Call this combined value $m^c$, and $m^c = m + s_N$. Conditional on the PL positioning $(\alpha_p, \gamma_{NP})$, the manufacturer and the retailer determine the optimal prices and coupon values by maximizing their total profits:

$$
\text{Max}_{p_N, p_P, m^c, s_P} \pi + \Omega = (p_N)q^H_N + (p_P)q^H_P + (p_N - m^c)q^L_N + (p_P - s_P)q^L_P,
$$

s.t. $m_c \geq 0, s_p \geq 0$ \hspace{1cm} (3.5)

The consumers decide their quantities of consumption based on the decisions made by the manufacturer and the retailer together in the first two stages.

We can solve the above two games and derive the equilibrium solutions conditional on the PL positioning by backward induction. First, maximizing the two consumers’ utility function in (3.1) and (3.2) leads to the two consumers’ demand for both products. Substituting the demand systems into the retailer’s profit maximization problem in (3.4) and solving (3.4), this research derives the retailer’s best responses of retail prices and store coupon values for both products to the NB wholesale price and manufacturer’s coupon value. By taking account of the retailer’s best responses, this research then works backwards and solves the manufacturer’s profit maximization problem in (3.3) for the wholesale price and manufacturer’s coupon value. In cooperative game, this research solves (3.5) directly for the equilibrium prices and

\footnote{Such setting is similar to Hu et al. (2004).}
coupon values. Note that whether or not the retailer should offer the PL will be revealed by the consumers’ final demand for the PL product. A detail procedure is presented in the next chapter. The optimal PL positioning will be explored and solved in Chapter 6 via a numerical example.
Chapter 4 Equilibrium Solutions Conditional on the PL Position

In both the non-cooperative or cooperative game game, this research starts from the “basic” scenario in which both consumer types are willing to purchase both products. Equilibrium solutions for this scenario are derived accordingly. By showing that the conditions to sustain the basic scenario may not always hold, the research proceeds to explore the equilibrium solutions in other scenarios. In particular, we will see that two other scenarios emerge: in one scenario, the high-demander is still willing to consume the PL product whereas the low-demander stops consuming it. The target PL customer in this scenario is therefore the price-insensitive one rather than the price-sensitive one. In the other scenario, both consumers avoid consuming the PL product, and therefore the retailer finds it best not to offer the PL product. We will also see that as consumers are always willing to purchase the NB product, the retailer always accepts the manufacturer’s offer and carries the NB product on its shelves.

Note that here this research uses $\alpha^n_H$, $\alpha^l_H$, $\alpha^n_L$, and $\alpha^l_L$ instead of $\alpha^n$, $\alpha^l$, $\alpha^n - d$ and $\alpha^l - d$ to facilitate the calculation, but the final equilibrium solutions conditional on the PL position will be presented using $\alpha^n$, $\alpha^l$, $\alpha^n - d$, and $\alpha^l - d$. As the equilibrium solutions derived below provide little or no economic intuition, research examining their properties is presented in the next chapter.
4.1 Non-Cooperative Strategies

4.1.1 The “Both Consumers Purchase the PL Product” Scenario

Suppose both consumers are willing to purchase both products. The two consumers’ demand system for the two products can be derived by maximizing the high-demanders utility function in (3.1) and the low-demanders utility function in (3.2):

\[
q_N^H = \frac{1}{\beta_N \beta_P - \gamma_{NP}} [(\alpha_N - p_N) \beta_P + \gamma_{NP} (p_P - \alpha_P)] ,
\]

\[
q_P^H = \frac{1}{\beta_N \beta_P - \gamma_{NP}} [(\alpha_P - p_P) \beta_N + \gamma_{NP} (p_N - \alpha_N)] ,
\]

\[
q_N^L = \frac{1}{\beta_N \beta_P - \gamma_{NP}} [(\alpha_N^L - p_N + m + s_N) \beta_P + \gamma_{NP} (p_P - s_P - \alpha_P^L)] ,
\]

\[
q_P^L = \frac{1}{\beta_N \beta_P - \gamma_{NP}} [(\alpha_P^L - p_P + s_P) \beta_N + \gamma_{NP} (p_N - m - s_N - \alpha_N^L)] . \quad (4.1)
\]

By using the demand systems in (4.1) and solving the retailer’s profit maximization problem in (3.4), the retailer’s best responses to \( w \) and \( m \) can be derived:

\[
p_N = \frac{1}{2}(\alpha_N^H + w), \quad p_P = \frac{1}{2}(\alpha_P^H) ,
\]

\[
s_N = \frac{1}{2}(\alpha_N^H - \alpha_N^L - m), \quad s_P = \frac{1}{2}(\alpha_P^H - \alpha_P^L) \quad (4.2)
\]

Inserting the retailer’s best responses (4.2) into the demand systems (4.1) leads to \( q_N^H, q_N^L, q_P^H \), and \( q_P^L \) as functions of \( w \) and \( m \):

\[
q_N^H = \frac{1}{2(\beta_N \beta_P - \gamma_{NP})} [(\alpha_N^H - w) \beta_P - \gamma_{NP} \alpha_P^H] ,
\]

\[
q_P^H = \frac{1}{2(\beta_N \beta_P - \gamma_{NP})} [\alpha_P^H \beta_N + \gamma_{NP} (w - \alpha_N^H)] ,
\]
\[
q^L_N = \frac{1}{2(\beta_P p_r - \gamma_{NP})}[(\alpha^L_N - w + m)\beta_P - \gamma_{NP}\alpha^L_P],
\]
\[
q^L_P = \frac{1}{2(\beta_P p_r - \gamma_{NP})}[(\alpha^L_P \beta_P + \gamma_{NP}(w - m - \alpha^L_N)].
\]

(4.3)

As quantities in (4.3) are required strictly positive in this scenario, we have

\[
w < \alpha^H_N - \frac{\gamma_{NP}}{\beta_P} \alpha^H_P, \quad (4.4)
\]
\[
w > \alpha^H_N - \frac{\beta_P}{\gamma_{NP}} \alpha^H_P, \quad (4.5)
\]
\[
w < \alpha^L_N + m - \frac{\gamma_{NP}}{\beta_P} \alpha^L_P, \quad (4.6)
\]
\[
w > \alpha^L_N + m - \frac{\beta_P}{\gamma_{NP}} \alpha^L_P. \quad (4.7)
\]

Conditional on \((\alpha_P, \gamma_{NP})\), the equilibrium wholesale price and manufacturer’s coupon value can then be derived by using the retailer’s best responses (4.2) and quantities of consumption (4.3) and solving the manufacture’s profit maximization problem in (3.3):

\[
w = \frac{1}{2}[(\alpha^H_N - \alpha^H_P - \frac{\gamma_{NP}}{\beta_P})], \quad m = \frac{1}{2}[(\alpha^H_N - \alpha^H_P - \frac{\gamma_{NP}}{\beta_P} - (\alpha^H_P - \alpha^L_P)]). \quad (4.8)
\]

For this scenario to hold, note that (4.8) must satisfy the four conditions from (4.4) to (4.7). By substituting (4.8) into the four conditions, one can show that (4.4) and (4.6) always holds; (4.5) holds if \(\frac{a^L_P}{a^L_N} > \frac{\gamma_{NP}}{2(\beta_P p_r - \gamma_{NP})^2}\); (4.7) holds if \(\frac{a^L_P}{a^L_N} > \frac{\gamma_{NP}}{2(\beta_P p_r - \gamma_{NP})^2}\). Since

\[
\frac{a^L_P}{a^L_N} > \frac{a^L_P}{a^L_N},
\]

the condition to guarantee (4.8) is

\[
\frac{a^L_P}{a^L_N} > \frac{\gamma_{NP}}{2(\beta_P p_r - \gamma_{NP})^2}. \quad (4.9)
\]
The equilibrium retail prices and store coupon values in this scenario can then be obtained by substituting the wholesale price and the manufacturer’s coupon in (4.8) into the retailer’s best responses in (4.2).

Note that (4.5) and (4.7) may not always hold, which implies the emergence of the two other scenarios:

1. If \( \frac{a_L}{a_L} \leq \frac{\gamma_{fL}}{2\beta_N - \frac{\alpha_P}{P}} < \frac{a_H}{a_H} \), then (4.7) can’t hold but (4.5) still holds; \( q^H_P \) is still strictly positive but \( q^L_P \) is zero.

2. If \( \frac{a_H}{a_H} \leq \frac{\gamma_{fL}}{2\beta_N - \frac{\alpha_P}{P}} \), then both (4.5) and (4.7) can’t hold; both \( q^H_P \) and \( q^L_P \) are zero.

More specifically, while only the high-demand consumer consumes the PL product in the former scenario, neither type of consumes the PL product in the latter scenario. The two scenarios are discussed in the following two subsections.

### 4.1.2 The “Only the High-Demander Purchases the PL Product”

**Scenario**

Since the low-demand consumer concentrates on consuming the NB product rather than both products in this scenario, his/her demand function for the NB product is derived by simply maximizing his/her utility function in (3.2) with respect to \( q^L_N \) only. The two consumers’ demand systems in this scenario are

\[
q^H_N = \frac{1}{\beta_N \beta_P - \gamma_{fN}} \left[ (\alpha_N - P_N) \beta_P + \gamma_{fP} (P_P - \alpha_P) \right],
\]
\[
q_p^H = \frac{1}{\beta_H \beta_p - \gamma_{wP}} \left[ (\alpha_p - p_p) \beta_N + \gamma_{NP} (p_N - \alpha_N) \right], \\
q_N^L = \frac{1}{\beta_N} (\alpha_N - d - p_N + m + s_N), \\
q_p^L = 0. 
\]

(4.10)

By the two consumers’ demand systems for both products in (4.10), one can derive the retailer’s best responses:

\[
p_N = \frac{1}{2} (\alpha_N^H + w), \quad p_p = \frac{1}{2} (\alpha_p^H), \\
s_N = \frac{1}{2} (\alpha_N^H - \alpha_N^L - m), \quad s_p = 0. 
\]

(4.11)

As \( q_N^H, \ q_P^H, \) and \( q_N^L \) are required strictly positive in this scenario, we have

\[
w < \alpha_N^H - \frac{\gamma_{NP}}{\beta_p} \alpha_p^H 
\]

(4.12)

\[
w > \alpha_N^H - \frac{\beta_N}{\gamma_{NP}} \alpha_p^H 
\]

(4.13)

\[
w - m < \alpha_N^L
\]

(4.14)

As condition (4.7) \( w > \alpha_N^L + m - \frac{\beta_n}{\gamma_{NP}} \alpha_p^L \) can’t hold in this scenario, we need to solve the manufacturer’s profit maximization problem in (3.3) by dealing with the following two cases separately: (1) \( w < \alpha_N^L + m - \frac{\beta_n}{\gamma_{NP}} \alpha_p^L \) and (2) \( w = \alpha_N^L + m - \frac{\beta_n}{\gamma_{NP}} \alpha_p^L \).

One may want to solve case (1) by tackling the manufacturer’s profit maximization problem directly and checking whether the equilibrium solutions satisfy \( w < \alpha_N^L + m - \frac{\beta_n}{\gamma_{NP}} \alpha_p^L \). As for case (2), simply treat \( w = \alpha_N^L + m - \frac{\beta_n}{\gamma_{NP}} \alpha_p^L \) as a constraint for the manufacturer’s profit maximization problem.

\[\text{It’s unnecessary for the retailer to offer coupons if } q_p^L = 0.\]
The manufacturer’s equilibrium wholesale price and coupon value in case (1) are:

\[ w = \frac{1}{2} (\alpha^H_N - \alpha^L_p - \frac{\gamma_{NP}}{\beta_p}), \quad m = \frac{1}{2} (\alpha^H_N - \alpha^L_N - \frac{\gamma_{NP}}{\beta_p} - \alpha^H_p). \]  

(4.15)

For the equilibrium solution (4.15) to hold, one can show that (4.15) satisfies (4.12) and (4.14); (4.15) satisfies (4.13) if \( \frac{\alpha^H_p}{\alpha^L_p} > \frac{\gamma_{NP}}{2\beta_p} \). Thus, the conditions for the equilibrium solutions (4.15) to hold are

\[ \frac{\alpha^H_p}{\alpha^L_p} < \frac{\gamma_{NP}}{2\beta_p}, \quad \alpha^H_N - \alpha^L_N > \frac{\gamma_{NP}}{\beta_p}. \]  

(4.16)

If \( \alpha^H_N - \alpha^L_N \leq \frac{\gamma_{NP}}{\beta_p}, \) one can proceed to derive the manufacturer’s equilibrium wholesale price and coupon value:

\[ w = \frac{1}{2(2\beta_p - \gamma_{NP})^2} \left[ \beta_N (\alpha^H_N - \gamma_{NP} \alpha_p) + \alpha^L_N (\beta_N \beta_p - \gamma_{NP}^2) \right], \]

\[ m = 0. \]  

(4.17)

Note that (4.17) satisfies \( w < \alpha^L_N + m - \frac{\beta_p}{\gamma_{NP}} \alpha^L_p \) if \( \frac{\alpha^H_p}{\alpha^L_p} < \frac{\gamma_{NP}}{2\beta_p} \). \( \text{(4.17) also satisfies conditions (4.12) and (4.14) because } w \leq \frac{1}{2} (\alpha^H_N - \alpha^H_p - \frac{\gamma_{NP}}{\beta_p}). \) \( \text{ Besides, given } \)

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\( \alpha^H_N - \alpha^L_N \leq \frac{\gamma \sigma}{\beta_N \alpha^H_p} \), (4.17) satisfies (4.13) if \( \frac{\alpha_p^L}{\alpha_p^H} > \frac{\gamma \sigma}{2 \beta_N - \frac{\gamma \sigma}{\beta_p}} \). Therefore, the conditions for the equilibrium solutions (4.17) to hold are

\[
\frac{\alpha_p^L}{\alpha_p^H} < \frac{\gamma \sigma}{\beta_N \alpha^H_p} < \frac{\gamma \sigma}{2 \beta_N - \frac{\gamma \sigma}{\beta_p}}, \quad \alpha^H_N - \alpha^L_N \leq \frac{\gamma \sigma}{\beta_p} \alpha^H_p .
\] (4.18)

Now consider case (2) in which \( w = \alpha^L_N + m - \frac{\beta_N}{\gamma \sigma} \alpha^L_p \). The equilibrium wholesale price and manufacturer’s coupon value are

\[
w = \frac{1}{2} \alpha^H_N - \frac{\gamma \sigma}{2 \beta_p} \alpha^H_p, \quad m = \frac{1}{2} \alpha^H_N - \alpha^L_N + \frac{\beta_N}{\gamma \sigma} \alpha^L_p + \frac{\gamma \sigma}{2 \beta_p} \alpha^H_p .
\] (4.19)

If \( \frac{1}{2} \alpha^H_N - \alpha^L_N + \frac{\beta_N}{\gamma \sigma} \alpha^L_p - \frac{\gamma \sigma}{2 \beta_p} \alpha^H_p > 0 \), the manufacturer’s coupon \( m \) in (4.19) is strictly positive. If \( \frac{1}{2} \alpha^H_N - \alpha^L_N + \frac{\beta_N}{\gamma \sigma} \alpha^L_p - \frac{\gamma \sigma}{2 \beta_p} \alpha^H_p \leq 0 \), then the equilibrium wholesale price and manufacturer’s coupon value turn to

\[
w = \alpha^L_N - \frac{\beta_N}{\gamma \sigma} \alpha^L_p, \quad m = 0 .
\] (4.20)

For the equilibrium solutions in (4.19) and (4.20) to hold, one can check conditions (4.12) through (4.14) and show that (4.19) and (4.20) satisfy the three conditions if \( \frac{\alpha_p^L}{\alpha_p^H} \leq \frac{\gamma \sigma}{2 \beta_N - \frac{\gamma \sigma}{\beta_p}} \). Besides, recall that the equilibrium wholesale prices and coupon values in (4.15) and (4.17) satisfy \( w < \alpha^L_N + m - \frac{\beta_N}{\gamma \sigma} \alpha^L_p \) if (and only if) \( \frac{\alpha_p^L}{\alpha_p^H} < \frac{\gamma \sigma}{2 \beta_N} \), which implies \( w = \alpha^L_N + m - \frac{\beta_N}{\gamma \sigma} \alpha^L_p \) if \( \frac{\alpha_p^L}{\alpha_p^H} \geq \frac{\gamma \sigma}{2 \beta_N} \). Therefore, the conditions for the equilibrium solutions in (4.19) to hold are

\[\tag{13}
\]

\[\tag{14}
\]

\[\tag{15}
\]

13 Use \( \alpha^H_N - \alpha^L_N \leq \frac{\gamma \sigma}{\beta_N \alpha^H_p} \), \( w - \alpha^H_N + \frac{\beta_N}{\gamma \sigma} \alpha^H_p \geq \alpha^H_N \beta_N (2 \beta_N \beta_p - \gamma \sigma \alpha^H_p) \). If \( \frac{\alpha_p^L}{\alpha_p^H} \geq \frac{\gamma \sigma}{2 \beta_N \alpha^H_p} \),

14 Use the assumption \( d < \alpha_p \).

15 Note that in the basic scenario, \( w > \alpha^L_N + m - \frac{\beta_N}{\gamma \sigma} \alpha^L_p \) if \( \frac{\alpha_p^L}{\alpha_p^H} > \frac{\gamma \sigma}{2 \beta_N \alpha^H_p} \).
\[
\frac{\gamma_{pN}}{2\beta_N} \leq \frac{a^p_H}{a^N} < \frac{\gamma_{pN}}{2\beta_N}, \quad \frac{1}{2} \alpha^N_N - \alpha^L_N + \frac{\beta_N}{\gamma_{pN}} \alpha^L_p - \frac{\gamma_{pN}}{2\beta_p} \alpha^H_p > 0, \quad (4.21)
\]

while the conditions for the equilibrium solutions in (4.20) to hold are

\[
\frac{\gamma_{pN}}{2\beta_N} \leq \frac{a^p_H}{a^N} < \frac{\gamma_{pN}}{2\beta_N}, \quad \frac{1}{2} \alpha^N_N - \alpha^L_N + \frac{\beta_N}{\gamma_{pN}} \alpha^L_p - \frac{\gamma_{pN}}{2\beta_p} \alpha^H_p \leq 0. \quad (4.22)
\]

Using the four pairs of wholesale price and manufacturer’s coupon value shown in (4.15), (4.17), (4.19), and (4.20), one can derive the equilibrium retail price and store coupon values by substituting each pair into the retailer’s best responses in (4.11).

### 4.1.3 The “Neither Purchases the PL Product” Scenario

In this scenario, both \( q^H_p \) and \( q^L_p \) are zero while both \( q^H_N \) and \( q^L_N \) are still strictly positive. The two demanders’ quantities of consumption on the NB product are

\[
q^H_N = \frac{1}{\beta_N} (\alpha_N - p_N), \quad q^L_N = \frac{1}{\beta_N} (\alpha_N - d - p_N + m + s_N), \quad q^H_p = q^L_p = 0. \quad (4.23)
\]

The retailer’s best responses are

\[
p_N = \frac{1}{2} (\alpha^H_N + w), \quad s_N = \frac{1}{2} (\alpha^H_N - \alpha^L_N - m), \quad p_p = \infty, \quad s_p = 0. \quad (4.24)
\]

Since \( q^H_N \) and \( q^L_N \) are still strictly positive, we have

\[
w < \alpha^H_N, \quad w - m < \alpha^L_N. \quad (4.25)
\]

Condition (4.5), \( w > \alpha^H_N - \frac{\beta_N}{\gamma_{pN}} \alpha^H_p \), can’t hold in this scenario, and therefore we deal with the following two cases: \( w < \alpha^H_N - \frac{\beta_N}{\gamma_{pN}} \alpha^H_p \) and \( w = \alpha^H_N - \frac{\beta_N}{\gamma_{pN}} \alpha^H_p \). In the
first case, simply solving the manufacturer’s profit maximization problem in (3.3) to
derive the equilibrium wholesale price and manufacturer’s coupon values
\[ w = \frac{1}{\alpha} \alpha_N^H, \quad m = \frac{1}{\alpha} (\alpha_N^H - \alpha_N^L). \] (4.26)

One can verify that (4.26) satisfies \( w < \alpha_N^H - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H \) if
\[ \frac{\alpha_P^H}{\alpha_N^H} < \frac{\gamma_\alpha}{2 \beta_\alpha}. \] (4.27)

Note that (4.27) is critical for (4.26) to hold because \( \frac{\alpha_P^H}{\alpha_N^H} < \frac{\gamma_\alpha}{2 \beta_\alpha}. \) 16

When \( w = \alpha_N^H - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H, \) the equilibrium wholesale price and manufacturer’s
coupon value are
\[ w = \alpha_N^H - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H, \quad m = \alpha_N^H - \frac{1}{\alpha} \alpha_N^L - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H. \] (4.28)

By (4.27), we know that \( w < \alpha_N^H - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H \) if (and only if) \( \frac{\alpha_P^H}{\alpha_N^H} < \frac{\gamma_\alpha}{2 \beta_\alpha}. \) Thus,
\[ w = \alpha_N^H - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H \] if (and only if) \( \frac{\alpha_P^H}{\alpha_N^H} \geq \frac{\gamma_\alpha}{2 \beta_\alpha}. \) 17 Besides, manufacturer’s coupon value
\( m \) in (4.28) is strictly positive if \( \alpha_N^H - \alpha_N^L > \frac{2 \beta_\alpha}{\gamma_\alpha} \alpha_P^H - \alpha_N^H. \) 18 Therefore, the
conditions for (4.28) to hold are
\[ \frac{\gamma_\alpha}{2 \beta_\alpha} \leq \frac{\alpha_P^H}{\alpha_N^H} \leq \frac{\gamma_\alpha}{2 \beta_\alpha}, \quad \alpha_N^H - \alpha_N^L > \frac{2 \beta_\alpha}{\gamma_\alpha} \alpha_P^H - \alpha_N^H. \] (4.29)

If \( \alpha_N^H - \alpha_N^L \leq \frac{2 \beta_\alpha}{\gamma_\alpha} \alpha_P^H - \alpha_N^H, \) the equilibrium wholesale price and manufacturer’s
coupon value turn to

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16 Recall that in this scenario, \( \frac{\alpha_P^H}{\alpha_N^H} \leq \frac{\gamma_\alpha}{2 \beta_\alpha}. \)

17 Recall that in the basic scenario, \( w > \alpha_N^H - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H \) if \( \frac{\alpha_P^H}{\alpha_N^H} \geq \frac{\gamma_\alpha}{2 \beta_\alpha}. \)

18 \( m = \alpha_N^H - \frac{1}{\alpha} \alpha_N^L - \frac{\beta_\alpha}{\gamma_\alpha} \alpha_P^H = \frac{1}{\alpha} (\alpha_N^H - \alpha_N^L + \alpha_N^H - \frac{2 \beta_\alpha}{\gamma_\alpha} \alpha_P^H). \)
\[ w = \alpha_N^H - \frac{\beta_w}{\gamma_N^P} \alpha_P^H, \quad m = 0. \]  

(4.30)

The conditions for (4.30) to hold are

\[ \frac{\gamma_N^P}{2\beta_N} \leq \frac{\alpha_N^H}{\alpha_N^L} \leq \frac{\gamma_N^P}{2\beta_N - \frac{1}{\gamma_N^P}} \quad \alpha_N^H - \alpha_N^L \leq \frac{2\beta_N}{\gamma_N^P} \alpha_P^H - \alpha_N^H. \]  

(4.31)

One can verify that the equilibrium solutions in (4.26), (4.28) and (4.30) do satisfy conditions in (4.25).\(^{19}\) Substituting the three pairs of the equilibrium wholesale prices and manufacturer’s coupon values into the retailer’s best responses (4.24) leads to the equilibrium retail prices and store coupon values in this scenario.

### 4.1.4 Summary of Equilibrium Solutions under Non-Cooperative Strategies

By the methods outlined above, the research summarizes the equilibrium prices and coupon values in the game under non-cooperative strategies. Conditional on market parameters and the PL positioning, i.e., the choices of \( \alpha_p \) and \( \gamma_{NP} \), the model yields equilibrium solutions for three scenarios and associated cases:

1. In the “neither purchases the PL product” scenario, there are three cases of equilibrium prices and NB coupon values depending on the PL positioning:

   (1) if \( \frac{\gamma_N^P}{2\beta_N} \leq \frac{\alpha_N^H}{\alpha_N^L} \leq \frac{\gamma_N^P}{2\beta_N - \frac{1}{\gamma_N^P}} \) and \( d > \frac{2\beta_N}{\gamma_N^P} \alpha_P - \alpha_N \), then

\[ w - m < \alpha_N^L \]  

in (4.25), note that when \( \alpha_N^H - \frac{1}{\gamma_N^P} \alpha_N^L - \frac{\beta_N}{\gamma_N^P} \alpha_P^H \leq 0 \),

\[ w - m - \alpha_N^L = \alpha_N^H - \alpha_N^L - \frac{\beta_N}{\gamma_N^P} \alpha_P^H < \alpha_N^H - \frac{1}{\gamma_N^P} \alpha_N^L - \frac{\beta_N}{\gamma_N^P} \alpha_P^H \leq 0. \]  

The rest of proofs are trivial.
w = \alpha_N - \frac{\beta_p}{\gamma_p} \alpha_p, \quad m = \frac{1}{2} \alpha_N + \frac{1}{2} d - \alpha_p \frac{\beta_p}{\gamma_p},

p_N = \alpha_N - \frac{1}{2} \frac{\beta_p}{\gamma_p} \alpha_p, \quad p_p = \infty,

s_N = \frac{1}{2} (\frac{\beta_p}{\gamma_p} \alpha_p - \frac{1}{2} \alpha_N + \frac{1}{2} d), \quad s_p = 0; \quad (4.32)

(2) if \quad \frac{\gamma_p}{2\beta_p} \leq \frac{\alpha_p}{\alpha_N} \leq \frac{\gamma_p}{2\beta_p} \quad \text{and} \quad d \leq \frac{2\beta_p}{\gamma_p} \alpha_p - \alpha_N, \quad \text{then}

w = \alpha_N - \frac{\beta_p}{\gamma_p} \alpha_p, \quad m = 0,

p_N = \alpha_N - \frac{1}{2} \frac{\beta_p}{\gamma_p} \alpha_p, \quad p_p = \infty,

s_N = \frac{1}{2} d, \quad s_p = 0; \quad (4.33)

(3) if \quad \frac{\alpha_p}{\alpha_N} < \frac{\gamma_p}{2\beta_p}, \quad \text{then}

w = \frac{1}{4} \alpha_N, \quad m = \frac{1}{2} d,

p_N = \frac{3}{4} \alpha_N, \quad p_p = \infty,

s_N = \frac{1}{4} d, \quad s_p = 0; \quad (4.34)

2. In the “only the high-demander purchases the PL product” scenario, there are four cases of equilibrium prices and NB coupon values:

(1) if \quad \frac{\gamma_p}{2\beta_p} \leq \frac{\alpha_p - d}{\alpha_N - d} \leq \frac{\gamma_p}{2\beta_p} \quad \text{and} \quad d < \frac{\gamma_p}{\beta_N - \gamma_p} \left( \frac{2\beta_p \beta_p - \gamma_p^2}{2 \gamma_p \gamma_p} \alpha_p - \frac{1}{2} \alpha_N \right), \quad \text{then}

w = \frac{1}{4} (\alpha_N - \alpha_p \frac{\gamma_p}{\gamma_p}), \quad m = d \left( 1 - \frac{\beta_p}{\gamma_p} \right) - \frac{1}{2} \alpha_N + \frac{2\beta_p \beta_p - \gamma_p^2}{2 \gamma_p \gamma_p} \alpha_p - \frac{1}{2} \alpha_N,

p_N = \frac{1}{4} (3\alpha_N - \alpha_p \frac{\gamma_p}{\gamma_p}), \quad p_p = \frac{1}{2} (\alpha_p),

s_N = \frac{1}{2} \frac{\beta_p}{\gamma_p} d + \frac{1}{4} \left( \alpha_N - \frac{2\beta_p \beta_p - \gamma_p^2}{\beta_P \gamma_p} \alpha_p - \frac{1}{2} \alpha_N \right), \quad s_p = 0; \quad (4.35)

(2) if \quad \frac{\gamma_p}{2\beta_p} \leq \frac{\alpha_p - d}{\alpha_N - d} \leq \frac{\gamma_p}{2\beta_p} \quad \text{and} \quad d \geq \frac{\gamma_p}{\beta_N - \gamma_p} \left( \frac{2\beta_p \beta_p - \gamma_p^2}{2 \gamma_p \gamma_p} \alpha_p - \frac{1}{2} \alpha_N \right), \quad \text{then}

w = \alpha_N - \alpha_p \frac{\beta_p}{\gamma_p} + \left( \frac{\beta_p}{\gamma_p} - 1 \right) d, \quad m = 0,
\[ p_N = \alpha_N - \frac{1}{2} [d + \frac{\beta_N}{\gamma_{NP}} (\alpha_p - d)], \quad p_p = \frac{1}{d} (\alpha_p), \]

\[ s_N = \frac{1}{2} d, \quad s_p = 0; \quad (4.36) \]

**3. If** \( \frac{\alpha_p - d}{\alpha_N - d < \frac{\gamma_{NP}}{\gamma_{PP}} < \frac{\gamma_{NP}}{\gamma_{PP}} < \alpha_N} \) \( \text{and} \quad \alpha_p \frac{\gamma_{NP}}{\gamma_{PP}} < d \), \( \text{then} \)

\[ w = \frac{1}{2} (\alpha_N - \alpha_p \frac{\gamma_{NP}}{\gamma_{PP}}), \quad m = \frac{1}{2} (d - \frac{\gamma_{NP}}{\gamma_{PP}} \alpha_p), \]

\[ p_N = \frac{1}{2} (3\alpha_N - \alpha_p \frac{\gamma_{NP}}{\gamma_{PP}}), \quad p_p = \frac{1}{d} (\alpha_p), \]

\[ s_N = \frac{1}{2} (d + \frac{\gamma_{NP}}{\gamma_{PP}} \alpha_p), \quad s_p = 0; \quad (4.37) \]

**4. If** \( \frac{\alpha_p - d}{\alpha_N - d < \frac{\gamma_{NP}}{\gamma_{PP}} < \frac{\gamma_{NP}}{\gamma_{PP}} < \alpha_N} \) \( \text{and} \quad \alpha_p \frac{\gamma_{NP}}{\gamma_{PP}} \geq d \), \( \text{then} \)

\[ w = \frac{1}{2} \frac{1}{(2\beta_N \beta_p - \gamma_{NP})} [\beta_N (\alpha_N \beta_p - \gamma_{NP} \alpha_p) + (\alpha_N - d)(\beta_N \beta_p - \gamma_{NP}^2)], \quad m = 0, \]

\[ p_N = \frac{1}{2} \alpha_N + \frac{1}{\alpha(2\beta_N \beta_p - \gamma_{NP})} [\beta_N (\alpha_N \beta_p - \gamma_{NP} \alpha_p) + (\alpha_N - d)(\beta_N \beta_p - \gamma_{NP}^2)], \quad p_p = \frac{1}{d} (\alpha_p), \]

\[ s_N = \frac{1}{2} d, \quad s_p = 0; \quad (4.38) \]

3. In the “both of the consumers purchase the PL product” scenario, if \( \frac{\gamma_{NP}}{\gamma_{PP}} < \frac{\alpha_p - d}{\alpha_N - d} \), \( \text{then} \)

\[ w = \frac{1}{2} (\alpha_N - \alpha_p \frac{\gamma_{NP}}{\gamma_{PP}}), \quad m = \frac{1}{2} d (1 - \frac{\gamma_{NP}}{\gamma_{PP}}), \]

\[ p_N = \frac{1}{2} (3\alpha_N - \alpha_p \frac{\gamma_{NP}}{\gamma_{PP}}), \quad p_p = \frac{1}{d} (\alpha_p), \]

\[ s_N = \frac{1}{2} (d + \frac{\gamma_{NP}}{\gamma_{PP}} \alpha_p), \quad s_p = \frac{1}{2} d. \quad (4.39) \]

Note that the equilibrium quantities conditional on the PL position can be derived by substituting the equilibrium prices and coupon values into the consumers’ demand systems in the three different scenarios. Here, the research lists only the equilibrium
quantities for both products in the scenario where both consumers are willing to consume both products:

\[ q^H_N = \frac{1}{\rho_n \rho_p - \gamma_{np}} \left( \alpha_N \beta_p - \alpha_p \gamma_{np} \right), \]

\[ q^H_p = \frac{1}{\rho_n \rho_p - \gamma_{np}} \left( \alpha_p \left(2\beta_N - \frac{\gamma_{np}^2}{\beta_p}\right) - \alpha_N \gamma_{np} \right), \]

\[ q^L_N = \frac{1}{\rho_n \rho_p - \gamma_{np}} \left(\left( \alpha_N - d \right) \beta_p - \left(\alpha_p - d \right) \gamma_{np} \right), \]

\[ q^L_p = \frac{1}{\rho_n \rho_p - \gamma_{np}} \left(\left( \alpha_p - d \right) \left(2\beta_N - \frac{\gamma_{np}^2}{\beta_p}\right) - \left(\alpha_N - d \right) \gamma_{np} \right). \] (4.40)

### 4.2 Cooperative Strategies

Starting with the basic scenario in which both of the consumers consume both products, we can use consumers’ demand systems in (4.3) and solve the joint profit maximization problem in (3.5) to derive the equilibrium prices and coupon values.\(^{20}\)

In particular, substituting the equilibrium prices and coupon values into the demand systems leads to the equilibrium quantities of consumption in this scenario:

\[ q^H_N = \frac{1}{2(\rho_n \rho_p - \gamma_{np})} \left( \alpha_N^H \beta_p - \alpha_p^H \gamma_{np} \right), \]

\[ q^H_p = \frac{1}{2(\rho_n \rho_p - \gamma_{np})} \left( \alpha_p^H \beta_N - \alpha_N^H \gamma_{np} \right), \]

\[ q^L_N = \frac{1}{2(\rho_n \rho_p - \gamma_{np})} \left( \alpha_N^L \beta_p - \alpha_p^L \gamma_{np} \right), \]

\[ q^L_p = \frac{1}{2(\rho_n \rho_p - \gamma_{np})} \left( \alpha_p^L \beta_N - \alpha_N^L \gamma_{np} \right). \] (4.41)

One can show that the quantities in (4.41) are all not guaranteed strictly positive. In particular, \( q^H_N \) and \( q^L_N \) are always strictly positive; \( q^H_p \) is strictly positive if

\(^{20}\) Simply replace \( m + s_N \) with \( m^p \)
\[
\frac{a_p^N}{a_N^N} > \frac{\gamma_p}{\beta_p}; \quad q_p^L \text{ is strictly positive if } \frac{a_p^N}{a_N^N} > \frac{\gamma_p}{\beta_p}. \quad \text{Since } \frac{a_p^N}{a_N^N} > \frac{a_p^L}{a_N^L}, \text{ the critical condition for } (4.41) \text{ to hold is } \frac{a_p^N}{a_N^N} > \frac{\gamma_p}{\beta_p}.
\]

As \( q_p^H, q_p^L > 0 \) may not always hold, we have the other two scenarios:

1. If \( \frac{a_p^N}{a_N^N} \leq \frac{\gamma_p}{\beta_p}, \) then \( q_p^H \) is still strictly positive while \( q_p^L \) is zero.

2. If \( \frac{a_p^N}{a_N^N} \leq \frac{\gamma_p}{\beta_p}, \) both \( q_p^H \) and \( q_p^L \) are zero.

The equilibrium prices and coupon values and quantities of consumption in the two scenarios can be easily derived by using the consumers’ demand systems in (4.10) and (4.23) and solving the profit maximization problem in (5).

The equilibrium solutions under cooperative strategies are summarized as follows.

1. In the “neither purchases the PL product” scenario, if \( \frac{a_p^N}{a_N^N} \leq \frac{\gamma_p}{\beta_p}, \) then

\[
p_N = \frac{1}{2}(\alpha_N), \quad p_P = \infty, \quad m^c = \frac{1}{2}d, \quad s_P = 0,
\]

\[
q_N^H = \frac{a_p^N}{2\beta_p}, \quad q_p^H = 0, \quad q_N^L = \frac{a_p^L}{2\beta_p}, \quad q_p^L = 0. \quad (4.42)
\]

2. In the “only the high-demander purchases the PL product” scenario, if

\[
\frac{a_p^N-d}{a_N^N-d} \leq \frac{\gamma_p}{\beta_p} < \frac{a_p^N}{a_N^N},
\]

then

\[
p_N = \frac{1}{2}(\alpha_N), \quad p_P = \frac{1}{2}(\alpha_P), \quad m^c = \frac{1}{2}d, \quad s_P = 0,
\]

\[
q_N^H = \frac{1}{2(\beta_P\beta_P - \gamma_{NP})}(\alpha_P^H - \alpha_N^H \gamma_{NP}), \quad q_p^H = \frac{1}{2(\beta_P\beta_P - \gamma_{NP})}(\alpha_P^H \beta_N - \alpha_N^H \gamma_{NP}),
\]

\[
q_N^L = \frac{a_p^L}{2\beta_p}, \quad q_p^L = 0. \quad (4.43)
\]

3. In the “both of the consumers purchase the PL product” scenario, if \( \frac{\gamma_p}{\beta_p} < \frac{a_p^N-d}{a_N^N-d}, \) then
\[ p_N = \frac{1}{2}(\alpha_N), \quad p_P = \frac{1}{2}(\alpha_P), \quad m^c = \frac{1}{2}d, \quad s_P = \frac{1}{2}d, \]

\[ q^H_N = \frac{1}{2(\beta_N \beta_P - \gamma_N \gamma_P)}(\alpha^H_N \beta_P - \alpha^H_P \gamma_{NP}), \]

\[ q^H_P = \frac{1}{2(\beta_N \beta_P - \gamma_N \gamma_P)}(\alpha^H_P \beta_N - \alpha^H_N \gamma_{NP}), \]

\[ q^L_N = \frac{1}{2(\beta_N \beta_P - \gamma_N \gamma_P)}(\alpha^L_N \beta_P - \alpha^L_P \gamma_{NP}), \]

\[ q^L_P = \frac{1}{2(\beta_N \beta_P - \gamma_N \gamma_P)}(\alpha^L_P \beta_N - \alpha^L_N \gamma_{NP}). \quad (4.44) \]
Chapter 5 Investigation of Equilibrium Solutions Conditional on PL Positioning

This research proceeds to investigate the properties of the equilibrium solutions conditional on the PL position. In particular, under either strategies taken by the manufacturer and the retailer, the target customer(s) of the PL can be identified by the consumers’ final demand for the PL product. The manufacturer under non-cooperative strategies has different strategic reactions to the PL positioning, and its pricing and couponing depends on which way the reaction takes. Because the conditional analytic solutions are complex, numerical analyses are used to demonstrate the patterns of the manufacturer’s pricing and couponing, and to help derive the patterns of the retailer’s NB pricing and couponing. The pricing and couponing for the NB product and the PL product under cooperative strategies can be inferred by the equilibrium solutions directly. This chapter, therefore, has two main goals: First, it investigates how the target customer changes as the PL positioning changes. Second, it investigates how manufacturer’s pricing and couponing strategically changes as PL quality (feature differentiation) changes holding feature differentiation (PL quality) fixed.
5.1 Target Customer of the PL

In last chapter, we’ve seen the emergence of three different scenarios in a range of the PL positioning no matter what strategies are taken: the “no one consumes the PL product” scenario, the “only the high-demander consumes the PL product” scenario, and the “both consumers consume the PL product” scenario. Let’s rename the three scenarios in order by Scenario 0, Scenario 1, and Scenario 2.

Our goal is to understand why the high-demander becomes the sole PL customer in Scenario 1 while the low-demander starts to consume the PL in Scenario 2. We begin, therefore, by checking the conditions by which each of the three scenarios can be sustained, looking first at non-cooperative strategies:

Scenario 0: if \( \frac{\alpha_P}{\alpha_N} \leq \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} \), then \( q_N^H > 0 \), \( q_N^L > 0 \), \( q_P^H = 0 \), and \( q_P^L = 0 \);

Scenario 1: if \( \frac{\alpha_P - d}{\alpha_N - d} \leq \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} \), then \( q_N^H > 0 \), \( q_N^L > 0 \), \( q_P^H > 0 \), and \( q_P^L = 0 \);

Scenario 2: if \( \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} < \frac{\alpha_P - d}{\alpha_N - d} \), then \( q_N^H > 0 \), \( q_N^L > 0 \), \( q_P^H > 0 \), and \( q_P^L > 0 \).

We can see that for a fixed \( \gamma_{NP} \), the high-demander starts to consume the PL product if \( \alpha_P > \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} \alpha_N \), and the low-demander starts to consume the PL product if

\[
\alpha_P > (1 - \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}})d + \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} \alpha_N, \quad \text{where} \quad (1 - \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}})d + \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} \alpha_N > \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} \alpha_N \quad \text{since} \quad d > 0 \quad \text{by assumption.} \]

On the other hand, for a fixed \( \alpha_P \), since \( \frac{\gamma_{NP}}{2\beta_N - \frac{\gamma_{NP}}{\beta_P}} \) is strictly increasing in \( \gamma_{NP} \), we can infer that the high-demander starts to consume the PL
product if \( \gamma_{NP} < \gamma_1 \) and the low-demandter starts to consume the PL product if \( \gamma_{NP} < \gamma_2 \), where \( \gamma_1 > \gamma_2 \).

Under cooperative strategies, the conditions for Scenario 0, Scenario 1, and Scenario 2 are respectively \( \frac{a_P}{a_N} \leq \frac{\gamma_P}{\gamma_N} \), \( \frac{a_P - d}{a_N - d} \leq \frac{\gamma_P}{\gamma_N} \), and \( \frac{\gamma_P}{\gamma_N} < \frac{a_P - d}{a_N - d} \). Thus, for a fixed \( \gamma_{NP} \), the high-demandter starts to consume the PL product if \( \alpha_P > \frac{\gamma_P}{\gamma_N} \alpha_N \), and the low-demandter starts to consume the PL product if \( \alpha_P > (1 - \frac{\gamma_P}{\gamma_N}) d + \frac{\gamma_P}{\gamma_N} \alpha_N \). For a fixed \( \alpha_P \), the high-demandter starts to consume the PL product if \( \gamma_{NP} < \beta_N \frac{a_P}{a_N} \) and the low-demandter starts to consume the PL product if \( \gamma_{NP} < \beta_N \frac{a_P - d}{a_N - d} \). Given that the high-demandter is the price-insensitive consumer and the low-demandter is the price-sensitive consumer, Result 1 summarizes the above findings and provides some intuition.

**Result 1.** Under either non-cooperative strategies or cooperative strategies,

(1) for a fixed level of PL quality, a larger degree of feature differentiation is required for the price-sensitive consumer than for the price-insensitive consumer to consume the PL product.

(2) for a fixed degree of feature differentiation, a higher PL quality is required for the price-sensitive consumer than for the price-insensitive consumer to consume the PL product.
(3) for a fixed level of PL quality, if the degree of feature differentiation is not large enough to induce the price-insensitive consumer to purchase the PL product, then neither consumer type will consume the PL product.

(4) for a fixed degree of feature differentiation, if the PL quality is not high enough to induce the price-insensitive consumer to purchase the PL product, then neither consumer type will consume the PL product.

Result 1 can be illustrated by Figure 1 and Figure 2, the maps of the target customers under two different strategies which are based on the following numerical example: \( \alpha_N = 3.03 \), \( \beta_N = 1.01 \), \( \beta_p = 2 \), \( d = 0.7 \), \( \alpha_p \in [1.02,3.02] \), and \( \gamma_{np} \in [0.005,1.005] \). The X axis is the degree of feature differentiation between the NB and the PL, where 0 denotes a PL that is very similar to the NB and 200 denotes a PL that is very distinctive from the NB. The Y axis is the PL quality, where 0 denotes a very low PL quality relative to the NB quality and 200 denotes a PL quality that is very close to the NB quality. For example, the point \((0,0)\) denotes \((\alpha_p,\gamma_{np}) = (1.02,1.005)\) and the point \((200,200)\) denotes \((\alpha_p,\gamma_{np}) = (3.02,0.005)\).

The lower dark triangle refers to the PL position in which neither consumer type consumes the PL, the less dark area in the middle refers to the PL position in which the target customer of the PL is the high-demander, and the upper least dark area refers to the PL position in which all consumers purchase the PL product. Figure 2,
which applies to cooperative strategies, is similar to Figure 1 in many ways. Result 1 is confirmed by both figures.

**Figure 1: Target Customers of the PL (Non-Cooperative strategies)**

![Figure 1](image1.png)

**Figure 2: Target Customers of the PL (Cooperative strategies)**

![Figure 2](image2.png)
5.2 Pricing and Couponing under Non-Cooperative Strategies

5.2.1 Manufacturer’s NB Pricing and Couponing

Based on the equilibrium results in Chapter 4 for the wholesale price and manufacturer’s coupon value, the manufacturer basically reacts to the retailer’s PL positioning in five ways with respect to the wholesale price and manufacturer’s coupon value.

1. Propose a wholesale price and a manufacturer’s coupon value just as if there were no PL.

2. Propose a wholesale price and a manufacturer’s coupon value to deter the retailer from offering the PL.

3. Propose a wholesale price and a manufacturer’s coupon value taking into account that the high-demander is the only PL customer.

4. Propose a wholesale price and a manufacturer’s coupon value to deter the low-demander from purchasing the PL.

5. Propose a wholesale price and a manufacturer’s coupon value taking into account that the PL customers are the high-demander and the low-demander.

In particular,

(1) if \( \frac{\alpha_r}{\alpha_h} < \frac{\gamma_p}{\beta_h} \), then the manufacturer takes the 1st way;
(2) if \( \frac{\gamma \sigma}{2 \beta_y} \leq \frac{\alpha}{\alpha_0} \leq \frac{\gamma \sigma}{2 \beta_y - \frac{\gamma \sigma}{\beta_y}} \), then the manufacturer takes the 2\(^{nd}\) way;

(3) if \( \frac{\alpha_0 - d}{\alpha_0 - d} < \frac{\gamma \sigma}{2 \beta_y} < \frac{\gamma \sigma}{2 \beta_y - \frac{\gamma \sigma}{\beta_y}} \), then the manufacturer takes the 3\(^{rd}\) way;

(4) if \( \frac{\gamma \sigma}{2 \beta_y} \leq \frac{\alpha_0 - d}{\alpha_0 - d} \leq \frac{\gamma \sigma}{2 \beta_y - \frac{\gamma \sigma}{\beta_y}} < \frac{\alpha}{\alpha_0} \), then the manufacturer takes the 4\(^{th}\) way; and

(5) if \( \frac{\gamma \sigma}{2 \beta_y - \frac{\gamma \sigma}{\beta_y}} < \frac{\alpha_0 - d}{\alpha_0 - d} \), then the manufacturer takes the 5\(^{th}\) way.

Continuing the numerical example above, we demonstrate the manufacturer’s strategies in Figure 3. As before, the X axis refers to the degree of feature differentiation between the PL and the NB, while the Y axis refers to the level of PL quality. Zone I is the area in which the manufacturer takes the 1\(^{st}\) way of reaction, and similar notation and logic apply to Zones II through V. A boundary between two adjacent zones refers to the threshold beyond which the manufacturer changes its way of reaction.

**Figure 3:** Manufacturer’s Five Zones of Reaction
Connecting Figure 3 with Figure 1, we can see that Zone I and Zone II correspond to the area where the PL is not offered; Zone III and Zone IV correspond to the area where only the high-demander is the target customer of the PL; Zone V is equivalent to the area where all consumers consume the PL product.

We know that the final demand for the PL product in Scenario 1 is zero, and intuitively, the retailer doesn’t offer the PL in Scenario 1. However, one should note that since Zone I is the area where the manufacturer acts as if there were no PL, the retailer doesn’t offer PL in Zone I because the PL product quality must be too poor and/or the PL product looks too similar to the NB for the retailer to sell it. In contrast, in Zone II the manufacturer takes the 2nd way of reacting to deter the PL entry because the retailer, facing a monopoly price, might introduce the PL. That is, in Zone II it is the manufacturer’s strategies that successfully deter the PL entry.

In Scenario 2, which covers Zones III and IV, the high-demander is the sole PL customer. However, the outcomes in Zones III and IV stem from different reactions from the manufacturer. In Zone III, the high-demander starts to consume the PL product and the manufacturer simply acts by taking account of the fact. However, in Zone IV, if the manufacturer still sets wholesale price and coupon value and acts as if it was in Zone III, the low-demander might be induced to consume the PL product. The manufacturer takes the 4th way to successfully prevent the low-demander from
consuming the PL product in Zone IV. In Scenario 3, since both consumers are attracted to consume the PL, the manufacturer simply takes the 5\textsuperscript{th} way.

Except for regions with a very high (low) PL quality or a very large (small) degree of feature differentiation, where the manufacturer takes the 5\textsuperscript{th} (1\textsuperscript{st}) way, a sufficient increase in the PL quality or a sufficient increase in the degree of feature differentiation alone can drive the manufacturer to change its strategic reaction.

Our next step, therefore, is to explore how the wholesale price and manufacturer’s coupon value behave in the five zones with different target customer(s) of the PL, conditional on variations of PL quality levels and degrees of feature differentiation. However, one should note that while the manufacturer has five strategic reactions to the PL positioning, it may choose not to offer coupons especially in Zone II, Zone III, and Zone IV. To see this, let’s re-draw the manufacturer’s strategies in Figure 4 by adding another criterion: whether the manufacturer offers NB coupons or not. The eight zones from Zone A to Zone H correspond to the manufacturer’s five ways of reactions. In particular, recognize that Zone A equals Zone I; Zone B plus Zone C equals Zone II; Zone D plus Zone E equals Zone III; Zone F plus Zone G equals Zone IV; Zone H equals Zone V. Note that Zone C, Zone D, and Zone F are the areas where the manufacturer does not offer NB coupons when taking the 2\textsuperscript{nd}, the 3\textsuperscript{rd}, and the 4\textsuperscript{th} way of reaction. These three zones generally correspond to cases where the PL
is positioned with PL quality not high enough and very small degree of feature differentiation.

To completely demonstrate the patterns of pricing and couponing, we further explore the numerical example. First, we concentrate on the areas where the manufacturer always offers NB coupons and, next, we pick the parameter values to ensure the manufacturer’s strategic reactions can all appear. Lastly, we pick other parameter values to check how the patterns of couponing and pricing change especially in the three zones where no manufacturer’s coupon is offered.

**Figure 4: Manufacturer’s Reaction to the PL Positioning**

A Variation in the PL Quality

Let’s fix the degree of feature differentiation by setting $\gamma_{NP} = 0.745$, which corresponds to $x = 52$ on the X-axis scale. Figure 5 depicts the manufacturer’s
strategies as it responds to variation in the PL quality: its couponing strategy is shown in the upper plot and its pricing strategy is shown in the lower plot.

**Figure 5: Manufacturer’s NB Couponing & NB Pricing –**

**Coupons Offered (γ_{NP} = 0.745)**

In Zone I, where the PL quality is too low for the retailer to offer the PL, the manufacturer sets the wholesale price and the NB coupon as if there were no pressure of the PL entry. As the PL quality increases, in Zone II, the retailer’s option to offer the PL becomes a threat to the manufacturer, and the manufacturer decreases its wholesale price to foreclose the PL sales. With the decrease of the wholesale price, the manufacturer can’t afford to offer coupons with large face value to the low-demander anymore, and therefore it decreases the manufacturer’s coupon face value.
As the PL quality gets even higher, it becomes better for the manufacturer to accommodate the PL entry. In Zone III, as the high-demander starts to consume the PL product, the intense competition between the NB and the PL causes the manufacturer to decrease the NB wholesale price, and manufacturer’s coupon value drops accordingly.

However, as the PL quality becomes high enough, the low-demander starts to be attracted by the PL, and in Zone IV the manufacturer increases the coupon value on purpose to prevent the low-demander from consuming the PL product. The wholesale price keeps decreasing in Zone IV. In this zone, the coupon value is the appropriate strategic tool to target the low-demander.

As the PL quality becomes really high, it’s not profitable for the manufacturer to stop the low-demander from purchasing the PL product with an even larger coupon value. In Zone V, the low-demander starts to consume the PL product and the manufacturer’s coupon is not impacted by the PL quality any more. From this example, we see that the overall competitive landscape between the manufacturer and the retailer changes as PL quality increases while holding feature differentiation fixed. Because quality increases generate increasing interest from different consumer types in turn, we see that it is often the coupon value that becomes the most effective response.
In a second example, we raise $\gamma_{NP}$ from 0.745 to 0.885 to re-examine the above patterns of the manufacturer’s pricing and couponing under circumstances when the manufacturer doesn’t offer coupons. With $\gamma_{NP} = 0.885$ corresponding to $x = 24$ on the X-axis scale, Figure 6 depicts the manufacturer’s strategies with a variation in the PL quality. In the upper plot, we can see that the manufacturer offers no coupons from the latter part of Zone II to the initial part of Zone IV. Recall that in Figure 5, the manufacturer’s coupon value decreases with the PL quality in Zone II. A similar pattern still holds in Figure 6. However, the pattern in Figure 5 that the manufacturer decreases coupon value in Zone III completely disappears in Figure 6, since no manufacturer’s coupon is offered in Zone III now.

**Figure 6: Manufacturer’s NB Couponing & NB Pricing –**

**Coupons Not Always Offered ($\gamma_{NP} = 0.885$ )**
The lower plot of Figure 6 shows the manufacturer’s pricing for this example when manufacturer’s coupons are not offered in Zone III. The pattern mostly coincides with the one in Figure 5 except the two discontinuance points in the beginning of Zone III and Zone IV. The discontinuity reflects that the manufacturer changes its pricing policy when the manufacturer’s coupon is not offered.

Recall that Zone IV corresponds to the area where the manufacturer tries to prevent the low-demander from consuming the PL product by offering coupons with larger face value. The lower plot of Figure 6 shows that wholesale price decreases faster in the initial part of Zone IV than in the rest part of Zone IV. As the initial part of Zone IV refers to the place in which the manufacturer’s coupon is not offered, Figure 6 suggests that when manufacturer’s coupons are not offered, the manufacturer decreases the wholesale price at a larger degree to prevent the low-demander’s switching.

A Variation in the Degree of Feature Differentiation

By setting $\alpha_p = 1.35$, which corresponds to $y = 33$ on the Y-axis scale, we present a third example, this time with PL quality fixed. Figure 7 therefore represents the manufacturer’s strategies as the degree of feature differentiation varies. In Zone I, as the PL imitates the NB and has little differentiation in features, the manufacturer undertakes no threat of the PL entry and therefore the manufacturer’s coupon and the
wholesale price remain at a monopoly level. The PL threat occurs in Zone II where the degree of feature differentiation gets larger, which forces a concession of the wholesale price and a decrease in the manufacturer’s coupon value.

**Figure 7: Manufacturer’s NB Couponing & NB Pricing –**

**Coupons Offered** \( (\alpha_p = 1.35) \)

The manufacturer finds it more profitable to accommodate the PL when the degree of feature differentiation becomes even larger. The manufacturer’s coupon and the wholesale price start to increase when entering Zone III because a larger feature differentiation between the PL and the NB in fact diminishes the competition between the PL and the NB and allows the manufacturer to increase the NB wholesale price as well as the manufacturer’s coupon.
While the degree of feature differentiation between two products increases further in Zone IV, the low-demandeer feels attracted to consuming the PL product for diversity, and the manufacturer feels the threat of the switching low-demandeer. Therefore, while a larger feature differentiation between two products allows the manufacturer to increase its wholesale price and its coupon value, the manufacturer has to offer coupons with an even larger face value to keep the low-demandeer loyal to the NB product. Here again we see that coupons are the most effective strategic tool when faced with a potential switch by consumer type.

The manufacturer eventually can’t prevent the low-demandeer from consuming the PL product when the features of the PL product become really distinctive from that of the NB product. In Zone V, while the manufacturer continues to increase the coupon value and the wholesale price due to larger and larger feature differentiation, the slope of the manufacturer’s coupon now is not as steep as the slope in Zone IV. This change occurs because the manufacturer finds it unnecessary to offer manufacturer’s coupons priced to retain the loyal customer since the low-demandeer is now no longer loyal to the NB product in Zone V.

In our fourth example, we increase the PL quality from $\alpha_p = 1.35$ to $\alpha_p = 1.72$, which corresponds to $y = 70$ on the Y-axis scale, Figure 8 represents the manufacturer’s pricing and couponing in response to the degree of feature
differentiation when manufacturer’s coupons may not be always offered. In the upper plot, the manufacturer doesn’t offer coupons from the lower part of Zone II through the whole Zone III to the initial part of Zone IV. Parts of Figure 8 are similar to Figure 7. As before, the manufacturer decreases (increases) NB coupon with the degree of feature differentiation in Zone II (Zone IV) where manufacturer’s coupons are still offered.

Figure 8: Manufacturer’s NB Couponing & NB Pricing –

Coupons Not Always Offered ($\alpha_p = 1.72$)

The lower plot of Figure 8 shows two substantial differences from Figure 7. First, we see the discontinuities occur again in the beginning of Zone III and Zone IV. Second, while the wholesale price increases with the degree of feature differentiation in Zone III through Zone V, we see a decrease in price in the initial part of Zone IV.
where the manufacturer’s coupon is not offered. Here, the manufacturer lowers the wholesale price in response of the increase in the feature differentiation when manufacturer’s coupons are not offered. Recall that in Figure 7 where the manufacturer can offer coupons with a larger face value and therefore increases the wholesale price through Zone IV; here, the manufacturer turns to lower the wholesale price to prevent the low-demander from switching to consume the PL product.

By the above examples, we can see that the manufacturer does react differently to the PL positioning in terms of its pricing \((w)\) and couponing \((m)\) strategy. The manufacturer reacts to the threat of the PL entry by decreasing the NB wholesale price to deter the PL entry, no matter the threat comes from an increase in the PL quality or the degree of feature differentiation. The manufacturer turns to accommodate the PL entry as the PL quality becomes high enough or the degree of feature differentiation becomes large enough; however, the impact of the PL quality on the NB price is contrast to the impact of the degree of feature differentiation. The manufacturer is shown to decrease the NB coupon value under the threat of the PL entry, but its couponing strategy after the PL entry depends on the target PL customer of the PL. Even when the manufacturer stops offering coupons under certain circumstances, its pricing strategy basically holds, except that the manufacturer intends to deter the
price-sensitive consumer from switching not by offering manufacturer’s coupons to
the price-sensitive consumer but by decreasing the wholesale price instead.

5.2.2 Retailer’s NB Pricing and Couponing

After the manufacturer’s strategic reaction to the PL positioning, it’s the retailer’s
turn to decide (i) whether or not to offer the NB and/or the PL, and (ii) the retail
prices and coupon values for the two products. In other words, after the
manufacturer’s move, there are four strategic decisions for the retailer to make: \( p_N \),
\( s_N \), \( p_P \), and \( s_P \). While the latter two decisions refer to the retailer’s PL pricing and
couponing strategy and shall be discussed in the next sub-section, here in this
sub-section we focus on the former two decisions, the retailer’s NB pricing and
couponing strategy.

The retailer’s NB pricing strategy can be inferred from its best response of the retail
NB price to the wholesale price. Specifically, \( p_N = \frac{1}{2}(\alpha_N + w) \) in all of the three
scenarios. Thus, how the retailer’s NB pricing changes with the PL position in terms
of the PL quality and the degree of feature differentiation can be directly inferred
from the pattern of the manufacturer’s pricing in Figure 5 through Figure 8.

Figure 9 represents the retailer’s NB couponing strategy \( s_N \) when manufacturer’s
coupons are always offered. The upper plot shows its couponing as the PL quality
increases (feature differentiation fixed) and the lower plot shows its couponing as the
degree of feature differentiation increases (PL quality fixed). Comparing Figure 9 to Figure 5 allows us to compare the retailer’s couponing with the manufacturer’s couponing. We can see that as the manufacturer decreases (increases) the manufacturer’s coupon, the retailer simply increases (increases) its own NB coupon value. The same result is found if we compare the retailer’s couponing with the manufacturer’s couponing in a variation of the degree of feature differentiation by re-examining Figure 9 in light of Figure 7.

**Figure 9: Retailer’s NB Couponing –**

*When Manufacturer’s Coupons Are Always Offered*

This result arises because the retailer’s best response for its NB coupon is given by $\frac{1}{2}(d - m)$. The retailer always offers store coupons on the NB product in an opposite direction to the manufacturer’s coupon. In fact, given the consumer type difference
$d$, after the manufacturer’s decision of NB coupon value $m$, the retailer simply further price-discriminates consumers by using NB retail coupons.

Figure 10 shows the retailer’s NB pricing and couponing for circumstances when manufacturer’s coupons are not always offered. Recall that in Figure 6, as the PL quality varies, the manufacturer doesn’t offer coupons in the entirety of Zone III. Since the retailer’s NB couponing is based on the manufacturer’s couponing behavior, we know that the pattern of the increasing retailer’s couponing in Zone III is supposed to disappear because the manufacturer’s coupon is zero, which is confirmed by the upper plot in Figure 10. The lower plot in Figure 10 also shows the opposite pattern of the manufacturer’s couponing in Figure 8.

**Figure 10: Retailer’s NB Couponing –
Manufacturer’s Coupons Not Always Offered**
After combining the manufacturer’s strategies and the retailer’s strategies for the
NB product, we are now able to offer the following results that summarize the above
findings.

**Result 2.** Under non-cooperative strategies, even though the consumer type
differences exist, the manufacturer may stop offering coupons

(1) when the PL places a threat of entry on the NB;

(2) when the PL is targeted at the price-insensitive consumer only.

**Result 3.** Under non-cooperative strategies, when the PL entry becomes a threat to the
NB,

(1) for circumstances when manufacturer’s coupons are always offered, the PL
threat always drives the manufacturer to lower manufacturer’s coupon, and the retailer
responds by raising its NB store coupon.

(2) the manufacturer always lowers the wholesale price, and the retailer responds by
raising its NB retail price, no matter manufacturer’s coupons are offered or not.

**Result 4.** Under non-cooperative strategies, for a fixed PL quality, as the degree of
feature differentiation increases,

(1) for circumstances when manufacturer’s coupons are always offered, the
manufacturer always increases its own coupon value, and the retailer responds by
decreasing its NB store coupon;
(2) the manufacturer increases the wholesale price, and the retailer responds by raising its NB retail price except when the manufacturer tries to prevent the price-sensitive consumer from consuming the PL product and manufacturer’s coupons are not offered. In this last case, the manufacturer decreases the wholesale price and the retailer responds by lowering its NB retail price.

**Result 5.** Under non-cooperative strategies, for a fixed degree of feature differentiation,

(1) if the PL quality is high enough to induce the price-insensitive consumer but not the price-sensitive consumer to consume the PL product, then the manufacturer decreases manufacturer’s coupon as PL quality increases, and the retailer increases its NB store coupon as PL quality increases when manufacturer’s coupons are offered;

(2) if the PL quality is high enough to induce the price-sensitive consumer but the manufacturer tries to prevent it from switching, the manufacturer always increases the manufacturer’s coupon and the retailer responds by decreasing its NB store coupon when manufacturer’s coupons are offered;

(3) if the PL quality is so high that the manufacturer finds it unprofitable to stop the price-sensitive consumer from consuming the PL product, then the manufacturer’s coupon and the retailer’s NB store coupon remain unaffected by the PL quality;
(4) the manufacturer always decreases the wholesale price as the PL quality increases, and the retailer decreases the NB retail price accordingly. If manufacturer’s coupons are not offered and the manufacturer tries to prevent the price-sensitive consumer from switching, the decrease in the wholesale price and the NB retail price becomes even larger.

A common thread in the above results is that the manufacturer’s couponing strategy and the retailer’s NB couponing strategy successively price discriminate the high-demander from the low-demander, and the retailer’ NB pricing strategy simply passes the manufacturer’s NB pricing through. The results, therefore, stem from the retailer’s position as a second mover in the manufacturer-Stackelberg game.

5.2.3 Retailer’s PL Pricing and Couponing

As the low-demander starts to consume the PL product in Zone V, it is necessary for the retailer to offer PL store coupons only in Zone V. Moreover, given that the optimal PL price is $P = \alpha_2$ and the optimal PL coupon is $d = \frac{1}{2}d$, we have Result 6.

**Result 6.** Under non-cooperative strategies,

1. there is no PL store coupon offered if the PL is targeted at the price-insensitive consumer;

2. the retailer’s PL price is determined by the PL quality only: the higher the quality, the higher the PL price;
(3) the retailer’s PL coupon is neither related to the PL positioning nor related to its price. It is determined by the difference in consumer type: the larger the difference, the larger the PL coupon value.

5.3 Cooperative Strategies

By the equilibrium prices and coupon values shown in Chapter 4, we know that when the manufacturer cooperates with the retailer, the rules of pricing and couponing for the NB product remain the same across the three scenarios: the NB price is $\frac{1}{2}\alpha_N$ and the NB coupon value is $\frac{1}{2}d$. The rules of pricing and couponing for the PL product are also unchanged in the second and the third scenario: the PL price is $\frac{1}{2}\alpha_P$ and the PL coupon value is $\frac{1}{2}d$. Recognize that the PL price and PL coupon value here are exactly the same as those under non-cooperative strategies.

We therefore have Result 7 and Result 8.

**Result 7.** Under cooperative strategies,

(1) the NB price relates to the NB quality only; the higher the NB quality, the higher the NB price.

(2) the NB coupon value relates to the consumer type difference only; the higher the difference between the consumer types, the higher the NB coupon value.

**Result 8.** Whether the manufacturer cooperates with the retailer or not doesn’t impact the PL price or PL coupon value: the PL price and coupon value under cooperative
strategies are exactly the same as the price and coupon level under non-cooperative strategies.

In summary, Chapter 5 shows that under non-cooperative strategies, the manufacturer changes its way of reaction to the PL positioning in terms of wholesale price and manufacturer’s coupon value, which in turn affects the retailer’s decision of offering the PL or not and how to price and coupon the NB product. The target PL customer(s) is(are) therefore varied with the PL position at which the retailer chooses in the first beginning. In contrast, under cooperative strategies, the rules of pricing and couponing on the NB remain the same no matter where the PL is positioned and whether the PL is offered. One thing shared by non-cooperative strategies and non-cooperative strategies is the rule of pricing and couponing the PL product.
Chapter 6 Optimal PL Position

As Chapter 5 explores the properties of the equilibrium solutions conditioning on the PL position, the remaining question is the following: where should the PL be positioned? This chapter explores the optimal PL position under the two different strategies by continuing the numerical example in Chapter 5. In particular, given a range of PL quality and the degree of feature differentiation, the optimal PL positioning under non-cooperative strategies is determined by the acme of the retailer profit in the range, while the optimal PL positioning under cooperative strategies is determined by the acme of the joint profit in the range. This chapter will show the somewhat surprising result for non-cooperative strategies that the retailer never positions the PL in some areas. Furthermore, even when the retailer is allowed to position the PL such that the PL product would be purchased by the consumer(s), the retailer may find it best to position the PL in the areas where not offering the PL at all is its optimal choice.

6.1 Non-Cooperative strategies

In the non-cooperative game, a PL position is optimal if the chosen PL quality and the chosen degree of feature differentiation maximize the retailer’s profit. Thus, in a plot of the retailer profit as a function of PL quality and degree of feature
differentiation, the PL position that corresponds to the acme of the retailer profit function is the retailer’s optimal choice. Figure 11 draws the retailer’s profit with the same parameters used in the numerical analyses in Chapter 5: $\alpha_N = 3.03$, $\beta_N = 1.01$, $\beta_p = 2$, $d = 0.7$, $\alpha_p \in [1.02, 3.02]$, and $\gamma_{NP} \in [0.005, 1.005]$. Obviously, the acme occurs in the position with the highest PL quality and the largest feature differentiation. The result suggests that, without restrictions on the PL quality and the degree of feature differentiation, the retailer always offers the PL and positions it at the highest PL quality and the largest degree of feature differentiation.

Figure 11: Retailer’s Profit

However, the PL quality may be constrained by the retailer’s present technology and a large degree of feature differentiation from the incumbent NB product may not be appreciated by consumers. Therefore, how the retailer chooses the optimal PL
position within a narrower range of the PL position is the focus of this chapter. In particular, recall that in the last chapter that we’ve shown that the manufacturer strategically reacts to the PL positioning in the second stage of the non-cooperative game, prior to the retailer’s choice of offering the PL or not and its pricing and couponing on both products in the third stage. Therefore, we are going to explore the retailer’s optimal choice of the PL positioning by sticking to the numerical example and answering the following questions in the next two sub-sections:

1. Within each zone of the manufacturer’s reaction, how does the retailer choose the optimal PL positioning?

2. Across zones of the manufacturer’s reaction, how does the retailer choose the optimal PL positioning?

To answer the first question, we begin by showing how the retailer profit changes with PL quality and the degree of feature differentiation within each zone of the manufacturer’s reaction. We then proceed to answer the second question by allowing the retailer to freely choose the PL positioning in a range, where different zones of the manufacturer’s reactions may be covered. More specifically, while answering the first question helps us to find out the acme of the retailer’s profit inside each of the zones and demonstrate the retailer choice of the optimal PL positioning corresponding to each of the manufacturer’s reactions, the acmes in these zones do not necessarily
represent the retailer’s optimal choice in a given range of the PL positioning. In other words, answering the second question helps us to find the acme of the retailer profit across different zones, and ultimately the optimal PL position. As the later sub-section will show, the retailer therefore never positions the PL in some zones since the acmes of these zones are always dominated by the acmes of the other zones.

6.1.1 The Optimal PL Position Within Each Zone of Manufacturer’s Reaction

In a zone of the manufacturer’s reaction, for a fixed degree of feature differentiation, if the retailer profit is increasing in PL quality, then its optimal choice of PL quality is always the highest PL quality level within the zone. Figure 12 shows how the retailer profit changes with PL quality in the zones of the manufacturer’s strategic reactions. In each zone, if $\frac{\partial \pi}{\partial t_r} > 0$, then we assign the symbol “+” to the zone; if $\frac{\partial \pi}{\partial t_r} < 0$, we assign the symbol “-“ to the zone; if $\frac{\partial \pi}{\partial t_r} = 0$, we assign the symbol “0” to the zone. In other words, the symbol “+”, “-“, and “0” respectively refers to the positive, negative, and zero impact of the PL quality on the retailer profit holding the degree of feature differentiation fixed.

The zones, which were named Zone A through Zone H, are now renamed. Zone A0 is the area in which the retailer’s profit doesn’t change with the PL quality (or feature
differentiation) since the manufacturer takes the 1st way of action as if there were no PL. Zone B+ through Zone H+ refer to the areas in which the retailer profit increases with PL quality and therefore the retailer always pursues for positioning the PL at the highest possible PL quality within these zones.

**Figure 12: Retailer Profit in a Variation of PL Quality**

(Within Each Zone of Manufacturer’s Reaction)

Similarly, in each zone of the manufacturer’s reaction, for a fixed PL quality, we can check how retailer profit changes as PL-NB feature differentiation increases. In particular, in the areas where the retailer profit decreases (increases) with PL-NB differentiation, the retailer should position the PL as closely to (far from) the NB as possible. Since an decrease in $\gamma_{NP}$ refers to an increase in the degree of PL-NB feature differentiation, in each zone, if $\frac{\partial \pi}{\partial \gamma_{NP}} < 0$, then we assign the symbol “+” to the
zone; if \( \frac{\partial \pi}{\partial y_{pr}} > 0 \), then we assign the symbol “-” to the zone; if \( \frac{\partial \pi}{\partial y_{pr}} = 0 \), then we assign the symbol “0” to the zone. Therefore, the symbols “0”, “+”, and “-” are used to reveal whether the retailer profit doesn’t change, increases, or decreases as the degree of feature differentiation increases. Figure 13 shows the plot of the change of the retailer’s profit in the degree of feature differentiation within each zone. The areas that were previously named from Zone A to Zone H are renamed with symbols “0”, “+”, and “-” attached.

Recall that in Figure 4, Zone A is the area in which the PL can’t cause any pressure on the PL while Zone B and Zone C are the areas in which the PL places a threat on the NB. Here in Figure 13, Zone A0, Zone B+, and Zone C+ imply that for a fixed PL quality, the retailer’s profit doesn’t change with the degree of feature differentiation when the PL can’t cause any pressure on the NB but the retailer’s profit increases as the degree of feature differentiation increases in the areas where the PL threatens the NB.

Zone D and Zone E in Figure 4 refer to the areas in which the manufacturer takes the 3rd way of reaction, i.e., where the manufacturer’s pricing and couponing is formed by taking into account that the high-demander is the target customer of the PL product, and the manufacturer offers NB coupons in Zone E but not in Zone D. In Figure 13, Zone D- refers to the area in which the retailer’s profit decreases with the
degree of feature differentiation especially when manufacturer’s coupons are not
offered. In the areas where the manufacturer offers NB coupons, while Zone E-
implies that the retailer’s profit doesn’t always increase with PL-NB differentiation,
the retailer benefits from larger PL-NB differentiation especially in Zone E+ where
the PL quality is very low and the feature of the PL is very different from the NB.

**Figure 13: Retailer Profit in a Variation of PL-NB Feature Differentiation**

(Within Each Zone of Manufacturer’s Reaction)

Zone F and Zone G in Figure 4 are the areas in which the manufacturer takes the 4th
way of reaction, i.e. preventing the low-d launderer from consuming the PL product,
and manufacturer’s coupons are offered in Zone G but not in Zone F. Zone F- and
Zone G+ in Figure 13 therefore suggest that the retailer profit decreases (increases)
with PL-NB differentiation without(with) manufacturer’s coupons offered in the areas
where the manufacturer’s reaction to the PL positioning is to deter the low-demander from switching.

Zone H- and Zone H+ are the areas in which the manufacturer takes the 5th way of action and the target customer of the PL product include the high-demander and the low-demander. For a fixed PL quality, Zone H- and Zone H+ imply that there exists a threshold lying between the two zones beyond which the retailer’s profit turns to increase with the degree of feature differentiation.

By the symbols shown in Figure 13, we can see that the retailer profit doesn’t always increase with the PL-NB differentiation even in the zones where the same manufacturer’s strategic reaction is taken. In the zones without manufacturer’s coupons offered, the retailer profit is shown to decrease with the PL-NB differentiation when the PL is offered.

6.1.2 The Optimal PL Positioning Across Zones of Manufacturer’s Reaction

According to the model developed in Chapter 3, the retailer picks the position which corresponds to the maximum of its profit within a range of PL position in terms of PL quality and the degree of feature differentiation. That is, given a range of the PL position $[\alpha, \bar{\alpha}] \times [\gamma, \bar{\gamma}]$, the retailer positions the PL at $(\alpha^*, \gamma^*)$ such that $(\alpha^*, \gamma^*)$
maximizes its profit within the range. For example, one can show by numerical calculation that given the range of the PL position \([1.02, 2] \times [0.005, 1.005]\), the retailer simply maximizes its profit at \((\alpha^*, \gamma^*) = (2, 0.005)\).

Staying with the numerical example used in the previous chapter where \(\alpha = 1.02\), \(\bar{\alpha} \in [1.02, 3.02]\), \(\gamma \in [0.005, 1.005]\), and \(\bar{\gamma} = 1.005\), we demonstrate the retailer’s optimal choice of the PL positioning in Figure 14. Zone \(O_1\), Zone \(O_2\), and Zone \(O_3\) are the available areas in which the PL product is offered and positioned, including, while Zone \(N_1\) and Zone \(N_2\) are the areas in which the PL product can be positioned but is never offered and Zone \(N_3\), Zone \(N_4\) and Zone \(N_5\) are the areas in which the PL product can never be positioned.

**Figure 14: Retailer’s Optimal PL Position**

*(Across Zones of Manufacturer’s Reaction)*
In particular, mapping the areas in which the retailer will position the PL with the manufacturer’s strategic reactions in Figure 4, we recognize that in Zone O₁, the manufacturer takes the 4\textsuperscript{th} way of reaction and offers NB coupons and the target customer of the PL product is the high-demander. In Zone O₂ and Zone O₃, the manufacturer takes the 5\textsuperscript{th} way of reaction and both the high-demander and the low-demander are the target customers of the PL product. In Zone N₁ and Zone N₂, the manufacturer takes the 1\textsuperscript{st} and the 2\textsuperscript{nd} way of reaction respectively and both consumers are unwilling to consume the PL product.

In Figure 14, Zone N₃, Zone N₄ and Zone N₅ are the areas in which the PL product can never be positioned. In other words, for any position in one of the three zones, the retailer can always replace it with another PL position so that its profit can be increased. Mapping these areas with the manufacturer’s strategy in Figure 4, we find that Zone N₃ encompasses the whole area in which the manufacturer takes the 3\textsuperscript{rd} way of reaction, and part of areas in which the 4\textsuperscript{th} or the 5\textsuperscript{th} way of reaction might be taken. In other words, the retailer never positions the PL in the areas where the manufacturer takes the 3\textsuperscript{rd} way of reaction. Particularly in Zone N₃, we also find that the retailer never positions the PL in the areas where the manufacturer might take the 4\textsuperscript{th} way of reaction but avoids offering NB coupons. Nor does the retailer position the PL in Zone N₄ and Zone N₅ where the manufacturer will take the 5\textsuperscript{th} way of reaction.
To explain the results in Figure 14, we go examine the retailer’s optimal choice of PL quality across zones of manufacturer’s reactions. We find that except in Zone N₁ where the retailer’s profit is not changed with the PL position, the retailer always positions the PL product at the highest possible PL quality in Zone O₁, Zone O₂, Zone O₃, and Zone N₂. While the retailer doesn’t position the PL product in Zone N₃, Zone N₄, and Zone N₅, numerical results also show that the positions in these zones are replaced by those with the same PL quality but different degree of feature differentiation. This implies that it is not PL quality but rather the PL-NB feature differentiation that brings out the pattern of the PL positioning in Figure 14.

Our next task is therefore to check the retailer’s optimal PL-NB feature differentiation across zones of the manufacturer’s reaction. A simultaneous examination of both Figure 14 and Figure 11 may illustrate these across-zone comparisons. By numerical results, Zone N₃ is dominated by the upper boundary of Zone N₂, Zone N₄ is dominated by the upper boundary of Zone O₁, and Zone N₅ is dominated by the upper boundary of Zone O₃. That is, for a given (upper bound of) PL quality, even when the retailer was able to position the PL at which the consumer(s) is(are) willing to make purchases, it would rather position the PL at smaller degree of feature differentiation. Moreover, since Zone N₂ is the area where
the PL is not offered, the retailer rather positioning the PL in N2 in stead of N3 implies that the manufacturer’s strategies to deter the PL entry do work!

As for the areas in which the retailer would position the PL, numerical results also show that the retailer’s choice is to differentiate as much as possible in Zone O1, Zone O2 and Zone N2. However, the retailer finds it better to position the PL as closely to the NB as possible in Zone O3. The retailer is indifferent to positioning anywhere in Zone N1 since its profit remains the same in this whole area. In fact, since the pattern of the PL positioning in Figure 14 is mainly determined by PL-NB feature differentiation, the retailer’s choice across zones of manufacturer’s reaction can be explained by Figure 13, the retailer’s choice within each zone of manufacturer’s reaction. Specifically, mapping Figure 14 with Figure 13, we can see that Zone O1, Zone O2 and Zone N2 are respectively encompassed by Zone G+, Zone H+, Zone B+, and Zone C+, which implies that the retailer should pursue for the largest PL-NB feature differentiation in these areas. The emergence of Zone O3 comes from the fact that the retailer seeks to decrease PL-NB feature differentiation in Zone H-. Zone N1 is exactly equal to Zone A0, and therefore the retailer’s choice is irrelevant to the degree of feature differentiation in this area.

The above findings are summarized in Result 9, Result 10, and Result 11.
**Result 9.** Under non-cooperative strategies, without constraints on the PL quality and the degree of feature differentiation between two products, the retailer always strives to offer the PL and position it at the highest quality and the largest degree of feature differentiation.

**Result 10.** Under non-cooperative strategies, with constraints on the PL quality and the degree of feature differentiation between two products, the PL may not be offered

1. if the PL quality is low, unless the PL can differentiate itself from the NB a lot;

2. even when the PL can be positioned such that only the price-insensitive consumer or both of the price-insensitive consumer and the price-sensitive consumer are attracted to consuming the PL product.

**Result 11.** Under non-cooperative strategies, with constraints on the PL quality and the degree of feature differentiation between two products,

1. the retailer always pursues positioning the PL at the highest possible PL quality except when the PL can’t cause any pressure on the NB;

2. if the retailer can position the PL very differently from the NB, no matter what PL quality level is, it positions the PL such that the PL is offered and both the price-insensitive consumer and the price-sensitive consumer are willing to consume it;
(3) if the retailer can’t position PL very differently from the NB and nor can it position PL at high quality level, it differentiates the PL from the NB to a degree such that the PL is offered but only the price-insensitive consumer buys the PL product while the price-sensitive consumer is still prevented from consuming the PL product;

(4) if the retailer can position PL quality at a high enough level but can’t differentiate the PL from the NB a lot, the retailer rather positions the PL as closely to the NB as possible such that the PL is offered and the price-sensitive consumer still consumes the PL product.

6.2 Cooperative Strategies

In the cooperative game, the optimal PL position is determined jointly by the manufacturer and the retailer. In other words, the optimal PL position under cooperative strategies corresponds to the acme of the joint profit. Figure 15 depicts the joint profit function, and obviously, without constraints on the PL positioning, the acme appears at position with the highest PL quality and the largest degree of feature differentiation, which is the same as the result under non-cooperative strategies.
Figure 15: Joint Profit

Figure 16: Joint Profit

(A Variation in PL Quality & A Variation in PL-NB Feature Differentiation)
Examining the partial differentiation of the joint profit on $\alpha_P$ and $\gamma_{NP}$, Figure 16 below shows that the joint profit always increases with $\alpha_P$ but decreases with $\gamma_{NP}$. As a smaller $\gamma_{NP}$ means a larger PL-NB feature differentiation, we can infer from Figure 16 that the impact of PL quality and that of PL-NB feature differentiation on the joint profit are similar: the joint profit increases with the PL quality when holding PL-NB feature differentiation constant and increases with PL-NB feature differentiation when holding PL quality constant in Scenario 1 and Scenario 2; however, a change in PL quality and a change in PL-NB feature differentiation doesn’t affect the joint profit in Scenario 0.

Figure 16 therefore explains why the acme of the joint profit occurs at the position with the highest PL quality and the largest degree of feature differentiation in Figure 15. Moreover, Figure 16 also suggests that even under restrictions on PL positioning, still, the PL product should be positioned at the highest possible PL quality and the largest possible degree of feature differentiation.

By the above findings, we have Result 12.

**Result 12.**

(1) Without constraints on the PL quality and the degree of feature differentiation, whether the manufacturer cooperates with the retailer or not doesn’t impact on the optimal PL position.
(2) With constraints on the PL quality and the degree of feature differentiation, under cooperative strategies, the optimal PL position always occurs at the highest possible PL quality and the largest degree of feature differentiation.

In summary, Chapter 6 shows the optimal PL positions under non-cooperative strategies and cooperative strategies. While the PL could be positioned more closely to the NB feature under non-cooperative strategies, it is always better for the PL to be positioned at higher PL quality no matter what strategies are taken.\(^{21}\)

\(^{21}\) Note that this result holds because here the unit variable manufacturing cost is assumed zero. As Choi and Coughlan (2006) indicate, “when it is costly to increase private label quality, minimum quality differentiation will not always be the best decision”, and interior quality solutions will be obtained.
Chapter 7 PL Expansion under Non-Cooperative Strategies

Before we start with another new topic in this chapter, a brief review will be helpful. By using the numerical example, we’ve seen in Chapter 6 that under non-cooperative strategies, the retailer positions the PL and offers it only in certain areas. Tracing back to Chapter 5, we also know that the target customers of the PL product vary in different areas where the manufacturer strategically reacts to the retailer’s PL positioning by taking different ways. Therefore, a complete picture of the game under non-cooperative strategies can be drawn by linking the PL positioning in the first stage with the manufacturer’s reaction in the second stage, the retailer’s decision of offering the PL or not in the third stage, and the consumers’ purchases in the final stage, which is shown in Figure 17.
In Figure 17, the retailer eventually offers the PL product only in the white areas where the manufacturer may take the 4th way of reaction to deter the low-demander from consuming the PL product, or it may take the 5th way and set prices and coupons of the NB product by taking into account that the PL customers include both the high-demander and the low-demander.

Continue using the numerical example, this chapter goes further to examine how PL expansion is driven by PL positioning in terms of PL quality and PL-NB feature differentiation. In particular, two measures are constructed to capture PL expansion: a value PL market share which is defined by $\frac{p_p (q_p^L + q_L^P)}{p_N (q_N^L + q_L^P)} + p_p (q_p^L + q_L^P)$ and a volume PL market share which is defined by $\frac{q_p^L + q_L^P}{q_N^L + q_L^P}$. Since prices and quantities of the two products are in fact functions of PL quality ($\alpha_p$) and PL-NB feature differentiation
(γ_{NP}), we can show the impacts on PL value market share (MS_{value}) and PL volume market share (MS_{volume}) by checking \( \frac{\partial MS_{value}}{\partial \gamma_{NP}} \), \( \frac{\partial MS_{volume}}{\partial \gamma_{NP}} \), and \( \frac{\partial MS_{volume}}{\partial \gamma_{NP}} \) in the areas where the PL is offered.

This chapter proceeds to re-examine the relationship between PL market share and the varieties of coupons found in Sethurman and Mittelstaedt (1992). Recall that Sethurman and Mittelstaedt (1992) construct three measures to represent couponing activities: unit volume percentage NB sold with manufacturer coupons, unit volume percentage NB sold with store coupons, and unit volume percentage PL sold with store coupons. These authors show that manufacturers’ couponing decreases PL value(volume) market share, NB store couponing increases PL value(volume) market share, and PL store couponing doesn’t impact on PL value(volume) market share. Here, in this research, we investigate couponing activities by focusing on “coupon value”, including manufacturer’s coupon \( m \), retailer’s NB coupon \( s_N \), and retailer’s PL coupon \( s_P \). As Chapter 5 also shows that the three types of coupons are primarily driven by PL quality and PL-NB differentiation, it is therefore natural for us to use PL quality and PL-NB feature differentiation and bridge PL expansion and couponing activities. In other words, we intend to examine how PL positioning impacts on PL market shares first, and then, by connecting the impacts with how
coupon values change with the PL positioning, we are able to describe the relationship between PL expansion and the three kinds of coupons.

### 7.1 PL Market Shares and PL Positioning

Figure 18 and Figure 19 respectively show the impact of PL quality and PL-NB feature differentiation on PL market shares. In Figure 18, while the retailer only offers the PL product and positions it in the least dark areas, for a fixed $\gamma_{NP}$, an increase in $\alpha_p$ always drives both PL value market share and PL volume market share to increase. In other words, PL market shares increase as PL quality increases.

**Figure 18: PL Expansion**

*(A Variation in PL Quality)*
Figure 19: PL Expansion

(A Variation in PL-NB Feature Differentiation)

On the other hand, in Figure 19, when the PL is offered, for a fixed $\alpha_p$, both PL value market share and PL volume market decrease as $\gamma_{NP}$ increases. An exception to this finding occurs in the dark area on the upper right plot, where PL value market share turns to increase as $\gamma_{NP}$ increases. Note the oval part in Figure 19 where the PL could be positioned right at the smallest PL-NB differentiation. Then a small change in $\gamma_{NP}$ doesn’t impact on PL market shares because the retailer never deviates from positioning the PL along the line.

Since PL-NB feature differentiation increases as $\gamma_{NP}$ decreases, Figure 19 suggests that PL market shares increase as PL-NB feature differentiation increases in most areas where the PL can be positioned and offered. Especially in the area with
high PL quality and large PL-NB feature differentiation, PL value market share turns to decrease with PL-NB feature differentiation but PL volume market share remains increasing with PL-NB feature differentiation.

Mapping Figure 18 and Figure 19 with target PL customer(s) shown in Figure 17 therefore suggest Result 13 and Result 14.

**Result 13.** For a given fixed degree of feature differentiation, both PL value market share and PL volume market share increase as PL quality increases, no matter who the PL customer(s) is(are).

**Result 14.** For a given PL quality, PL value market share and PL volume market share increase as PL-NB feature differentiation increases when the price-insensitive consumer is the only PL customer. When both the price-insensitive consumer and the price-sensitive consumer are the PL customers, PL value market share decreases with PL-NB feature differentiation only when PL quality is high and PL-NB feature differentiation is really large, but PL volume market still increases with PL-NB feature differentiation.

### 7.2 PL Expansion & Coupons

By Figure 17, we know that the manufacturer takes either the 4th way of reaction with manufacturer’s coupons offered or the 5th way of reaction in the areas where the PL could be positioned, and the PL customer may include only the high-demand or
both consumers. By Chapter 5, we know that these areas are encompassed in Zone IV and Zone V, and by Result 4 and Result 5 and Result 6, we already know the couponing patterns in Zone IV and Zone V:

1. for a given fixed PL-NB feature differentiation, with an increase in the PL quality, if the manufacturer’s coupons are offered, the manufacturer increases the manufacturer’s coupon and the retailer decreases the NB store coupon when the high-demander is the only PL customer; alternatively, when both the high-demander and the low-demander are the PL customers, the manufacturer’s coupon and the NB store coupon remain unchanged with the PL quality;

2. for a given PL quality, with an increase in PL-NB feature differentiation, when the manufacturer’s coupons are offered, the manufacturer always increases the manufacturer’s coupon and the retailer decreases the NB store coupon;

3. the PL store coupon has nothing to do with the PL quality or the degree of feature differentiation.

Therefore, the couponing patterns in these areas can be inferred from the couponing patterns in Zone IV and Zone V, which are shown in Figure 20 and Figure 21. Mapping Figure 20 with Figure 18 connects PL market shares with the three kinds of coupons using PL quality as a bridge. Alternatively, mapping Figure 21 with Figure 19 connects PL market shares with the three kinds of coupons using PL-NB feature
differentiation as a bridge. By also referring to Figure 17, we know that the relationship between PL expansion and couponing activities depends on who the PL customer(s) is(are). Result 15, Result 16, and Result 17 below summarize the findings.

**Figure 20: Couponing Patterns**

*(A Variation in PL Quality)*
**Result 15.** If PL expansion is primarily driven by PL quality but not by PL-NB feature differentiation, and

1. if the PL is positioned such that the price-sensitive consumer is the only PL customer, then both PL value market share and PL volume market share increase with manufacturer’s coupon value but decrease with retailer’s NB coupon value;
2. if the PL is positioned such that both price-insensitive consumer and price-sensitive consumer are the PL customers, then both the manufacturer’s coupon value and the retailer’s NB coupon value have no impact on PL value market share and PL volume market share.
**Result 16.** If PL expansion is primarily driven by PL-NB feature differentiation but not by PL quality, and

(1) if the PL is positioned such that the price-insensitive consumer is the only PL customer, then both PL value market share and PL volume market share increase with manufacturer’s coupon value but decrease with the retailer’s NB coupon value;

(2) if the PL is positioned such that both the price-insensitive consumer and the price-sensitive consumer are the PL customers, then PL value market share decreases with the manufacturer’s coupon value but increases with the retailer’s NB coupon value only when the PL quality is very high and the degree of the feature differentiation is very large, while PL volume market share remains increasing with the manufacturer’s coupon value and increasing with the retailer’s NB coupon value.

**Result 17.** The retailer’s PL coupon has no impact on PL expansion, no matter whether PL expansion is driven by PL quality or by PL-NB feature differentiation.

By Result 15, Result 16 and Result 17, we are ready to re-examine Sethurman and Mittelstaedt’s (1992) findings. As they show that manufacturers’ couponing decreases both PL value market share and PL volume market share and retailers’ NB couponing increases both PL value market share and PL volume market share, our results
indicate that no matter whether PL expansion is driven by PL quality or PL-NB feature differentiation, manufacturer’s couponing never decreases PL volume market share and retailer’s NB couponing never increases PL volume market share. Additionally, manufacturer’s couponing is shown to decrease PL value market share and retailer’s NB couponing is shown to increase PL value market share only when PL expansion is primarily driven by PL-NB feature differentiation, PL quality is high enough, and PL-NB feature differentiation is large enough. On the other hand, our results also show that PL expansion has nothing to do with retailer’s PL couponing, which coincides with Sethurman and Mittelstaedt’s (1992) finding that retailers’ PL couponing do not impact on PL value market share and PL volume market share.

Using the analytic model and numerical example, our results therefore suggest that PL quality or PL-NB feature differentiation alone can’t fully capture the relationship between PL expansion and NB couponing activities. Besides, our results provide an explanation for why PL couponing activities do not impact on PL expansion. Overall, this dissertation reflects the importance to consider both PL quality and PL-NB feature differentiation in NB versus PL competition.
Chapter 8 An Empirical Investigation of Retailers’ Couponing Strategies

Based on the model in Chapter 3, this dissertation solved the model and derived its solutions in Chapter 4, described the pricing and couponing strategies taken by the manufacturer and the retailer in Chapter 5, showed the optimal PL positioning in Chapter 6, and explored the relationship between PL expansion and couponing activities in Chapter 7. While a large number of results are derived and described in previous chapters, this dissertation lastly desires to empirically test the results that can unambiguously translate to observable behavior.

We focus the empirical tests on the retailer’s couponing strategies as they relate to the degree of (horizontal) feature differentiation between the PL and the NB product shown previously in Chapter 5. In particular, from Result 4, we know that the retailer who strives for a higher degree of the PL feature differentiation from the NB tends to offer its own NB coupons with lower face value. Alternatively, Result 6 suggests that the face value of the retailer’s PL coupons is unrelated to the PL feature differentiation. In short, observed outcomes from a variety of retailers and consumers should show a negative relationship between the face value of retailers’ NB coupons and feature differentiation, but independence for retailers’ PL coupons and feature
differentiation. The objective of this chapter, therefore, is to address the following questions using observed household purchase data: (i) Do we observe the predicted result that PL-NB feature (horizontal) differentiation has a negative effect on $s_N$, retailers’ NB store coupons? (ii) Do we observe the predicted result that PL-NB feature differentiation has no effect on $s_P$, retailers’ PL store coupons?

At least two major steps must be taken before applying the theoretical model to real world purchase data. First, because the theoretical model features a single manufacturer’s NB and a single retailer’s PL, we must address the fact that the data contain information on many manufacturers and retailers. In general, focus our attention on the top selling NBs and PLs. More specifically, we filter the data to look only at top retailers’ PLs and the top NBs carried by these top retailers. Second, the theoretical model’s treatment of PL positioning must be re-created empirically. To accomplish this, we (i) assume that NB quality and PL quality are constant in the short term, and (ii) construct an empirical measure of feature differentiation. After taking these two steps, this chapter investigates the relationship between this feature differentiation measure and coupon values, incorporating several additional factors as control variables. Because coupon use rather than coupon availability is recorded in the data set (described below), coupon values are observed in a form of truncated data, and this research henceforth applies truncated regression models to separately test
whether the responses of retailer coupon values to feature differentiation measure coincide with the theoretical result.  

For these particular tests, a major empirical drawback exists in that numerous observations have no information whatsoever on coupon use. These observations are necessarily treated on missing values and dropped. However, two separate rationales could exist for the missing information: For any observation, a missing coupon value during the transaction period may refer to a consumer who didn’t search for the coupon or to a consumer who searched but did not find the coupon. These two cases are different. While the consumer in the former case was a non-coupon user, the consumer in the latter case was the type of consumer who uses coupons but he/she couldn’t find the coupon because the retailer didn’t issue any coupon during the time period. In the latter case, the product’s coupon value is zero.

In addition to taking the data deficiencies as given, this research also tries to recover more information from the data set and implements the following procedure: for a particular product in a particular market, if any non-zero coupon value occurs in any time period within one year, then we assume that there had existed at least one consumer who searched for coupons. Furthermore, we assume that a lack of observed coupon redemptions in other time periods is indication not of failed consumer

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22 Details on truncated models can be found in Greene (2003).
searches, but rather of a firm’s decision not to offer coupons. In other words, in the cases of periods of coupon redemption and some other periods of no redemptions, we assign a zero for the coupon value in these other periods. Alternatively, if no coupon activity is observed at all for a particular product in a particular market, then that observation is regrettably dropped. Using this procedure of selectively adding zeros, a censored (rather than a truncated) data set is also constructed, and this research applies the SUR Tobit model to test retailers’ couponing strategies, which captures the possible correlation in the targeted retailers’ couponing on the targeted PLs and the targeted NBs.\textsuperscript{23}

8.1 Data

Nielsen HomeScan data represent the food purchase decisions of a panel of approximately 40,000 U.S. households across the U.S., including 52 markets representing major metropolitan areas and mid-sized cities. This research filters this large dataset by focusing on the 2006 data to avoid a change in product quality, and by aggregating all the individual trip data up to the quarterly level (i.e., three months of trips). This research further filters the data by picking three specific product modules: ketchup, peanut butter, and mayonnaise.\textsuperscript{24} We investigate these three

\textsuperscript{23} Refer to Cameron and Trivedi (2005) for details on the SUR Tobit model.

\textsuperscript{24} These three categories have been picked by several empirical studies and, more importantly, they were used either with other product categories or alone to address retailer’s pricing rule in a channel or
modules simultaneously by introducing two dummy variables to capture possible product differentials among product categories (using one category, peanut butter, as the reference case).

Focusing on food retailers with market power, this research identifies each retailer with the top-selling PL in each of the 52 Homescan markets for each of the four quarters of 2006. These retailers are consequently named the leading retailers. In particular, by using information such as brand codes, attributes of products, and dollars paid by each consumer in each store, this research calculates the market shares for all PLs. Comparison of market shares among all PLs helps to identify the top-selling PL in each market for each quarter. One should note, however, that the top PL can change from one quarter to the next.

Once the top PLs are established, the next step is to identify the targeted NBs. Intuitively, for any top PL in some market in some quarter, its target is the NB with significant market power, and naturally the NB with the highest market share is the candidate. However, the data show that some leading retailers do not carry the top NBs. This research thus calculates the store shares of the NBs for each leading retailer,

coupon usage or store brand purchases. For example, to capture the interactions among manufacturers and retailer-manufacturers interactions, Villas-Boas and Zhao (2000) pick the ketchup category and Sudhir (2001) picks the peanut butter category. Silva-Risso and Bucklin (2004) work on the ketchup category to discuss the effect of coupon promotions. Hansen et al. (2006) checks the store brand purchase behavior in mayonnaise and peanut butter categories.
and then picks the store-level, top NB with which the top PL competes directly. We implicitly assume, therefore, that the couponing strategies identified in previous chapters (i) hold for competition between the top NB and the top PL in each market, and (ii) all top NB and PLs follow the same strategies.

Our independent variables are retail NB coupon value and retail PL coupon value. To calculate retail NB coupon value, for any targeted NB in some market in some quarter, this research gathers observations with coupon redemptions on this targeted NB in that market in that quarter and takes average of all coupon values of these observations. Similarly, for any targeted PL in some market in some quarter, it calculates retail PL coupon value by taking average of all non-zero coupon values of the targeted PL in that market in that quarter. Such procedure creates a truncated data because the coupon values for the targeted NBs and PLs are calculated by the observable coupon uses. In other words, for any targeted NB (PL) in some market in some quarter, if there is no coupon use for the targeted NB (PL) in that market in that quarter, then it is the observation with coupon value truncated at zero. A censored data is further built up by using the procedure described before.

Nine attributes of product description, including flavor, form, formula, container, salt-content, style, type, product, and variety, are recorded for each purchase. These attributes plus product size and packaging are considered as different horizontal
dimensions of the product feature. For any top PL and for each of these horizontal dimensions, this research constructs an indicator variable which equals zero if the top PL shares the same attribute with the top NB and one otherwise.²⁵ These indicator variables are then summed to form a compound measure capturing the total product feature differentiation between the top PL and the top NB.²⁶

This research also incorporates demographic information to reflect the consumer type differences in each market for each of the four quarters. Market-level demographic information includes average household size, average household income, the percentage of Hispanic people in the market, average age of female household heads, the percentage of female household heads working over 35 hours, and the percentage of female household heads with at least college degree. This research doesn’t include the information such as the percentage of male household heads with at least college degree, the average age of male household heads, and the percentage of male household heads working over 35 hours to avoid multi-collinearity problems.²⁷

²⁵ The notion here is similar to the discrete distance measure mentioned by Pinkse and Slade (2004), Rojas and Peterson (2008), Rojas (2008), Rofahl and Richards (2009), and Bonanno (2009).

²⁶ The method of constructing a feature differentiation measure emphasizes the discrete nature of the product attributes. To examine the robustness of estimation results relative to alternative methods of variable construction, please refer to the appendix.

²⁷ Such setting doesn’t impact on the main results of this research.
Market characteristics are introduced to capture the market structure in each quarter. The number of NBs and the Herfindahl index for all NBs in each market are chosen to evaluate the brand proliferation and the size dispersion of all NBs, where the Herfindahl index is defined as the sum of the square of market shares of all NBs. On the other hand, PL threat is composed of two parts: PL presence and PL market power. To capture the first part, this research uses as an instrument the PL distribution, which is defined as the percentage of stores carrying PLs. The PL share, a proxy for PL market power, is derived by calculating the aggregate market share of all PLs. This research also introduces the percentage of the supermarket sales of the top four retailers to capture the retailer power.

This research takes account of store characteristics, including different retailer-based pricing strategies. A HILO (High-Low) store sometimes offers specials and deep discounts for some items, but an EDLP (Everyday Low Price) store offers lower average prices and less variability in prices is shown both across items and across time.\(^{28}\) In the model that follows, this research calculates the standard deviation of the weekly prices of the product carried on store shelves (for each of the

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\(^{28}\) Retailers’ pricing strategies are related to consumers’ purchasing behavior. For example, Bell and Lattin (1998) indicate that large basket shoppers prefer EDLP stores while small basket shoppers prefer HILO stores. As consumers tend to be loyal to stores and store pricing format (Rhee and Bell 2002), Bonfrer and Chintagunta (2004) further find that store loyal customers are inclined to purchase PLs and less store loyal customers are inclined to be brand loyal. Retailers might want to induce store switchers using traffic builder products in key categories and raise NB prices to take advantage of them.
three product categories under investigation) and includes this variable as another
control for HILO or EDLP-type stores.

A leading retailer’s PL and NB couponing decision may also depend on the
manufacturer’s couponing strategy and therefore, a dummy variable is introduced to
reflect whether or not the manufacturer of the leading NB has issued its own coupons.
In addition, the market power of the retailer’s major competitors may also impact the
retailer’s couponing decisions. For this reason, we examine other NBs carried the
retailer’s shelves, and identify the second-leading NB as a major competitor. Two
other dummy variables are therefore introduced: The first dummy variable is used to
identify whether the store-level leading NB is a market leader, and the second dummy
variable is used to identify whether the second-leading NB is a market leader.

Additionally, a leading retailer may carry other PLs besides the already-identified
leading PL. The second-leading PL particularly places a pressure on the top PL and/or
changes the retailer’s couponing on the top PL if the second leading PL is also the
second market leader of all PLs. This research therefore introduces a dummy variable
to capture such effect.

In testing the leading retailers’ NB coupon values, 167 observations are used and
53 observations are truncated at zero. On the other hand, 130 observations are used to
test the retailer’s PL coupon values and 53 observations are truncated at zero. Only 86
observations are qualified and used in testing the SUR Tobit model, where 25 observations of retailer’s NB coupon values are recorded as zeros, and 30 observations of retailers PL coupon values are recorded as zeros. Lastly, this research introduces a variable to account for possible quarter effects.

Tables 1, Table 2, and Table 3 list the descriptive statistics for the variables used in the three models. As we can see, though this research takes account of eleven product attributes, the average degree of feature differentiation is always less than 2, which implies that the PL product and the NB product do share a lot of common features. While the variables are the same in all the Tables (and econometrics models), their descriptive statistics vary based on observed sample size.
Table 1: Descriptive Statistics

(Truncated Model- Store Coupon on the NB)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Units</th>
<th>Min.</th>
<th>Mean</th>
<th>Max.</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Store Coupon on NB</strong></td>
<td>cents</td>
<td>0.458</td>
<td>3.096</td>
<td>11.781</td>
<td>2.329</td>
</tr>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation</td>
<td>Integer</td>
<td>0</td>
<td>1.316</td>
<td>5</td>
<td>1.100</td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>cents</td>
<td>0</td>
<td>1.132</td>
<td>5.140</td>
<td>0.922</td>
</tr>
<tr>
<td>Leading NB with manufacturer's coupon offered</td>
<td>0/1</td>
<td>0</td>
<td>0.825</td>
<td>1</td>
<td>0.382</td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>0/1</td>
<td>0</td>
<td>0.693</td>
<td>1</td>
<td>0.463</td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>0/1</td>
<td>0</td>
<td>0.105</td>
<td>1</td>
<td>0.308</td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>0/1</td>
<td>0</td>
<td>0.281</td>
<td>1</td>
<td>0.451</td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>Percent</td>
<td>2.549</td>
<td>15.878</td>
<td>35.957</td>
<td>0.071</td>
</tr>
<tr>
<td>Private label distribution</td>
<td>Percent</td>
<td>17.647</td>
<td>42.103</td>
<td>66.667</td>
<td>0.098</td>
</tr>
<tr>
<td>Number of National brands</td>
<td>Integer</td>
<td>2</td>
<td>11.763</td>
<td>24</td>
<td>5.329</td>
</tr>
<tr>
<td>National brand Herfindahl index</td>
<td>Index</td>
<td>0.211</td>
<td>0.451</td>
<td>0.784</td>
<td>0.148</td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>Percent</td>
<td>41.843</td>
<td>68.282</td>
<td>89.440</td>
<td>0.108</td>
</tr>
<tr>
<td><strong>Demographic Information</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average income</td>
<td>Dollars</td>
<td>44684.70</td>
<td>60745.28</td>
<td>77523.52</td>
<td>8315.587</td>
</tr>
<tr>
<td>Average household size</td>
<td>People</td>
<td>2.294</td>
<td>2.604</td>
<td>3.007</td>
<td>0.175</td>
</tr>
<tr>
<td>Average age of female heads of households (HH)</td>
<td>Years</td>
<td>49.938</td>
<td>53.818</td>
<td>59.319</td>
<td>1.956</td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>Percent</td>
<td>0.274</td>
<td>6.619</td>
<td>24.880</td>
<td>0.054</td>
</tr>
<tr>
<td>Female HH working over 35 hours</td>
<td>Percent</td>
<td>22.247</td>
<td>35.959</td>
<td>43.466</td>
<td>0.040</td>
</tr>
<tr>
<td>Female HH with at least college degree</td>
<td>Percent</td>
<td>45.556</td>
<td>62.221</td>
<td>70.955</td>
<td>0.058</td>
</tr>
<tr>
<td><strong>Other Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product dummy-mayo</td>
<td>0/1</td>
<td>0</td>
<td>0.430</td>
<td>1</td>
<td>0.497</td>
</tr>
<tr>
<td>Product dummy-ketchup</td>
<td>0/1</td>
<td>0</td>
<td>0.281</td>
<td>1</td>
<td>0.451</td>
</tr>
<tr>
<td>Quarter</td>
<td>1/2/3/4</td>
<td>1</td>
<td>2.5</td>
<td>4</td>
<td>1.169</td>
</tr>
<tr>
<td><strong>Number of Observations=114</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Descriptive Statistics

(Truncated Model- Store Coupon on the PL)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Units</th>
<th>Min.</th>
<th>Mean</th>
<th>Max.</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Store Coupon on PL</strong></td>
<td>cents</td>
<td>0.056</td>
<td>3.277</td>
<td>12.542</td>
<td>2.658</td>
</tr>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation</td>
<td>Integer</td>
<td>0</td>
<td>1.117</td>
<td>3</td>
<td>0.843</td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>cents</td>
<td>0</td>
<td>1.285</td>
<td>17.025</td>
<td>1.995</td>
</tr>
<tr>
<td>Leading NB with manufacturer's coupon offered</td>
<td>0/1</td>
<td>0</td>
<td>0.857</td>
<td>1</td>
<td>0.352</td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>0/1</td>
<td>0</td>
<td>0.649</td>
<td>1</td>
<td>0.480</td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>0/1</td>
<td>0</td>
<td>0.130</td>
<td>1</td>
<td>0.338</td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>0/1</td>
<td>0</td>
<td>0.351</td>
<td>1</td>
<td>0.480</td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>Percent</td>
<td>4.756</td>
<td>19.306</td>
<td>37.397</td>
<td>0.089</td>
</tr>
<tr>
<td>Private label distribution</td>
<td>Percent</td>
<td>17.647</td>
<td>42.679</td>
<td>67.647</td>
<td>0.104</td>
</tr>
<tr>
<td>Number of National brands</td>
<td>Integer</td>
<td>3</td>
<td>13.195</td>
<td>21</td>
<td>5.171</td>
</tr>
<tr>
<td>National brand Herfindahl index</td>
<td>Index</td>
<td>0.1777</td>
<td>0.412</td>
<td>0.750</td>
<td>0.136</td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>Percent</td>
<td>0.438</td>
<td>0.700</td>
<td>0.867</td>
<td>0.098</td>
</tr>
<tr>
<td><strong>Demographic Information</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average income</td>
<td>Dollars</td>
<td>47553.29</td>
<td>58257.25</td>
<td>77523.52</td>
<td>6837.409</td>
</tr>
<tr>
<td>Average household size</td>
<td>People</td>
<td>2.332</td>
<td>2.592</td>
<td>2.871</td>
<td>0.156</td>
</tr>
<tr>
<td>Average age of female heads of households (HH)</td>
<td>Years</td>
<td>49.938</td>
<td>53.759</td>
<td>58.529</td>
<td>1.864</td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>Percent</td>
<td>0.346</td>
<td>6.683</td>
<td>24.880</td>
<td>0.059</td>
</tr>
<tr>
<td>Female HH working over 35 hours</td>
<td>Percent</td>
<td>26.389</td>
<td>35.649</td>
<td>48.416</td>
<td>0.039</td>
</tr>
<tr>
<td>Female HH with at least college degree</td>
<td>Percent</td>
<td>48.367</td>
<td>61.785</td>
<td>70.833</td>
<td>0.059</td>
</tr>
<tr>
<td><strong>Other Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product dummy-mayo</td>
<td>0/1</td>
<td>0</td>
<td>0.390</td>
<td>1</td>
<td>0.491</td>
</tr>
<tr>
<td>Product dummy-ketchup</td>
<td>0/1</td>
<td>0</td>
<td>0.195</td>
<td>1</td>
<td>0.399</td>
</tr>
<tr>
<td>Quarter</td>
<td>1/2/3/4</td>
<td>1</td>
<td>2.493</td>
<td>4</td>
<td>1.059</td>
</tr>
</tbody>
</table>

Number of Observations=77
Table 3: Descriptive Statistics (SUR Tobit Model)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Units</th>
<th>Min.</th>
<th>Mean</th>
<th>Max.</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Store Coupon on NB</strong></td>
<td>cents</td>
<td>0</td>
<td>2.201</td>
<td>10.714</td>
<td>2.326</td>
</tr>
<tr>
<td><strong>Store Coupon on PL</strong></td>
<td>cents</td>
<td>0</td>
<td>2.281</td>
<td>12.542</td>
<td>2.816</td>
</tr>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation</td>
<td>Integer</td>
<td>0</td>
<td>0.988</td>
<td>3</td>
<td>0.914</td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>cents</td>
<td>0</td>
<td>1.138</td>
<td>4.616</td>
<td>0.896</td>
</tr>
<tr>
<td>Leading NB with manufacturer’s coupon offered</td>
<td>0/1</td>
<td>0</td>
<td>0.872</td>
<td>1</td>
<td>0.336</td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>0/1</td>
<td>0</td>
<td>0.733</td>
<td>1</td>
<td>0.445</td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>0/1</td>
<td>0</td>
<td>0.081</td>
<td>1</td>
<td>0.275</td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>0/1</td>
<td>0</td>
<td>0.314</td>
<td>1</td>
<td>0.467</td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>Percent</td>
<td>4.756</td>
<td>17.228</td>
<td>40.475</td>
<td>0.083</td>
</tr>
<tr>
<td>Private label distribution</td>
<td>Percent</td>
<td>17.647</td>
<td>41.817</td>
<td>64.444</td>
<td>0.096</td>
</tr>
<tr>
<td>Number of National brands</td>
<td>Integer</td>
<td>3</td>
<td>12.349</td>
<td>24</td>
<td>5.403</td>
</tr>
<tr>
<td>National brand Herfindahl index</td>
<td>Index</td>
<td>0.211</td>
<td>0.443</td>
<td>0.809</td>
<td>0.138</td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>Percent</td>
<td>43.823</td>
<td>68.110</td>
<td>86.712</td>
<td>0.100</td>
</tr>
<tr>
<td><strong>Demographic Information</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average income</td>
<td>Dollars</td>
<td>47886.46</td>
<td>59821.75</td>
<td>77523.52</td>
<td>6693.454</td>
</tr>
<tr>
<td>Average household size</td>
<td>People</td>
<td>2.332</td>
<td>2.613</td>
<td>2.925</td>
<td>0.171</td>
</tr>
<tr>
<td>Average age of female heads of households (HH)</td>
<td>Years</td>
<td>49.938</td>
<td>53.427</td>
<td>58.529</td>
<td>2.127</td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>Percent</td>
<td>0.346</td>
<td>5.810</td>
<td>24.575</td>
<td>0.046</td>
</tr>
<tr>
<td>Female HH working over 35 hours</td>
<td>Percent</td>
<td>29.182</td>
<td>35.514</td>
<td>43.466</td>
<td>0.031</td>
</tr>
<tr>
<td>Female HH with at least college degree</td>
<td>Percent</td>
<td>48.367</td>
<td>62.135</td>
<td>70.833</td>
<td>0.054</td>
</tr>
<tr>
<td><strong>Other Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product dummy-mayo</td>
<td>0/1</td>
<td>0</td>
<td>0.442</td>
<td>1</td>
<td>0.500</td>
</tr>
<tr>
<td>Product dummy-ketchup</td>
<td>0/1</td>
<td>0</td>
<td>0.256</td>
<td>1</td>
<td>0.439</td>
</tr>
<tr>
<td>Quarter</td>
<td>1/2/3/4</td>
<td>1</td>
<td>2.523</td>
<td>4</td>
<td>1.082</td>
</tr>
</tbody>
</table>

**Number of observations=86**
8.2 Empirical Results

Table 4 lists the empirical results the truncated regression models of retailers’ NB and PL coupon levels. The main results, shown in the first line, confirm the results of the theoretical model. More specifically, the coefficient of PL-NB feature differentiation is negative and significant for the retailers’ NB coupons but not significantly different from zero for the PL coupons. In other words, while retailers’ PL coupon values are not influenced by an increase in feature differentiation, an increase in PL-NB feature differentiation results in smaller retailer-based NB coupon values. Thus, the theoretical model’s result is confirmed for mayonnaise, ketchup, and peanut butter.

In addition to this main result, the estimation provides some further insights. Focusing first on retailer-based NB couponing, Table 4 shows that a higher Herfindahl index places a downward pressure on the coupon value of the leading NBs, which suggests that in a more concentrated market, a leading retailer offers a smaller coupon value thereby declining to heavily promote the top NB. A larger standard deviation of the store weekly prices contributes to increasing the store coupon value of the top NBs. This result implies that a HILO store (with large price deviations) tends to use coupons with higher face value to attract consumers to the top NB. On the other hand, an EDLP store (with a low price standard deviation) is disinclined to
offer coupons with large face value since it already offers a low price. On average, leading retailers are also shown to offer NB coupons with larger values in the markets with more Hispanic people. NB coupon values on are also larger in the product category of ketchup than in peanut butter.

Turning to retailer-based PL couponing, the empirical results in Table 4 show that PL coupons have larger face values when the stores carry the market leaders in the stores. This result implies that the top PLs do compete with the NB market leaders by using price promotions. Larger retailer-based PL coupon values appear in markets with higher average income level, a smaller percentage of female heads of household with at least college degree, and a smaller percentage of female household heads working over 35 hours. The leading retailers also tend to lower PL coupon values in the year end.
Table 4: Results in the Truncated Models (z-stats in parentheses)

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>NB retail coupons</th>
<th>PL retail coupons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation</td>
<td>-0.549*</td>
<td>-0.637</td>
</tr>
<tr>
<td></td>
<td>(-1.76)</td>
<td>(-0.83)</td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>1.275***</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>(4.21)</td>
<td>(0.54)</td>
</tr>
<tr>
<td>Leading NB with manufacturer's coupon offered</td>
<td>0.031</td>
<td>1.475</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.72)</td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>-0.205</td>
<td>4.454***</td>
</tr>
<tr>
<td></td>
<td>(-0.17)</td>
<td>(3.2)</td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>-0.208</td>
<td>5.028**</td>
</tr>
<tr>
<td></td>
<td>(-0.15)</td>
<td>(2.77)</td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>-0.552</td>
<td>0.202</td>
</tr>
<tr>
<td></td>
<td>(-0.61)</td>
<td>(0.18)</td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>1.271</td>
<td>9.651</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.75)</td>
</tr>
<tr>
<td>Private label distribution</td>
<td>-1.724</td>
<td>1.219</td>
</tr>
<tr>
<td></td>
<td>(-0.49)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Number of National brands</td>
<td>0.135</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>(1.13)</td>
<td>(0.43)</td>
</tr>
<tr>
<td>National brand Herfindahl index</td>
<td>-9.014**</td>
<td>0.319</td>
</tr>
<tr>
<td></td>
<td>(-2.40)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>3.901</td>
<td>2.597</td>
</tr>
<tr>
<td></td>
<td>(1.02)</td>
<td>(0.35)</td>
</tr>
<tr>
<td><strong>Demographic Information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average income</td>
<td>-1.95x10^{-6}</td>
<td>3.063x10^{-4}***</td>
</tr>
<tr>
<td></td>
<td>(-0.04)</td>
<td>(3.03)</td>
</tr>
<tr>
<td>Average household size</td>
<td>-2.510</td>
<td>-2.159</td>
</tr>
<tr>
<td></td>
<td>(-0.92)</td>
<td>(-0.33)</td>
</tr>
<tr>
<td>Average age of female heads of households (HH)</td>
<td>-0.091</td>
<td>0.941</td>
</tr>
<tr>
<td></td>
<td>(-0.39)</td>
<td>(1.57)</td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>19.856***</td>
<td>3.595</td>
</tr>
<tr>
<td></td>
<td>(2.72)</td>
<td>(0.27)</td>
</tr>
</tbody>
</table>
Female HH working over 35 hours | -4.824  | -24.549*  
                    | (-0.44) | (-1.66)   
Female HH with at least college degree | -10.876 | -27.875**  
                     | (-1.39) | (-2.1)   

**Other Control variables**

Product dummy-mayo | 2.205  | -1.907  
                     | (1.55) | (-0.79)   
Product dummy-ketchup | 3.101** | -2.677  
                      | (2.00) | (-0.95)   
Quarter | -1.999 | -0.923**  
            | (-0.83) | (-2.42)   
constant | 19.333 | -41.649  
            | (0.90) | (-0.76)   

Notes: *** = statistically significant at the 99 percent level; ** at the 95 percent level; * at the 90 percent level.

Table 5 presents the results of the SUR Tobit estimation, where missing coupon values are treated differently. The most important result once again confirms the theoretical prediction. The estimated coefficients on feature differentiation are negative and significant for the NB store coupons but not statistically significant for the PL store coupons.

Impacts on coupon levels from other control variables in general follow the same pattern as in the truncated model. Leading retailers tend to offer larger PL coupon values if the top store-level NBs are also the NB market leader. Retailers’ HILO or EDLP pricing strategy does matter in explaining an increase in the NB coupon values, but has no impact on the PL coupons. Retailers are also inclined to offer larger store NB coupons in ketchup than in peanut butter, but there is no difference in the PL coupon values.
Some differences do exist between the results of the SUR Tobit model and the results of the truncated regression models. An increase in the percentage of Hispanic people is shown to have a positive impact on the store NB and PL coupon values, while an increase in the percentage of highly-educated female heads of household is shown to lower the value of both NB and PL coupons. Two variables are shown not significant in the truncated regression models but significant in the SUR Tobit model: An increase in the PL distribution helps to increase the value of store NB coupons, and the leading retailers tend to offer NB coupons with higher face value in mayonnaise than in peanut butter.
Table 5: Results in the SUR Tobit model (z-stats in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>Dependent Variable</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NB retail coupons</td>
<td>PL retail coupons</td>
</tr>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation</td>
<td>-0.990**</td>
<td>0.342</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.25)</td>
<td>(0.52)</td>
<td></td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>1.079***</td>
<td>0.080</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.07)</td>
<td>(0.16)</td>
<td></td>
</tr>
<tr>
<td>Leading NB with manufacturer's coupon offered</td>
<td>1.391</td>
<td>1.212</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.40)</td>
<td>(0.83)</td>
<td></td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>0.948</td>
<td>1.867**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.06)</td>
<td>(2.31)</td>
<td></td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>-0.094</td>
<td>2.003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.07)</td>
<td>(1.33)</td>
<td></td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>-0.867</td>
<td>0.905</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.08)</td>
<td>(1.01)</td>
<td></td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>8.125</td>
<td>4.907</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.16)</td>
<td>(0.50)</td>
<td></td>
</tr>
<tr>
<td>Private label distribution</td>
<td>8.608*</td>
<td>-3.909</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.7)</td>
<td>(-0.58)</td>
<td></td>
</tr>
<tr>
<td>Number of National brands</td>
<td>0.165</td>
<td>0.054</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.41)</td>
<td>(0.39)</td>
<td></td>
</tr>
<tr>
<td>National brand Herfindahl index</td>
<td>-2.566</td>
<td>-2.010</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.82)</td>
<td>(-0.44)</td>
<td></td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>3.386</td>
<td>7.870</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.70)</td>
<td>(1.23)</td>
<td></td>
</tr>
<tr>
<td><strong>Demographic Information</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average income</td>
<td>7.92x10^{-5}</td>
<td>10.28x10^{-5}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.43)</td>
<td>(1.19)</td>
<td></td>
</tr>
<tr>
<td>Average household size</td>
<td>-0.046</td>
<td>0.730</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.01)</td>
<td>(0.15)</td>
<td></td>
</tr>
<tr>
<td>Average age of female heads of households (HH)</td>
<td>0.092</td>
<td>0.450</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
<td>(1.14)</td>
<td></td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>32.735***</td>
<td>18.317**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.98)</td>
<td>(2.01)</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Estimate</td>
<td>Std. Error</td>
<td>z-value</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>----------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>Female HH working over 35 hours</td>
<td>-13.800</td>
<td>-22.058</td>
<td>-1.01</td>
</tr>
<tr>
<td>Female HH with at least college degree</td>
<td>-14.878*</td>
<td>-31.658**</td>
<td>-1.74</td>
</tr>
<tr>
<td><strong>Other Control variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product dummy-mayo</td>
<td>3.387**</td>
<td>-1.606</td>
<td>2.24</td>
</tr>
<tr>
<td>Product dummy-ketchup</td>
<td>3.695**</td>
<td>-2.518</td>
<td>2.30</td>
</tr>
<tr>
<td>Quarter</td>
<td>0.032</td>
<td>-0.555</td>
<td>0.12</td>
</tr>
<tr>
<td>constant</td>
<td>-8.211</td>
<td>-9.101</td>
<td>-0.26</td>
</tr>
</tbody>
</table>

Notes: *** = statistically significant at the 99 percent level; ** at the 95 percent level; * at the 90 percent level.
Chapter 9 Conclusions

This research explores NB versus PL competition beyond the scope of current literature. While current literature focuses on the pricing strategies and shows how the NB price(s) vary with a mere threat of the PL entry, an actual PL entry, or a PL expansion, this research considers both the pricing and the couponing strategies and explicitly models three different kinds of coupons including manufacturer’s coupons, retailer’s NB coupons, and retailer’s PL coupons. In particular, taking into account of potential differences in consumer’s willingness to pay for the NB product and the PL product this research answers the ultimate question, “what type of consumer is buying the PL”?

By incorporating two different dimensions of the PL positioning, one horizontal and one vertical, this research explores a series of retailer decisions under both non-cooperative and cooperative strategies. The following specific decisions are considered: offering the PL or not, positioning the PL vertically and horizontally, pricing both the NB and the PL, and possibly couponing on either one or both products. In particular, taking account of the manufacturer’s reaction in terms of setting wholesale price and manufacturer’s coupon value, this research sets up a game-theoretical model to capture the decisions made by the retailer and the
manufacturer. Analyses with a numerical example are then presented to explore the properties of equilibrium solutions. Inspired by Sethurman and Mittelstaedt’s (1992) findings showing the relationship between PL market share and varieties of coupons, this research further re-examines the relationship by continuing the numerical example and using the two dimensions of the PL positioning as a bridge. Finally, employing two different econometric models, a truncated model and a SUR Tobit model, this research empirically tests the retailer’s couponing strategies and confirms an important theoretical prediction.

**Target PL Customer(s).** This research suggests that the price-sensitive consumer is not necessarily the target customer of the PL, no matter what strategies are taken. In fact, for a fixed PL quality (or for a fixed degree of feature differentiation), a larger feature differentiation (a higher PL quality) is required for the price-sensitive consumer than for the price-insensitive one to consume the PL product. Thus, there occurs a scenario in which the price-sensitive consumer purchases the NB product only, while the PL customer is the price-insensitive one. In another scenario, both price-sensitive and price-insensitive consumers are willing to purchase the PL products.

As Sayman et al. (2002) mention, “…when there exists a price-sensitive segment in the market, it may be better (for the retailer) not to target the leading NB and instead
to use the SB (store brand) to target this segment.” This research shows that the price-sensitive consumer might avoid consuming the PL product and the PL product could be used instead to target the price-insensitive segment.

**NB Pricing and Couponing Strategies.** This research shows that the patterns of NB pricing and couponing not only depend on whether the manufacturer cooperates with the retailer or not, but also vary with the PL quality as well as the degree of feature differentiation. Under cooperative strategies, the NB price relates with the NB quality only and the NB coupon value simply captures the consumer type difference.

In contrast, under non-cooperative strategies, while an increase in the PL quality or an increase in the degree of feature differentiation between the PL and the NB can trigger a PL entry, the PL threat always places a downward pressure on the NB wholesale price and the NB retail price. A threat of the PL entry also decreases manufacturer coupon value, but raises store coupons on the NB.

For a fixed PL quality, if the PL is offered and positioned more differently from the NB, while the NB wholesale price and the NB retail price increase with the degree of feature differentiation, the manufacturer tends to increase the NB coupon value but the retailer tends to decrease its own NB coupon value.

On the other hand, for a fixed degree of feature differentiation, the NB wholesale price and the NB retail price decrease with the PL quality. If the PL is offered and
positioned with lower quality, the manufacturer decreases the coupon value anticipating that the PL customer is only a price-insensitive consumer. As PL quality gets higher, the manufacturer raises the coupon value to prevent the price-sensitive consumer from switching to the PL product, but eventually stops increasing the coupon value once the PL quality so high that preventing the price-sensitive consumer from purchasing the PL product is not profitable. The retailer simply offers NB coupons in an opposite direction to the manufacturer’s couponing.

When discussing the impact of the PL threat and its actual entry on NB prices, Mills (1995) and Bontems et al. (1999) focus on the role of PL quality (relative to the NB quality) and consider non-cooperative strategies only. This research therefore complements their findings by (i) taking account of both quality (vertical) and feature (horizontal) differentiation relative to the NB and (ii) demonstrating pricing and couponing strategies under both non-cooperative strategies and cooperative strategies.

PL Pricing and Couponing Strategies. The patterns of PL pricing and couponing under two different strategies are exactly the same: the PL price is determined only by the PL quality and the PL coupon is determined only by the consumer type difference. The retailer’s PL coupons are offered only when the price-sensitive consumer starts to purchase the PL product, either because the PL is a good substitute for the NB (i.e., when the PL quality is high enough), and/or because the PL allows him or her to
enjoy diversity (i.e., when the PL feature is very different from the NB).

**PL. Positioning.** This research shows that without restrictions on PL quality and PL-NB feature differentiation, the PL is always positioned at the highest possible quality and the largest possible degree of feature differentiation, no matter what strategies are taken.²⁹

However, with restrictions on PL quality and PL-NB feature differentiation, under non-cooperative strategies, while the retailer finds it best to position the PL at the highest possible quality level, it may choose a smaller degree of feature differentiation for the PL from the NB such that the price-insensitive consumer is the only PL customer. In contrast, under cooperative strategies, the PL is always better positioned at higher PL quality and larger PL-NB feature differentiation.

This research also shows that the retailer may rather choose to not to offer the PL product at all, even when the PL can be positioned such that it will be purchased by the consumer(s). While both Mills (1995) and Bontems et al. (1999) indicate that PL quality is the only factor driving a retailer choice to offer a PL product or not, this research shows that whether the PL is offered or not depends on both the PL quality and the degree of feature differentiation between two products. In particular, it is possible that even when the PL quality is high, the retailer may chose not to offer the

²⁹ Such positioning is also beneficial to all consumers, for they enjoy diversity from consuming the NB product and the PL product.
PL when it is similar in feature to the NB. Whereas Mills (1995) shows that the PL product is offered only when it is a good substitute for the NB product, this research suggests that the PL product can be offered when its product quality is low, as long as the PL can differentiate itself from the NB in a certain degree.

**PL Expansion.** Using as a starting point Sethurman and Mittelstaedt’s (1992) finding that manufacturers’ couponing (retailers’ NB couponing) decrease (increase) PL value market share and PL volume market share, and retailers’ PL couponing does not impact on PL market shares, this research re-examines the relationship between PL expansion and couponing activities. This research focuses on the range in which the retailer offers and positions the PL, and uses PL quality and PL-NB feature differentiation to bridge PL expansion and couponing activities.

This research shows that for a fixed degree of feature differentiation, PL value market share and PL volume market share always increase as PL quality increases. On the other hand, for a fixed PL quality level, PL value market share starts to decrease as PL-NB feature differentiation increases only in the range where PL quality is really high and the degree of feature differentiation is really large. In this area, PL volume market share remains increasing with PL-NB feature differentiation.

By referring to the impact of PL positioning on couponing patterns, this research shows that it is possible for PL value market share to decrease with manufacturer’s
couponing and increase with retailer’s NB couponing if PL expansion is driven by PL-NB feature differentiation. However, it is impossible for PL volume market share to behave in this way, no matter the driver of PL expansion is either PL quality or PL-NB feature differentiation. Therefore, this research suggests that PL quality or PL-NB feature differentiation alone can’t fully explain the relationship between PL expansion and NB couponing activities, and more importantly, it is necessary to consider both PL quality and PL-NB feature together in the NB versus PL competition.

This research also shows that retailer’s PL couponing has nothing to do with PL market shares, no matter whether PL expansion is driven by PL quality or PL-NB feature differentiation, which supports Sethurman and Mittelstaedt’s (1992) finding of the relationship between PL expansion and PL couponing activities.

**Empirical Findings on Retailer’s Couponing.** This research further targets on the retailer’s couponing strategy and empirically tests whether real-world retailers’ couponing on the NB products and their own PL products coincide with the model’s prediction. This research focuses on the retailers whose PL products top the markets and the store-level top NB products carried by these retailers. After limiting attention to these products, we construct a measure using 11 attributes of product features to capture the feature differentiation between the targeted PL and the targeted NB. By
picking three different product modules, including ketchup, mayonnaise, and peanut butter, this research employs two different econometric models. Estimation results show that with an increase in the feature difference between the targeted NB and the targeted PL, the leading retailers tend to decrease the targeted NB coupon values but not change PL retail coupon values. These empirical results confirm the theoretical prediction.

**Limitations.** While this research focuses on competition between one PL and one NB within a distribution channel, whether the PL targets on the leading NB or the second-tier NB or the other NB in the market is not addressed. However, by the empirical test results, this research demonstrates that the leading retailer’s couponing strategy confirms the theoretical results no matter whether the targeted NB tops in the market or not. In other words, in the real world, even under the competition among the incumbent NBs, the couponing strategy predicted in this research is observed for the leading retailers who often target their PLs on the top-selling NBs within their own stores. On the other hand, optimal coupon strategy by non-leading retailers is not addressed in this research and thus remains unknown. Consequently, this research is a starting point for future studies to consider the role of the inter-store competition among retailers in couponing strategies.
In addition, while the theoretical predictions are confirmed by empirical results even with a low number of observations, the other limitation of this research concerns the data on coupon redemptions, which is generally very sparse. Augmenting the data by including more than three product modules could increase the number of observations and therefore the robustness of the results in this research.
Appendix

As a check on robustness, the research proceeds to revise the measure of feature
differentiation and re-test the two econometric models. Recall that the measure of the
feature differentiation used in the previous tests was formed by eleven attributes of
product features including flavor, form, formula, container, salt-content, style, type,
product, variety, the product packaging, and product size. Since product size, different
from the other ten attributes, can be categorized in continuous space of product
feature instead of discrete space, for any targeted PL, this research proceeds to use
absolute size distance between it and its targeted NB to capture the size differentiation
between the two products. The other ten attributes are again used to form a compound
measure of the feature differentiation in discrete space. For the new estimation, both
feature differentiation measures, one discrete and one continuous, are included.

Table A.1 and Table A.2 are test results in the truncated models and the SUR Tobit
model respectively. The results in both models show that the feature differentiation in
discrete space causes a downward pressure on the NB coupon value, while the feature
differentiation in continuous space doesn’t impact on the NB coupon value at all. On
the other hand, the truncated model in Table A.1 shows that the PL coupon value is
not impacted by the feature differentiation of discrete attributes but positively
impacted by the size difference. The SUR Tobit model in Table A.2 shows that the PL store coupon value is not related to the feature differentiation either in discrete space or in continuous space. Since the model predicts a negative relationship between the NB coupon value and feature differentiation but independence for retailers’ PL coupons and feature differentiation, the first line in Table A.1 and Table A.2 confirm the model prediction but the second line in Table A.1 seems contradictory to the model prediction.

Table A.1: Results in the Truncated Models –

Two Measures of Feature Differentiation (z-stats in parentheses)

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Store Coupon-NB</th>
<th>Store Coupon-PL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation-discrete</td>
<td>-1.102**</td>
<td>-0.348</td>
</tr>
<tr>
<td></td>
<td>(-2.11)</td>
<td>(-0.40)</td>
</tr>
<tr>
<td>Feature differentiation-continuous</td>
<td>0.031</td>
<td>0.115*</td>
</tr>
<tr>
<td></td>
<td>(1.55)</td>
<td>(1.89)</td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>1.146***</td>
<td>0.061</td>
</tr>
<tr>
<td></td>
<td>(3.86)</td>
<td>(0.47)</td>
</tr>
<tr>
<td>Leading NB with manufacturer's coupon offered</td>
<td>0.081</td>
<td>2.405</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(1.24)</td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>0.020</td>
<td>5.155***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(3.24)</td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>-0.014</td>
<td>5.453***</td>
</tr>
<tr>
<td></td>
<td>(-0.01)</td>
<td>(2.99)</td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>-0.543</td>
<td>0.307</td>
</tr>
<tr>
<td></td>
<td>(-0.67)</td>
<td>(0.29)</td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>2.670</td>
<td>13.204</td>
</tr>
<tr>
<td></td>
<td>coefficient</td>
<td>standard error</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Private label distribution</td>
<td>-0.327</td>
<td>0.114</td>
</tr>
<tr>
<td></td>
<td>(-0.45)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Number of NBs</td>
<td>0.106</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(1.01)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>NB Herfindahl index</td>
<td>-8.224**</td>
<td>-1.125</td>
</tr>
<tr>
<td></td>
<td>(-2.38)</td>
<td>(-0.18)</td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>2.914</td>
<td>1.682</td>
</tr>
<tr>
<td></td>
<td>(0.86)</td>
<td>(0.24)</td>
</tr>
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</table>

### Demographic Information

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<thead>
<tr>
<th></th>
<th>coefficient</th>
<th>standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average income</td>
<td>1.3x10^{-5}</td>
<td>3.56x10^{-4}***</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(3.21)</td>
</tr>
<tr>
<td>Average household size</td>
<td>-2.601</td>
<td>-2.784</td>
</tr>
<tr>
<td></td>
<td>(-1.02)</td>
<td>(-0.42)</td>
</tr>
<tr>
<td>Average age of female heads of</td>
<td>-0.055</td>
<td>0.936</td>
</tr>
<tr>
<td>households (HH)</td>
<td>(-0.26)</td>
<td>(1.53)</td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>20.051***</td>
<td>-0.516</td>
</tr>
<tr>
<td></td>
<td>(2.94)</td>
<td>(-0.04)</td>
</tr>
<tr>
<td>Female HH working over 35 hours</td>
<td>-9.354</td>
<td>-30.036*</td>
</tr>
<tr>
<td></td>
<td>(-0.91)</td>
<td>(-1.91)</td>
</tr>
<tr>
<td>Female HH with at least college degree</td>
<td>-9.598</td>
<td>-30.464**</td>
</tr>
<tr>
<td></td>
<td>(-1.34)</td>
<td>(-2.30)</td>
</tr>
</tbody>
</table>

### Other Control variables

<table>
<thead>
<tr>
<th></th>
<th>coefficient</th>
<th>standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product dummy-mayo</td>
<td>2.122*</td>
<td>-1.898</td>
</tr>
<tr>
<td></td>
<td>(1.68)</td>
<td>(-0.85)</td>
</tr>
<tr>
<td>Product dummy-ketchup</td>
<td>1.984</td>
<td>-3.225</td>
</tr>
<tr>
<td></td>
<td>(1.48)</td>
<td>(-1.21)</td>
</tr>
<tr>
<td>Quarter</td>
<td>-0.334</td>
<td>-1.236***</td>
</tr>
<tr>
<td></td>
<td>(-1.53)</td>
<td>(-3.14)</td>
</tr>
<tr>
<td>constant</td>
<td>18.414</td>
<td>-38.675</td>
</tr>
<tr>
<td></td>
<td>(0.95)</td>
<td>(-0.68)</td>
</tr>
</tbody>
</table>

Notes: *** = statistically significant at the 99 percent level; ** at the 95 percent level; * at the 90 percent level.

To explain the positive impact of the size difference on PL store coupon value in Table A.1, we re-test the truncated models by using both the size of the store leading NBs and the size of the leading PLs instead of the absolute size difference between
the two products. By doing this, this research intends to separate the effect caused by the size of the leading NBs from the effect caused by the size of the leading PLs. As described by the predicted model, the NB product feature is assumed fixed, and the retailer positions the PL by choosing the feature difference between the two products. Therefore, if we see a positive impact from the size of the leading NBs but not the size of the leading PLs, then the leading retailers’ PL couponing does not change with PL product feature conditional on the product feature of leading NBs.

**Table A.2: Results in the SUR Tobit model –**

**Two Measures of Feature Differentiation** (z-stats in parentheses)

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Store Coupon-NB</th>
<th>Store Coupon-PL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation-discrete</td>
<td>-1.941***</td>
<td>1.190</td>
</tr>
<tr>
<td>(-2.64)</td>
<td>(1.39)</td>
<td></td>
</tr>
<tr>
<td>Feature differentiation-continuous</td>
<td>0.027</td>
<td>0.054</td>
</tr>
<tr>
<td>(0.93)</td>
<td>(1.16)</td>
<td></td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>1.189***</td>
<td>-0.031</td>
</tr>
<tr>
<td>(3.62)</td>
<td>(-0.07)</td>
<td></td>
</tr>
<tr>
<td>Leading NB with manufacturer's coupon offered</td>
<td>1.138</td>
<td>1.207</td>
</tr>
<tr>
<td>(1.21)</td>
<td>(0.87)</td>
<td></td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>0.957</td>
<td>2.107**</td>
</tr>
<tr>
<td>(1.09)</td>
<td>(2.54)</td>
<td></td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>0.268</td>
<td>1.953</td>
</tr>
<tr>
<td>(0.20)</td>
<td>(1.32)</td>
<td></td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>-1.201</td>
<td>1.146</td>
</tr>
<tr>
<td>(-1.45)</td>
<td>(1.23)</td>
<td></td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>9.801</td>
<td>5.873</td>
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<td>Variable</td>
<td>Coefficient</td>
<td>Standard Error</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Private label distribution</td>
<td>7.197*</td>
<td>(1.34)</td>
</tr>
<tr>
<td>Number of National brands</td>
<td>0.134</td>
<td>(1.18)</td>
</tr>
<tr>
<td>National brand Herfindahl index</td>
<td>-3.076</td>
<td>(-0.95)</td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>0.706</td>
<td>(0.14)</td>
</tr>
</tbody>
</table>

**Demographic Information**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average income</td>
<td>1.102x10^-4*</td>
<td>(1.94)</td>
<td>8.99x10^-5</td>
<td></td>
</tr>
<tr>
<td>Average household size</td>
<td>-2.999</td>
<td>(-0.81)</td>
<td>2.121</td>
<td></td>
</tr>
<tr>
<td>Average age of female heads of households (HH)</td>
<td>0.017</td>
<td>(0.06)</td>
<td>0.469</td>
<td></td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>31.368***</td>
<td>(4.22)</td>
<td>16.650**</td>
<td></td>
</tr>
<tr>
<td>Female HH working over 35 hours</td>
<td>-18.759</td>
<td>(-1.46)</td>
<td>-18.987</td>
<td></td>
</tr>
<tr>
<td>Female HH with at least college degree</td>
<td>-13.344*</td>
<td>(-1.70)</td>
<td>-31.315***</td>
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</tbody>
</table>

**Other Control variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product dummy-mayo</td>
<td>2.811*</td>
<td>(1.95)</td>
<td>-1.420</td>
<td></td>
</tr>
<tr>
<td>Product dummy-ketchup</td>
<td>2.678*</td>
<td>(1.76)</td>
<td>-2.379</td>
<td></td>
</tr>
<tr>
<td>Quarter</td>
<td>-0.176</td>
<td>(-0.72)</td>
<td>-0.578</td>
<td></td>
</tr>
<tr>
<td>constant</td>
<td>6.337</td>
<td>(0.22)</td>
<td>-14.351</td>
<td></td>
</tr>
</tbody>
</table>

Notes: *** = statistically significant at the 99 percent level; ** at the 95 percent level; * at the 90 percent level.

The new test results are in Table A.3. We can see that the positive sign occurs only in the size of the store leading NBs but not the size of the leading PLs. Thus, the model’s results may not be contradicted. A possible reason for the positive sign is that
larger size of NBs often accompanies a lower per unit NB price, which drives the retailers to offer PL coupons with larger face value to compete with the NBs.

**Table A.3: Results in the Truncated Models**

Sizes of the Leading NBs and PLs (z-stats in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>Dependent Variable</th>
<th>Store Coupon-NB</th>
<th>Store Coupon-PL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Store Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature differentiation-discrete</td>
<td>-1.112** (-2.12)</td>
<td>-0.424 (-0.49)</td>
<td></td>
</tr>
<tr>
<td>Leading NB’s size</td>
<td>-0.018 (-0.48)</td>
<td>0.159* (1.94)</td>
<td></td>
</tr>
<tr>
<td>Leading PL’s size</td>
<td>-0.028 (-1.15)</td>
<td>-0.072 (-0.84)</td>
<td></td>
</tr>
<tr>
<td>Standard deviation of weekly prices</td>
<td>1.174*** (4.05)</td>
<td>0.095 (0.75)</td>
<td></td>
</tr>
<tr>
<td>Leading NB with manufacturer’s coupon offered</td>
<td>-0.437 (-0.57)</td>
<td>2.567 (1.25)</td>
<td></td>
</tr>
<tr>
<td>The 1st leading NB tops at the 1st of all NBs</td>
<td>-0.480 (-0.42)</td>
<td>4.636*** (3.12)</td>
<td></td>
</tr>
<tr>
<td>The 2nd leading NB tops at the 1st of all NBs</td>
<td>-0.272 (-0.21)</td>
<td>4.531** (2.36)</td>
<td></td>
</tr>
<tr>
<td>The 2nd leading PL tops at the 2nd of all PLs</td>
<td>-0.724 (-0.81)</td>
<td>0.689** (0.69)</td>
<td></td>
</tr>
<tr>
<td><strong>Market Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private label share</td>
<td>1.172 (0.18)</td>
<td>11.578 (0.98)</td>
<td></td>
</tr>
<tr>
<td>Private label distribution</td>
<td>-1.656 (-0.53)</td>
<td>1.003 (0.12)</td>
<td></td>
</tr>
<tr>
<td>Number of NBs</td>
<td>0.127 (1.15)</td>
<td>0.067 (0.38)</td>
<td></td>
</tr>
<tr>
<td>NB Herfindahl index</td>
<td>-8.038** (-2.37)</td>
<td>-2.414 (-0.39)</td>
<td></td>
</tr>
<tr>
<td>Supermarket retail CR4</td>
<td>2.757</td>
<td>2.825</td>
<td></td>
</tr>
</tbody>
</table>
### Demographic Information

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average income</td>
<td>2.71x10^{-5}</td>
<td>(0.53)</td>
</tr>
<tr>
<td>Average household size</td>
<td>-2.053</td>
<td>(0.709)</td>
</tr>
<tr>
<td>Average age of female heads of households (HH)</td>
<td>-0.039</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Percent hispanic</td>
<td>19.974***</td>
<td>(3.14)</td>
</tr>
<tr>
<td>Female HH working over 35 hours</td>
<td>-6.974</td>
<td>(-0.66)</td>
</tr>
<tr>
<td>Female HH with at least college degree</td>
<td>-10.306</td>
<td>(-1.47)</td>
</tr>
</tbody>
</table>

### Other Control variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product dummy-mayo</td>
<td>2.087</td>
<td>(1.56)</td>
</tr>
<tr>
<td>Product dummy-ketchup</td>
<td>2.510</td>
<td>(1.64)</td>
</tr>
<tr>
<td>Quarter</td>
<td>-0.227</td>
<td>(-1.05)</td>
</tr>
<tr>
<td>constant</td>
<td>17.114</td>
<td>(0.87)</td>
</tr>
</tbody>
</table>

Notes:  *** = statistically significant at the 99 percent level; ** at the 95 percent level; * at the 90 percent level.
Bibliography


Chintagunta, P.K., Bonfrer, A., Song, I., 2002. Investigating the effects of store brand


Ping-Chao Wu was born in Taipei, Taiwan, on June 6, 1976. She received a B.B.A. degree and a M.B.A. degree in Finance from National Taiwan University in 1998 and 2000, respectively. From 2003 to 2005, she enrolled in the Statistics Master’s program and Accounting Doctoral program at National Chengchi University, and graduated with a M.S. degree in Statistics in June 2005. Winning a 2003 Taiwan government scholarship in the field of Economics for studying abroad, she started her study in the Economics Doctoral program at the Pennsylvania State University in September 2005. In August 2007, she graduated with a M.A. degree in Economics and transferred to the Agricultural, Environmental, and Regional Economics program at the Pennsylvania State University.