College of Business Administration

IOWA

The University of Iowa, Iowa City, Iowa

Analysis of National Brand - Store Brand Competition

Raj Sethuraman

Working Paper Series No. 91-22
October 1991

ANALYSIS OF NATIONAL BRAND - STORE BRAND COMPETITION

Raj Sethuraman*

October 1991

*Assistant Professor of Marketing, College of Business Administration, The University of Iowa, Iowa City, Iowa 52242.

I thank Anne Coughlan of Northwestern University and Birger Wernerfelt of MIT for their helpful comments. I also thank John Totten of Information Resources Inc. for providing the data.

ANALYSIS OF NATIONAL BRAND - STORE BRAND COMPETITION

ABSTRACT

This paper analyzes the competition between national brand and store brand using simple game-theoretic models. It attempts to answer the following questions: What is the incentive for a retailer to carry a store brand? Why do store brands pervade certain product categories and not others? Are they mechanisms through which the retailer gains channel power? What pricing strategy should the retailer adopt with respect to the national brand and the store brand? What impact does a store brand have on the marketing strategy of the national brand manufacturer?

The model focuses on two parameters: price sensitivity and advertising sensitivity. Specifically it is shown that a store brand will be introduced in markets which have high cross-price sensitivity between national brand and store brand, and low advertising sensitivity. When the cross-price sensitivity is higher, the retailer will sell larger quantities of store brand, gain higher total profits and a higher share of channel profits. A market power explanation is provided and the strategic implications for the manufacturer and the retailer are discussed. The model predicts a negative relationship between store brand share and price differential between national brand and store brand. The prediction is consistent with actual observations for grocery products.

ANALYSIS OF NATIONAL BRAND STORE BRAND COMPETITION

INTRODUCTION

A significant development in marketing that has generated great interest among manufacturers, retailers, and public policy makers, is the phenomenon of store branding. Consumer goods marketers with heavy financial investments in branded items have been increasingly concerned about the channel power and profits that retailers gain by selling merchandise under their own labels. Faced with severe competition from the store brands, these manufacturers have to find answers to some hard questions: should they increase their advertising? decrease the price? or adopt some other strategy? Retailers are themselves trying to understand in which product categories they should introduce store brands and what strategies they should adopt with respect to the store brand and the national brand. In the 1970s, the Atlantic and Pacific Co. (A&P), Safeway, Kroger and other large chains packed private labels for purposes of company vanity (Martin 1977). A&P has since had to cut back on its store brand production and resort to selective store branding. Safeway and Kroger have begun downplaying their own brands (Salmon and Cmar 1987). The government has also monitored the performance of store brands to determine the extent of store branding and the impact of store brands on retail margins and consumer prices (Report of the National Commission for Food Marketing 1966).

These concerns create an intriguing set of questions regarding the aspect of store branding:

1. Why do store brands exist? What is the incentive for a retailer to carry a store brand? Why do we see store brands pervade certain product categories and not others?
2. Do retailers use store brands to gain market power over national brand manufacturers (gain a higher share of channel profits) or to corner a generic, price sensitive segment?
3. What strategy should the retailer adopt in promoting the national brand and the store brand? For instance, should retailers highlight the price differential between the two brands with "compare and save" slogans?
4. What impact should the presence of a store brand have on the marketing strategy of the national brand manufacturer? Should he lower his price and advertising or raise them?

The empirical and managerial literature on store brands is extensive. Most of the research findings have been based on intuition, after the fact explanations, and actual observations (Stern 1966, Cook and Schutte 1967, Bellizzi et al 1981). Very little theoretical work has investigated competition between national brands and store brands. Rao (1990) analyzed a store brand - national brand duopoly in a three stage equilibrium framework, focusing on price promotions and found that store brands should never promote in equilibrium. Raju, Srinivasan and Lal (1990) analyzed the role played by brand loyalty in determining optimal price promotional strategies in the context of a market in which a strong brand (one with high brand loyalty) competes with a weak brand (one with low brand loyalty) and shows that stronger brands promote less frequently than the weaker brands. Both these studies focus on price promotions and they do not incorporate the role of the retailer: the national brand is the "strong" brand and store brand is the "weak" brand. Lattin (1987) incorporates the retailer in his successive monopoly model, but focuses on how store brands affect manufacturer trade deals and retail price promotions. He finds that manufacturers will never offer trade deals if the retailer does not carry a store brand.

In this paper we address the questions we have raised using simple game theoretic models and extend the literature in the following important ways:

a) We incorporate the role of the retailer in understanding store brands, and we introduce advertising as a strategic decision variable of the manufacturer, in addition to price.

b) We derive implications for the national brand manufacturer and the retailer and show that the introduction of a store brand can enable the retailer to gain a higher share of channel profits or market power.

c) From the model results, we specify hypotheses regarding store brand penetration and provide empirical support for one of the hypotheses.

We believe this theoretical development, backed by some empirical evidence will enhance our understanding of the phenomenon of store branding and its marketing implications.

We first consider a simple manufacturer - retailer model (Model N), in which only the national brand is sold. We then introduce the store brand (Model NS) and derive the conditions under which the introduction of a store brand will be most beneficial to the retailer. Specifically, we show that a store brand will be introduced and will proliferate in markets which have high price sensitivity and low advertising sensitivity. In such markets, the retailer will sell larger quantities of store brand and gain higher total profits and higher share of channel profits. We also derive results on equilibrium price and advertising strategies. Then, we test the robustness of the results and show that the basic results hold even when some assumptions are relaxed. We, then, discuss the implications of the basic results. Next, we use data to show that our results on store brand penetration are consistent with actual observations. Finally, we discuss the limitations and directions for future research.

MODEL N - NATIONAL BRAND ONLY

Assumptions

We assume one manufacturer of the national brand selling its product through one retailer. The demand function faced by the retailer is,

$$q_1 = a - b\,p_1 + f\sqrt{A} \qquad (1)$$

The manufacturer sets the wholesale price (w_1) and advertising (A). The retailer sets the retail price of the national brand (p_1), given the wholesale price and advertising. The manufacturer is a Stackelberg leader. That is, he knows how the retailer will behave and takes this knowledge into consideration while setting his decision variables. We assume the marginal cost of manufacturing is constant and set the cost to zero.

Discussion

Linear demand is a common assumption in the marketing and economics literature and can be derived from a quadratic consumer utility function. Further, linearity may not be very restrictive for analyzing comparative statics results, since the assumption may be reasonable in a small neighborhood around equilibrium. Typically, national brand manufacturers promote their brand through heavy advertising intended to communicate the brand's benefits to the consumers and persuade them to buy the brand. The effect of advertising is represented as an outward shift in demand for the national brand. From empirical evidence it is reasonably clear that the overall impact of advertising is to increase the demand for the brand (Scherer 1980, Assmus, Farley and Lehmann 1984). The square root advertising effect has been used in marketing for analytical tractability (Doraiswamy, McGuire, and Staelin 1979). "f" represents a measure of the sensitivity of the national brand demand to its advertising and can be interpreted as the ability to increase demand through increased advertising. Models of marketing channels and vertical integration areas have predominantly assumed Stackelberg behavior (McGuire and Staelin 1983, Coughlan 1985), because of the belief that, typically, manufacturers move first and that the retailers are price takers. Empirical evidence has consistently shown marginal cost to be constant in the relevant range of production (Mansfield p. 223). The assumption of constant marginal cost permits us to set the cost to zero without affecting the results.

Later, we discuss these assumptions in greater detail and test the robustness of our results when some of these assumptions are relaxed.

Game Structure

The retailer sets p_1 given w_1 and A and solves

$$\underset{p_1}{\text{Maximize}} \quad (p_1 - w_1).q_1\,(p_1, A) - F_1.$$

The manufacturer sets w_1 and A and solves

$$\underset{w_1, A}{\text{Maximize}} \quad w_1.q_1\,(p_1^R(w_1, A), A) - A - F_1'.$$

where $p_1^R(w_1,A)$ is the reaction function from the retailer's problem that specifies the rules used by the retailer in setting the prices when faced with a given wholesale price (w_1) and advertising (A). F_1 and F_1' are the fixed costs associated with the national brand for the retailer and the manufacturer respectively.

The solutions obtained from the model are presented in Tables 1 and 2.

What happens when the retailer introduces a store brand?

MODEL NS - NATIONAL BRAND AND STORE BRAND

Assumptions

When the retailer offers a store brand at price p_2, consumers will switch from the national brand to the store brand depending upon

a) their price sensitivity in that product category, and

b) the price differential (p_1-p_2) between the two brands.

For a given price differential, the higher the price sensitivity, the more consumers will switch from the national brand to the store brand. Conversely, for a given price sensitivity, the higher the price differential $(p_1 - p_2)$, the more consumers will switch. These assumptions of consumer behavior have been empirically validated (Johnson 84) and used by modelers (Rao 1990). We also assume that if the price of the store brand is greater than or equal to the price of the national brand, no one buys the store brand. The assumption - which implicitly states that the national brand is the premium brand - is consistent with general observations. Consistent with the generally accepted notion that store brand are "unadvertised private labels," we assume that the store brand is not advertised. It is possible that some store brands may benefit indirectly from the advertising of the store name. Such indirect effects are not considered. We also assume that the demand for the store brand is driven only by the price differential between the national brand and the store brand.

These assumptions give rise to the following demand structure for the store brand (q_2) and the national brand (q_1):

$$q_2 = c\,(p_1 - p_2) \quad \text{when} \quad p_1 > p_2$$

$$= 0 \qquad\qquad \text{when} \quad p_1 \leq p_2$$

$$q_1 = a - b\,p_1 - c\,(p_1 - p_2) + f\sqrt{A} \quad \text{for } p_1 > p_2$$

"c" can be interpreted as the size of the prince-sensitive segment or as a measure of the cross-price sensitivity between the national brand and the store brand; higher c implies a higher propensity to switch to the store brand. When c=0, no switching takes place and the situation is the same as when only the national brand is offered (Model N). Notice that these demand characteristics satisfy the following reasonable conditions.

a) At a given price p_1, the demand for the national brand in the presence of a store brand is less than or equal to the demand for the national brand when a store brand is not present.

$$q_1 (p_1)|_{NS} \leq q_1 (p_1)|_N \text{ for all } p_1$$

b) At a given p_1, the total demand when a store brand is offered equals the demand when only the national brand is offered.

$$q_1 (p_1)|_{NS} + q_2 (p_2)|_{NS} = q_1 (p_1)|_N \text{ for all } p_1, p_2$$

c) When a store brand is introduced at a lower price, the demand for the national brand becomes more price sensitive (b + c).

We further assume that the marginal costs of manufacturing the store brand and the national brand are equal and constant, and we set them to zero.

Game Structure

The retailer sets p_1 and p_2 given w_1 and A and solves

$$\underset{p_1,\, p_2}{\text{Maximize}}\ (p_1 - w_1).q_1 (p_1, p_2, A) + p_2.q_2 (p_1, p_2) - F_1 - F_2.$$

The manufacturer sets w_1 and A and solves

$$\underset{w_1, A}{\text{Maximize}}\ w_1.q_1 (p_1^R(w_1, A), p_2^R(w_1, A), A) - A - F_1'.$$

where $p_1^R(w_1,A)$, $p_2^R(w_1,A)$ are the reaction functions or rules from the retailer's problem and F_2 is the fixed cost associated with the store brand.

Results from Model NS

The equilibrium solution of the model is given in Tables 1 and 2. An equilibrium with positive prices, quantities and profits exists when the sufficient second order condition, $8(b + c) - f^2 > 0$, holds.[1]

[1]The inequality condition is applicable only when the prices (p_1, p_2) and advertising (A) are measured in the same consistent units (say dollars) and b,c,f represent corresponding parameters. When they are measured in different units, the inequality relationship will change but can be transformed to the original condition by adjusting for differences in units of measurement. For example, if advertising is

We derive insights from the model by focusing on two parameters: the cross-price sensitivity between the national brand and the store brand (c) and the advertising sensitivity (f), assuming other parameters to be constant.

Introduction of Store Brand

The retailer will introduce a store brand if the incremental profits he obtains from the introduction is sufficient to cover the related fixed costs and assure him of some minimum profits. The incremental profits given by,

$$\Delta\Pi_r = \Pi_r|_{NS} - \Pi_r|_N = \frac{4a^2(b+c)(b+4c)}{b[8(b+c)-f^2]^2} - \frac{4a^2b}{(8b-f^2)^2}$$

represents the magnitude of the incentive to introduce a store brand: the higher the incremental profits, the more is the likelihood of store brand introduction.

Figure 1 illustrates the effect of c and f on incremental profits for the case, $a = 10$, $b = 1$. When the advertising sensitivity (f) is lower, the incremental profits are higher and increase with cross-price sensitivity (c). When the advertising sensitivity is higher, the incremental profits are lower and they decrease with price sensitivity. The implications from these observations are stated formally in the following propositions.

<u>Proposition 1.</u> *For any given values of a, b, and c, there exists a threshold level of advertising sensitivity (f*) above which a retailer should never introduce a store brand.*

<u>Proposition 2.</u> *Given a and b, a retailer is more likely to introduce store brands in markets characterized by lower advertising sensitivity (f) and higher price sensitivity (c).*

Proof: See Appendix 1.

Store Branding and Market Power

In the industrial economics literature, power has been conceptualized in terms of the ability of one's action to change the economic returns of another. Power has been operationalized through

---

now measured in hundreds of dollars (H\$) instead of dollars, then, $\hat{f}$ (A in H\$) = 10f (A in \$) and the SSOC is $800(b+c) - \hat{f}^2 > 0 \Rightarrow 8(b+c) - f^2 > 0$ which is the original condition. The above arguments hold for all inequality conditions discussed later.

performance measures like ROI, profits and relative profits of the parties involved in the transaction. Consistent with these notions, we define a member's share of the total channel profits as an index of his market power. The ratio of retailer's profits from the national brand to manufacturer's profits $[\Pi_1/\Pi_m]$ and the ratio of retailer's total profits to manufacturer's profits $[\Pi_r/\Pi_m]$ represent two indices of the retailer's market power. The following proposition states the impact of store branding on market power.

Proposition 3. *When conditions are favorable for store brand introduction ($\Delta\dot{\Pi}_r > 0$), the retailer will gain market power by introducing a store brand.*

Proof: Appendix 1

Store Branding and Retailer Strategies

When a store brand is introduced, the retailer will lower the price and sell lower quantities of the national brand. His profits from the national brand may decrease. His ability to gain higher total profits will depend on his ability to gain higher profits from the store brand. In markets characterized by higher cross-price sensitivity between the national brand and the store brand, the retailer will avail of the switching propensity and sell larger quantities of the store brand while maintaining a lower price differential between the two brands, thus gaining higher profits from the store brand. We state the key results in the following proposition:

Proposition 4. *The unit volume and dollar volume share of store brand sold will be higher in markets with higher price-sensitivity (c) but the price differential between the national brand and the store brand will be lower in these markets.*

Proof: Obtained by differentiating the relevant expressions in Table 2.

Store Branding and Manufacturers Strategies

Proposition 5. *When the retailer introduces a store brand, the national brand manufacturer should reduce his wholesale price and advertising.*

Proof: Differentiating the relevant expressions in Table 1, we get $\frac{dw}{dc} < 0$ and $\frac{dA}{dc} < 0$. Since $c=0$ represents Model N and $c>0$ represents Model NS, we have $w|_{NS} < w|_N$ and $A|_{NS} < A|_N$.

An Intuitive Explanation for the Propositions

When there is no store brand, the retailer's demand function for the national brand is q_N (Figure 2). The marginal revenue curve, from economic theory is the line (MRR) bisecting the angle between q_N and the y-axis. This line is the derived demand curve faced by the manufacturer with corresponding marginal revenue curve, MRM. The retailer and the manufacturer set their prices (p_1 and w_1) to equate marginal revenue to marginal cost. Through application of the properties of similar triangles, it can be shown that the ratio of retailer margin to manufacturer margin is always one-half (Bresnahan and Reiss 1985). Consequently, the retailer's share of total revenues is 1/3.

When a store brand is introduced, the demand configurations are as follows: for a given price p_2 ($<p_1$) of the store brand, the national brand loses $c(p_1-p_2)$ to the store brand. Hence the demand for the national brand becomes more elastic ($b+c$) and rotates inward from q_N to q_1 (Figure 3a). For a given price p_1 ($>p_2$) of national brand, the store brand (q_2) gains $c(p_1-p_2)$, as depicted in Figure 3b.

Consider the national brand situation. The demand and hence the marginal revenue is depressed. The manufacturer and the retailer therefore have to reduce the price of the national brand and sell less quantity. The change in national brand demand has a concurrent effect on advertising. Because of the reduction in price and quantity, manufacturer will generate less total revenue and less marginal revenue from advertising and will therefore reduce his level of advertising. Because advertising decreases, the national brand demand shifts inward, the size of the shift depending on the advertising sensitivity (f). When f is larger, the national brand demand is depressed considerably, to q_1' (say). This further reduces the price and quantity of the national brand. Consequently, the store brand is unable to command a high price and its demand is also depressed to q_2'. The retailer therefore sells small quantities at low prices. This p_1,p_2 combination yields lower profits than when there is no store brand, and the retailer does not have the incentive to introduce his brand. When f is smaller, however, the reduction in demand due to advertising is not high and the demand functions are q_1'' and q_2'' (say). With this demand structure, the retailer is able to choose a p_1,p_2 combination such that he increases his total profits and share of profits.

A similar explanation can be provided for the effect of price sensitivity (c) on retailer and manufacturer variables. When the price sensitivity increases, the national brand demand becomes more price elastic and shifts from q_1 to q_1' (Figure 4a). For the same p_1, the store brand shifts from q_2 to q_2' (Figure 4b). The shift (q_1 to q_1') results in a decrease of national brand price, quantity sold and advertising. If f is large, the advertising decrease can appreciably decrease the demand for the national brand. The retailer may then be unable to command a high price on the national brand; hence his pricing flexibility with respect to the store brand is also reduced, and there is no potential increase in profits. However, when f is low, the inward shift is not considerable and the resultant demand could be (say) q_1'' for the national brand and q_2'' for the store brand. In this case, the retailer decreases the price of the national brand and sells less; he decreases the price of the store brand but sells more. The retailer makes the price differential smaller and gains higher profits and share of channel profits when price sensitivity (c) increases.

ROBUSTNESS OF MODEL RESULTS

In the basic model we have made several assumptions about the cost and demand structures. To test the robustness of the results, we relaxed some of the model assumptions. We analyzed a more general linear model that allows for cross price and cross advertising effects and for increase in primary demand. We introduced constant but unequal marginal costs. We analyzed a quantity setting Cournot model where the retailer decides on what quantities to "move" instead of what prices to set. The details of the model formulation are given in Appendix 2. The results of the analysis are given in Sethuraman (1989).

In all the above cases the following basic results hold good: (a) the retailer is more likely to introduce a store brand when the advertising sensitivity is lower and the cross-price sensitivity is higher; (b) when the price sensitivity is higher the retailer is better off - his profits and share of channel profits increase; and (c) as the market becomes more price sensitive, the quantity sold and revenue share of the store brand increase.

In this general linear model, it is possible for the optimal price of the store brand to be higher than the price of the national brand. In such cases, the result on price differential (Proposition 4) does not apply. However, in frequently purchased grocery markets, which our model is primarily attempting to understand, such instances represent less than 5% of the product categories. It is also possible for the retailer to sell a larger quantity of the store brand than of the national brand, but the result on store brand shares (Proposition 4) still holds. Manufacturer advertising decreases or remains the same when a store brand is introduced, for a wide range of parameter conditions. However, in some cases, especially when f and g are higher, manufacturer advertising can increase. So, our basic result (Proposition 5) appears to hold particularly in mature product markets, where the advertising sensitivity may be lower.

Next, we analyze a model where one national brand is carried by several retailers and assume a non-linear (constant elasticity) demand function for the national brand (Appendix 3). We show that the basic results hold. Finally, we construct a simple model with multiple manufacturers and multiple retailers and argue that the basic results will hold in this case as well (Appendix 4). Thus, the results from the basic model appear to be fairly robust.

DISCUSSION OF RESULTS

In this section, we provide some answers to the questions we posed at the beginning concerning store brand penetration and its implications for market power and manufacturer/retailer strategies.

Store Branding and Market Power

Our model finds that in markets characterized by higher price sensitivity and lower advertising sensitivity, a retailer will introduce a store brand and choose an appropriate price combination to gain higher total profits and higher share of channel profits (a measure of market/channel power). This finding attains special significance in light of Porter's theory (Porter 1976): in a frequently purchased convenience goods category, the consumer demands a nearby outlet, is unwilling to shop around and desires no sales help. In view of these buying characteristics, if the manufacturer can develop a brand image through advertising, the retailer is unable to influence the purchasing decision of the consumer in the store. This factor reduces the retailer's credible bargaining power; hence, the manufacturer garners all the channel profits through advertising. Our model suggests that, by introducing a store brand and suitably pricing the two brands, the retailer can influence the purchase decision. Thus store brands seem to represent a countervailing mechanism by which retailers can gain market power and garner a higher share of channel profits.

Store Branding and Manufacturer Advertising

Our model indicates that in mature frequently purchased product markets in which the price sensitivity is higher and the advertising sensitivity is lower (Sethuraman and Tellis 1991), and hence the chance of introduction of a store brand is higher (Proposition 2), the manufacturer should decrease this advertising (relative to the situation when there is no store brand), and decrease his wholesale price, when a store brand is introduced.

However, an immediate reaction of several manufacturers to the issue of store brands is to advertise more, to keep out private brands. For instance, Grey Advertising's newsletter (Advertising Age, July 23, 1973, p.76) lists advertising as the first ammunition for 'war' with private labels. Campbell Soup, reportedly concerned about private label inroads, decided to revamp and enhance its advertising campaign and sought new creative inputs (Advertising Age, June 30, 1975, p.1). General Foods, in response to store brand invasion, decided to cut down its trade promotion and emphasize advertising (Advertising Age, Nov 3, 1986, p.1). Our analysis seems to support the contention of Aaker and Carman (1982) that a substantial amount of advertising for established, frequently purchased consumer brands today may represent overadvertising, advertising under conditions of saturation. An advertising increase without a substantial impact on demand merely increases the manufacturer's transfer price and hence the price of the national brand. The retailer then has more room to increase store brand prices, and he takes a "free ride" on the national brand price escalation.

Store Branding and Retailer Strategies

Retailers should selectively introduce store brands in markets with low advertising sensitivity and high price sensitivity. Indiscriminate store branding may hurt both the manufacturer and the retailer. Particularly when the national brand demand is responsive to its advertising (say in cosmetics and growth products), introduction of a store brand may force the manufacturer to reduce his advertising and fight on the basis of price. This decrease could reduce the sales and retailer margins on the national brand, and the resulting loss in profits can not be compensated by the gain in profits from the store brand, particularly if the cross-price sensitivity is low. Whereas, in less advertising sensitive and more price sensitive markets, the retailer can sell larger quantities of store brand and derive higher revenues and profits from the store brand sales and thus increase his total profits.

Since the retailer benefits when cross-price sensitivity between the national brand and the store brand is high, the retailer can attempt to influence the cross-price sensitivity by improving the packaging and shelf facing of store brands and highlighting price differences. This result probably explains why we see shelf talkers in retail outlets carry slogans, "Compare price of store brand with price of national brand and Save!"

Store Branding and Price Differential

Manufacturers commonly believe that the best way to limit private brand sales is to narrow the price differential between the national brand and the store brand. Retailers who wish to support the store brands will increase the price differential, though they accept that it is a tricky business. Most operators report that price differential between 10 and 15% is ideal (Progressive Grocer, Feb 1989). Below 10%, consumers will buy the national brand and above 20% or so, consumers will impute lower quality to the private label and may not buy it. These observations indicate that, up to a certain point, a greater price differential between national brands and store brands lead to higher store brand share or a positive relationship between store brand share and price differential.

We provide a rival explanation from our analytical work. We find price differential decreases and store brand share increases with price sensitivity (c). Because store brands proliferate in highly price sensitive markets and because in these markets price differentials at the optimum are small, we should find a negative association between store brand share and price differential. To the retailer, these results suggest that he need not be too concerned about maintaining a large price differential in price sensitive markets.

Store Brands and Average Retail Price

Our model shows that the availability of a competing store brand at a lower price will exert a downward pressure on the average retail price of the product, as would be expected. That is, store brand introduction (proliferation) reduces the average retail price of the product. If it were so, public policy makers would encourage store branding so long as it did not reduce the quality of the product.

HYPOTHESES - STORE BRAND PENETRATION

In this section, we specify some hypotheses regarding store brand penetration that arise from the model results and emprically test one of them. Store brand penetration is generally measured by the volume or dollar share of store brands in that category (Cook and Schutte 1967, Albion 1983). If national brand manufacturers can understand the conditions under which store brands proliferate, they can identify product categories in which store branding is pervasive and devise suitable marketing strategies. Retailers can also introduce store brands in those categories conducive to private label growth.

Several empirical researchers have tried to identify the antecedents and consequences of store brand proliferation. These researchers have analyzed the data at two levels: the retailer and the market. At the retail level, for example, Albion (1983) used the "Wholesale Analysis Report" of a supermarket chain with over $300 million in sales as the database for his extensive study on brand gross margins and store branding. At the market level, analysis is based on aggregate market data (Cook and Schutte 1967). This analysis enables us to better understand the overall market conditions at the industry level.

Hypotheses

The basic model and its extensions have implications for proliferation of store brands. Our model results state that $d[q_2/(q_1+q_2)]/dc > 0$ and $d[R_2/(R_1+R_2)]/dc > 0$ and that $d[(p_1-p_2)/p_1]/dc < 0$. "c" can be interpreted as a measure of the size of the price-sensitive segment or the cross-price sensitivity. Here, c is the component of price sensitivity due to change in selective demand, or consumer switching.

Hypothesis 1 **The quantity sold and dollar share of store brand in a product category increases with cross-price sensitivity between national brand and store brand.**

Hypothesis 2: **The price differential between national brand and store brand in a product category decreases with cross-price sensitivity between national brand and store brand.**

Together, these two hypotheses indicate the relationship between price differential and store brand share. If store brand share increases with price sensitivity and price differential decreases with price sensitivity, then we may find a negative relationship between price differential and store brand share.

Hypothesis 3: **The quantity sold and dollar share of store brand in a product category is negatively related to the price differential between national brand and store brand.**

Several theories and hypotheses have been advanced to explain store brand penetration (see Sethuraman 1991 for a detailed review). The dominant production related view is that the extent of store branding in a category is determined by the ease with which a product of reasonable quality can be manufactured in that category. The dominant market-related view is that the extent of store branding is related to the extent to which a product has become a "commodity", as characterized by little tangible difference among brands, high rate of consumer switching, and hence, high price sensitivity. The production view and the market view are somewhat related since, in general, products which are easy to manufacture are the ones that exhibit high price sensitivity. However, viewed in isolation, the production argument is myopic. For instance, we observe very low store brand shares in salt, a product whose manufacturing costs are substantially low. It is also not conceivable that store brand shares are lower in toiletries like toothpaste because of the inability to manufacture product of comparable quality. A more plausible explanation is that the price sensitivity may not be high in such items. Further, conversations with private label marketers reveals that retailers who carry store brands in the regular cereals market are unwilling to carry store brands in the kids' cereal category even though the manufacturing process is the same, because, they believe, in kids' products, it is difficult to switch consumers on the basis of price. Thus, store branding appears to be more market driven.

Hypothesis 3 is interesting because it contradicts a relatively common belief that high store brand shares are associated with high price differentials. Cook and Schutte (1967) find, through simple "high-low" comparisons of a few selected non durable goods, that significant percentage price differentials between the brands are related to high private brand share.

These hypotheses have been derived from results which are valid for models with single retailer, and multiple retailers. Hence they can be tested both at the individual retailer level and at the aggregate market level. Market level data are obtained by aggregating across retailers and hence are likely to be less precise than individual retailer data. In particular, aggregate data do not capture the activities of small regional brands. However, extensive retailer data are difficult to obtain and the results from one retailer may not be generalizable to other retailers. In spite of the reduced precision, we believe, aggregate data would provide useful generalizable results about the total market. Here, we use the aggregate Infoscan Supermarket Review database for the empirical analysis. We are unable to test H1 and H2 due to lack of price sensitivity data. We test Hypothesis 3 here.

Data

The Infoscan Supermarket Review data (1988) of Information Resources Inc. is a comprehensive survey of grocery store sales that provides information by brand for over 160 product categories (e.g., bread) which are further divided into over 400 subcategories or types (e.g., white bread). The information is collected from a nationally projectable sample of over 2400 stores covering 49 metropolitan markets. The data directly provides dollar share, volume share and price per volume of private labels by category and by type, for total U.S. The average national brand price was computed as the volume weighted average price of all national brands in the category. The price differntial was computed as (NB price - SB Price) / NB Price.

Type Level Data

The Infoscan data provides information on 437 types of grocery products. Of these, private levels were sold in 279 product types. Fourteen observations had negative price differential (price of the store brand was greater than the price of the national brand). These observations were deleted as they were not consistent with our model assumptions. Five observations which had low (less than 50%) ACV weighted distribution and three observations with extreme values (store brand share or price differential greater than 85%) were also deleted bringing the number of useable observations to 257.

Category Level Data

The Infoscan supermarket review provides information on 166 grocery product types. Of these, 137 categories showed private label sales. The private label dollar share and volume share were computed by aggregating across the various types in a category. The average category private label price was computed as the volume weighted average of the private label prices of the types that comprise a category. The average price of the national brand was computed in a similar way. However, in some categories, there were just one or two types which had private label and these types accounted for less than 50% of the category volume. The ten such "under-represented" categories were deleted. After deleting observations with price differential less than zero and those with extreme values, 101 observations were available for the analysis.

Test of Hypothesis 3

We tested the relationship between store brand share and price differential with both category level data and type level data. In the category level data, the correlation between price differential and store brand dollar share is -0.43 ($p=.00$) and that between price differential and volume share is -0.25 ($p=.01$). The corresponding correlations in the type level data are -0.37 ($p=.00$) and -0.2 ($p=.00$).

As a further test of hypothesis 3, we performed a regression analysis. The dependent variable is store brand share and the focal independent variable is price differential. We included the following available independent variables as covariates: unit volume percentage of category sales sold through merchandising (CATMERCH), unit volume percentage of private labels sold through merchandising (PLMERCH), and category dollar volume (CATDOLSALE). Store brand shares may be driven by the level of merchandising activity in the category and the level of merchandising activity for the store brand. It is also believed that store brand shares will be higher in categories which have high dollar volume. The regression results are reported in Table 3. The coefficient of price differential is significant at the 5% level. Thus, there appears to be strong evidence of a negative relationship between store brand share and price differential.

CONCLUSIONS AND FUTURE RESEARCH

Faced with severe competition from the store brands or private labels, the manufacturers of national brands have to decide on the appropriate pricing and advertising strategies. The retailers also have to decide whether to introduce a store brand in a product category, and, having introduced one, they have to decide on what strategies to adopt when marketing both the national brand and the store brand. In this paper we analyze some simple game-theoretic models that look at the competition between a national brand manufacturer and a retailer who sells both the national brand and the store brand. We obtain and discuss some intuitive results regarding a retailer's incentive to introduce a store brand and the equilibrium marketing strategies that will (or should) be adopted by the national brand manufacturer and the retailer. From the model results, we conclude the following.

1. The retailer has the incentive to introduce a store brand in product markets characterized by high price sensitivity and low advertising sensitivity.

2. Under such demand conditions, the retailer gains higher profits from the store brand and gains higher total profits .

3. In this process, the retailer gains a higher share of total channel profits, which we consider as a measure of market power or channel power. Thus the store brand is a mechanism by which a retailer gains channel power when price sensitivity is high and advertising sensitivity is low.

4. The reason for this occurrence can be explained as follows. When the price sensitivity is high, consumers switch from national brand to store brand. The manufacturer reduces his price and advertising. If the effect of advertising on demand is small, then retailer can exploit the demand structure to his benefit. He decreases the price of the national brand and sells lower quantity of it. He decreases the price of the store brand but sells higher quantities of it. He brings the price differential closer and gains higher profits and a higher share of channel profits.

5. In such conditions, the retailer sells higher quantities of the store brand and derives higher revenues from selling the store brand.

6. In such conditions, the optimal strategy for the national brand manufacturer is to decrease his advertising and decrease his transfer price to the retailer.

From these results we obtain some empirical implications regarding store brand penetration. We hypothesize that higher category price sensitivity is related to higher store brand penetration and lower price differential between the two brands. Using simple correlation and regression analysis, we show that the data obtained at the market level is consistent with our hypotheses. As hypothesized, and contrary to common belief, we find a negative relationship between store brand share and price differential. These empirical findings can help the manufacturer recognize those categories in which store branding will be pervasive and devise suitable strategies for the national brand. They can also help the retailer identify those markets conducive to store branding so that he may resort to selective store branding and adopt appropriate strategies.

There are several limitations in our analysis and they provide directions for future research. We analyzed simple extensions to the basic model by incorporating non-linear demand, cost structure, multiple manufacturers, and multiple retailers, and found that the basic results are fairly robust. Further analysis of these and more complex models can provide insights into other store brand related questions such as: Are store brands used as price discriminating devices or segmentation tools? What is the effect of asymmetric competition on store branding, etc.?

The empirical analysis of store brand penetration included only a few available variables affecting store brand proliferation. Future research should attempt to understand store brand penetration through a comprehensive empirical analysis at both the individual retail level and at the aggregate market level.

TABLE 1

Equilibrium Solution

	Model N	Model NS
Manufacturer Advertising, $\sqrt{A}$	$\frac{af}{8b-f^2}$	$\frac{af}{8(b+c)-f^2}$
Manufacturer Price, w_1	$\frac{4a}{8b-f^2}$	$\frac{4a}{8(b+c)-f^2}$
Quantity of NB, q_1	$\frac{2ab}{8b-f^2}$	$\frac{2a(b+c)}{8(b+c)-f^2}$
Retail price of NB, p_1	$\frac{6a}{8b-f^2}$	$\frac{2a(3b+2c)}{b[8(b+c)-f^2]}$
Retail margin on NB, p_1-w_1	$\frac{2a}{8b-f^2}$	$\frac{2a(b+2c)}{b[8(b+c)-f^2]}$
Retail price of SB, p_2		$\frac{4a(b+c)}{b[8(b+c)-f^2]}$
Quantity of SB, q_2		$\frac{2ac}{8(b+c)-f^2}$
Quantity share of SB, $q_2/(q_1+q_2)$		$\frac{c}{b+2c}$
Price Differential, $\frac{p_1-p_2}{p_1}$		$\frac{b^2}{3b+2c}$

Note:

NB = National Brand
SB = Store Brand

TABLE 2

Equilibrium Profits and Revenues

	Model N	Model NS
Manufacturing Profits, Π_m	$\frac{a^2}{8b-f^2}$	$\frac{a^2}{8(b+c)-f^2}$
Retailer Profit on NB, Π_1	$\frac{4a^2b}{(8b-f^2)^2}$	$\frac{4a^2(b+c)(b+2c)}{b[8(b+c)-f^2]^2}$
Retailer Profit on SB, $\Pi_2(R_2)$		$\frac{8a^2c(b+c)}{b[8(b+c)-f^2]^2}$
Total retailer profits, Π_r	$\frac{4a^2b}{(8b-f^2)^2}$	$\frac{4a^2(b+c)(b+4c)}{b[8(b+c)-f^2]^2}$
Share of profits, $\Pi_r/(\Pi_m+\Pi_r)$	$\frac{4b}{12b-f^2}$	$\frac{4(b+c)(b+4c)}{4(b+c)(3b+4c)-bf^2}$
Revenue from NB, R_1	$\frac{12a^2b}{(8b-f^2)^2}$	$\frac{4a^2(b+c)(3b+2c)}{b[8(b+c)-f^2]^2}$
Revenue share of SB, $R_2/(R_1+R_2)$		$\frac{2c}{3b+4c}$

Note: NB = National Brand
SB = Store Brand
Fixed costs not included (assumed zero)

TABLE 3

Regression Results: Store Brand Share vs. Price Differential

	Dep. Var: SB Dollar Share			Dep. Var: SB Volume Share		
	Estimate	t value	p value	Estimate	t value	p value
Category Data						
Intercept	24.87	6.53	.00	25.86	5.33	.00
Price Differential	-0.29	-4.87	.00	-0.20	-2.63	.01
PLMERCH	0.08	0.83	.41	0.14	1.06	.29
CATMERCH	-0.17	-1.51	.13	-0.21	-1.50	.14
CATDOLSALE	0.0005	0.68	.50	.0007	0.71	.48
	R^2 = 0.21 n = 101			R^2 = 0.09 n= 101		
Type Data						
Intercept	30.1	11.0	.00	30.22	9.49	.00
Price Differential	-0.35	-6.87	.00	-.21	-3.69	.00
PLMERCH	0.19	1.94	.05	-.001	-1.0	.32
CATMERCH	-0.30	-2.79	.01	0.25	2.12	.04
CATDOLSALE	-0.001	-0.93	.35	-.35	-2.76	.01
	R^2 = 0.17 n = 271			R^2 = 0.08 n= 257		

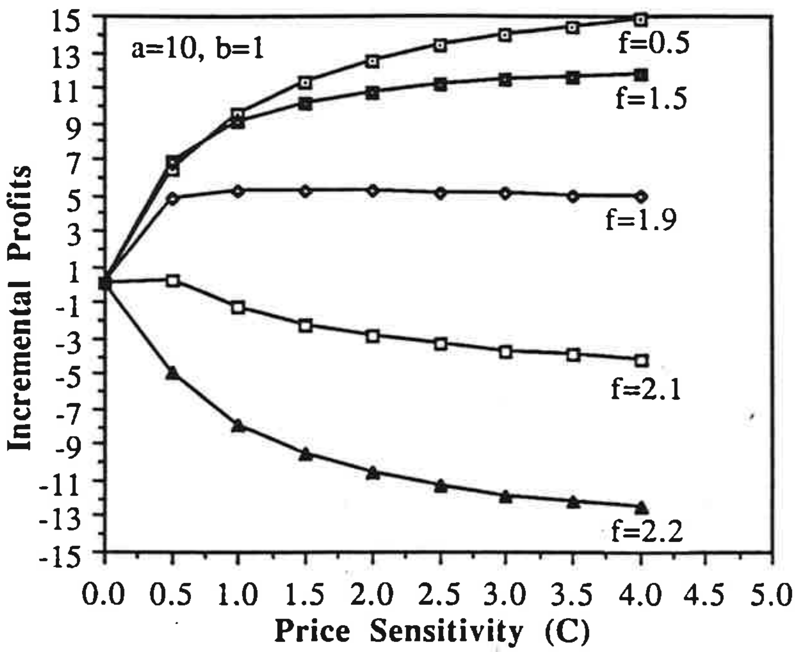

Figure 1. Incremental Profits and Price/Advertising Sensitivities

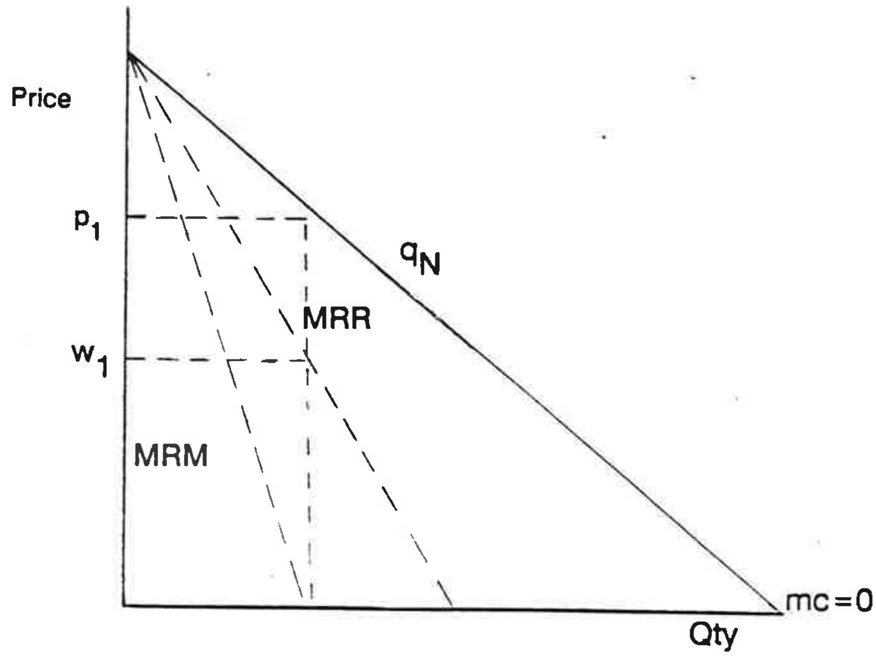

Figure 2. National Brand Only

q_N = Demand for National Brand

MRR = Marginal Revenue Curve for Retailer

MRM = Marginal Revenue Curve for Manufactures

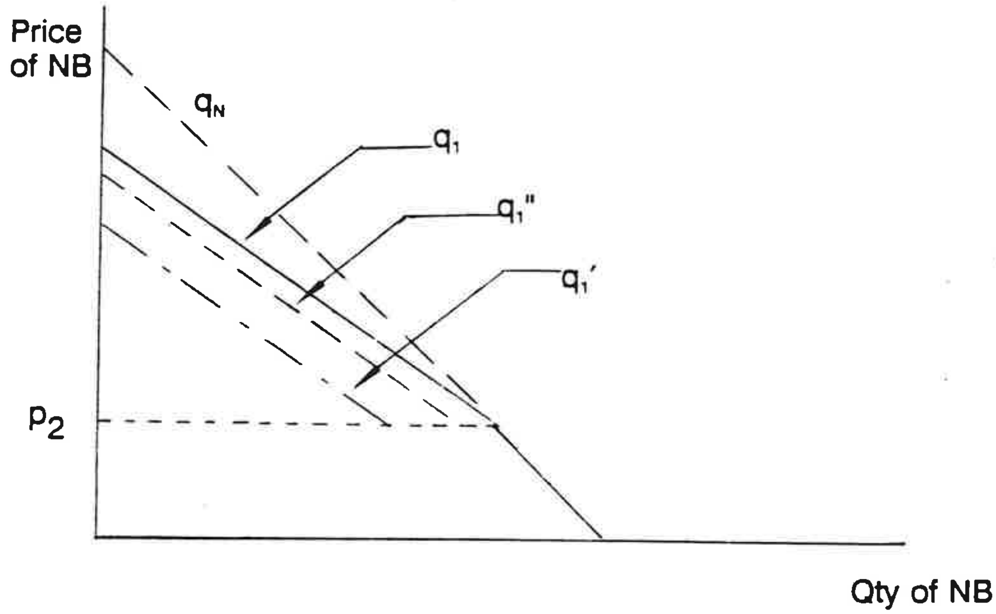

Figure 3a Effect of Store Brand Introduction on National Brand Demand

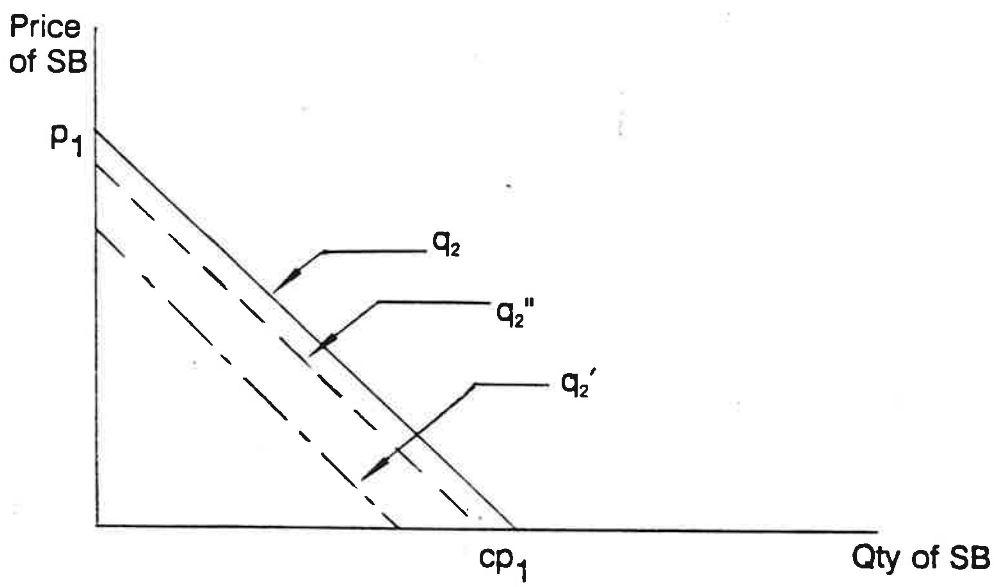

Figure 3b Effect of Store Brand Introduction on Store Brand Demand

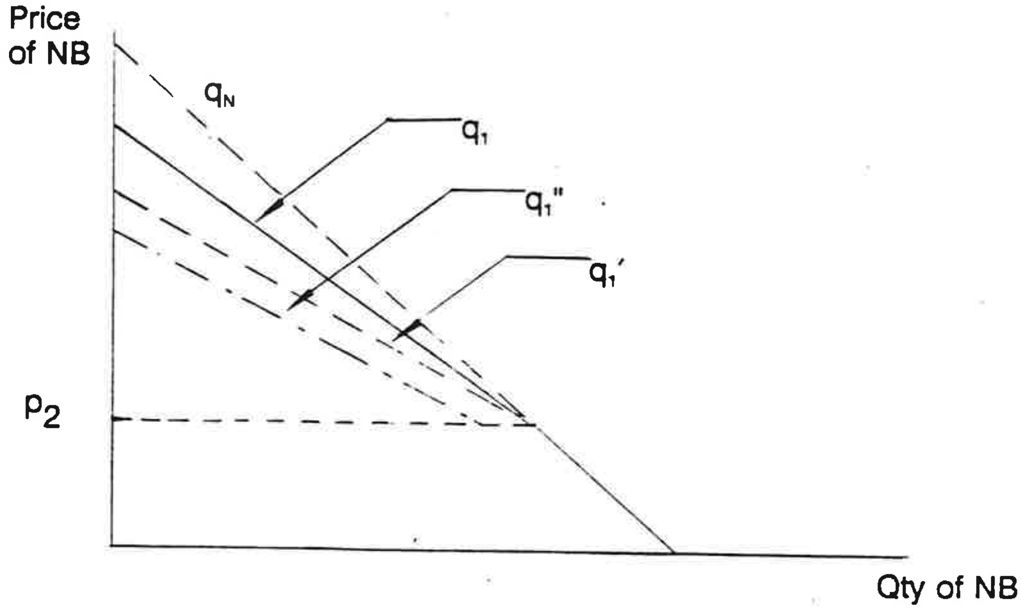

Figure 4a Effect of Price Sensitivity (c) on National Brand Demand

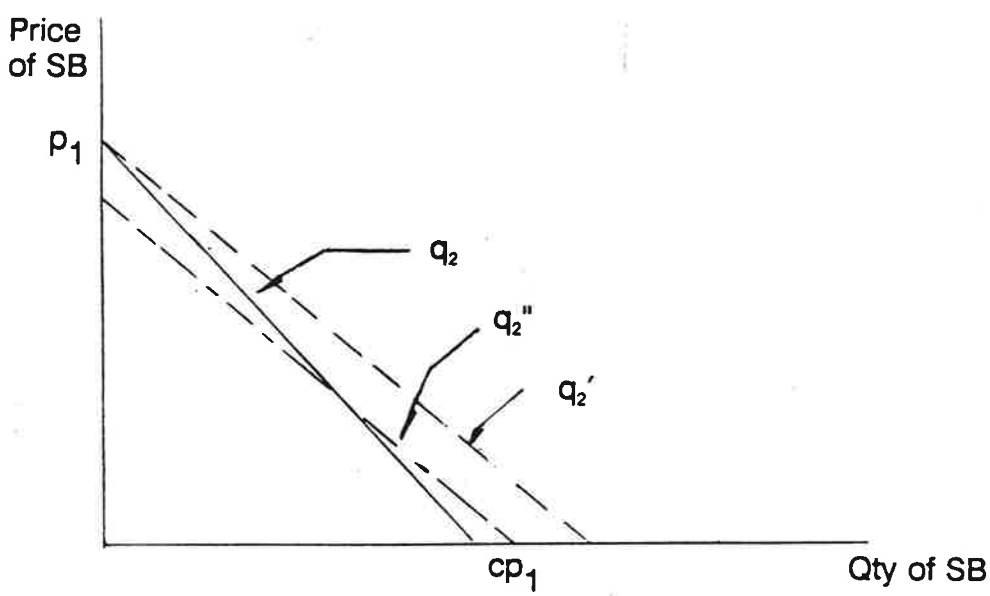

Figure 4b Effect of Price Sensitivity (c) on Store Brand Demand

REFERENCES

Aaker A. David and James M. Carman (1982), "Are You Overadvertising?," Journal of Advertising Research, 22, 4(Aug/Sep), 57-70.

Albion, Mark S. (1983), Advertising's Hidden Effects, Boston: Auburn publishing co.

Assmus, Gert, John U. Farley and Donald R. Lehmann (1984), "How Advertising Affects Sales: Meta Analysis of Econometric Results," Journal of Marketing Research, 21 (February), 65-74.

Bellizzi, Joseph A., John Hamilton, Hanu Kruckenberg, Warren Martin (1981), "Consumer Perceptions of National, Private and Generic Brands," Journal of Retailing, 57 (November), 56-70.

Bresnahan, Timothy, F. and Peter C. Reiss (1985), "Dealer and Manufacturer Margins," Rand Journal of Economics, 16 (summer), 253-268.

Cook, Victor J. and Thomas C. Schutte (1967), Brand Policy Determination, Boston: Allyn and Bacon.

Coughlan, Anne T. (1985), "Competition and Cooperation in Marketing Channel Choice: Theory and Application," Marketing Science, 4 (Spring), 110-129.

Doraiswamy, K., T. McGuire, and R. Staelin (1979), " An Analysis of Alternative Advertising Strategies in a Competitive Franchise Framework," in 1979 Educator's Conference Proceedings, N. Beckwith et al, eds., Chicago, IL: American Marketing Association.

Johnson, Tod (1984), "The Myth of Declining Brand Loyalty," Journal of Advertising Research, 24 (February - March), 9-17.

Lattin, James M. (1987), "The Impact of Store Brands on the nature of Manufacturer's Trade Deals and Retail Price Promotions," Working Paper, Stanford University.

Mansfield, Edwin (1988), Micro Economics: Theory, Applications, 5th ed., New York: Norton.

Martin, Sam (1977), "Frozen Food Private Label - An Appraisal of its True Role in Today's Marketing," Quick Frozen Foods, August, 18-24.

McGuire, Tim and Richard Staelin (1983), "An Industry Equilibrium Analysis of Downstream Vertical Integration," Marketing Science, 2 (Spring), 161-192.

Porter, Michael E. (1976), Advertising, Structure and Bilateral Market Power, Cambridge MA: Harvard University Press.

Raju, Jaganmohan S., V. Srinivasan, and Rajiv Lal (1990), "The Effects of Brand Loyalty on Competitive Price Promotional Strategies," Management Science, 36 (March), 276-304.

Rao, Ram C. (1990), "Pricing and Promotions in Asymmetric Duopoly," Marketing Science (Forthcoming).

Report of the U.S. National Commission for Food Marketing (1966), Special studies in Food Marketing, Technical Study #10 (June).

Salmon, W.J. and Karen A. Cmar (1987), "Private Labels are Back in Fashion," Harvard Business Review, May-June, 99-106.

Scherer, F.M (1980), "Industrial Market Structure and Economic Performance, Chicago: Rand McNally Publishing Co. (2nd ed.)

Sethuraman, Raj (1989), "Analysis of National Brand Store Brand Competition," Unpublished Doctoral Dissertation, Northwestern University.

________ (1991), "Store Brand Penetration - Causes and Effects," Interim Report prepared under a grant from the Marketing Science Institute.

________ and Gerard J. Tellis (1991), "An Analysis of the Trade-Off between Advertising and Price Discounting," Journal of Marketing Research, May (Forthcoming).

Solomon and Hymowitz (1987), "P&G Makes Changes in the Way it Develops and Sells Products," Wall Street Journal, Aug 11.

Stern, Louis W. (1966), "The New World of Private Brands," California Management Review, Spring, 8 (3),43-50.

APPENDICES

APPENDIX 1

Basic Model - Proofs of Propositions

Proof of Proposition 1

Incremental profits (excluding fixed costs) for the retailer from introducing a store brand,

$$\Delta\Pi_r = \Pi_r|_{NS} - \Pi_r|_N = \frac{4a^2(b+c)(b+4c)}{b[8(b+c)-f^2]^2} - \frac{4a^2 b}{(8b-f^2)^2} \qquad \text{(A1.1)}$$

$$\frac{d\Delta\Pi_r}{dc} = \frac{4a^2}{b} \cdot \frac{[24b(b+c) - f^2(5b+8c)]}{[8(b+c) - f^2]^3} > 0 \quad \text{iff}$$

$$f^2 < \frac{24b(b+c)}{5b+8c} \qquad \text{(A1.2)}$$

The RHS of condition (A1.2) is decreasing in c. Hence,

$$f^2 > \left.\frac{24b(b+c)}{5b+8c}\right|_{c=0} = \frac{24b}{5}$$

$$\Rightarrow f^2 > \frac{24b(b+c)}{5b+8c} \;\forall c \Rightarrow \frac{d\Delta\Pi_r}{dc} < 0 \;\forall c.$$

Because $c = 0$ represents Model N ($\Delta\Pi_r = 0$) and $c > 0$ represents Model NS, $f^2 > \frac{24b}{5}$ implies incremental profits are always negative and a store brand should never be introduced. That is, $f^2 = \frac{24b}{5}$ is clearly the upper limit (threshold) for introducing a store brand. If the fixed costs of introducing a store brand are included, the threshold advertising sensitivity will be lower.

Proof of Proposition 2

Proposition 2 holds if the incremental profits from introducing a store brand are higher when the advertising sensitivity, f, is lower and the cross-price sensitivity, c, is higher. We prove this by showing that $\frac{d\Delta\Pi_r}{dc} > 0$ when f is lower and $\frac{d\Delta\Pi_r}{df} < 0$ when c is higher.

$\frac{d\Delta\Pi_r}{dc} > 0$ if condition (A1.2) is met. In this case, higher "c" implies higher incremental profits.

However, given b, RHS of (A1.2) is decreasing in c which implies that f has to be lower to meet condition (A1.2). Hence, $\frac{d\Delta\Pi_r}{dc} > 0$ for wider range of c when f is lower.

$$\frac{d\Delta\Pi_r}{df} = 16a^2 \left[\frac{(b+c)(b+4c)}{b[8(b+c)-f^2]^3} - \frac{b}{(8b-f^2)^3}\right] \tag{A1.3}$$

$$\text{Sign of } \frac{d\Delta\Pi_r}{df} = \text{Sign } \{(8b-f^2)^3(b+c)(b+4c) - b^2[8(b+c)-f^2]^3\} \tag{A1.4}$$

$$= \text{Sign } \{bc[5 - \frac{24b}{8b-f^2}] + c^2[4 - \frac{192b^2}{(8b-f^2)^2}] - \frac{512b^2c^3}{(8b-f^2)^3}\} \tag{A1.5}$$

after simplifying and rearranging.

$\frac{d\Delta\Pi_r}{df} < 0$ always when $f > 1.78$ b. When $f < 1.78$ b, the higher the "c", the larger is the third expression in (A1.5) relative to the first two expressions and the greater is the chance of $\frac{d\Delta\Pi_r}{df}$ being negative. That is, $\frac{d\Delta\Pi_r}{df} < 0$ when c becomes higher.

Hence, for any given values of a and b, a store brand will most likely be introduced when f is lower and c is higher.

Condition A1.2 may also be met if b were high and this would indicate that store brand would be introduced when b is higher. To assess this, we compute

$$\text{Numerator of } \frac{d\Delta\Pi_r}{db} = b^2(8b+f^2)\ [(8b-f^2)^3+(8c)^3+3(8c)^2(8b-f^2)+3(8b-f^2)^2(8c)]$$

$$- (8b-f^2)^3\ [8(b+c)(b^2+8bc+4c^2)+f^2(b^2-4c)^2]$$

We are unable to sign $\frac{d\Delta\Pi_r}{db}$; hence we can not state that higher b is a favorable condition for store brand introduction. In any case, the basic results given in Proposition 2 do not change.

Proof of Proposition 3

A store brand will be introduced when the incremental profits are greater than zero. That is,

$$\Delta\Pi_r = \frac{4a^2(b+c)(b+4c)}{b[8(b+c)-f^2]^2} - \frac{4a^2b}{(8b-f^2)^2} > 0 \qquad \text{(Fixed costs assumed zero)}$$

$$=> \frac{(b+c)(b+4c)}{b^2} > \left[\frac{8(b+c)-f^2}{8b-f^2}\right]^2 \qquad \text{(A1.6)}$$

The ratio of retailer profits to manufacturer profits from the national brand are,

$$\left.\frac{\Pi_1}{\Pi_m}\right|_{NS} = \frac{4(b+c)(b+2c)}{b[8(b+c)-f^2]} \quad \text{and} \quad \left.\frac{\Pi_1}{\Pi_m}\right|_{N} = \frac{4b}{8b-f^2}$$

The ratio of channel profits from the national brand will be higher when a store brand is introduced if

$$\left.\frac{\Pi_1}{\Pi_m}\right|_{NS} - \left.\frac{\Pi_1}{\Pi_m}\right|_{N} > 0$$

$$=> \frac{(b+c)(b+2c)}{b^2} > \frac{8(b+c)-f^2}{8b-f^2}$$

$$=> \left[\frac{(b+c)(b+2c)}{b^2}\right]^2 > \left[\frac{8(b+c)-f^2}{8b-f^2}\right]^2$$

which is always true when condition (A1.6) holds since

$$\left[\frac{(b+c)(b+2c)}{b^2}\right]^2 > \frac{(b+c)(b+4c)}{b^2} > \left[\frac{8(b+c)-f^2}{8b-f^2}\right]^2$$

$$\left.\frac{\Pi_1}{\Pi_m}\right|_{NS} > \left.\frac{\Pi_1}{\Pi_m}\right|_{N}$$

$$=> \left.\frac{\Pi_r}{\Pi_m}\right|_{NS} > \left.\frac{\Pi_r}{\Pi_m}\right|_{N} \qquad \text{since } \Pi_r = \Pi_1 + \Pi_2 > \Pi_1 \ (\Pi_2 > 0)$$

APPENDIX 2

Extension to General Linear Model

a. <u>General Linear Model</u>

We analyzed a more general demand structure of the form:

$$q_1 = a_1 - b_1 p_1 + c_1 p_2 + f\sqrt{A}$$
$$q_2 = a_2 - b_2 p_2 + c_2 p_1 - g\sqrt{A}$$

with the reasonable assumptions that

$a_i > 0 \quad b_i > 0 \quad c_i > 0 \quad i = 1,2 \quad 0 \le g \le f$
$b_i > c_i \quad i = 1,2$ since own price effects are greater than cross price effects.

The basic model is a special case of this model where $a_2 = g = 0$, $b_2 = c_1 = c_2 = c$ and $b_1 = b+c$. This demand function allows for both primary demand expansion and for demand substitution when a store brand is introduced.

b. <u>Cost Structure</u>

We introduced constant but unequal marginal costs and solved the following game structure using the above general linear demand structure:

The retailer sets p_1 and p_2 given w_1 and A and solves

$$\underset{p_1,\, p_2}{\text{Maximize}}\ (p_1 - w_1).q_1\,(p_1,p_2,A) + (p_2 - k_2)\,.q_2\,(p_1,p_2) - F_1 - F_2.$$

The manufacturer sets w_1 and A and solves

$$\underset{w_1, A}{\text{Maximize}}\ (w_1 - k_1).q_1\,(p_1^R(w_1,A), p_2^R(w_1,A)) - A - F_1'.$$

where $p_1^R(w_1,A)$, $p_2^R(w_1,A)$ are the reaction functions from the retailer's problem. k_1, k_2 are the marginal costs of production of the national brand and the store brand respectively.

c. <u>Quantity Setting Model</u>

We analyzed the following quantity setting Cournot model where the retailer decides on the quantities to "move" instead of prices. The retailer sets q_1 and q_2 given w_1 and A and solves

$$\underset{q_1,\, q_2}{\text{Maximize}}\ (p_1\,(q_1,q_2,A) - w_1).q_1 + p_2\,(q_1,q_2,A)\,.q_2 - F_1 - F_2.$$
$$\text{s.t. } q_1 + q_2 \le Q$$

The manufacturer sets w_1 and A and solves

$$\underset{w_1, A}{\text{Maximize}}\ (w_1 - k_1).q_1\,(w_1,A) - A - F_1'.$$

where $p_1(q_1,q_2,A)$, $p_2(q_1,q_2,A)$ are the inverse demand functions. Q is the total quantity (due to market saturation or available shelf space) that can be sold.

APPENDIX 3

Extension to Non-Linear Demand Function and Multiple Retailers

Model N - Assumptions

1. One national brand carried by n retailers in the market.
2. Market demand for the national brand (N) is a function of the (geometric) average retail price, and advertising, and is related as

$$q_N = a(\bar{p})^{-\alpha} A^{\gamma} \tag{A3.1}$$

where $\bar{p}$ = geometric average retail price = $(p_1 p_2 \ldots p_n)^{1/n}$

3. Retailer i's market share of the national brand is a function of the retailer's price relative to (geometric) average competitors' price and is related as,

$$m_i = b_i \left(\frac{p_i}{\bar{p}_i} \right)^{-\beta_i} \quad \text{where } \bar{p}_i = (p_1 p_2 \ldots p_{i-1} p_{i+1} \ldots p_n)^{1/n-1} \tag{A3.2}$$

So, each retailer faces a demand,

$$q_{Ni} = q_N \cdot m_i = a(\bar{p})^{-\alpha} A^{\gamma} \cdot b_i \left(\frac{p_i}{\bar{p}_i} \right)^{-\beta_i}$$

$$= a\, p_i^{-(\frac{\alpha}{n} + \beta_i)}\, b_i\, (p_1 p_2 \ldots p_{i-1} p_{i+1} \ldots p_n)^{-(\frac{\alpha}{n} - \frac{\beta_i}{n-1})} A^{\gamma} \tag{A3.3}$$

Solution

When all retailers sell only the national brand, each retailer maximizes his profits and solves,

$\max_{p_i} (p_i - w)\, q_i$, and the optimal retail price is

$$p_i = w \frac{\lambda_i}{\lambda_i - 1} \quad \text{where } \lambda_i = \frac{\alpha}{n} + \beta_i$$

We assume symmetry among retailers, (i.e.) $\beta_1 = \beta_2 = \ldots = \beta_n = \beta$

$$\text{Then, } p_i = w \frac{\lambda}{\lambda - 1} \;\forall\, i, \text{ where } \lambda = \frac{\alpha}{n} + \beta \tag{A3.4}$$

Equation (A3.4) yields the same price for all retailers (a condition that usually exists in competitive retail markets), but each retailer may get different market share (b_i) depending on their location and attractiveness. Substituting the price from (A3.4) into equation (A3.3), we get

$$q_{Ni} = ab_i\, w^{-\alpha} \left(\frac{\lambda}{\lambda-1}\right)^{-\alpha} A^{\gamma} \tag{A3.5}$$

$$q_N = \sum_{i=1}^{n} q_{Ni} = a \left(\frac{\lambda}{\lambda-1}\right)^{-\alpha} w^{-\alpha} A^{\gamma} \tag{A3.6}$$

λ represents the (own) price elasticity for the retailer, α is the price elasticity for the manufacturer, and γ is the advertising elasticity. The national brand manufacturer solves,

$\underset{w,A}{\text{Max}}\ (w - c_m)\, q_N - A$ where c_m is the unit variable cost for the national brand. The optimum values are,

$$w = c_m \left(\frac{\alpha}{\alpha-1}\right)$$

$$A = \left[a\left(\frac{\gamma}{\alpha}\right)\left(\frac{\lambda}{\lambda-1}\right)^{-\alpha} \left(\frac{\alpha}{\alpha-1}\right)^{1-\alpha} (c_m)^{1-\alpha} \right]^{1/(1-\gamma)}$$

$$\Pi_m = A\left(\frac{1-\gamma}{\gamma}\right)$$

Retailer i's profits, $\Pi_{ir} = \dfrac{\alpha b_i}{(\lambda-1)(1-\gamma)}$

and the ratio of profits, $\dfrac{\Pi_{ir}}{\Pi_m} = \dfrac{\alpha b_i}{(\lambda-1)(1-\gamma)}$

Model NS - <u>Assumptions</u>

1. The role of store brand (2) is only to wean consumers away from the national brand (1), once they have entered the retail outlet. Thus, while the competition for the national brand is across retailers, the competition between the national brand and the store brand is within the retail outlet.

2. Retailers fix the (Nash equilibrium) price of the national brand first, and then each retailer fixes the price of his store brand.

3. The store brand gains market share in proportion to the price differential between the national

brand and the store brand. Specifically, if retailer i introduces a store brand, then market share

of store brand, $m_{2i} = \theta_i \left(\frac{p_{1i}-p_{2i}}{p_{1i}}\right)$. (A3.7)

$$q_{1i} = q_{Ni}(1 - m_{2i})$$

$$q_{2i} = q_{Ni} \cdot m_{2i}$$

θ_i is dimensionless and indicates the extent of switching due to price differential. Interviews with retailers and private label marketers suggest that assumptions (1)-(3) are reasonable representations of the real world (Sethuraman 1991). We believe equation (A3.7) is reasonable in the normal range of a firm's operation.

Solution

Given these assumptions, the retailers first solve

$\max_{p_{1i}} (p_{1i} - w)\, q_N$ as in Model N and set

$$p_{1i} = w\frac{\lambda}{\lambda-1} \quad \text{and} \quad q_{Ni} = ab_i\left(\frac{\lambda}{\lambda-1}\right)^{-\alpha} w^{-\alpha} A^{\gamma}$$

Then, retailer i solves,

$\max_{p_{2i}} (p_{1i} - w)\, q_{1i} + (p_{2i}-c_{si})\, q_{2i}$ or

$$\max_{p_{2i}} (p_{1i} - w)\, q_{Ni} + [(p_{2i}-c_{si})-(p_{1i}-w)]\, q_{Ni} \cdot m_{2i}$$

which yields,

$$p_{1i} - p_{2i} = \frac{w-c_{si}}{2}$$

and $$q_{2i} = q_{Ni} \cdot \theta_i \left(\frac{w-c_{si}}{w}\right)\left(\frac{\lambda-1}{2\lambda}\right) = q_{Ni} \cdot m_{2i} = q_N \cdot b_i \cdot m_{2i}$$

$$q_{1i} = q_{Ni}\left[1 - \theta_i \left(\frac{w-c_{si}}{w}\right)\left(\frac{\lambda-1}{2\lambda}\right)\right] = q_{Ni}(1 - m_{2i}).$$

c_{si} is the unit variable cost of the store brand.

Manufacturer demand for the national brand, $q_1 = \sum_{i \in S} q_{1i} + \sum_{i \notin S} q_{1i}$

where S is the set of all retailers who introduce the store brand (actually S is endogenously determined, but we abstract away from the problem since it does not affect our results).

For simplicity, and without loss of generality, we consider the case where just one retailer introduces a store brand. Then, the total national brand demand is given by,

$$q_1 = a \left(\frac{\lambda}{\lambda-1}\right)^{-\alpha} w^{-\alpha} A^{\gamma} \left[1 - \theta_i b_i \left(\frac{w - c_{si}}{w}\right) \left(\frac{\lambda-1}{2\lambda}\right)\right]$$

$$= q_N (1 - b_i m_{2i}) = q_N \cdot m_{1i} \quad \text{where } m_{1i} = 1 - b_i m_{2i}.$$

Manufacturer solves,

$$\max_{w,A} \; (w - c_m) q_1 - A \quad \text{which yields the FOCs}$$

$$(w - c_m) \frac{\partial q_1}{\partial w} + q_1 = 0 \tag{A3.8}$$

$$(w - c_m) \frac{\partial q_1}{\partial A} - 1 = 0 \tag{A3.9}$$

We can not explicitly solve the FOCs but can make the following arguments.

Equation (A3.8) implies $w = c_m \cdot \frac{\varepsilon_w}{\varepsilon_w - 1}$, where ε_w is the elasticity of national brand demand faced by the manufacturer with respect to its wholesale price $\left(-\frac{\partial q_1 / q_1}{\partial w / w}\right)$. We introduce the minus sign in order to work with positive numbers. We will omit subscript i hereafter.

$$q_{1|NS} = q_N \cdot m_1 \tag{A3.10}$$

Differentiating both sides of (A3.10) with respect to w and multiplying by $-\frac{w}{q_N \cdot m_1}$, we get

$$\underset{(+)}{\varepsilon_{w|NS}} = \underset{(+)}{\varepsilon_{w|N}} + \underset{(+)}{\varepsilon_{mw|NS}} \quad \text{where } \varepsilon_{mw|NS} = -\frac{\partial m_1 / \partial w}{m_1 / w} > 0 \text{ and } \varepsilon_{w|N} = \alpha.$$

Thus, when a store brand is introduced, the manufacturer's demand becomes more elastic, $\varepsilon_w|_{NS} > \varepsilon_w|_N$.

Hence, $w|_{NS} = c_m \frac{\varepsilon_w}{\varepsilon_w - 1}|_{NS} < w|_N = c_m \frac{\varepsilon_w}{\varepsilon_w - 1}|_N$. (Proposition 5)

$-\frac{\partial m_1}{\partial w} = \theta b(\frac{\lambda-1}{2\lambda}) \frac{c_s}{w^2}$ increases with θ for given w. m_1 decreases with θ.

Hence, $\varepsilon_{mw} = -\frac{\partial m_1}{\partial w} \cdot \frac{w}{m_1}$ increases with θ or $\varepsilon_w|_{NS}$ increases with θ.

$\frac{d\varepsilon_w}{d\theta} > 0 \Rightarrow \frac{dw}{d\theta} < 0$ and $\frac{dq_1}{d\theta} < 0 \Rightarrow w|_{NS} < w|_N$ and $q_1|_{NS} < q_1|_N$.

From equation (A3.9), manufacturer advertising, $A = \gamma(w-c_m)q_1$

Since the introduction of store brand reduces national brand demand and makes it more elastic,

$$A|_{NS} = \gamma(w-c_m)\, q_1|_{NS} < A|_N = \gamma(w-c_m)\, q_1|_N \qquad \text{(Proposition 5)}$$

Further, the reduction in advertising,

$$A|_N - A|_{NS} = \gamma[(w-c_m)q_1|_N - (w-c_m)\, q_1|_{NS}]$$

is likely to be greater when γ is high and q_1 (and q_2) will become smaller. The retailer is unlikely to benefit from store brand introduction (Proposition 1)

Manufacturer profits, $\Pi_m|_{NS} = (w-c_m)\, q_1 - A = (w-c_m)\, q_1\, (1-\gamma)|_{NS}$
$< \Pi_m|_N = (w-c_m)\, q_1\, (1-\gamma)|_N$

Since $\frac{dw}{d\theta} < 0$, it follows that

$$\frac{dp_1}{d\theta} = (\frac{\lambda}{\lambda-1}) \frac{dw}{d\theta} < 0$$

$$\frac{d(p_1-w)}{d\theta} = (\frac{1}{\lambda-1}) \frac{dw}{d\theta} < 0$$

$$\frac{dp_2}{d\theta} = (\frac{\lambda}{\lambda-1} - \frac{1}{2}) \frac{dw}{d\theta} < 0 \quad (\lambda > 1)$$

$$\frac{d[(p_1-p_2)/p_1]}{d\theta} = \frac{\lambda-1}{2\lambda} \cdot \frac{c_s}{w^2} \cdot \frac{dw}{d\theta} < 0 \qquad \text{(Proposition 4)}$$

$$\frac{d(p_1-w)}{d\theta} < 0 \text{ and } \frac{dq_1}{d\theta} < 0 \Rightarrow \frac{d\Pi_1}{d\theta} < 0$$

Since $\theta = 0$ represents Model N and $\theta > 0$ represents Model NS, the conditions, $\frac{d\Pi_2}{d\theta} > 0$ and $\frac{d\Pi_r}{d\theta} > 0$, must hold for some range of θ values in order for a store brand to be introduced. The larger the θ values for which $\frac{d\Pi_2}{d\theta} > 0$ and $\frac{d\Pi_r}{d\theta} > 0$, the more the total retailer profits, or the more likely that a store brand will be introduced. We will assume we are operating in the range where $\frac{d\Pi_r}{d\theta} > 0$.

$$\frac{d(p_2-c_s)}{d\theta} < 0 \text{ and } \frac{d\Pi_r}{d\theta} > 0 \Rightarrow \frac{dq_2}{d\theta} > 0.$$

$$\frac{dq_1}{d\theta} < 0 \text{ and } \frac{dq_2}{d\theta} > 0 \Rightarrow \frac{d[q_2/(q_1+q_2)]}{d\theta} > 0 \qquad \text{(Proposition 4)}$$

$$\frac{\Pi_1}{\Pi_m} = \frac{(p_1-w)q_1}{(w-c_m)q_1-A} = \frac{w}{w-c_m} \cdot \frac{1}{(\lambda-1)(1-\gamma)}$$

$$\frac{d(\Pi_1/\Pi_m)}{d\theta} = \underset{(+)}{\frac{1}{(\lambda-1)(1-\gamma)}} \Big[-\underset{(-)}{\frac{c_m}{(w-c_m)^2}}\Big] \underset{(-)}{\frac{dw}{d\theta}} > 0$$

or $$\frac{\Pi_1}{\Pi_m}\Big|_{NS} > \frac{\Pi_1}{\Pi_m}\Big|_{N} \qquad \text{(Proposition 3)}$$

Since $\Pi_2 > 0$ and $\frac{d\Pi_2}{d\theta} > 0$ it follows that

$$\frac{d(\Pi_r/\Pi_m)}{d\theta} = \frac{d[(\Pi_1+\Pi_2)/\Pi_m]}{d\theta} > 0 \text{ or } \frac{\Pi_r}{\Pi_m}\Big|_{NS} > \frac{\Pi_r}{\Pi_m}\Big|_{N} \qquad \text{(Proposition 3)}$$

Since $\theta > 0$ implies introduction of store brands (Model NS), it follows from the above arguments that store brands will most likely be introduced in markets where price sensitivity (θ) is high and advertising elasticity (γ) is low (Proposition 2).

We also tested the validity of our arguments through numerical procedures for a wide range of parameter values θ(0.1 to 4), α(1 to 4), λ(1 to 4), and γ(0 to 1). First the manufacturer's maximization problem was solved numerically to obtain w^* and A^* using Mathematica program. The Mathematica software performs differentiation operations and uses Newton-Raphson procedure for maximization. The profit function was concave and yielded a unique maximum. Other price and profit values were computed from w^* and A^*. Propositions 1-5 were found to hold good thus indicating that our basic results are robust.

APPENDIX 4

Extension to Multiple Manufacturers

Model N - Assumptions

1. One retailer selling m national brands.
2. Total demand for the retailer is a function of the average national brand price at the retail outlet and total advertising, and is related as,

$$q_t = a(\bar{p})^{-\alpha} A_t^{\phi} \quad \text{where } \bar{p} = (p_1 \, p_2 \cdots p_m)^{1/m}$$

$$A_t = A_1 + A_2 + \ldots + A_m$$

3. Market share for each national brand (i) is determined as,

$$m_i = b_i \left[\frac{p_i}{p_{-i}} \right]^{-\beta} \left[\frac{A_i}{A_{-i}} \right]^{\gamma} \quad \text{where}$$

$$p_{-i} = \prod_{\substack{k=1 \\ k \neq i}}^{m} p_k^{1/(m-1)} \qquad A_{-i} = \sum_{\substack{k=1 \\ k \neq i}}^{m} A_k \qquad q_i = q_t \cdot m_i$$

Solution

The retailer's problem is, $\underset{p_1, p_2, \ldots, p_m}{\text{Maximize}} \sum_{i=1}^{m} (p_i - w_i)\, q_i$

yielding the m FOC equations

$$(p_i - w_i) \frac{\partial q_i}{\partial p_i} + \sum_{\substack{k=1 \\ k \neq i}}^{n} (p_k - w_k) \frac{\partial q_k}{\partial p_i} = 0 \qquad i = 1,2,\ldots,m \qquad \text{(A4.1)}$$

The set of m equations should yield

$$p_i^* = f(w_i, w_{-i}, A_i, A_{-i}, \text{parameters}) \qquad i = 1,2,\ldots,m$$

Each manufacturer (i) then solves

$$\text{Maximize} \ (w_i - c_{mi})\, q_i - A_i$$

The system of equations is difficult to solve and we impose symmetry and seek equilibrium p_i, w_i, A_i that are equal across all manufacturers. The (equal) optimal wholesale price (w_1) and retail price (p_1) are,

$$p_1 = w\left(\frac{\alpha}{\alpha-1}\right)$$

$$w_1 = c_m\left(\frac{\lambda}{\lambda-1}\right) \quad \text{where } \lambda = \frac{\alpha}{m} + \beta$$

If we make a reasonable assumption that $\frac{dA_t}{dA_i} \cong 0 \; \forall \; i$, i.e., the total advertising is not affected by small changes in one manufacturer's advertising, then $A = \gamma(w-c_m)\, q_N$. Details of these arguments are available from the author.

Model NS - Assumptions

1. When a store brand (2) is introduced, the retailer first fixes the price of the national brands (1) and then the price of the store brand.
2. The store brand weans away certain market share from each of the national brands in proportion to the price differential as given by,

$$m_2 = \theta\left(\frac{p_1-p_2}{p_1}\right)$$

where p_1 is the (equal) optimal price of the national brand and p_2 is the price of the store brand.

The structure of the model is then similar to the model in Appendix 3 and the results should hold.

Models in Appendix 3 and Appendix 4 can be combined and a model with m manufacturers and n retailers can be analyzed. The basic results should hold. The analysis involves long derivatives and complex notations and are not included here.