The Introduction and Performance of Store Brands

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We present an analytical framework for understanding what makes a product category more conducive for store brand introduction. We also investigate market characteristics that help explain differences in store brand market share across product categories. Our findings suggest that the introduction of a store brand is likely to increase retailer's profits in a product category if the cross-price sensitivity among national brands is low and the cross-price sensitivity between the national brands and the store brand is high. Our model predicts that the store brand share would also be greater under these conditions. In addition, we find that the introduction of a store brand is more likely to lead to an increase in category profits if the category consists of a large number of national brands—even though the store brand market share is expected to be lower when there are a large number of national brands. We compare the key predictions of our model with data on 426 grocery product categories. The data are consistent with the predictions of the model.
(*Private Labels; Retailing; New Product Introduction; Pricing; Distribution Channels; Game Theory*)

1. Introduction

Store brands, or private labels, are brands owned, controlled, and sold exclusively by a retailer. Private labels were first introduced over 100 years ago in a few product categories, such as tea, and are now available in over 60% of all grocery products (Fitzell 1982). Spurred by their steady growth, several large retailers, including the Atlantic and Pacific Tea Company (A&P), Safeway, and Kroger, introduced private labels in a large number of product categories (Martin 1977). However, this strategy of greater emphasis on private labels reduced overall category profitability in many instances (Tedlow 1990). As a result, major chains like Safeway and Kroger had to either withdraw or de-emphasize private labels in several product categories (Salmon and Cmar 1987).

Private labels in grocery products are on the rise again, with sales of about $22 billion in 1989 and growing steadily (Liesse 1991). According to the Food Marketing Institute, the percentage of grocery shoppers buying private labels increased from 37% in 1990 to 44% in 1991 (Holton 1992). Some observers attribute this increase to the current economic climate; however, others believe that this growth trend may continue because private labels now provide acceptable quality at reasonable prices (Karolefski 1990), consumers are giving less importance to brand names (Morgenson 1991), and retailers are becoming more proficient at managing their private labels (Lenchek 1990). In this changing environment, we believe that the following issues have become potentially relevant from a retailer's perspective:

1. What characteristics make a category more conducive for private label introduction? A better understanding of this issue can help identify appropriate categories, thereby reducing the need to withdraw private labels at a later date, as reported in Salmon and Cmar (1987).
2. What factors influence private label shares in a product category?

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An understanding of these issues may also help national brand managers, for whom private labels are becoming a major source of competition.

In this paper, we develop a parsimonious analytical model to understand the effect of the following characteristics on private label introduction and market share:

- The number of national brands in a product category
- The cross-price sensitivity among national brands
- The cross-price sensitivity between the national brands and the store brand
- The base-level of demand of the store brand

The results of our empirical analysis, using data from 426 product categories, are consistent with the key predictions of our model.

Prior empirical research on private labels has examined predominantly characteristics of consumers who buy private labels and/or generics (Bellizzi et al. 1981, McEnally and Hawes 1984, Szymanski and Busch 1987). Recently, Hoch and Banerji (1993) and Sethuraman (1992) have examined cross-category differences in store brand market share. Research on price promotions has compared promotional strategies of national and store brands (Blattberg and Wisniewski 1989, Lal 1990, Lattin 1991, Narasimhan 1989, Raju et al. 1990, and Rao 1991). Our focus in this research is to study category characteristics that affect private label introduction and market share—issues that have not received as much attention in prior research.

Our analysis provides several potentially interesting qualitative insights. In general, we expect the store brand share to be smaller in product categories where there are a large number of national brands, because the total pie has to be divided among a larger number of participants. Some retailers may extend this argument and conclude that it may not be wise to introduce a store brand in categories where there are already a large number of national brands. Our analysis provides one possible explanation for why this line of reasoning is not necessarily appropriate. In fact, other things being equal, our model predicts that the introduction of a store brand is more likely to increase retailer's profits in product categories consisting of a larger number of national brands. Market data are consistent with this prediction.

Our model also helps refine conjectures about private labels presented in prior research. For example, it has been generally believed that private labels are introduced, and command higher shares, in "commodity products" that are characterized by very few tangible differences among brands and a high rate of price-based switching (Stern 1966). However, Sethuraman (1989, p. 131) found case evidence that was counter to this conventional wisdom. The analysis presented in this paper clarifies this controversy by highlighting that it is important to distinguish between two types of competition—price competition among national brands, and the price competition between the store brand and the national brand. Our model predicts that if the price competition between the national brand and the store brand is high, it is more profitable for the retailer to introduce a store brand, and the equilibrium store brand share is also high. On the other hand, if the price competition among the national brands is high, the introduction of a store brand is not as profitable, and its share is also lower.

The rest of the paper is organized as follows. In §2, we present an analytical model and examine the problem of store brand introduction. In §3, we study factors that influence cross-category differences in store brand market share. By contrasting the results in §3 with those in §2, we are able to study whether conditions that favor private label introduction are the same as those that lead to a higher store brand market share. The analytical results in §§2 and 3 lead to some potentially interesting predictions. We compare a few key predictions of our model with market data in §4. In §5, we summarize our findings, outline the limitations, and suggest directions for future research.

2. Store Brand Introduction

We begin by studying a market consisting of two national brands. Later, we analyze a more general case where the market consists of k national brands.

2.1. Product Category with Two National Brands

We label the two national brands as $i = 1, 2$; each marketed by a manufacturer, labeled correspondingly as $i = 1, 2$. The retailer has the option to introduce a store brand to augment the assortment. We assume that the retailer does so only if it increases the total profits from the product category.

The pricing decisions are assumed to be as follows. For the national brands, each manufacturer determines the wholesale prices that maximizes his/her profit. Given these wholesale prices, the retailer decides on the retail prices that maximize the retailer's total category profits. The manufacturers of national brands know the retailer's decision rule and incorporate it in the decision to set wholesale prices. In game-theoretic terms, each manufacturer acts as a Stackelberg leader (McGuire and Staelin 1983, Moorthy 1985, Coughlan 1985).

We assume that the retailer buys the store brand at a fixed per-unit cost from a manufacturing source. In line with the existing industry practice (Cook and Schutte 1967, McMaster 1987), we assume that the retailer has a long-term price contract with this source (we relax this assumption in §2.3 and examine its effect on our results). Typically, the retailer buys the store brand at a price that is very close to the marginal cost (McMaster 1987). We assume that the price at which the retailer procures the store brand is equal to the marginal cost of production. We also assume that the marginal cost of production of the national brand and of the store brand are equal. For ease of exposition, we set both to zero.

Demand Structure Prior to Store Brand Introduction. We assume that the demand functions for the two national brands (labeled as q_1 and q_2) are as follows:

$$q_1 = \tfrac{1}{2}[1 - p_1 + \theta(p_2 - p_1)], \quad (1)$$

$$q_2 = \tfrac{1}{2}[1 - p_2 + \theta(p_1 - p_2)], \quad (2)$$

where p_1 and p_2 are the prices of national brands 1 and 2, respectively, and $\theta \in (0, 1)$ is a measure of the degree of cross price sensitivity between the two national brands. As in McGuire and Staelin (1983), we restrict ourselves to those prices that lead to a nonnegative demand.

A demand function that contains a term for own price effect and another term that captures the effect of the difference between own price and the price of the competing brand is consistent with individual utility maximization behavior (Shubik and Levitan 1980).[1] When retail prices are set equal to zero, the demand for each national brand equals $\frac{1}{2}$, and the category demand equals one unit.

Demand Structure after Store Brand Introduction. In the presence of a store brand, the demand for the two national brands (q_1 and q_2), and the demand for the store brand (q_s), are assumed to be as follows:

$$q_1 = \frac{1}{2+\alpha}\left[1 - p_1 + \frac{1}{2}[\theta(p_2 - p_1) + \delta_1(p_s - p_1)]\right], \quad (3)$$

$$q_2 = \frac{1}{2+\alpha}\left[1 - p_2 + \frac{1}{2}[\theta(p_1 - p_2) + \delta_2(p_s - p_2)]\right], \quad (4)$$

$$q_s = \frac{1}{2+\alpha}\left[\alpha - p_s + \frac{1}{2}[\delta_1(p_1 - p_s) + \delta_2(p_2 - p_s)]\right], \quad (5)$$

where p_s is the price of the store brand, and $\delta_i \in (0, 1)$ is a measure of the cross price sensitivity between national brand i and the store brand. The model allows the store brand to be positioned asymmetrically with respect to the two national brands. In the case of frequently purchased packaged goods, one often notices that some store brands are positioned so as to mimic a national brand, whereas others are not targeted at a particular national brand. Our model captures either of these two positioning options. For example, high δ_1 and low δ_2 represents the case where the store brand is positioned so as to mimic national brand 1, while $\delta_1 = \delta_2 = \delta$ allows us to model a situation where the store brand competes equally with both national brands.

The intercept of the store brand is assumed to be equal to $\alpha/(2 + \alpha)$. When $\alpha = 0$, we have a situation where the store brand has no base level of demand. In the context of our model, this assumption also implies that the store brand price has to be lower than the price of at least one of the two national brands before the store brand gets any consumers. $\alpha = 1$ represents a situation where the base level of demand is equal to the base level of demand of the national brands. We expect $\alpha \in [0, 1)$.

The price difference between the two national brands is weighted by θ, and the price difference between the store brand and national brand i is weighted by δ_i. In the case where there is no store brand, each national

[1] Shubik and Levitan (1980, p. 88) propose the model, $q_i = \frac{1}{2}(r - sp_i + t(\bar{p} - p_i))$, where $\bar{p}$ is the average price. Our parsimonious model has a similar form, but fewer parameters.

brand has only one competing brand. But when we consider a market consisting of two national brands and a store brand, each brand has two competitors. As there are two price-difference terms in (3)–(5), we divide the weighted sum of the price difference terms by the number of price difference terms to get the average.

While the relative magnitudes of δ and θ may vary depending on the nature of consumer heterogeneity in preferences and the positioning strategies adopted by the competing national brands in a product category, it is important to note that demand functions (3)–(5) do not limit us to any particular relationship between θ and the δ's.

Prior to store brand introduction, when all prices are set equal to zero, category demand equals one unit. Examining (3)–(5), we note that even after store brand introduction, if all prices are set equal to zero, category demand remains unchanged and equals one unit.

When we set $\alpha = 1$ and $\delta_1 = \delta_2 = \theta$ in (3)–(5), we get a demand structure that is very much like (1)–(2), but for a three national brand market. Hence, on the demand side, the following two factors distinguish a store brand from a national brand in our model.

1. Base level of demand α is less than one.
2. The cross-price sensitivities δ_1 and δ_2 can be different from θ.

On the cost side, we assume that the retailer buys the store brand at a fixed per-unit cost from the store brand manufacturer. In other words, our analysis in this section assumes that the store brand manufacturer is not a strategic player because the wholesale price of the store brand is fixed at marginal cost.

2.1.1. Equilibrium Prior to Store Brand Introduction. The equilibrium results are derived formally in the appendix.[2] Here we provide a brief sketch of the solution approach.

The Retailer's Profit Maximization Problem. The problem stated in (6) involves selecting retail prices so as to maximize the retailer's category profits:

$$\max_{p_1, p_2} \sum_{i=1}^{2} [(p_i - w_i)q_i]. \tag{6}$$

Solving this problem gives retail prices $\hat{p}_1$ and $\hat{p}_2$ as functions of wholesale prices w_1 and w_2 (and the parameters δ_1, δ_2, and θ). Substituting these retail price expressions in (1) and (2), we obtain $\hat{q}_1$ and $\hat{q}_2$ as functions of w_1 and w_2.

Manufacturer i's Profit Maximization Problem. Manufacturer i's problem stated in (7) involves selecting wholesale price w_i so as to maximize own profits. Note that while solving the manufacturer's problem, we write $\hat{q}_i$ as a function of w_1 and w_2:

$$\max_{w_i} [w_i \hat{q}_i(w_1, w_2)]. \tag{7}$$

The solution to (7) gives the equilibrium wholesale prices (w_1^* and w_2^*). Substituting these equilibrium wholesale prices in $\hat{p}_1$, $\hat{p}_2$, $\hat{q}_1$, and $\hat{q}_2$, we obtain the equilibrium retail prices and demand for the national brands. Expressions for the equilibrium retail and wholesale prices for national brand i (p_i^* and w_i^*), unit sales (q_i^*), category sales (Q^*), manufacturer's profit (Π_i^*), and retailer's profit (Π_r^*) are given in Table 1 (column 3). The equilibrium obtained is the unique Stackelberg equilibrium. Consequently, assuming that wholesale prices are given by (w_1^*, w_2^*) the retailer has no incentive to deviate from equilibrium retail prices (p_1^*, p_2^*). Further, a particular manufacturer does not benefit by deviating from the equilibrium wholesale price, assuming that the other manufacturer and the retailer behave optimally.

From Table 1, equilibrium retail and wholesale prices are lower for higher values of the cross-price sensitivity among the national brands (θ). Retail margins on national brands are higher for higher values of θ. Equilibrium demand q_i^* increases as θ increases because higher θ leads to lower prices. As higher θ leads to higher retail margins as well as higher demand for national brands, the retailer profits are also higher. In other words, the retailer benefits when the price competition between the two national brands is higher. Category sales also increase as θ increases.

2.1.2. Equilibrium after Store Brand Introduction. The analytical representation of the profit maximization problem of the retailer is as follows:

[2] The derivations of the equilibrium expressions in Tables 1–3, along with the proofs of the various propositions and lemmas in this paper, are in an appendix. Copies of this appendix may be obtained on request from Marketing Department, The Wharton School, University of Pennsylvania, Philadelphia, PA 19104.

Table 1 Two National Brand Product Category*

(1)	(2)	(3) Before SB	(4) After SB
Wholesale price of NB1	w_1^*	$\frac{1}{(2+\theta)}$	$\frac{(8+6\theta+4\delta_2)}{(16+8\delta_1+8\delta_2+4\delta_1\delta_2+16\theta+4\delta_1\theta+4\delta_2\theta+3\theta^2)}$
Wholesale price of NB2	w_2^*	$\frac{1}{(2+\theta)}$	$\frac{(8+6\theta+4\delta_1)}{(16+8\delta_1+8\delta_2+4\delta_1\delta_2+16\theta+4\delta_1\theta+4\delta_2\theta+3\theta^2)}$
Retail price of NB1	p_1^*	$\frac{3+\theta}{2(2+\theta)}$	$\frac{w_1^*}{2}+\frac{(4+2\delta_1+4\delta_2+2\delta_1\delta_2+4\theta+2\delta_1\theta+2\delta_2\theta)+\alpha(2\delta_1+\delta_1\delta_2+\delta_1\theta+\delta_2\theta)}{2(4+4\delta_1+4\delta_2+3\delta_1\delta_2+4\theta+3\delta_1\theta+3\delta_2\theta)}$
Retail price of NB2	p_2^*	$\frac{3+\theta}{2(2+\theta)}$	$\frac{w_2^*}{2}+\frac{(4+2\delta_2+4\delta_1+2\delta_1\delta_2+4\theta+2\delta_1\theta+2\delta_2\theta)+\alpha(2\delta_2+\delta_1\delta_2+\delta_1\theta+\delta_2\theta)}{2(4+4\delta_1+4\delta_2+3\delta_1\delta_2+4\theta+3\delta_1\theta+3\delta_2\theta)}$
Demand for NB1	q_1^*	$\frac{1+\theta}{4(2+\theta)}$	$\frac{(8+4\delta_1+4\delta_2+2\delta_1\delta_2+10\theta+3\delta_1\theta+2\delta_2\theta+3\theta^2)}{2(2+\alpha)(16+8\delta_1+8\delta_2+4\delta_1\delta_2+16\theta+4\delta_1\theta+4\delta_2\theta+3\theta^2)}$
Demand for NB2	q_2^*	$\frac{1+\theta}{4(2+\theta)}$	$\frac{(8+4\delta_2+4\delta_1+2\delta_1\delta_2+10\theta+3\delta_2\theta+2\delta_1\theta+3\theta^2)}{2(2+\alpha)(16+8\delta_1+8\delta_2+4\delta_1\delta_2+16\theta+4\delta_1\theta+4\delta_2\theta+3\theta^2)}$
Retail price of the SB	p_s^*	—	$\frac{2(\delta_1+\delta_2+\delta_1\delta_2+\delta_1\theta+\delta_2\theta)+\alpha(4+2\delta_1+2\delta_2+\delta_1\delta_2+4\theta+\delta_1\theta+\delta_2\theta)}{2(4+4\delta_1+4\delta_2+3\delta_1\delta_2+4\theta+3\delta_1\theta+3\delta_2\theta)}$
Demand for the SB	q_s^*	—	$\frac{\alpha}{2(2+\alpha)}+\frac{(4\delta_1+4\delta_2+4\delta_1\delta_2+3\delta_1\theta+3\delta_2\theta)}{2(2+\alpha)(16+8\delta_1+8\delta_2+4\delta_1\delta_2+16\theta+4\delta_1\theta+4\delta_2\theta+3\theta^2)}$
Category Sales (units)	Q^*	$\frac{1+\theta}{2(2+\theta)}$	$q_1^*+q_2^*+q_s^*$
Manufacturer's Profit	Π_i^*	$\frac{1+\theta}{4(2+\theta)^2}$	$w_i^*q_i^* \cdots i=1,2$
Retailer's profits	Π_r^*	$\frac{(1+\theta)^2}{4(2+\theta)^2}$	$(p_1^*-w_1^*)q_1^*+(p_2^*-w_2^*)q_2^*+p_s^*q_s^*$

NB1: National Brand 1
NB2: National Brand 2
SB: Store Brand

* All proofs are in the appendix.

$$\max_{p_1,p_2,p_s} \sum_{i=1}^{2} [(p_i - w_i)q_i] + p_s q_s. \quad (8)$$

Solving this problem gives retail prices $\hat{p}_1$, $\hat{p}_2$, and $\hat{p}_s$ as functions of wholesale prices w_1 and w_2. Substituting these retail price expressions in (3) and (4), we obtain demands ($\hat{q}_1$, $\hat{q}_2$, and $\hat{q}_s$) as functions of w_1 and w_2. The profit maximization problem of national brand manufacturer i is as follows:

$$\max_{w_i}[w_i\hat{q}_i(w_1, w_2)]. \quad (9)$$

The solution to (9) gives the equilibrium national brand wholesale prices. Substituting these equilibrium wholesale prices in $\hat{p}_1$, $\hat{p}_2$, $\hat{p}_s$, $\hat{q}_1$, $\hat{q}_2$, and $\hat{q}_s$, we obtain expressions for the equilibrium retail prices and demand for the national brands and the store brand. The equilibrium retail prices (p_i^*), wholesale prices (w_i^*), demand (q_i^*), equilibrium price of the store brand (p_s^*), demand (q_s^*), category sales (Q^*), the manufacturer's profit (Π_i^*), and the retailer's profits (Π_r^*) are given in Table 1 (column 4). The equilibrium obtained is the unique Stackelberg equilibrium.

We discuss next a few salient characteristics of the equilibrium after store brand introduction. These features provide some insights into pricing of national brands and store brands, as well as some intuition for the results pertaining to store brand introduction.

A higher θ implies greater competition among national brands. Therefore higher θ leads to lower equilibrium national brand wholesale prices, and higher equilibrium demand for national brands. Retail margins on national brands are higher for higher values of θ because the retailer benefits as a consequence of greater competition among national brands. As higher θ implies that the two national brands compete more with one another, we would expect the difference in their prices to be lower for higher values of θ. This is in fact the case. Furthermore, the average retail price of the national brands $((p_1^* + p_2^*)/2)$ is lower for higher values of θ.

Other things remaining the same, an increase in either δ_1 or δ_2 increases the equilibrium store brand price and demand. Consequently, an increase in either δ_1 or δ_2 increases retailer's profits on the store brand. It is interesting to note that while an increase in θ leads to lower average equilibrium retail prices of the national brands, an increase in either δ_1 or δ_2 leads to a higher equilibrium store brand retail price (see §2.3 for additional details).

The equilibrium store brand price is lower than the equilibrium price of either of the two national brands for all values of α, θ, δ_1, and δ_2. However, the price difference between the store brand and a national brand depends on how the store brand competes with that particular national brand. If δ_1 is higher than δ_2, it implies that the store brand competes more with national brand 1 than with national brand 2. In such situations, the store brand is the lowest priced brand, national brand 1 is in the middle, and national brand 2 is the highest priced brand.

Examining the effect of store brand introduction on the profits that the retailer makes from national brands is helpful in understanding the conditions necessary for a profitable store brand introduction. Define $\Pi_r^b[NB]$ to be the retailer's profits from the national brands before store brand introduction, and $\Pi_r^a[NB]$ to be the retailer's profit from the national brands after store brand introduction. Then it is possible to show that the retailer's profits from national brands decline as a consequence of store brand introduction. We state this result formally as Lemma 1.

LEMMA 1. *Other things remaining the same, store brand introduction reduces retailer's profits from the national brands*

$$(\Pi_r^a[NB] - \Pi_r^b[NB] \leq 0).$$

The intuition for Lemma 1 is as follows. The introduction of a store brand increases the competition in the category, and leads to lower equilibrium demand and retail margins of both national brands. Consequently, the retailer's profits from national brands decline after store brand introduction.

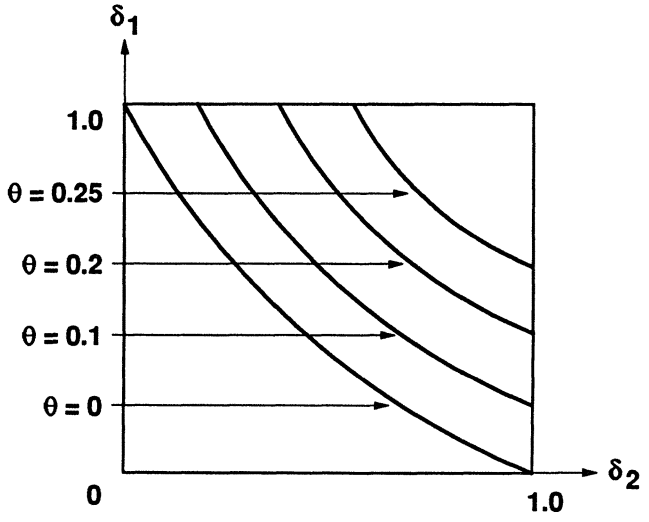
2.1.3. The Decision to Introduce a Store Brand. The purpose of this section is to examine the effect of cross-price sensitivities (θ, δ_1 and δ_2), and store brand base level demand (α) on the decision to introduce a store brand. In each case, we first illustrate the result graphically and then formally state the related proposition.

Effect of National Brand Cross-price Sensitivity (θ). Define Π_r^b to be the retailer's total profits from the category before store brand introduction and Π_r^a to be the retailer's profits after store brand introduction. A retailer will introduce a store brand if the total category profits after store brand introduction are greater than the profits before store brand introduction, i.e., when the difference in profits $\Pi_r^a - \Pi_r^b > 0$. The greater the difference in profits, the more likely is the introduction of a store brand. Figure 1(a) describes the locus of the points (contours) where $\Pi_r^a - \Pi_r^b > 0$ along the δ_1-δ_2 axes for different values of θ. Figure 1(a) has been drawn keeping α fixed.[3] The region to the upper right of each contour is the region of store brand introduction where $\Pi_r^a - \Pi_r^b > 0$. Figure 1(a) suggests that the store brand introduction region becomes smaller as θ increases. In fact, if θ exceeds a certain level, it is not profitable for

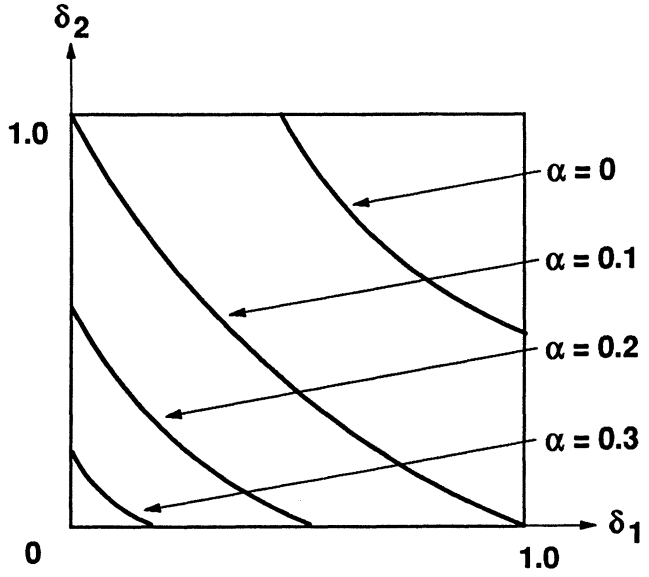
[3] While the choice of α does not affect the qualitative implications, Figure 1(a) is drawn for the case $\alpha = 0$. In the context of our model, $\alpha = 0$ implies that the store brand price has to be lower than the price of at least one of the national brands before the store brand gets any consumers. This is generally consistent with market data. In over 95% of the categories that we examine later in §4, the average price of the store brand is lower than the price of the national brands in the same product category.

Figure 1 Region of Store Brand Introduction in a Two National Brand Market

Note: The region of introduction lies toward the top right of each curve.



(a) Effect of θ (α constant)



(b) Effect of α (θ constant)

the retailer to introduce a store brand. We show formally that $\partial[\Pi_r^a - \Pi_r^b]/\partial\theta < 0$. The result is summarized in Proposition 1.

PROPOSITION 1. *Other things being equal, store brand introduction leads to higher category profits for the retailer when the cross-price sensitivity between the national brands (θ) is lower.*

The intuition for Proposition 1 is as follows. As discussed in §2.1.2., the retail and wholesale prices of national brands decrease when the national brand price competition (θ) increases. However, the retail demand and the retail margin of the national brands increase, with the result the retailer gets higher profits when θ is high. However, the θ effect is more pronounced when there is no store brand than when there is a store brand. That is, a retailer gains much higher profits with high θ when there is no store brand than when there is a store brand, for the following reasons. With the introduction of a store brand, θ is no longer the sole determinant of retailer's profits. Furthermore, when θ is high, the average national brand retail price decreases, which in turn depresses the price and margin of the store brand, resulting in smaller total category profits for the retailer. Hence, when the price competition between national brands is high, a retailer is better off not introducing a store brand.

Effect of Cross-price Sensitivity Between National Brands and Store Brand (δ_1 and δ_2). Figure 1(a) also suggests that as θ becomes larger, either δ_1 or δ_2 must increase for the store brand introduction to remain profitable. In other words, while higher θ reduces the store brand's ability to increase category profits, higher values of δ_1 or δ_2 enhance the store brand's ability to increase category profits for the retailer. We show analytically that an increase in either δ_1 or δ_2 increases the retailer's profits in the region where the introduction of a store brand is profitable. The result pertaining to the effect of δ_1 and δ_2 is summarized in Proposition 2.

PROPOSITION 2. *Other things being equal, store brand introduction leads to higher category profits for the retailer when the cross-price sensitivities between the national brands and the store brand (δ_1 and δ_2) are higher.*

The intuition for Proposition 2 is as follows. The introduction of a store brand lowers the equilibrium demand and retail margins of both national brands. Consequently, the retailer's profits from national brands decline after store brand introduction (see Lemma 1). In order for the introduction to be profitable, the retailer's profits from the store brand should make up for the loss in national brand profits. As discussed in §2.1.2, higher values of δ_1 or δ_2 result in higher retailer profits from the store brand. When the cross-price sensitivity

between the national brand and the store brand is high, the store brand can gain greater sales without setting its price much lower than the national brands. Hence, a retailer can gain greater category profits if it can introduce a store brand whose cross-price sensitivity with the national brand is high.

Effect of Store Brand Base Level Demand (α). Figure 1(b) represents the locus of points where $[\Pi_r^a - \Pi_r^b] > 0$, along the δ_1-δ_2 axes for different values of α keeping θ fixed. The region to the top right of the contours represents the region of store brand introduction where $[\Pi_r^a - \Pi_r^b] > 0$. As can be seen, as α increases, the region expands, i.e., shifts downwards towards the origin. We show analytically that an increase in α increases the retailer's profits in the region where the introduction of a store brand is profitable. The result pertaining to the effect of α is stated in Proposition 3.

PROPOSITION 3. *Other things being equal, store brand introduction leads to higher category profits for the retailer when the base level demand of the store brand* (α) *is higher.*

The intuition for Proposition 3 is similar to that for Proposition 2. The introduction of a store brand lowers the equilibrium demand and retail margins of both national brands. Consequently, the retailer's profits from national brands decline after store brand introduction. In order for the introduction to be profitable, the retailer's profits from the store brand should make up for the loss in national brand profits. Higher values of α imply that the strength of store brand demand relative to national brands is high. Hence the store brand can gain greater sales without setting its price much lower than the national brands. Therefore, a retailer can gain greater category profits if it can introduce a store brand whose base level demand is high.

Summary of Propositions. Propositions 1–3 can be summarized as follows.

1. Categories where the price competition among national brands is high are not good candidates for store brand introduction.

2. A retailer is better off introducing a store brand (a) that will exhibit a higher cross-price sensitivity with the national brand (a store brand that can draw more consumers from the national brand for a given price differential), and/or (b) whose base level demand is high.

2.2. Product Category with More Than Two National Brands

We now consider a product category consisting of k national brands labeled as $i = 1, 2, 3, \cdots k$; each marketed by a manufacturer, labeled correspondingly as $i = 1, 2, 3, \cdots k$. The purpose of this section is to investigate the effect of number of national brands (k) in the product category on the decision to introduce a store brand. We also show that the results derived in Propositions 1–3 for the two brand model hold qualitatively in the k-brand model also.

Demand Structure Prior to Store Brand Introduction. For reasons of analytical tractability, while examining a market consisting of more than two national brands, we assume that (1) the national brands are positioned symmetrically with respect to one another and (2) the store brand is positioned symmetrically with respect to the national brands. For each national brand i, the demand function prior to store brand introduction is as follows:

$$q_i = \frac{1}{k}\left[1 - p_i + \frac{1}{k-1}\left[\sum_{j \neq i} \theta(p_j - p_i)\right]\right], \quad (10)$$

where p_i is the price of national brand i, and θ is a measure of the degree of cross price sensitivity among national brands. Equation (10) reduces to Equation (1) when we set $k = 2$.[4] $\theta \in (0, 1)$ represents the effect of price differences between brand i and all other brands on brand i's demand (q_i). Because there are $(k-1)$ terms in the summation, we divide the sum of $(k-1)$ price difference terms by $(k-1)$ to get the average.

As in the two national brand case, when all national brand prices are set equal to zero, the total category demand equals one unit. When the price of national brand i is raised by one unit, keeping the price of all competing brands the same, its demand reduces by $\frac{1}{k}(1+\theta)$ unit. When the price of *all competing brands* is raised by one unit, the demand for brand i increases by θ/k units, so that own-price effects are stronger than

[4] Equation (10) may also be rewritten as $q_i = \frac{1}{k}[1 - p_i + \theta(\overline{p_j} - p_i)]$, where $\overline{p_j}$ is the average price of the competing brands. The demand function, $q_i = \frac{1}{k}[a_1 - a_2 p_i + a_3(\bar{p} - p_i)]$, where $\bar{p}$ is the average price, is consistent with individual utility maximization behavior (Shubik and Levitan 1980, p. 129). Our parsimonious model has the same structure with fewer parameters.

the cross-price effects. Equation (10) implies that the category demand is given by

$$Q = 1 - \tfrac{1}{k}(p_1 + p_2 + \cdots + p_k).$$

Demand Structure after Store Brand Introduction. In the presence of a store brand, the demand for each of the k national brands (q_i), and the demand for the store brand (q_s), are assumed to be as follows:

$$q_i = \frac{1}{k+\alpha}\left[1 - p_i + \frac{1}{k}\left[\sum_{j\neq i}\theta(p_j - p_i) + \delta(p_s - p_i)\right]\right], \tag{11}$$

$$q_s = \frac{1}{k+\alpha}\left[\alpha - p_s + \frac{1}{k}\left[\sum_{i}\delta(p_i - p_s)\right]\right], \tag{12}$$

where $\delta \in (0, 1)$ is a measure of the cross price sensitivity between a national brand and the store brand. Equations (11)–(12) have a number of features that are similar to equations (3)–(5) of the two national brand case. In order to differentiate the competition among national brands and the competition between a national brand and a store brand, we weigh $(p_j - p_i)$ by θ whereas we weigh $(p_s - p_i)$ by δ. In (11)–(12), when all prices are set equal to zero, category demand equals one unit—the same as the category demand prior to store brand introduction when prices are set equal to zero. This too is consistent with Equations (3)–(5). Equation (10) contained $(k-1)$ price difference terms. Therefore, the normalization was done by dividing by $(k-1)$. As there are a total of k price difference terms in (11)–(12), we divide by k to get the average. The store brand intercept in (12) is equal to $\alpha/(k+\alpha)$.

2.2.1. Equilibrium Prior to Store Brand Introduction. The sequence of pricing decisions is the same as the one we assumed in §2 while examining the two national brand market. The equilibrium prices, demands, and profits, prior to store brand introduction are summarized in column 3 of Table 2. The procedure used to solve for the equilibrium was similar to the one used in §2.1.1. The equilibrium can be shown to be unique. As in the two national brand case, the equilibrium retail and wholesale prices are lower when θ, the cross-price sensitivity among the national brands, is higher. Equilibrium demand for national brand i, q_i^* is higher for higher values of θ because higher θ leads to lower prices. Category sales are also higher when θ is higher because of its effect on the retail prices. q_i^* is lower when the number of national brands k is higher.

The symmetry assumption, along with the other features of the demand function, leads to an equilibrium where category profits do not depend on k. Hence, adding another symmetric national brand does not affect category profits. Raju and Dhar (1990) analyze two additional sets of demand models. The first demand model led to a situation where category profits decreased in k. In the second case, the category profits increased in k. In both these cases, the qualitative results obtained were similar to the ones obtained using equations (10)–(12).

2.2.2. Equilibrium After Store Brand Introduction. The equilibrium expressions after store brand introduction are summarized in Table 2 (column 4). As in the two national brand case, other things remaining the same, a higher θ leads to lower equilibrium national brand wholesale prices, retail prices, and a higher demand for national brands. Higher δ implies higher equilibrium demand and price of the store brand, and lower equilibrium price and demand for a national brand.

The introduction of a store brand lowers the equilibrium demand and retail margins of a national brand. Consequently, as in the two national brand case (see Lemma 1), retailer's total profits from national brands decline after store brand introduction. However, it is interesting that the magnitude of this decrease is lower if there are more national brands in the product category. It is reasonable to expect that store brand introduction leads to increased competition in the product category. This increase in competition reduces retailer's profits on national brands. However, the increase in competition due to the introduction of one additional brand (the store brand) is not that much when the number of national brands is already high. We state this result formally as Lemma 2.

LEMMA 2. *Other things being equal, the introduction of store brand reduces the retailer's profits from national brands. However, the reduction in profits is smaller in product categories that contain more national brands.*

2.2.3. Store Brand Introduction Decision. Our main objective in this section is to examine how the number of national brands in the product category

Table 2 More than Two National Brands*

(1)	(2)	(3) Before SB	(4) After SB
Retail price of the NB	p_i^*	$\frac{3+\theta}{2(2+\theta)}$	$\frac{k(1+\delta)+\alpha\delta}{2(k+\delta+k\delta)}+\frac{k}{2[k(2+\theta)+2\delta-\theta]}$
Wholesale price of the NB	w_i^*	$\frac{1}{(2+\theta)}$	$\frac{k}{[k(2+\theta)+2\delta-\theta]}$
Retail margin of the NB	$p_i^*-w_i^*$	$\frac{3+\theta}{2(2+\theta)}$	$\frac{k(1+\delta)+\alpha\delta}{2(k+\delta+k\delta)}-\frac{k}{2[k(2+\theta)+2\delta-\theta]}$
Quantity sold for the NB	q_i^*	$\frac{1+\theta}{2k(2+\theta)}$	$\frac{k(1+\theta)+\delta-\theta}{2(k+\alpha)[k(2+\theta)+2\delta-\theta]}$
Retail price for the SB	p_s^*	—	$\frac{\delta k+\alpha(k+\delta)}{2(k+\delta+k\delta)}$
Quantity sold for the SB	q_s^*	—	$\frac{\delta k+\alpha(k(2+\theta)+2\delta-\theta)}{2(k+\alpha)[k(2+\theta)+2\delta-\theta]}$
Category Sales (units)	Q^*	$\frac{1+\theta}{2(2+\theta)}$	$\frac{1}{2}-\frac{k^2}{2(k+\alpha)[k(2+\theta)+2\delta-\theta]}$
Manufacturer's profit	Π_i^*	$\frac{1+\theta}{2k(2+\theta)^2}$	$\frac{k[k(1+\theta)+\delta-\theta]}{2(k+\alpha)[k(2+\theta)+2\delta-\theta]^2}$
Retailer's profits	Π_r^*	$\frac{(1+\theta)^2}{4(2+\theta)^2}$	$[\Sigma_i (p_i^*-w_i^*)q_i^*]+p_s^*q_s^*$

NB: National Brand
SB: Store Brand
* All proofs are in the appendix.

affects the retailer's decision to introduce the store brand. The region where it is profitable for the retailer to introduce the store brand is outlined in Figure 2. The region where it is profitable to introduce the store brand is towards the top left corner of each contour.

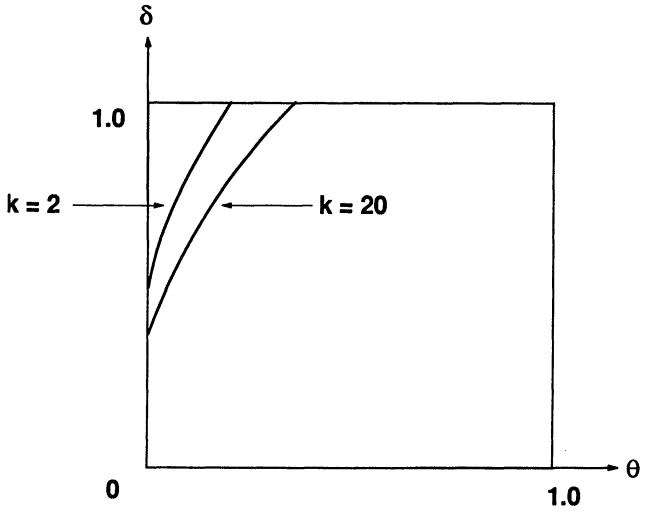
Figure 2 is drawn keeping α fixed.[5] We note in Figure 2 that one needs higher δ for higher values of θ for the store brand to lead to an increase in category profits. Further, if θ exceeds a critical level, it is not profitable to introduce the store brand. This is consistent with the results in Propositions 1 and 2. In Figure 2, for higher values of k, the region where introduction of the store brand leads to an increase in category profit becomes larger. The introduction of a store brand increases the level of competition in the category because of an increase in the number of competing brands. Higher competition leads to lower profits on the national brands. For the store brand to increase category profit, it must compensate for this reduction. However, when the number of national brands is large to begin with, the introduction of an additional brand does not have as large an effect on profits that the retailer makes on the national brands (Lemma 2). The result in Figure 2 pertaining to the effect of k is summarized below in Proposition 4.

PROPOSITION 4. *Other things being equal, store brand introduction is more likely to increase category profits for the retailer if the category has more national brands.*

[5] While the choice of α does not affect the qualitative implications that one obtains from Figure 2, for the reasons outlined in footnote 3, Figure 2 is drawn for the case where $\alpha = 0$.

Figure 2 The Effect of k on Store Brand Introduction (α constant)

The region of introduction is toward the top left of each curve.



Effect of θ, α, and δ on Store Brand Introduction. We also show analytically in the appendix that the results in Propositions 1, 2, and 3 pertaining to the effects of θ, δ, and α, derived for the two national brand market, continue to hold in the k brand case also. Hence, our results for the k national brand model, as well as the two national brand model, suggest that a higher base level of demand of the store brand and a higher cross-price sensitivity between the store brand and the national brand increase the likelihood of a profitable store brand introduction. At the same time, higher cross-price sensitivity among the national brands limits the extent to which the introduction of a store brand can lead to additional category profits for the retailer. Furthermore, whether or not a particular combination of δ, θ, and α will lead to a profitable store brand introduction depends on the number of national brands in the product category.

2.2.4. Minimum α and δ for Profitable Store Brand Introduction. The analysis so far has implicitly treated θ, δ, α, and k as category characteristics. It can be argued that the cross-price sensitivity among national brands (θ) and the number of national brands (k) are category characteristics that are potentially independent of the store brand. However, the base level of demand of the store brand (α) and the cross-price sensitivity between the store brand and the national brands (δ) are characteristics of the store brand.[6] In the analysis that follows, we provide some qualitative guidelines pertaining to the minimum value of α and δ that may be needed before store brand introduction becomes profitable.

Before proceeding with the formal analysis, it may be worthwhile to examine this problem more qualitatively. We do this using the key results illustrated in Figures 1 and 2. First, we note from Figure 1(a) and (b) that higher θ implies that one needs higher δ's or a higher α before store brand introduction becomes profitable. Hence, lower α and δ values that might be sufficient for a profitable store brand introduction should occur for lower values of θ. On the other hand, from Figure 2 we can deduce that higher k makes the requirements of δ and/or α less stringent. Hence, if we are trying to obtain some lower bounds on α and δ that make store brand introduction profitable, we can arrive at these lower bounds by examining the limiting case where $\theta = 0$.

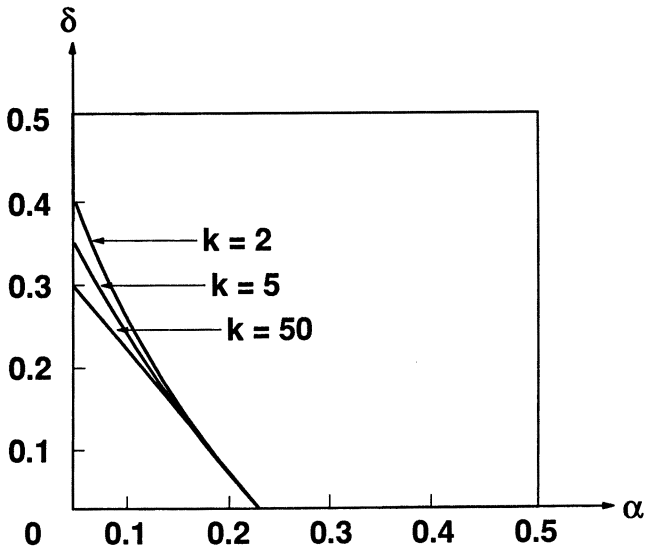
The profit difference before and after store brand introduction for a market consisting of k national brands, and assuming the limiting case where $\theta = 0$, is given by

$$\Pi_r^a - \Pi_r^b = \frac{(\alpha(\delta + k) + \delta k)(4\alpha(\delta + k) + 3\delta k - k - \delta)}{k(\alpha + k)(\delta + k)(\delta + k + \delta k)}. \tag{13}$$

Hence, store brand introduction will lead to higher profits only if $(4\alpha(\delta + k) + 3\delta k - k - \delta)$ is greater than zero. The lower bounds on α and δ will depend on k and are given implicitly by the equation $[4\alpha(\delta + k) + 3\delta k - k - \delta] = 0$. Using the implicit function theorem, it is possible to show that, other things being equal, if one has a higher δ (α), one needs lower α (δ) to make store brand introduction profitable. The combination of minimum α and δ necessary for store brand introduction for different values of k are plotted in Figure 3. Note that as k increases, the curve moves downwards towards the origin. Hence, the lower bounds on α and/or δ decrease when k is higher.

[6] More likely, these are characteristics that are affected by the nature of the store brand as well as the nature of the product category. Retailers may find it easier to offer store brands with higher base levels of demand in some categories than in others.

Figure 3 **Minimum α and δ for Store Brand Introduction**



2.3. Store Brand vs. National Brand Introduction

In this section we examine how the results might change in the k national brand case if, instead of a store brand, the retailer were considering introducing a differentiated national brand with cross-price sensitivity δ. Our model assumes that the store brand has the following features that distinguish it from a national brand.

(1) Base level of sales (α) is lower than that of a national brand.

(2) Store brand manufacturer is not a strategic player in that, unlike the manufacturers of national brands, the store brand manufacturer does not set wholesale prices.

(3) Cross price sensitivity δ is different from θ.

To understand whether or not the results will be any different if the retailer were considering introducing a new national brand with cross-price sensitivity δ, we need to analyze the case where $\alpha = 1$, and include the store brand manufacturer as a strategic player. The equilibrium expressions to study this case are reported in Table 3. We show in the appendix that the difference in the retailer profits profits before and after introduction of a differentiated national brand $[\Pi_r^a - \Pi_r^b]$ is given by

$$\Pi_r^a - \Pi_r^b = \frac{(\delta - \theta) f(\theta, \delta, k)}{4(k+1)(2+\theta)^2 g(\delta, \theta, k)}, \quad (14)$$

where $f(\theta, \delta, k) \geq 0$ and $g(\delta, \theta, k) > 0$. Further, as the denominator is positive, we can conclude from equation (14) that the region where national brand introduction leads to an increase in retailer profits is given by the condition $\delta > \theta$. Note that while the difference in profits $\Pi_r^a - \Pi_r^b$ does depend on k, whether or not $\Pi_r^a - \Pi_r^b \geq 0$ only depends on whether or not $\delta > \theta$. The intuitive justification for this result is the following. Prior to the introduction of a differentiated national brand, retailer profits were equal to $(1+\theta)^2/4(2+\theta)^2$. The retailer profits were not affected by k, but increased with θ. If the new brand is identical in all other respects to the existing brands, for the retailer to gain from the introduction of a new national brand, the new brand must increase the overall price competitiveness among the national brand manufacturers. This will be true when $\delta > \theta$.

To summarize, while considering the problem of store brand introduction, we assumed that the base level of demand for the store brand was less than one, and also that the store brand manufacturer was not a strategic player. These features are consistent with market data and the observed industry practice. When these features were included in the model, we obtained a region that is qualitatively different than the region described by the condition $\delta > \theta$. More specifically, the region where store brand introduction is profitable became larger for higher values of k, implying that store brand introduction has a greater likelihood of increasing category profits in categories that contain a larger number of national brands, a result that we show later is consistent with market data. However, the introduction region of a differentiated national brand does not depend on k. Overall, the results in this section, when contrasted with the results in §§2.1 and 2.2, lead us to conclude that the conditions for store brand introduction are qualitatively distinct from the conditions that determine whether or not the introduction of a differentiated national brand will increase retailer profits.

It may also be potentially interesting to note that the equilibrium price of the differentiated national brand is lower for higher values of δ. Recall that store brand

Table 3 Introduction of a Differentiated National Brand*

		Differentiated National Brand†
Wholesale Price of the NB	w_i^*	$\frac{k(2+2\delta)+\delta}{2(1+\delta)[k(2+\theta)+2\delta-\theta]-\delta^2}$
Retail Price of the NB	p_i^*	$\frac{k(2+2\delta)+\delta}{2[2(1+\delta)[k(2+\theta)+2\delta-\theta]-\delta^2]}+\frac{k+k\delta+\delta}{2(k+k\delta+1)}$
Demand of the NB	q_i^*	$\frac{(\delta+2k+2\delta k)(\delta+k+k\theta-\theta)}{2k(k+1)[2(1+\delta)(k(2+\theta)+2\delta-\theta)-\delta^2]}$
Wholesale Price of the DNB	w_s^*	$\frac{k\delta+[k(2+\theta)+2\delta-\theta)]}{2(1+\delta)[k(2+\theta)+2\delta-\theta]-\delta^2}$
Retail Price of the DNB	p_s^*	$\frac{k\delta+[k(2+\theta)+2\delta-\theta)]}{2[2(1+\delta)[k(2+\theta)+2\delta-\theta]-\delta^2]}+\frac{k\delta+(k+\delta)}{2(k+\delta+k\delta)}+\frac{w_s^*}{2}$
Demand of the DNB	q_s^*	$\frac{(1+\delta)(2\delta+2k+\delta k-\theta+k\theta)}{2(k+1)[2(1+\delta)(k(2+\theta)+2\delta-\theta)-\delta^2]}$
Retailer Profits	Π_r^*	$\Sigma_i (p_i^*-w_i^*)q_i^*+(p_s^*-w_s^*)q_s^*$

NB: National Brand
DNB: Differentiated National Brand
†: To maintain continuity, we use the subscript s for a differentiated national brand [DNB].
* All proofs are in the appendix.

price in §§2.1 and 2.2 increased for higher values of δ. Hence, it is the combination of the two assumptions, $\alpha < 1$, and the store brand manufacturer not being a strategic player, that lead to this reversal of the effect of δ on equilibrium store brand price.

3. Differences in Store Brand Share

Our analysis in §2 allowed us to examine characteristics that make a product category more conducive for store brand introduction. In this section, we examine category characteristics that explain differences in store brand market share. It is potentially interesting to understand whether or not the factors that make a category conducive for store brand introduction are also the ones that allow the store brand to achieve a higher market share in the category.

Whether we consider the two national brand model or the k national brand model, the results are similar. Hence, we present results for only the k-national brand model. For the k national brand case, the equilibrium market share (in units) of the store brand (ms_s^*) is equal to $ms_s^* = q_s^* / \sum_{i=1}^{k} q_i^* + q_s^*$. Substituting for q_i^* and q_s^* from Table 2, we obtain

$$ms_s^* = \frac{\delta k + \alpha(2\delta + 2k + k\theta - \theta)}{k[k + (k-1)\theta + 2\delta] + \alpha(2\delta + 2k + k\theta - \theta)}. \quad (15)$$

Propositions 5–8 next summarize what our model has to say about characteristics that affect equilibrium store brand share. All proofs are in the appendix.

PROPOSITION 5. *Equilibrium store brand share is smaller in product categories where the cross-price sensitivity among national brands (θ) is higher.*

The cross-price sensitivity among national brands (θ) represents the extent to which the national brands compete with one another. Equation (15) predicts that store brand share will be smaller in categories where θ is high. Higher θ suggests greater competition among the national brands, and more competition lowers the prices of the national brands, leading to a lower demand for the store brand. Lower prices of national brands also

increase the demand for national brands. Both these effects lead to a smaller equilibrium store brand market share.

PROPOSITION 6. *Equilibrium store brand share is larger in product categories where the cross-price sensitivity between the national brands and the store brand is higher.*

The intuition for this result is as follows. In equation (5) and in equation (13), for a fixed price differential between the national brands and the store brand, a higher δ implies a higher demand for the store brand. From equation (3), and equation (11), higher δ also reduces the demand of the national brand as $p_s < p_i$. Hence, one would expect the store brand share to be larger in product categories where δ is higher.

PROPOSITION 7. *Equilibrium store brand market share is higher where the store brand has a higher base level of demand.*

We expect the store brand share to be higher in categories where the base level of demand, a measure of the relative strength of the store brand, is higher. Proposition 7 is consistent with this intuition.

PROPOSITION 8. *Equilibrium store brand market share is smaller when the category contains a larger number of national brands.*

We expect the store brand share to be lower in product categories consisting of a large number of national brands because more national brands implies that each individual brand (including the store brand) can only command a smaller share. Proposition 8 is consistent with this intuition.

3.1. Implications

Comparing Propositions 5–8 with Propositions 1–4 allows us to contrast the store brand introduction decision with market share performance of store brands.

1. From Proposition 5, store brand share is lower when the cross-price sensitivity among the national brands is high. From Proposition 1, we note that such categories are also not very conducive for store brand introduction.

2. From Proposition 6, store brand share is higher when the cross-price sensitivity between the national brands and the store brand is high. Proposition 2 suggests that such categories are also more conducive for store brand introduction.

3. From Proposition 7, store brand share is higher when the store brand can command a higher base level of demand. Proposition 2 suggests that in categories where this is possible, the store brand introduction is also likely to lead to higher category profits.

4. From Proposition 8, store brand market share is *lower* in product categories that contain a larger number of national brands. *However, from Proposition 4, it follows that such categories are more conducive for store brand introduction.*

4. Empirical Analysis

Our objective in conducting the empirical analysis is to find out whether market data are consistent with some of the key predictions of our analytical model. We are not testing the superiority of our model, or explanation, over other alternatives. Hence, we recognize that our empirical analysis is not the most rigorous test of our analytical model.

We examine whether the following predictions of our analytical model are consistent with market data.

1. Other things being equal, private labels are more likely to be introduced in categories with (a) smaller cross-price sensitivity among national brands (Proposition 1), and (b) larger number of national brands (Proposition 4).

2. Other things being equal, market share of private labels will be higher in product categories with (a) smaller cross-price sensitivity among national brands (Proposition 5), and (b) smaller number of national brands (Proposition 8).

We were unable to examine the validity of the predictions in the remaining propositions because satisfactory measures of cross-price sensitivity between the store brand and the national brand, and the base level of demand of the store brand, were not available.

4.1. Data

The data used in our study were obtained by combining information on product category characteristics in the Infoscan Supermarket Review™ (Information Resources, Inc. 1988a) with the information on category price elasticities from the Infoscan Report on Trade Promotions (Information Resources, Inc. 1988b). The

Infoscan Supermarket Review is a comprehensive survey of grocery store sales that provides information (aggregate U.S.) by brand, including the private label. The data were provided for 438 product categories. The product categories were defined by the data supplier and conform to the product definitions commonly used by retailers in their decision making. The price elasticity data were available on 426 of these 438 product categories.

4.2. Measures

Store Brand Introduction (SBINTRO). Of the 426 product observations, 281 contained store brands or private labels. We created an indicator variable that took the value one if the category contained a private label, and zero otherwise.

Store Brand Share (SBSHARE). Predictions 2(a) and 2(b) relate store brand unit share to category characteristics. Infoscan Supermarket Review provides direct measures of store brand unit share. The mean store brand unit shares in the 281 product categories was 20.1%. The categories with very large private label shares (over 60%) were milk, different types of frozen vegetables, refrigerated snacks and pies, first aid treatments, and whole coffee beans. Low private label share (less than 2%) categories included oriental food items, chewing gum, deodorants, and cigarettes.

Number of National Brands (NUMBRAND). The analytical model assumed that each national brand manufacturer supplies only one national brand. In practice, a manufacturer often offers more than one brand in a product category. Consequently, we used two measures for the number of national brands—number of distinct brands in a product category, and number of distinct vendors. Both measures yielded similar results, hence only the results for the first measure, number of distinct brands, are reported.

National Brand Cross-Price Sensitivity (PRSEN). We used category price elasticity reported in the Infoscan Report on Trade Promotions[7] as a measure of national brand cross-price sensitivity (θ). Price elasticities, being dimensionless, are easily interpreted and compared across categories. However, the linkage between average category price elasticity obtained from IRI data that we use in the empirical analysis, and the national brand cross-price sensitivity θ in the analytical model, requires additional explanation.

1. IRI data provide a measure of average own-price elasticity. We believe that using own-price elasticity as a surrogate for national brand cross-price sensitivity θ is reasonable in our context because in our parsimonious demand model, there is a one-to-one relationship between own price sensitivity $(1 + \theta)$ and the cross-price sensitivity θ.

2. The empirical measure is an elasticity measure obtained from a multiplicative (log-linear) model, whereas we used linear demand functions in the analytical model. However, we expect the estimates obtained from the two models to be monotonically related—if the price sensitivity of category 1 is greater than that of category 2 when both are estimated from a linear model, the price sensitivity of category 1 is likely to be greater than that of category 2 when estimated using a log-linear model as well. Past studies (Metwally 1975, Brodie and de Kluyver 1984, Carpenter et al. 1988) found similar ordering of price elasticities across different model specifications. *We repeated our analysis using rank orders of the IRI price elasticities instead of their absolute values. The results did not change.*

3. For categories that did not contain a private label, the category elasticity measure represents price competition among national brands. For categories that contained a store brand, the average number of national brands was equal to 12.1. Hence, a measure that is an average of the price elasticities of all brands should primarily represent the price elasticity of national brands.

4.2.1. Covariates. The relationship between the store brand introduction variable (SBINTRO) or store brand market share (SBSHARE), and the two predictors

[7] The price elasticity estimation in the Infoscan Report on Trade Promotions uses weekly data collected at the UPC level. A regression model is estimated assuming weekly sales of each UPC item in the product category as a multiplicative function of item price and item promotional activity. A single price coefficient is estimated for each category. Thus, the coefficient represents the price elasticity for an average item in the category. The price elasticities across product categories in the IRI data ranged from −1.2 to −4.1. This is within the normal range reported in previous research (Bolton 1989, Sethuraman and Tellis 1991).

number of national brands (NUMBRAND) and cross-price sensitivity (PRSEN) might be spurious if it occurs because of other mediating factors. Identifying and accounting for these factors, wherever possible, is therefore desirable. If any of these covariates are significant, one might also want to incorporate them explicitly in future modeling efforts. We used the following three covariates in our analysis.

Category Retail Sales (CATSALES). Though not explicitly included in our analytical model, one can argue that retailers may find it desirable to introduce store brands in product categories that generate larger sales volumes. It is possible that these categories with larger sales volumes also have a larger number of national brands. To examine whether the differences in number of national brands explains store brand introduction after accounting for differences in category sales, we used category sales as a covariate in our analysis. Category sales data are directly available in the Infoscan Supermarket Review.

Private labels may also be introduced, or attain higher shares, because of supply side factors such as cost of production and cost of transportation. There is very little theory to guide us about the inclusion of such variables. Further, measures of supply side factors were not readily available in our data. However, we were able to include the following two variables available in our data, which we thought might capture at least some of the supply side factors.

Bakery / Deli Products (BAKDEL). Retailers are more likely to introduce private labels if it is easy for them to produce the product. Bakery and Deli products, such as pastry and meat, require limited investment and can often be produced on-site.[8] We classified categories into those that are bakery / deli items by an indicator variable that takes the value one if it is a bakery / deli item, and zero otherwise.

Frozen Goods (FROZEN). Given the perishable nature of many frozen goods, speedy transportation to the selling location is essential. In addition, the need for refrigeration increases the transportation cost substantially. Thus it might be preferred that the production site be close to the selling location. Consequently, retailers may be motivated to buy these products locally and market them as private labels. We included an indicator variable to which we assigned a value of one if the product is a frozen good, and zero otherwise.

[8] Though it pertains to the demand side, one might argue that consumers also desire freshness in these products—often a store is rated based on the quality of its bakery and deli items. The desire for freshness make these products good candidates for setting up in-house manufacturing facilities and selling as private labels.

4.3. Model Details and Estimation Procedure

Store Brand Introduction. The variable SBINTRO is a zero / one indicator variable. Hence, we used logistic regression. We estimated the following three models:

1. Model INTRO1: This particular model used the two predictors, the number of national brands (NUMBRAND), and the national brand cross-price sensitivity (PRSEN). These variables allowed us to examine the validity of predictions 1(a) and 1(b).

2. Model INTRO2: Along with the two predictors NUMBRAND and PRSEN, this model also included category sales (CATSALES). Category sales may be related to the number of national brands in a product category. This model allowed us to examine the explanatory power of the number national brands variable (NUMBRAND) after partialing out the effect of category sales.

3. Model INTRO3: This model included NUMBRAND, PRSEN, CATSALES, and the two covariates, BAKDEL and FROZEN, that capture cost side effects.

We describe Model INTRO3 in detail below. The logistic regression assumed that the probability of a private label introduction in a product category is given by

$$\mathrm{P(SBINTRO)} = \frac{e^{v_1}}{e^{v_0} + e^{v_1}}, \quad \text{where} \qquad (16)$$

$v_i = a_0 + a_1(\mathrm{NUMBRAND}) + a_2(\mathrm{PRSEN}) + a_3(\mathrm{CATSALES}) + a_4(\mathrm{BAKDEL}) + a_5(\mathrm{FROZEN}),$

$i = 0$ for categories with no store brand,

$= 1$ for categories with store brand.

In this model, a positive coefficient for (say) a_1 would indicate that the probability of private label introduction is greater in categories with larger number of national brands. Our analytical results predict a_1 to be positive and a_2 to be negative. Based on our earlier discussion, we would also expect a_3, a_4, and a_5 to be positive.

Store Brand Market Share. To examine predictions 2(a) and 2(b) pertaining to market share, we used mul-

tiple regression. A logistic regression may have been appropriate here also as the dependent variable, store brand market share, is bounded between 0 and 1. We repeated our the analysis using logistic regression. The results were qualitatively similar. We estimated the following three models.

1. Model SHARE1: This model used only two predictors, the number of national brands (NUMBRAND), and the national brand cross-price sensitivity (PRSEN). These variables allowed us to examine the validity of predictions 2(a) and 2(b).

2. Model SHARE2: Along with the two predictors NUMBRAND and PRSEN, this model also included category sales (CATSALES).

3. Model SHARE3: This model included NUMBRAND, PRSEN, CATSALES, and the two additional covariates BAKDEL and FROZEN.

Model SHARE3 is described in some detail below. The market share of private labels in product category j is given by

$$\begin{aligned}\text{SBSHARE}_j = {} & b_0 + b_1(\text{NUMBRAND})_j \\ & + b_2(\text{PRSEN})_j + b_3(\text{CATSALES})_j \\ & + b_4(\text{BAKDEL})_j + b_5(\text{FROZEN})_j + \epsilon_j, \end{aligned} \tag{17}$$

where $\epsilon_j \sim N(0, \sigma^2)$ and independently distributed. Based on predictions 2(a) and 2(b), we expected b_1 and b_2 to be negative. There was little theory to guide us about the signs of b_3, b_4, and b_5.

4.4. Store Brand Introduction: Empirical Findings

Preliminary univariate analysis revealed that the average number of national brands for categories that contain a private label was 12.1, and that for categories without a private label was 5.1. The difference in means was significant ($p < 0.01$). All comparisons in this section are based on conservative two-tailed tests. The average (absolute) price elasticity for categories with private labels was 2.3 and for those without private labels was 2.4. The difference, though small, was statistically significant ($p < 0.07$). The results of the logistic regression are reported in Table 4.

The coefficient of number of national brands was positive and statistically significant ($p < 0.01$) in all three models. This is consistent with the prediction of our analytical model. Note that the magnitude of the coefficient decreased when CATSALES was added as an explanatory variable in Model INTRO2 because categories with larger number of national brands were also larger in terms of category sales. The coefficient of price elasticity was negative and significant ($p < 0.10$) in all three models. *Overall, these results are consistent with model predictions that private labels are more likely to be introduced in product categories with larger number of national brands, and lower price competition among national brands.*

Table 4 Empirical Results—Store Brand Introduction

	Model INTRO1		Model INTRO2		Model INTRO3	
Variable	Coeff	*t*-value	Coeff	*t*-value	Coeff	*t*-value
Number of NB	0.14	6.57[a]	0.08	3.59[a]	0.08	3.59[a]
NB Cross-Price Sensitivity	−0.41	−1.70[c]	−0.48	−1.92[b]	−0.46	−1.76[c]
Category Sales ($ millions)			0.003	3.83[a]	0.003	3.77[a]
Bakery/Deli					1.9	1.79[c]
Frozen Goods					0.43	1.10
χ^2	73.1[a]		98.0[a]		103.9[a]	

NB: national brands
[a]: significant at $p = 0.01$
[b]: significant at $p = 0.05$
[c]: significant at $p = 0.10$

Covariates. The relationship between store brand introduction and category sales (CATSALES) was statistically significant, suggesting that private labels are more likely to be introduced in large volume categories. The coefficient of bakery/deli dummy was positive and statistically significant, indicating that private labels are more likely to be introduced in bakery/deli products in our data. The coefficient of frozen goods was not statistically significant. Including the covariates did not affect the signs and the statistical significance of (NUMBRAND) and (PRSEN).

4.5. Store Brand Market Share: Empirical Findings

The correlation coefficient between private label share and number of national brands was -0.25 ($p < 0.01$), and the correlation coefficient between private label share and price elasticity was -0.12 ($p < 0.03$). These are consistent with predictions 2(a) and 2(b). The regression results are reported in Table 5. Heteroscedasticity was detected using the BPG test (Judge et al. 1988) and corrected using the weighted least squares approach (Kmenta 1986, p. 269–83). *Consistent with predictions from the analytical model, the coefficient of number of national brands and price sensitivity were negative and significant*.

Covariates. The coefficient of category sales (CATSALES) was not statistically significant, implying that even though private labels are more likely to be introduced in large volume categories, their market share is not necessarily larger in these categories. The bakery/deli dummy, as well as the frozen goods dummy, were also not statistically significant. The addition of the covariates into the model did not affect the signs and the statistical significance of (NUMBRAND) and (PRSEN).

4.6. Examining the Robustness of Regression Results

We repeated our analysis by excluding 19 categories that we believed may have been outliers using the following criteria:

1. Extreme Observations. We repeated the analyses after excluding smaller categories (less than $1 million sales), and larger categories (greater than $6 billion U.S. sales). The average dollar sales for categories in the sample was $400 million.

2. Low ACV Weighted Distribution Index Categories. This index measures the extent of distribution coverage for a product category. If a category is sold in few outlets, or if only smaller outlets carry the product, the index is low. Typical grocery products have over 80% ACV distribution index. We chose 30% as the cutoff and excluded those products with less than 30% ACV weighted distribution index.

The qualitative nature of the results was not affected. We also repeated the empirical analysis pertaining to store brand market share using store brand dollar share (instead of unit share) as the dependent variable. The qualitative nature of the results did not change.

5. Summary, Limitations, and Future Research

We proposed an analytical model to understand what makes a product category more conducive for store brand introduction. The model also helped explain cross-category differences in store brand market shares. Our key findings are as follows.

1. While the traditional view states that private labels proliferate in price sensitive markets, we highlight the importance of distinguishing between two types of price competition—price competition among national brands and price competition between national brands and the store brand. Higher price competition among national brands makes private label introduction less attractive and decreases store brand share. On the other hand, higher price competition between national brands and the store brand favors private label introduction and increases store brand share. Retailers may want to take both factors into account when deciding on their private label programs.

2. We also highlight that the argument—there is no place for private labels if there are already a large number of national brands in the market—may not be appropriate. We found that the introduction of a store brand is more likely to increase category profits if the category consists of a larger number of national brands.

5.1. Limitations and Future Research

While the proposed framework provides several potentially interesting qualitative insights, it has a number of limitations. We did not model inter-store competition. It has been argued that retailers introduce store brands in response to competition from other stores (McMaster

Table 5 Empirical Results—Store Brand Market Share

	Model SHARE1		Model SHARE2		Model SHARE3	
Variable	Coeff	*t*-value	Coeff	*t*-value	Coeff	*t*-value
Number of NB	−0.53	−4.3[a]	−0.56	−3.9[a]	−0.56	−3.9[a]
NB Cross Price Sensitivity	−5.2	−2.1[b]	−5.3	−2.1[b]	−4.5	−1.8[c]
Category Sales ($ millions)			0.001	0.4	0.001	0.4
Bakery/Deli					4.4	0.8
Frozen Goods					6.3	1.6
R^2	0.07, F = 11.2[a]		0.08, F = 7.5[a]		0.09, F = 5.1[a]	

NB: national brands
[a]: significant at $p = 0.01$
[b]: significant at $p = 0.05$
[c]: significant at $p = 0.10$

1987). We did not take into account demand interdependence across product categories. Our analysis also did not examine the effects of other marketing mix variables such as advertising or promotions. Sethuraman (1989) provides a framework that allows one to examine how advertising affects the competition between a store brand and national brands.

It may also be useful to examine additional category characteristics, and study how these affect store brand introduction decision. As an illustrative example, our empirical analyses suggested that category size affects introduction decisions but not market share (see Tables 4 and 5). Our model can be extended to study category sales in the following manner. Assume a set of demand equations that are identical to (11)–(12) except that we multiply each by s, where s captures category size. The inclusion of s in the demand model does not affect equilibrium prices as the first order conditions remain unchanged. As all demand equations are multiplied by s, the parameter s has no effect on the equilibrium market share of the store brand. However, s does affect demand. If we assume that the store brand introduction decision is conditional on the increase in profits being large enough to cover a predetermined level of fixed costs, and these fixed costs are not dependent on category size (s), it follows that larger values of s will make the category more conducive for store brand introduction. Researchers may want to examine more detailed empirical studies, such as Hoch and Banerji (1993) and Sethuraman (1992), for identifying additional category characteristics that may be included to develop richer models.

Store brand positioning is an another fruitful area of future research. In some instances, the retailers position the store brand so that it mimics a particular national brand, whereas in other instances, the store brand is not targeted at the market of a particular national brand. Determining which of these two options is optimal may be of interest from a managerial perspective. Under a restrictive set of assumptions, our model predicts that from a retailer's perspective, the optimal positioning for the store brand is one where the store brand competes equally with the two national brands.[9] While examining the new brand positioning problem from a manufacturer's perspective in the context of a market consisting of two consumer segments, Eliashberg and Manrai (1992) suggest that it is optimal to go after a single segment when consumer heterogeneity is high, but adopt a mid-point positioning otherwise. In our research, the two national brands can be thought of as

[9] In the context of the two brand model analyzed in §2, let us assume that $\delta_1 + \delta_2 = 2d$, where $2d$ is a constant. This assumption essentially implies that in order to position the store brand closer to one national brand, it must be moved away from the other national brand. We show in the appendix that the retailer profits are maximized when $\delta_1 = \delta_2 = d$.

serving two market segments, thus paralleling the Eliashberg/Manrai scenario to some extent. Our research, however, suggests that a mid-point positioning is always optimal when one examines the problem from a retailer's perspective. In other words, our result does not depend on the specific values of δ and θ. One of the reasons for the observed difference in recommendations might be that while the retailer's profits depend on the profits from the national brands (existing brands) as well as the store brand (the new brand), a manufacturer introducing a new brand is not concerned about the consequences of new brand introduction on the existing brands of other manufacturers. We do want to emphasize that our model, and the model in Eliashberg and Manrai (1992), despite some similarities in the scenarios they capture, are not directly comparable. Consequently, the results from the two models might differ, not just because we are examining the problem from a retailer's perspective, but also due to differences in model specifications. More generally, as compared to positioning decisions from a manufacturer's perspective, which has been the focus of much of prior research (see Green and Krieger 1989 for a recent review), examining positioning recommendations from a retailer's perspective may be a useful area of future research.

Often times, one of the manufacturers of national brands also supplies the store brand to the retailer (Cook and Schutte 1967). Though it is important to model this explicitly in future research, our analysis is still relevant if the manufacturer of the national brand operates these two functions as separate profit centers.

While our model does allow for asymmetric cross-price effects between the store brand and the national brands (i.e., the store brand competes to a different degree with each of the national brands), we were not able to capture some unique price effects pertaining to private labels that have been pointed in previous literature. In particular, Blattberg and Wisniewski (1989) suggest that a change in store brand price does not affect the demand for the national brand as much as the change in national brand price affects the store brand demand. In our model, a price difference term, whether it appears in the store brand demand function or the demand function of a national brand, is multiplied by the same parameter.

In order to examine the robustness of our results, we examined two additional sets of demand functions.[10] The qualitative results were similar. Yet, there may be other demand structures that lead to different results. The assumed linearity of our demand functions can also be a potential cause for concern. Prior research has shown that nonlinear demand functions may yield qualitative insights that are different than the ones arrived at using linear demand functions (Hauser and Wernerfelt 1989, Choi 1991). To the extent that the predictions of our model are consistent with the data, our choice of a parsimonious demand function seems justified. However, it is important to examine nonlinear demand functions in future research.

Our analysis assumed that the retailer buys the store brand from a manufacturing source at a fixed per-unit cost. In other words, it was assumed that the store brand manufacturer is not a strategic player. Using the expressions in Table 3, we found that the key qualitative results reported in this paper did not change, except that the region where store brand introduction leads to an in-

[10] The first set of demand models assumed the national brand demand prior to store brand introduction to be

$$q_i = \frac{1}{k}\left[1 - p_i + \frac{\theta}{k-1}\sum_{j\neq i}(p_j - p_i)\right].$$

After store brand introduction we assumed that

$$q_i = \frac{1}{k}\left[1 - p_i + \frac{\theta}{k}\sum_{j\neq i}(p_j - p_i) + \frac{\delta}{k}(p_s - p_i)\right],$$

and

$$q_s = \frac{1}{k}\left[\alpha - p_s + \frac{\delta}{k}\sum_{j=1}^{k}(p_j - p_s)\right].$$

In the second set, we assumed the national brand demand prior to store brand introduction to be

$$q_i = \frac{1}{k} - p_i + \frac{\theta}{k-1}\sum_{j\neq i}(p_j - p_i).$$

After store brand introduction, we assumed that

$$q_i = \frac{1}{k+\alpha} - p_i + \frac{\theta}{k}\sum_{j\neq i}(p_j - p_i) + \frac{\delta}{k}(p_s - p_i) \quad \text{and}$$

$$q_s = \frac{\alpha}{k+\alpha} - p_s + \frac{\delta}{k}\sum_{j=1}^{k}(p_j - p_s).$$

crease in retailer profits became smaller when we allowed the store brand manufacturer to be a strategic player.

While analyzing the k national brand market, we assumed that all national brands are symmetrically positioned and have the same base level of sales. We did not examine whether our results hold in an asymmetric market. Furthermore, while our model is static, dynamic models that allow repositioning of the national brands in response to store brand introduction, or models that allow national brand manufacturers to launch fighting brands, may be an interesting area for future research.

Our empirical analysis used aggregate U.S. market data. Future research may want to test our model predictions using data from individual retail outlets or chains. The measure used for national brand price sensitivity in the empirical analysis has its limitations and needs to be refined. Our empirical results might be consistent with a number of alternative explanations. For example, it can be argued that retailers might find it easier to introduce store brands in product categories that contain a larger number of national brands because such product categories are likely to have lower entry barriers. Comparing our explanation with competing explanations is another interesting area of future empirical research.[11]

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