

Private label positioning: Quality versus feature differentiation from the national brand

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Abstract

This paper investigates the retailer's problem of positioning her private label against two national brands in terms of both product quality and product features. Using a demand function derived from consumer utility, we show that the private label's best positioning strategy depends on the nature of the national brands' competition and its own quality. When the national brands are differentiated, a high quality private label should position closer to a stronger national brand, and a low quality private label should position closer to a weaker national brand. When the national brands are undifferentiated, the private label should differentiate from both national brands.

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Introduction

By 1999, private label products (or equivalently, store brands) accounted for over 20 percent of supermarket unit sales and 15.7 percent of dollar sales (Williams 2000). In 77 of 250 supermarket product categories, private labels in the U.S. collectively have higher unit market shares than their strongest nationally branded competitor, while they are second or third in 100 of those categories (Quelch and Harding 1996). Among other retailer benefits, private labels add diversity to the product line in a retail category (Raju et al. 1995; Soberman and Parker in press). This product differentiation can reflect *quality* differences or just differences in *features*.¹

Improvements in both packaging/features as well as quality have been partially responsible for private label sales growth in U.S. grocery retailing in the late 1980s (Wellman 1997). How to position a private label product in competition with national brands is thus an extremely important managerial question. However, it is still not well understood how the probable relationship between quality and feature positioning affects the profitability of private labels, nor how varying degrees of feature differentiation between national brands affect the optimal positioning of the private label. We attack these questions in the present research and show that enriching our analytic understanding of these issues affects the predictions about how retailers can optimally position their private labels in competition with national brands.

Quality differentiation usually exhibits itself through the perception that private labels are of lower quality than the corresponding national brands (e.g., Ann Page canned soups – the A&P grocery chain's former private label – were widely viewed as lower quality than Campbell's canned soups).²

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¹ The analytic modeling literature refers to quality differentiation as *vertical differentiation* and to feature differentiation as *horizontal differentiation*. A *quality* attribute is one for which a consumer's ideal point is infinite (more is always better). A *feature* attribute is one for which a consumer's ideal point is finite (e.g., color, package size, labeling, flavor). The legal literature's discussion of "trade dress" is a reference to feature differentiation (or the lack thereof) through such attributes as packaging and labeling.

² One of the authors met and interviewed the son of the flavor chemist for A&P's private label products. This unfortunate man was forced to eat Ann Page private label products, including canned soups, throughout his childhood. He readily admitted that the Ann Page brand was significantly

Quality differentiation is based on the notion that the characteristic on which differentiation occurs is one for which *all* consumers value the highest possible level (all else held constant – such as price). A superior quality national brand may lose its quality differentiation from the private label if private-label retailers are eventually able to match the national brand's technology and perception (e.g., President's Choice cookies compared to the national brand Chips Ahoy). However, the quality differentiation literature predicts that a second product – a private label in our context – in the market would find it optimal to differentiate itself by offering a lower quality product than that of the market leader (Shaked and Sutton 1982; Moorthy 1988). For instance, Moorthy obtains a quality-price equilibrium where two brands are positively but finitely separated in their quality levels. Likewise, Desai (2001) shows that, in a competitive scenario, firms optimally offer different quality products respectively for different market segments.

In contrast, feature differentiation refers to the degree to which products have different forms, sizes, or packaging. Different brands in a category may exhibit little feature differentiation (e.g., McCormick and Spice Islands spices both come in jars that fit the standard kitchen spice rack, and both brands sell a broad range of commonly-used spices), or more significant feature differentiation (e.g., Progresso canned soup comes in a pop-top can while Campbell's requires a can opener; Kleenex brand facial tissues interlock, enabling a special top-of-box dispensing feature, while Puffs brand dispenses out of a larger hole spanning the top and side of the box, and can dispense multiple tissues at a time). Unlike a "quality" characteristic, a "feature" characteristic of a product is one for which "more" is not always "better," and can include characteristics where variety is valued by the consumer. For example, the consumer may prefer full-sized facial tissue boxes in some rooms of the house, versus the "boutique" size in other rooms; different flavors of jam, yogurt, or other food products; or liquid versus powder plant fertilizer for different sized plants or for indoor versus outdoor use. When products are differentiated only through feature differences, the literature sometimes finds that minimum differentiation is optimal (Hotelling 1929), and other times that maximum differentiation is the equilibrium (d'Aspremont et al. 1979). Sayman et al. (2002) add a third brand (a private label) in their model, in which the two incumbent national brands are assumed to be maximally feature-differentiated. They find that it is optimal for the private label to imitate the stronger of the two national brands. Their empirical study reveals that although a store brand is often made to look like a national brand (i.e., minimizes feature differentiation), an imitation may not have much impact on its quality perceptions, indicating

worse than the national brand competitors. This depiction of the private label as lower quality than the national brand is consistent with standard representations in the literature as well; see, for example, Soberman and Parker (in press).

independence between the two dimensions of differentiation.

Many private label retailers have purposely sought to *minimize* feature differentiation from national brands, by making their packaging, sizes, typeface, and labeling extremely similar to their respective target brands. In a mid-1990s lawsuit against Venture Stores, Inc., Unilever alleged trademark infringement of Venture's lotion for mimicking its Vaseline Intensive Care Lotion (Harvey et al. 1998). However, the court ruled in Venture's favor, stating that the Venture store brand's label explicitly invited the consumer to compare Venture's product with its target brand.

Two interesting features of this case deserve mention in our context. First, the principle upheld was the legality of *minimum* feature differentiation (or horizontal differentiation, in economic and legal terms); but one of the basic insights of location modeling is the optimality of *maximum* feature differentiation. Second, while the apparent issue is the lack of pure *feature* differentiation through trade dress imitation, it would seem intuitively that Venture was also trying to signal a product of similar *quality* to its consumers. This suggests that in many real-world cases, the retailer's positioning of the private label inherently involves both feature and quality positioning messages to its consumers. The concept of differentiation of the private label from the national brand is thus not a unidimensional concept. The overall interchangeability or substitutability between them is a function of both quality and feature differences across products, and the retailer's positioning choice for its private label will naturally reflect both dimensions.³ Our model investigates the nature of national brand-private label competition in a market characterized by *both* quality and feature differentiation.

In sum, this paper moves beyond the existing literature in several dimensions. It allows for the purchase of multiple brands within a product category, a phenomenon that is seen in many commonly purchased categories but not explicitly considered in the modeling literature. It allows the degree of feature differentiation between the private label and competing national brands to vary, and the results show that this has a substantive effect on the private label's optimal position in the marketplace. It examines the interaction between feature and quality differentiation, considering that one may be correlated with the other, and shows that this

³ The inclusion of more than one dimension of differentiation has been considered in the location-modeling literature. One such model was proposed by Vandenbosch and Weinberg (1995), who assume that the products being sold are characterized by two quality dimensions. Their equilibrium solution is "max-min" differentiation in which the strong brand locates at the best position (i.e., high quality on both product dimensions) and the second brand chooses maximum differentiation in one dimension and minimum differentiation in the other in a large part of the parameter space. While their model does consider two dimensions, they do not consider the differences between quality differentiation and feature differentiation; further, theirs is a location model with fixed total category demand, as opposed to our flexible demand utility-based model.

affects the profitability of optimal positioning of the private label. And finally, this work is grounded in consumer utility theory, and does not rely on ad hoc specifications of the demand function; we show that this affects the interpretation of the effect of demand parameters on optimal positioning of the private label in a way that prior work has not done.

In what follows, we first introduce a model of two competing national brands and one private label. Although closed-form solutions can be derived for the private label's optimal strategy, they are too complex for meaningful interpretation. Therefore, we resort to numerical methods to investigate their properties in the following section. One of our key findings is that, when the two national brands are significantly differentiated in their features, the private label's optimal strategy is to minimize feature differentiation from one of the national brands. Further, its target brand to imitate depends on its own quality level: when its quality is high, the private label should imitate the stronger brand; otherwise, the weaker one. But when two incumbent national brands are *feature-undifferentiated* (e.g., offer similar flavors and packaging), the retailer is better off maximally differentiating her private label from the national brands in the feature dimension. In addition, we investigate the impact of private label positioning on national brand profits. The last section summarizes of our results and delineates directions for future research.

The model

In this section, we present a triopoly (three-product) demand model derived from a consumer utility framework. The three products are two national brands and one private label. The two national brands can have various degrees of feature and/or quality differentiation. In some product categories (such as teabags), two leading national brands (Lipton and Twining's) are not highly differentiated in features (e.g., flavors, nature of the teabag). On the other hand, in a category like copy paper, products are differentiated in their features (e.g., paper suitable for black-and-white printing versus color printing), and the retailer would typically decide to position its private label between the different features offered by the national brands. This is in fact what Office Depot does, offering private label copy paper for black-and-white copying but not for color copying.⁴ However, in the teabags case, the private label tea may have another option than imitating the two similar national brands—it may differentiate “outside the space” between the two national brands. Indeed, in the author's kitchen, the private label teabag is peppermint flavored tea, which is not available in the major national brands, but is valued for its different (flavor) feature.

Feature differentiation can be a profitable strategy in categories where consumers buy just one unit if they are segmented into groups with different valuations placed on the feature dimension of the product. But it can also be useful in a market where individual consumers value variety, and routinely buy and hold multiple different brands in a product category. This is an extremely common occurrence: we polled a convenience sample of nine (9) respondents to ask in what categories they hold both private labels and national brands. The sample revealed that joint holdings of private labels and national brands were present in 10.8 product categories per household on average. Categories mentioned by more than one respondent include (in alphabetical order, with numbers of respondents mentioning the category): butter/margarine (three), cereal (three), cheese (three), cookies (two), cooking oil (three), soaps (five), jam (three), juice (three), lunch meat (two), milk (two), paper towels (four), pasta (three), plastic storage bags (six), spices (two), sugar (two), tea bags (four), and tomato sauce (two). Table 1 reports more detail on the findings, including reasons given for holding both a national brand and a private label; for example, in the paper towel category, it was common for the respondent to say that she puts national brand paper towels in the kitchen, typically for texture or form (one household has half-size paper towel sheets in the kitchen, available only as a national brand, to minimize waste), and to stock private label paper towels with household cleaning supplies, where it was felt that any paper towel would be satisfactory.

This very common type of response indicates clearly that consumers routinely do buy and hold both national brands and private labels, and do so for various reasons, some based on form differentiation (e.g., flavor [teabags, jams, cookies, and lunchmeat], package sizes [rice, potato chips], or form [powder and liquid fertilizer]), and some based on quality needs (e.g., national brand stewed tomatoes are higher quality, but the higher quality is not needed in all recipes; some respondents reported using private label teabags for “everyday,” saving national brand teabags for special occasions or visitors). Brands can of course differ in both quality *and* features (e.g., Ziploc storage bags are viewed as both higher quality than the store brand, and different in form because they come in different sizes and with different “zipper” technologies). Finally, note that our research focus is on the strategic question of how a private label should be positioned against national brand competition; at this level of inquiry, it is important to take account of actual holding of products in the home, to understand the position that private labels serve in the household's consumption and hence purchase patterns. Given the broad set of products mentioned by respondents, it is therefore reasonable to expand the scope of inquiry to explicitly consider multi-unit, multi-brand purchases in a category. We capture this in our demand functions, which are derived from a consumer utility-maximizing framework.

Our representative consumer utility function takes the following standard quadratic form widely used in economics

⁴ Source: Office Depot catalog, issue valid through 10/19/2004.

Table 1
Summary of consumer survey of holding/usage of both national brand and private label products in the household

Respondent	Categories in which household holds both national brand and private label	Reasons for holding both national brand and private label in the household
One (married couple with one teenager at home)	Bathroom cleaners, coffee, facial tissue, jam, juice, light bulbs, lotion, pain relievers, paper towels, plastic storage bags, shampoo, tea bags, vitamins	Taste/sensory differentiation (coffee, jam, juice, tea bags); different forms fit different uses for same product category (bathroom cleaner, light bulbs, plastic storage bags, vitamins), everyday versus "special" use (facial tissue, lotion, paper towels), stocking up but no perceived differentiation (pain relievers), different family members have different favored products (shampoo)
Two (married couple with one teenager at home)	Cereal, cheese, flour, garbage bags, jam, ketchup, oatmeal, paper towels, plastic storage bags, rice, soap, soda, spices, tea bags	Taste/sensory differentiation (cheese, jam, soap, soda, spices); different forms fit different uses for same product category (flour, garbage bags, oatmeal, paper towels, plastic storage bags, rice), everyday versus "special" use (tea bags), different family members have different favored products (cereal, ketchup)
Three (married couple, no kids, husband's job is out of town)	Coffee creamer, cooking oil, milk, soap, socks, soup/broth, spices, sweetener, yogurt	Taste/sensory differentiation (milk, spices, yogurt); different forms fit different uses for same product category (soap, soup/broth, sweetener), stocking up but no perceived differentiation (coffee creamer, cooking oil, socks), different family members have different favored products (milk)
Four (married couple, five young children, kitchen is being remodeled)	Bacon, butter, cookies, crème rinse (for hair), frozen vegetables, lunch meat, paper plates, plastic storage bags, soap, sugar	Taste/sensory differentiation (butter, cookies); different forms fit different uses for same product category (bacon, lunch meat, paper plates, plastic storage bags, sugar), everyday versus "special" use (soap), different family members have different favored products (crème rinse, frozen vegetables)
Five (married couple with four boys)	Aluminum foil, butter, cereal, granola bars, juice, lotion, mustard, pancake mix, pasta, pickles, plastic storage bags, salsa, seafood sauce	Taste/sensory differentiation (cereal, salsa); different forms fit different uses for same product category (granola bars, juice, pancake mix, pickles), stocking up but no perceived differentiation (aluminum foil, butter, lotion, mustard, pasta, plastic storage bags, seafood sauce)
Six (married couple, "empty nesters")	Cheese, cooking oils, milk, paper towels, pasta, plastic storage bags, popping corn	Taste/sensory differentiation (cooking oils); different forms fit different uses for same product category (milk, pasta, plastic storage bags, popping corn), everyday versus "special" use (cheese, paper towels)
Seven (married couple with two kids)	Bread, butter/margarine, cheese, dog treats, olives, paper towels, pasta	Taste/sensory differentiation (olives); different forms fit different uses for same product category (bread, butter/margarine, dog treats, paper towels), everyday versus "special" use (cheese), stocking up but no perceived differentiation (pasta)
Eight (married couple with two kids)	Bread crumbs, canned tuna, cereal, dried fruits, dried beans, nuts, tea bags, tomato sauce, vinegar	Taste/sensory differentiation (bread crumbs, dried fruits, nuts, tea bags, vinegar); different forms fit different uses for same product category (canned tuna, dried beans, tomato sauce), different family members have different favored products (cereal)
Nine (married couple with two kids)	Ballpoint pens, canned baked beans, cookies, cooking oil, hot dog buns, jam, juice, laundry detergent, lunch meat, plant fertilizer, plastic storage bags, potato chips, reams of printing paper, stewed tomatoes, tea bags	Taste/sensory differentiation (cookies, cooking oil, jam, lunch meat, stewed tomatoes, tea bags); different forms fit different uses for same product category (ballpoint pens, canned baked beans, laundry detergent, plant fertilizer, plastic storage bags, potato chips), everyday versus "special" use (reams of printing paper), stocking up but no perceived differentiation (hot dog buns, juice)

(Dixit and Stiglitz 1977; Singh and Vives 1984; Häckner 2000):

$$U(q_1, q_2, q_p) = (\alpha_1 - p_1)q_1 + (\alpha_2 - p_2)q_2 + (\alpha_p - p_p)q_p - \frac{1}{2}(\beta_1 q_1^2 + \beta_2 q_2^2 + \beta_p q_p^2 + 2\gamma_{12} q_1 q_2 + 2\gamma_{1p} q_1 q_p + 2\gamma_{2p} q_2 q_p), \quad (1)$$

where q_i is the quantity of product i consumed and p_i is the price of product i ($i = 1, p$), and the subscript p represents the private label. The other parameters have standard interpretations in utility theory, which can be seen by examining the marginal utility of consumption for the three products:

$$\frac{\partial U}{\partial q_i} = \alpha_i - \beta_i q_i - \gamma_{ij} q_j - \gamma_{ip} q_p - p_i, \quad i = 1, 2,$$

$$j = 3 - i; \quad \frac{\partial U}{\partial q_p} = \alpha_p - \beta_p q_p - \gamma_{1p} q_1 - \gamma_{2p} q_2 - p_p.$$

Clearly, the higher is any product's α parameter, the higher is the marginal utility of consumption of that product (whether national brand or private label); thus, α_1 , α_2 , and α_p represent the intrinsic quality of each product. We assume that $\min\{\alpha_1, \alpha_2\} > \alpha_p$. The difference between α_i and α_p is therefore a measure of the *quality differentiation* between a national brand and the private label. The parameter β_i (or β_p) measures the rate at which the marginal utility of consumption for product i (or p) declines with units of the product consumed, or equivalently, the rate at which the consumer becomes *satiated* with consumption of the product. It is natural to assume that $\min\{\beta_1, \beta_2\} > \beta_p$, reflecting a steeper marginal utility decline for the less valued private label. Note that this representative utility approach embodies *aggregate preference for diversity* via parameters in the utility function.

Finally, the $\gamma \in [0, \beta]$ parameters measure the rate of decline of marginal utility of consumption for one product with respect to the consumption of one of the other products. For example, γ_{1p} represents the interchangeability or substitutability between products 1 and p . More specifically, $\gamma_{1p}^2 / (\beta_1 \beta_p)$ expresses the degree of feature differentiation, ranging from zero when the goods are independent to one when the goods are perfect substitutes (Singh and Vives 1984).⁵ Therefore, the utility function (1) captures both quality and feature differentiation between the national and store brands.

The utility-maximizing consumer will optimally allocate the quantities consumed by solving the first-order conditions: $(\partial U / \partial q_1) = 0$, $(\partial U / \partial q_2) = 0$, and $(\partial U / \partial q_p) = 0$. Solving these three first-order conditions for q_1 , q_2 , and q_p , we obtain the

following demand system:

$$q_1 = \frac{1}{T} [B_1 - (\beta_2 \beta_p - \gamma_{2p}^2) p_1 + (\beta_p \gamma_{12} - \gamma_{1p} \gamma_{2p}) p_2 + (\beta_2 \gamma_{1p} - \gamma_{12} \gamma_{2p}) p_p], \quad (2)$$

$$q_2 = \frac{1}{T} [B_2 + (\beta_p \gamma_{12} - \gamma_{1p} \gamma_{2p}) p_1 - (\beta_1 \beta_p - \gamma_{1p}^2) p_2 + (\beta_1 \gamma_{2p} - \gamma_{12} \gamma_{1p}) p_p], \quad (3)$$

and

$$q_p = \frac{1}{T} [B_3 + (\beta_2 \gamma_{1p} - \gamma_{12} \gamma_{2p}) p_1 + (\beta_1 \gamma_{2p} - \gamma_{12} \gamma_{1p}) p_2 - (\beta_1 \beta_2 - \gamma_{12}^2) p_p], \quad (4)$$

where

$$T = \beta_1 \beta_2 \beta_p + 2\gamma_{12} \gamma_{1p} \gamma_{2p} - \beta_1 \gamma_{2p}^2 - \beta_2 \gamma_{1p}^2 - \beta_p \gamma_{12}^2,$$

$$B_1 = \alpha_1 (\beta_2 \beta_p - \gamma_{1p}^2) - \alpha_2 (\beta_p \gamma_{12} - \gamma_{1p} \gamma_{2p}) - \alpha_p (\beta_2 \gamma_{1p} - \gamma_{12} \gamma_{2p}),$$

$$B_2 = -\alpha_1 (\beta_p \gamma_{12} - \gamma_{1p} \gamma_{2p}) + \alpha_2 (\beta_1 \beta_p - \gamma_{1p}^2) - \alpha_p (\beta_1 \gamma_{2p} - \gamma_{12} \gamma_{1p}),$$

$$B_3 = -\alpha_1 (\beta_2 \gamma_{1p} - \gamma_{12} \gamma_{2p}) - \alpha_2 (\beta_1 \gamma_{2p} - \gamma_{12} \gamma_{1p}) + \alpha_p (\beta_1 \beta_2 - \gamma_{12}^2).$$

For the demand coefficients to have sensible signs and for the second order conditions to be satisfied, we require $\beta_i \geq \gamma_{ik}$ for any $\{i, k\} \in \{1, 2, p\}$, $k \neq i$, and $\beta_p \geq \beta_i$ for $i = 1, 2$. That is, the rates of decrease in own-marginal utilities are greater than cross-marginal utilities, and satiation occurs faster when consuming the private label than when consuming a national brand.

Note that these demand functions are in the same form as that of the most popular linear demand function. However, our demand coefficients are explicitly expressed in terms of the underlying utility parameters. It is easy to see that changing one of the γ substitutability parameters, for example, nonlinearly affects the intercept as well as all price coefficients of each demand function. Therefore, our demand structure provides clear insights into the effects of changes in underlying utility parameters on market outcomes rather than postulating ad hoc own-price and cross-price effects on demand, which has been much criticized as a major limitation of traditional linear demand functions.

While national brand manufacturer i determines the wholesale price (w_i) for his product i whose quality level is α_i , the retailer's decision is to choose the optimal level of quality differentiation (α_p) of her store brand from the national brands, the degree of feature differentiation (γ_{1p} , γ_{2p}) between its store brand and each of the national brands, and the retail prices for the national brands and the private label (p_1 , p_2 , p_p). Since the focus of our paper is on the

⁵ Several papers including Blattberg and Wisniewski (1989) and Sethuraman et al. (1999) document the existence of this asymmetric price effects between the two quality tier products. Actual modeling of this asymmetry requires a nondifferentiable demand function that is kinked at every price point, and developing such a model is beyond the scope of the current study.

retailer's decisions, we assume that α_1 and α_2 are already given.⁶ Observing the quality levels of the national brands and *anticipating* subsequent price equilibrium, the retailer positions her private label product in the quality and feature dimensions. Thus, our equilibrium is sub-game perfect, in which the second-stage price equilibrium is reached immediately after the differentiation decisions. Price competition is modeled as a manufacturer-Stackelberg game, in which manufacturer i sets the national brand's wholesale price (w_i) anticipating the retailer's pricing reaction in all three brands.

The retailer is assumed to use product-line pricing as part of category management. The manufacturer-Stackelberg pricing game is solved recursively, starting from the retailer's pricing decision. The retailer thus maximizes her combined profit:

$$\text{Maximize}_{p_1, p_2, p_p} \Pi_R = (p_1 - w_1)q_1 + (p_2 - w_2)q_2 + (p_p - v_p)q_p, \quad (5)$$

where v_p is the unit variable cost of the private label, which is assumed to be an increasing function of α_p (that is, creating a higher-quality private label product results in a higher marginal cost of production). Solving the first-order conditions ($(\partial \Pi_R / \partial p_1) = 0$, $(\partial \Pi_R / \partial p_2) = 0$, $(\partial \Pi_R / \partial p_p) = 0$) for p_1 , p_2 , and p_p , we obtain the following retailer reaction functions:

$$p_1 = \frac{w_1 + \alpha_1}{2}, \quad p_2 = \frac{w_2 + \alpha_2}{2}, \quad p_p = \frac{\alpha_p + v_p}{2}. \quad (6)$$

To guarantee that the retail margin is positive, we require that $\alpha_1 \geq w_1$. It is interesting to note that p_p is independent of the national brands' wholesale prices, even though the three products are interrelated in demand. The retailer chooses the private label's price based only on its own quality and variable cost. We found that this is a property of any linear demand that has symmetric cross-price effects (i.e., $(\partial q_i / \partial p_j) = (\partial q_j / \partial p_i)$, $i \neq j$).⁷ Under such a demand function, product-line pricing implies that it is in the retailer's best interest not to link the

private label's price to the level of the national brand's wholesale price.

Result 1. Suppose the demand is represented by a linear function with symmetric cross price effects. When the retailer employs product-line pricing, the private label's optimal price is independent of the national brands' wholesale prices.

However, as shown in Hall et al. (2004), a linear demand with asymmetric cross-price effects produces interdependent reaction functions in category pricing. On the other hand, Moorthy (2005) shows that, when there is no retailer competition (such as in our model), a linear demand function tends to produce "balanced" retail pass-through rates where both positive and negative effects of the other brand's cost change are roughly cancelled out.

Given the retailer's reaction functions (6), each manufacturer's pricing decision is to choose his wholesale price so as to maximize his short-term profit:

$$\text{Maximize}_{w_i} \Pi_{Mi} = (w_i - v_i)q_i[p_i(w_i), p_j(w_j), p_p], \quad (7)$$

where v_1 is his unit variable cost ($w_1 \geq v_1$). Solving its first-order condition, we can derive closed-form solution of the optimal wholesale prices. Also, by substituting these equilibrium wholesale prices into the reaction functions (6), we can derive closed-form equilibrium retail prices for the two national brands and the store brand as well as all other equilibrium quantities. However, these solutions are complex and not amenable to immediate analytic interpretation.⁸ We therefore investigate their properties numerically in the following sections.

Investigating the equilibrium solution's properties

The closed-form equilibrium quantities are very messy and are functions of the nine utility parameters ($\alpha_1, \alpha_2, \alpha_p, \beta_1, \beta_2, \beta_p, \gamma_{12}, \gamma_{1p}, \gamma_{2p}$) and the manufacturers' variable costs (v_1, v_2, v_p). Moreover, with the parameter restrictions imposed in the previous section, the solutions are not amenable to analytical analysis, because the equilibrium quantities are discontinuous and highly nonlinear outside the parameter ranges. Therefore, we resort to an extensive numerical analysis to examine the equilibrium properties. We first present the results from our full model in which the two national brands are significantly differentiated in features, and then discuss a special case in which the two national brands are not significantly feature-differentiated. For simplicity, we assume all variable manufacturing costs are normalized to zero.

⁶ Clearly, over a longer time frame the national brands' quality levels are not given parametrically, but can be altered through product innovation by the national brand manufacturers. In the short run, however, national brands are fixed in quality and indeed, the branding effort most manufacturers undertake locks them in to a specified quality range for their products, a key part of the brand's image. Given these considerations, we proceed with the assumption that the quality levels of the two national brands are fixed at α_1 and α_2 . Note that Sayman et al. (2002) also make this assumption, saying: "We assume that NB positions are fixed. Although NBs may prefer to reposition, it does not happen often even over the long run."

⁷ Symmetric cross-price effects emerge from any general utility maximization framework. Asymmetric cross-price effects, which are sometimes observed in grocery scanner panel data, could arise in some non-standard utility circumstances: for example, where the consumer gets utility not just from consuming product, but from getting a "good deal" on price as well. However, such departures from standard utility formulations are beyond the scope of the present work.

⁸ The solutions are presented in Appendix A.

Case 1: The two national brands are differentiated in the feature dimension

To examine a case where the two national brands are feature-differentiated, we start by denoting $\gamma_{12} = \gamma > 0$ for ease of exposition. The feature-positioning decision for the retailer involves deciding where to place the private label in the range of features represented by the national brands' differentiation. Suppose that the private label "perfectly" imitates national brand 1: i.e., $\gamma_{1p}^2 / (\beta_1 \beta_p) = 1$. Since $\beta_p \geq \beta_1$, perfect substitution would occur at $\gamma_{1p} \geq \beta_1$, beyond the allowable range. That is, as long as $\beta_p > \beta_1$, the private label cannot be a perfect substitute (in the feature dimension) for the national brand. In this case, we let $\gamma_{1p} = \beta_1$ and $\gamma_{2p} = \gamma$ (that is, the private label and national brand 1 are equally feature-differentiated from national brand 2). The converse statements are true when the private label imitates national brand 2.⁹

We make some assumptions to improve the tractability of the analysis:

- $\beta_1 = \beta_2 = \beta$ (that is, the marginal utility parameter for national brand 1 equals that for national brand 2).
- We normalize by setting $\beta = 1$ without loss of generality, but retain a key assumption that $\beta_p \geq \beta = 1$.
- $\alpha_1 \geq \alpha_2 \geq \alpha_p$ (with full generality, we designate national brand 1 as the higher-quality brand).
- $v_p = 0$ (the variable cost of private label production is normalized to zero).

Our assumption that $\beta_1 = \beta_2 = \beta$ implies the following linear rule for the feature position of the private label: $\gamma_{1p} = \beta - k$ and $\gamma_{2p} = \gamma + k$, where $k \in [0, (\beta - \gamma)]$. When $k = 0$, the private label horizontally imitates national brand 1; and when $k = \beta - \gamma$, it imitates national brand 2. With these specifications, equilibrium prices, quantities, and profits in the channel are thus functions of $\alpha_1, \alpha_2, \alpha_p, \beta_p, \gamma$, and k . We can then examine the retailer's decisions on its private label's quality ($0 \leq \alpha_p \leq \alpha_2$) and its feature differentiation ($0 \leq k \leq (\beta - \gamma)$) that maximize her total profit, as functions of the fundamental utility parameters: γ (the feature differentiation between the national brands), β_p (the private label's unattractiveness as quantity consumed increases), and the relative quality levels of the two national brands (α_1 and α_2).

For any specific values of the utility parameters ($\alpha_1, \alpha_2, \alpha_p, \beta_p$, and γ) that satisfy the conditions discussed in the previous section, we numerically show that the retailer's profit is a convex function of k as well as α_p . This means that as k increases, retail profit first falls, and then eventually rises with further increases in k ; and similarly for increases in α_p . In short, a graph of profit as a function of k (holding α_p constant) would look like a "U" shape, with the highest values at the minimum and maximum value of k , and similarly, a graph of profit as a function of α_p (holding k constant) would also look like a "U"

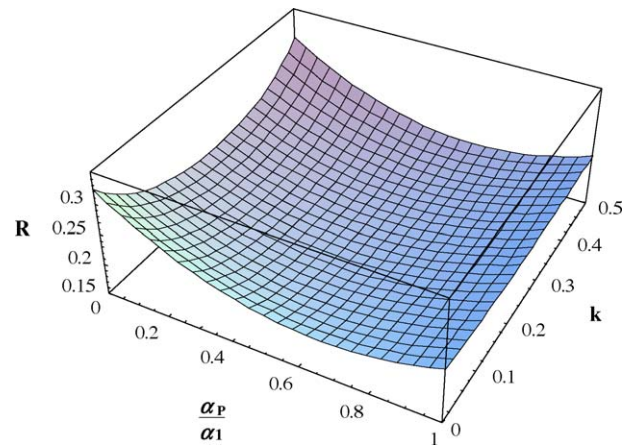


Fig. 1. Retailer profit in vertical and horizontal differentiations. (Parameter values used: $\alpha_1 = 1.1, \alpha_2 = 1.0, \beta = 1, \beta_p = 1.5, \gamma = 0.5$).

shape. A typical shape of the retailer profit function, letting α_p and k both vary, and given a set of specific utility parameters ($\alpha_1 = 1.1, \alpha_2 = 1.0, \beta_p = 1.5, \gamma = 0.5$), is shown in Fig. 1. The key reason we care about these convexity characteristics of the retail profit function is its immediate implication that the retailer will make the most profit by choosing either minimum or maximum values of both feature and quality differentiation from the national brand; some intermediate level of differentiation is less profitable. In the following, we first examine the retailer's profit function with specific parameter values, and then employ an extensive sensitivity analysis to show that the properties can be generalized to all values in the feasible parameter domain.

Effects of quality differentiation

Fig. 1 shows that the retailer's profit initially decreases as the private label's quality (α_p) increases, and then increases as it approaches that of the second national brand ($\alpha_2 = 1$). As defined above, this means equivalently that retail profit is convex in α_p . This convexity can be verified by checking the sign of the second order derivative of Π_R with respect to α_p in all feasible utility parameter domains. The result of this sensitivity analysis is presented in Appendix A (Fig. A1), which results from a numerical computation of the minimum values of $\partial^2 \Pi_R / \partial \alpha_p^2$ with respect to α_p and k for a set of 16 even-interval sample values of $\beta_p \in [1.2, 2]$ and $\gamma \in [0, 0.7]$, which cover the reasonable parameter domain. The Figure shows that the second order derivative of the retailer's profit with respect to the quality parameter (α_p) is nonnegative for all potential values of β_p and γ (for any fixed α_1 and α_2), implying that *retailer profit is convex in its private label's quality regardless of the utility parameter values*. This immediately implies that maximum retailer profit occurs where α_p takes on either its minimum value (of zero) or its maximum value (of α_2).

To establish which of these is optimal, consider next Fig. 2. In Fig. 2, the lower curve shows a set of points for which the retailer's profit is invariant with respect to a change in

⁹ For numerical exploration, we examine the parameter range up to $\gamma_{1p} = \beta_1$.

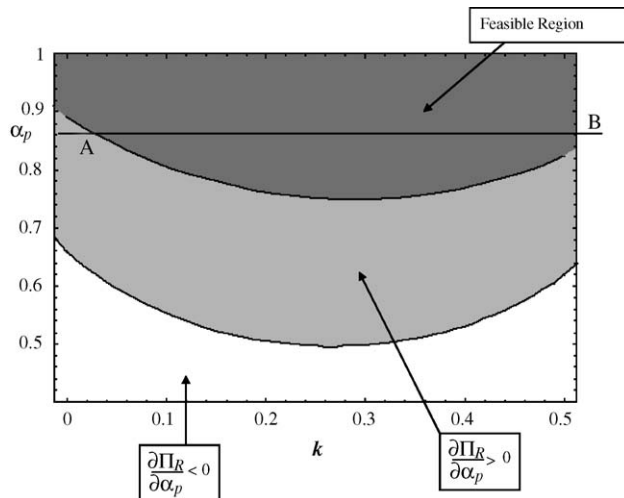


Fig. 2. Parameter region for feasible differentiation. (Parameter values used: $\alpha_1 = 1.1$, $\alpha_2 = 1.0$, $\beta = 1$, $\beta_p = 1.5$, $\gamma = 0.5$). Note: The feasible region (where the private labels demand is positive) is completely within the region in which the retailer's category profit increases as the private label's quality increases. Suppose the private label's quality is 0.85. Due to the convexity of the profit function with respect to the feature differentiation parameter k , the optimal differentiation is the corner solution within the feasible region: i.e., either point A or B. Our numerical solution in Table 2 shows that point A ($k = 0.0396$) provides higher retailer profit than point B ($k = 0.5$).

α_p . Below this curve (in the white area of the Figure), the retailer's profit decreases in α_p ; above the curve (in both the light gray and dark gray regions of the Figure), it increases in α_p .

However, not all pairs of (α_p, k) are feasible strategies for the retailer. When the private label's quality is below a certain level ($\hat{\alpha}_p$), its demand becomes negative, and this defines the feasible quality range for the private label. This minimum quality level depends on the degree of feature differentiation of the private label (k). That is, for demand to be nonnegative, the private label's quality cannot be lower than the minimum quality $\hat{\alpha}_p(k)$. In Fig. 2, the upper curve (the boundary between the light gray and dark gray regions) represents the minimum quality function $\hat{\alpha}_p(k)$.

Now we are interested in finding the properties of the retailer's profit within this feasible region. We note in Fig. 2 that the feasible strategy region is contained within the region where quality increases lead to profitability increases. Therefore, the retailer finds it in her best interest to increase the quality of the private label up to that of the second national brand, as long as the quality cost is negligible. These insights together lead to Result 2.

Result 2. For a fixed value of the feature substitutability parameter γ and costless private label quality (α_p) improvement, it is optimal for the retailer to seek minimum quality differentiation from the second national brand (i.e., to maximize the private label's quality level).

Note that our minimum quality differentiation result holds when quality choices can be freely made and it hence reflects

a strategic motive for private label positioning. When higher quality implies a higher cost, our results more closely match those from some location models in the economics literature (e.g., Shaked and Sutton 1982; Tirole 1989) which use quadratic cost functions to obtain interior quality solutions. When it is costly to increase private label quality, minimum quality differentiation will not always be the best decision (for example, private-label liquid laundry detergent is not widely viewed as having a quality level equal to that of the national brands). The functional form of the cost function then tempers the incentive to increase private-label quality, but does not invalidate the quality-increasing incentive we uncover here.

We move next to a discussion of the effects of feature differentiation, in which we assume that the private label's quality has already been set at *certain feasible level*.

Effects of feature differentiation

Focusing now on feature differentiation of the private label, we establish in this section that due to the convexity of the retailer profit in feature differentiation (k), it is never optimal for the retailer to position her private label *between* two national brands that are themselves significantly feature-differentiated. Instead, given national brand feature differentiation, it is optimal for the private label to minimally differentiate from one of the two national brands. Raju et al. (1995) and Sayman et al. (2002) find that when the two national brands are of different quality, it is always optimal for the store brand to imitate the stronger national brand. But their interpretations of what we call feature and quality differentiation are not derived from utility fundamentals as ours is and do not therefore fully represent the interaction among the national brands and the store brand.¹⁰ In our utility-based formulation, we do show that if the store brand's quality is high enough, it is optimal to feature-position it closest to the higher-quality national brand, as these authors do. But when the private label's quality is sufficiently low, it cannot generate positive sales volume when feature-imitating the

¹⁰ The demand functions posited by Raju et al. (1995) and Sayman et al. (2002) are essentially the same. The reason our finding concerning optimal feature positioning differs from theirs lies in our derivation of demand from utility fundamentals. Raju et al. acknowledge the "assumed linearity" of their demand function but do not consider utility-derived demand functions explicitly. Sayman et al. (2002) say "we assume that positioning affects only cross-price sensitivity and not other attributes such as quality. This is a limitation of our model . . ." Both sets of authors assume cross-price sensitivity (the derivative of private-label demand with respect to the price of one of the national brands) to be represented by a single parameter δ_1 , while our utility-based formulation (see Eqs. (2) through (4) above) shows that it is in fact a much richer function of all of the marginal-utility variables. Our formulation indeed *does* show that a change in feature positioning – our γ parameter – affects both the cross-price demand effect and the intercept of the demand function (what Sayman et al. call the "base level of demand"). Although Sayman et al. argue that their simpler model formulation gives "clean" results, our analysis shows that the results are not fully generalizable, and that optimal feature positioning does indeed have to take into account the quality of the private label relative to the national brands.

higher-quality national brand; we show that when this is so, imitating the feature positioning of the lower-quality national brand is the most profitable retailer strategy.

As a basis for these results, we first examine the generality of the convexity of retail profits with respect to k within the parameter region. *Convexity* of a function means that the function is shaped like a “U” with respect to the variable of interest: thus, the function takes on its highest values when the variable is either very low or very high. In our context, we establish that the retailer’s profit function is convex with respect to k , that is, that minimal or maximal feature differentiation of the private label produces the highest profits – not some intermediate level of feature differentiation. We show this convexity in Appendix A (Fig. A2) for all utility parameter values, not just the ones used to create Fig. 1. Thus, the retailer’s optimal feature positioning for the private label is either as close as possible to the higher-quality national brand, or to the lower-quality national brand.

Given the convexity of the profit function, the retailer’s optimal feature position might seem to be to imitate the stronger national brand as in Sayman et al. (2002).¹¹ However, given our utility function specification, we are able to show that national brand 1 can be of so much greater quality that a private label trying to imitate it in features simply cannot sell a positive quantity. In Fig. 2, for example, we note that the feasible (i.e., positive-demand) range of feature differentiation (k) of the private label between the two national brands depends on its quality level (α_p). In this Figure, national brand 1 has a quality parameter α_1 equal to 1.1, while the lower-quality national brand 2 has a quality parameter α_2 equal to 1.0. Then consider an example where $\alpha_p = 0.95$, that is, where the private label’s quality is close to, but not quite equal, to that of the lower-quality national brand. In the example in Fig. 2, it is optimal for the private label to maximally imitate the higher-quality national brand 1. However, as discussed above, it cannot be a perfect substitute for the national brand because its β parameter is strictly lower. When the private label’s quality drops further to, say $\alpha_p = 0.85$, the closest possible (or “maximum”) imitation of the stronger brand is $k = 0.0396$ (Point A), which produces a higher total retailer profit than the maximum imitation of the weaker brand $k = 0.4936$ (Point B). Any closer imitation than this (any value of k less than 0.0396) results in negative demand for the private label product (see Table 2 for all related numerical quantities). Thus, when the private label’s quality is not “high enough,” pretending to be a knock-off of the stronger brand may not be convincing enough to generate positive demand. The private label’s quality needs to be sufficiently high if it is to be positioned against a high-quality national brand. At an even lower quality level (below $\alpha_p = 0.85$), however, it is optimal for the private label to imitate the weaker brand.

Lastly, we note that in order to guarantee a nonnegative demand for the private label (given the other parameter values in this example), the minimum possible quality for the private label is $\alpha_p = 0.7475$, in which case the *only* feasible feature differentiation is $k = 0.2898$ (as seen in the bottom row of Table 2). Bold numbers in the profit columns in Table 2 indicate the optimal feature positioning of the private label at various quality levels. At a “high” intrinsic quality level (i.e., $1.000 \geq \alpha_p \geq 0.900$), the private label’s optimal feature-position is closer to the stronger national brand. When its intrinsic quality is relatively lower (i.e., $0.900 \geq \alpha_p \geq 0.850$), the private label still optimally imitates the stronger brand, but not up to the “maximum” level. Within the range of $0.850 \geq \alpha_p \geq 0.7475$, however, the optimal feature-position of the private label is to move closer to the weaker national brand. We formalize this in Result 3 below.

Result 3. A higher-quality private label is better off positioning closer to the stronger national brand, while a lower-quality private label is better off positioning closer to the weaker national brand.

Combining insights from the above two subsections, we find that it is optimal for the retailer to position the private label (a) with *minimum quality differentiation* from the national brands, and (b) with *minimum feature differentiation* from one of the two national brands, with the targeted national brand depending on the private label’s given quality level. The minimum quality differentiation result intuitively means that the private label’s quality should be improved as far as possible; this is because quality is a product characteristic for which more is *always* better than less, in the consumer’s eyes, and therefore the private label does best at the highest possible quality level. The feature differentiation result, given a quality level for the private label, is an interesting and non-obvious one. Given the already-existing feature differentiation of the national brands, and consumers’ utility placed on variety, the private label intuitively does best maximizing its difference from *one* of the national brands. This is only possible by imitating the feature positioning of the *other* national brand. The interesting question is then which national brand to imitate in features? The private label is best off imitating the feature positioning of the lower-quality national brand because this positions it head-to-head against the least threatening national brand (from a quality perspective)—thus maximizing its sales potential. If the private label were to imitate the feature position of the higher-quality national brand instead, its sales would suffer more, due to the greater discrepancy between its quality and that of the stronger national brand.

An example of minimum *feature* differentiation is President’s Choice chocolate chip cookies, which mimics the stronger national brand Chips Ahoy rather than another leading national brand like Pepperidge Farm. Pepperidge Farm feature-differentiates by offering larger individual cookies, with fewer cookies per package and different packaging designs and materials. It is perceived as being a higher-

¹¹ Raju et al. (1995) do not consider the possibility of national brands with different quality levels.

Table 2
Optimal private label differentiation^a

α_p	Lower k	Π_R [imitate stronger brand]	Upper k	Π_R [imitate weaker brand]
1.000	0.0000	0.2401	0.5000	0.2363
0.950	0.0000	0.2317	0.5000	0.2268
0.900	0.2387	0.2246	0.5000	0.2186
0.850	0.0396	0.2128	0.4936	0.2117
0.800	0.1076	0.1999	0.4679	0.2022
0.750	0.2500	0.1880	0.3293	0.1884
0.7475	0.2898	0.1876	0.2898	0.1876

(Parameter values used: $\alpha_1 = 1.5, \alpha_2 = 1.0, \beta = 1, \beta_p = 1.5, \gamma = 0.5$)

^aNotes:

- Notation:
 α_p = Private label’s quality (recall the requirement that $\alpha_p \leq \alpha_2$; here, $\alpha_2 = 1.0$)
 Lower k = the closest feasible feature imitation towards the stronger national brand (brand 1)
 Upper k = the closest feasible feature imitation towards the weaker national brand (brand 2)
- Gray-shaded cells indicate the feature positioning that maximizes the retailer’s category profit, given various values for private-label quality, α_p ; thus, for $0.850 \leq \alpha_p \leq 1.0$, retailer category profit is maximized with the private label imitating the feature positioning of the stronger national brand 1; for $0.750 \leq \alpha_p \leq 0.800$, retailer category profit is maximized with the private label imitating the feature positioning of the weaker national brand 2; and for $\alpha_p = 0.7475$, the only feasible position is in the middle, $k=0.2898$. Below this quality, there is no demand for the private label.

quality cookie than Chips Ahoy. President’s Choice cookies physically resemble the Chips Ahoy cookie in texture, taste, and packaging (dimensions of feature differentiation), and are generally viewed as being of comparable quality to Chips Ahoy. Another example, focused on quality positioning, occurs with paper towels. A&P’s store brand paper towel (\$1.29 per roll) resembles the weaker brand Marcal (\$1.69) in package colors and “look-quality” more than it does the market leader Scott (\$1.89). The Marcal brand is made from recycled paper, which generally implies a lower quality, whereas the store brand’s quality is perceived to be significantly lower than that of the market leader’s.

These results characterize the optimal positioning strategy of the private label when competing with two feature-differentiated national brands. In the next section, we consider the private label’s positioning strategy when facing two non-feature-differentiated national brands.

Case 2: The two national brands are undifferentiated in the feature dimension

When the two national brands lack feature differentiation, the private label can have another option for its feature positioning—to differentiate from both national brands. The teabag example mentioned above exemplifies this choice; the national brands offer similar flavor choices, and the store brand offers a completely different choice: peppermint tea. Another example is the jam category. Two national brands

on Jewel Food Stores’ shelves are Smuckers and Welch’s. While both are high-quality brands, Smuckers is more associated with jams, while Welch’s is more associated with grape juice, and therefore might exhibit a lower quality (α) parameter. Both national brands offer an array of jam flavors, but the Jewel brand offers flavors that neither national brand does (blueberry preserves, cherry preserves, and blackberry jam were stocked on the store shelf in the Jewel brand but not in either of the national brands). In a category like this where consumers value variety and routinely buy and stock multiple flavors in their homes, feature-differentiation through flavor is chosen by the store managing its private label. While the teabag and jam categories do exhibit some feature differentiation between the national brands, we analyze this sort of behavior by simplifying to assume the feature differentiation is absent. A small degree of feature differentiation will not alter the model’s results.

In our demand functions (2)–(4), having undifferentiated national brands would mean that $\gamma_{1p} = \gamma_{2p} = \gamma_p$ from our private label’s point of view: that is, the private label is equally differentiated from both national brands in the feature dimension. Further, a lack of feature differentiation between the two national brands means that consuming a unit of either one has an equal effect on the marginal utility of consuming an incremental unit of one of the brands. Mathematically, this implies that the cross-price demand parameter (γ_{12}) is essentially the same as the own-price demand parameter ($\beta_1 = \beta_2 = \beta$); but to insure that the problem has an interior solution, we need to

introduce a small number ε such that $\gamma_{12} = \beta - \varepsilon$, where we recollect that γ_{12} is the cross-product substitutability parameter between the two national brands.

We can derive closed-form solutions for the equilibrium profits of the retailer and manufacturer, as well as equilibrium prices and quantities.¹² To improve interpretability of the results, we make the same assumptions as above in the case of feature-differentiated national brands. By normalizing $\beta = 1$, we have $\gamma_{12} = 1 - \varepsilon$. For simplicity, we first examine the case where the two national brands are characterized by the same quality: $\alpha_1 = \alpha_2 = \alpha \geq \alpha_p$. Let $x \in [0, 1]$ denote the level of quality differentiation such that $\alpha_p = x\alpha$. With these specifications, equilibrium prices, quantities, and profits in the channel are thus functions of x , γ_p , β_p , and α . We can then examine the quality (x) and feature (γ_p) values that maximize retailer profit, as functions of the fundamental utility parameters: β_p (the private label's marginal unattractiveness as quantity consumed increases) and α (the quality level of the two national brands). An analysis of the equilibrium demand for the store brand shows that store-brand sales are positive only when $\gamma_p < x$, which is analogous to Fig. 2's upper curve. Intuitively, this condition implies that if the store brand is "too inferior" in quality to the national brands (i.e., if $x < \gamma_p$), store-brand demand will be negative. Alternatively, the condition implies that the relative quality of the store brand as compared to national brands places a limit on how feature-differentiated the store brand can be from the national brands, and still garner positive sales; the higher is the store brand's quality, the more differentiated in feature it can be and still survive in the market.

Without loss of generality, we therefore restate γ_p as $\gamma_p = y \cdot x$, with $y \in [0, 1]$. Equilibrium retailer profit in this situation, as ε approaches zero, is given by $(\alpha^2[\beta_p + x^2(1 - 2y)])/4(\beta_p - x^2y^2)$. The choice of the optimal degree of feature differentiation of the store brand from the national brands translates in this context to a choice of the value of y (in the permitted range of $0 \leq y \leq 1$) that maximizes these equilibrium retailer profits. It is straightforward to show that this profit expression is decreasing in y : the optimal value of y is thus zero, implying maximal feature differentiation of the store brand from the national brands. We can also easily show that (if it were costless) the retailer would choose *minimal* quality differentiation of the store brand from the national brands, that is, $x = 1$. Finally, it is also easy to show that in this situation, maximal feature differentiation of the store brand also maximizes unit sales of the store brand. However, the range of the parameter y implies that the relative quality level of the private label limits the degree of feature differentiation. A higher private label's quality allows it to more differentiate from the national brands, as formalized in Result 4.

Result 4. When the two national brands are undifferentiated in the feature dimension, it is optimal for the private label to

feature-differentiate from the national brands. The higher the private label's quality, the more it can differentiate.

Intuitively, feature differentiation of the private label is optimal when the national brands are not feature-differentiated because of the value consumers place on variety, as represented in our utility function specification. For example, one consumer we interviewed buys national brand pasta for herself and her husband, which is available only in small package sizes; when her college-age son entertains friends at home, however, she provides store-brand mostaccioli because it comes in a much larger package size that is unavailable in any of the national brands. In this case, it is package size that is the feature differentiator between the national brands and the private label.

We can also extend our results to a case where the two national brands, while undifferentiated in *feature*, are *quality* differentiated (i.e., $\alpha_1 > \alpha_2 \geq \alpha_p$). We show a numerical example of this more complicated case in Appendix A to illustrate that (a) the more quality differences there are between the two national brands, the more stringent is the condition on minimum quality of the store brand to guarantee positive store-brand sales; and (b) it is still optimal for the retailer to maximize the feature differentiation of the store brand from the national brands (subject to positive sales of the store brand), as above. Thus, our results on the optimality of maximum feature differentiation of the store brand, given national brands that lack feature differentiation, holds regardless of the quality differences between the national brands.

Summary

Interestingly, therefore, the nature of competitive positioning between the national brands affects the relative position the retailer wishes to establish for its store brand. In the case of feature differentiation between the national brands, the retailer optimally positions the store brand at the same feature position as one or the other of the national brands (consistent with Sayman et al. 2002). But here, when the national brands themselves are essentially undifferentiated in features, it is no longer in the retailer's best interest to choose a feature position equal to those of the national brands; instead, retail profit is maximized by maximally differentiating the store brand from the national brands in the feature dimension. Sayman et al. (2002) do not derive this result, because they do not consider the possibility that the private label feature-differentiates from two national brands. Thus, in a multiple-national-brand world, private-label positioning decisions optimally take account of the existing national-brand competition.

In sum, our analysis of the case of two national brands competing with the private label shows that optimal positioning of the private label should take into account the relative feature positions of the national brands as well as the relative quality of the private label itself. When national brands are significantly differentiated only in the feature dimension,

¹² The solutions for a simplified setting where the two national brands are identical are presented in Appendix A.

the private label can choose a feature position equivalent to one of the national brands. A relatively high quality private label should position closer to the stronger brand, but a lower quality private label should position toward the weaker brand. But when national brands are not differentiated in the feature dimension, the results are quite different: the retailer optimally *maximizes* the feature differentiation between the private label and the national brands. But the degree of possible differentiation is proportional to its relative quality level.

Impact of private-label positioning on national brand profits

Our main focus in this paper is on the retailer's decision of how to position the private label versus the national brand. However, it is interesting to examine the impact of these decisions on the national-brand manufacturer as well. One can imagine a longer time horizon than we model here, where a national-brand manufacturer, knowing the retailer's strategic and tactical incentives to position the private label and to price both products, would optimally invest in its own feature and/or quality differentiation efforts through time. While modeling this more extensive game is beyond the scope of this paper, it is instructive to think about the impact on the manufacturer of these retailer actions.

It can be shown that the manufacturer's equilibrium profit expression in the single national brand case is convex in the value of γ : decreasing in γ initially, then eventually increasing with further increases in γ . The same convexity can be observed in the case of two feature-undifferentiated national brands. Further analysis reveals that the national brand manufacturer, like the retailer, benefits from facing a private label that is maximally feature-differentiated from the national brand. The manufacturer's equilibrium profit can also be shown to be *decreasing* in α_p , the quality of the private label, holding the manufacturers' national brand quality constant (whether there are two or just one national brands in the marketplace). Thus, like the retailer, the national brand manufacturer benefits from products that are feature-differentiated; but unlike the retailer, the national brand manufacturer also benefits from competing with a lower-quality private label product.

The implications are somewhat daunting for the national brand manufacturer, particularly when we take into account the likely positive correlation (rather than independence) between increases in private label quality and increases in the γ parameter (that is, decreases in feature differentiation between the private label and national brand). The national brand manufacturer is harmed by a strategic retailer that seeks to increase the quality of the private label—*particularly* if this quality increase also comes at the expense of a higher level of γ . Such a situation implies a double penalty to manufacturer-level profits.

Recognizing these implications, a strategically oriented manufacturer is likely to persist in efforts to both increase

its quality and to increase its feature differentiation from the private label through time. A case in point would be the pharmaceutical industry's strategy of developing an "improved" version of a prescription drug as its patent expires. The new drug typically tries to distance itself from the old one in both its efficacy (e.g., strength) and feature (e.g., purple pill) dimensions. In the differentiated national brands case, on the other hand, a higher quality private label is more likely to imitate the stronger brand in both feature and quality dimensions and share the segment revenue. Depending on the comparative strength and feature differentiation possibilities, therefore, it is conceivable that a national brand might actively seek the position of the second quality brand, rather than the top quality position.

Discussion of results and future research directions

The majority of the location theory literature suggests that maximum differentiation in both quality and feature dimensions is the optimal positioning strategy for a rival brand such as a private label. However, the push to make private label products "better," which decreases differentiation, is not surprising, given our analysis. Even when a successful private label attacks the national brand by creating an offering of virtually equal quality, a retailer's profitability can increase if this product improvement is not too costly and/or is accompanied by persistent feature differentiation. Nevertheless, there are hints that retailers perceive extensive private-label marketing campaigns – that could increase the quality perception of their store brands – to be very expensive. A costly campaign, combined with an initially reasonably favorable private label product position, may not in fact be a profitable move by the retailer.

Our analysis shows that optimal differentiation strategies by the private label depend on several underlying factors. When the national brands are substantially differentiated in features, the private label, if its quality is relatively high, is generally better off imitating the stronger national brand (as in the example of a store brand of liquid detergent imitating Tide rather than Woolite) or one of two parity-quality national brands (as with Office Depot copy paper). However, a lower quality private label would be better off positioning towards the weaker brand. When the national brands lack clear feature differentiation, the private label is better off taking a distinct position (as in the peppermint tea or jam examples).

The national-brand manufacturer, meanwhile, does best in a retail environment where his brand is "king" in quality, and is highly feature-differentiated from the private label. National brands thus stand to be hurt by strategic moves on the part of retailers to improve the quality of private labels and their close positioning. On a larger level, the rational response of national brand manufacturers is to continually increase the quality of their national brands, find new methods of feature differentiation (such as novel packaging, sizes, and product forms), or both.

Finally, our research shows that the *nature* of differentiation matters in private label—national brand competition. Product substitutability is not a unidimensional concept; a focus on quality investments alone obscures the importance of feature differentiation in maintaining a vibrant product category. Our utility-based demand model, allowing for the possibility of natural market expansion with greater product variety as well as greater product quality, highlights the multiple positioning opportunities open to retailers as they seek to optimize their investments in private labels, as well as to manufacturers seeking to preserve their national-brand dominance in the market.

This paper thus contributes to the private label—national brand competition and positioning dialogue on multiple fronts. The purchase of multiple brands in a product category, commonly seen in real consumer behavior but not considered in prior work, is considered here. Our work expands on previous work in the area by also allowing the degree of feature differentiation between the private label and national brands to vary, and by combining a consideration of feature and quality positioning of the private label versus its national brand

private label from an analytic and predictive point of view. Our research results suggest testable implications for future research, regarding the most likely combinations of positioning one might observe in national brand-private label competition, and the most likely conditions under which one would observe investments in improving the private label’s quality. We also focus on a manufacturer-retailer interaction where the retailer is assumed to be a category manager. A different, but interesting, research question is what incentives such a retailer has to use category management rather than individual product management within the category to position and price its products. This research question could provide some interesting insights not only into the retailer’s decisions, but also into the manufacturer’s optimal defensive national brand positioning strategies, given that it sells through a retailer that either does or does not practice category management.

Appendix A. Technical appendix

Solution for the two national brand case

$$w_1^* = \frac{\alpha_2(\beta_1\beta_p - \gamma_{1p}^2)(\beta_p\gamma_{12} - \gamma_{1p}\gamma_{2p}) + \alpha_1[\beta_p^2\gamma_{12}^2 - \gamma_{1p}^2\gamma_{2p}^2 + 2\beta_p\gamma_{1p}(\beta_2\gamma_{1p} - \gamma_{12}\gamma_{2p}) - 2\beta_1\beta_p(\beta_2\beta_p - \gamma_{2p}^2)] - (\alpha_p - v_p)[\gamma_p\beta_p\gamma_{12}^2 + \gamma_p^2(2\beta_2\gamma_{1p} - 3\gamma_{12}\gamma_{2p}) - \beta_1(2\beta_2\beta_p\gamma_{1p} - \beta_p\gamma_{12}\gamma_{2p} - \gamma_{1p}\gamma_{2p}^2)]}{\beta_p^2\gamma_{12}^2 - 3\gamma_{1p}^2\gamma_{2p}^2 + 4\beta_1\beta_p\gamma_{2p}^2 - 2\beta_p\gamma_{12}\gamma_{1p}\gamma_{2p} - 4\beta_1\beta_2\beta_p^2 + 4\beta_2\beta_p\gamma_{1p}^2}$$

$$w_2^* = \frac{\alpha_1(\beta_2\beta_p - \gamma_{2p}^2)(\beta_p\gamma_{12} - \gamma_{1p}\gamma_{2p}) + \alpha_2[\beta_p^2\gamma_{12}^2 - \gamma_{1p}^2\gamma_{2p}^2 + 2\beta_p\gamma_{1p}(\beta_2\gamma_{1p} - \gamma_{12}\gamma_{2p}) - 2\beta_1\beta_p(\beta_2\beta_p - \gamma_{2p}^2)] - (\alpha_p - v_p)[\gamma_{2p}\beta_p\gamma_{12}^2 + \gamma_{2p}^2(2\beta_1\gamma_{2p} - 3\gamma_{12}\gamma_{1p}) - \beta_2(2\beta_1\beta_p\gamma_{2p} - \beta_p\gamma_{12}\gamma_{1p} - \gamma_{2p}\gamma_{1p}^2)]}{\beta_p^2\gamma_{12}^2 - 3\gamma_{1p}^2\gamma_{2p}^2 + 4\beta_1\beta_p\gamma_{2p}^2 - 2\beta_p\gamma_{12}\gamma_{2p}\gamma_{1p} - 4\beta_1\beta_2\beta_p^2 + 4\beta_2\beta_p\gamma_{1p}^2}$$

$$p_1^* = \frac{\alpha_2(\beta_1\beta_p - \gamma_{1p}^2)(\beta_p\gamma_{12} - \gamma_{1p}\gamma_{2p}) + \alpha_1[2\beta_p^2\gamma_{12}^2 - 4\gamma_{1p}^2\gamma_{2p}^2 + 2\beta_p\gamma_{1p}(3\beta_2\gamma_{1p} - 2\gamma_{12}\gamma_{2p}) - 6\beta_1\beta_p(\beta_2\beta_p - \gamma_{2p}^2)] - (\alpha_p - v_p)[\gamma_{1p}\beta_p\gamma_{12}^2 + \gamma_{1p}^2(2\beta_2\gamma_{1p} - 3\gamma_{12}\gamma_{2p}) - \beta_1(2\beta_2\beta_p\gamma_{1p} - \beta_p\gamma_{12}\gamma_{2p} - \gamma_{1p}\gamma_{2p}^2)]}{2(\beta_p^2\gamma_{12}^2 - 3\gamma_{1p}^2\gamma_{2p}^2 + 4\beta_1\beta_p\gamma_{2p}^2 + 4\beta_2\beta_p\gamma_{1p}^2 - 2\beta_p\gamma_{12}\gamma_{1p}\gamma_{2p} - 4\beta_1\beta_2\beta_p^2 + 4\beta_1\beta_p\gamma_{1p}^2)}$$

$$p_2^* = \frac{\alpha_1(\beta_2\beta_p - \gamma_{2p}^2)(\beta_p\gamma_{12} - \gamma_{1p}\gamma_{2p}) + \alpha_2[2\beta_p^2\gamma_{12}^2 - 4\gamma_{1p}^2\gamma_{2p}^2 + 2\beta_p\gamma_{1p}(3\beta_2\gamma_{1p} - 4\gamma_{12}\gamma_{2p}) - 6\beta_1\beta_p(\beta_2\beta_p - \gamma_{2p}^2)] - (\alpha_p - v_p)[\gamma_{2p}\beta_p\gamma_{12}^2 + \gamma_{2p}^2(2\beta_2\gamma_{2p} - 3\gamma_{12}\gamma_{1p}) - \beta_2(2\beta_{12}\beta_p\gamma_{2p} - \beta_p\gamma_{12}\gamma_{1p} - \gamma_{2p}\gamma_{1p}^2)]}{2(\beta_p^2\gamma_{12}^2 - 3\gamma_{1p}^2\gamma_{2p}^2 + 4\beta_1\beta_p\gamma_{2p}^2 + 4\beta_2\beta_p\gamma_{1p}^2 - 2\beta_p\gamma_{12}\gamma_{1p}\gamma_{2p} - 4\beta_1\beta_2\beta_p^2 + 4\beta_1\beta_p\gamma_{1p}^2)}$$

counterparts. These additions to the modeling structure are not just complications added on to prior work; we show that they have significant impacts on the profitability of private label positioning decisions. Finally, we consider these factors in a fully consistent consumer utility-based model that allows us to examine the true fundamental effects of underlying utility factors on retailers’ optimal positioning of their private label products.

The focus of this research is on the positioning decision of the retailer that manages both a national brand and a pri-

$$p_p^* = \frac{\alpha_p}{2}.$$

See Table A1.

A.1. A special case: vertically differentiated, but horizontally undifferentiated national brands—a numerical example

For simplicity, assume that $\beta_1 = \beta_2 = 1$, $\gamma_{1p} = \gamma_{2p}$, and $\gamma_{12} = \beta_1 - \varepsilon$. The second equality comes from the fact that

Table A1
Equilibrium values (assuming the two national brands are identical)

	Results for manufacturer and/or national brand	Results for retailer and/or private label
Wholesale price, w_1^* and retail margin, m_1^* for the NB	$\frac{\beta_p(\alpha_1 + v_1) - \gamma(\alpha_p - v_p)}{2\beta_p}$	$\frac{\beta_p(\alpha_1 - v_1) + \gamma(\alpha_p - v_p)}{4\beta_p}$
Retail prices, p_1^* and p_p^*	$\frac{\beta_p(3\alpha_1 + v_1) - \gamma(\alpha_p - v_p)}{4\beta_p}$	$\frac{\alpha_p + v_p}{2}$
Quantities, q_1^* and q_p^*	$\frac{\beta_p(\alpha_1 - v_1) - \gamma(\alpha_p - v_p)}{4(\beta_1\beta_p - \gamma^2)}$	$\frac{2\beta_1\beta_p(\alpha_p - v_p) - \gamma^2(\alpha_p - v_p) - \beta_p\gamma(\alpha_1 - v_1)}{4\beta_p(\beta_1\beta_p - \gamma^2)}$
Profits of NB mfg., Π_M^* , and retailer, Π_R^*	$\frac{(\beta_p(\alpha_1 - v_1) - \gamma(\alpha_p - v_p))^2}{8\beta_p(\beta_1\beta_p - \gamma^2)}$	$\frac{4\beta_1\beta_p(\alpha_p - v_p)^2 + Y_a}{16\beta_p(\beta_1\beta_p - \gamma^2)}$

^a $Y = [\beta_p(\alpha_1 - v_1) + \gamma(\alpha_p - v_p)][\beta_p(\alpha_1 - v_1) - 3\gamma(\alpha_p - v_p)]$; retailer profit function is the sum of retail profits across the private label and the national brand.

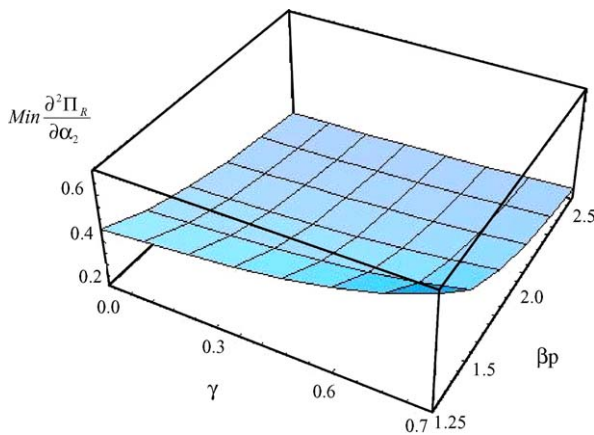


Fig. A1. Sensitivity analysis to check convexity of the retailer profit with respect to α_p . Note: The vertical axis represents the value of the second order derivative minimized with respect to the two differentiation parameters (α_p and k) at any given pair of values of the two non-decision parameters (β_p and γ). Since all *minimum* values of the second order derivatives are positive within the plausible parameter range, this numerically demonstrates that the retailer profit function is convex in α_p .

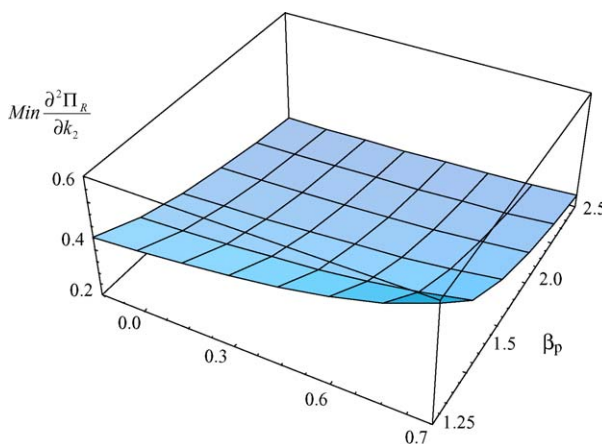


Fig. A2. Sensitivity analysis to check convexity of the retailer profit with respect to k . Note: The vertical axis represents the value of the second order derivative minimized with respect to the two differentiation parameters (α_p and k) at any given pair of values of the two non-decision parameters (β_p and γ). Since all *minimum* values of the second order derivatives are positive within the plausible parameter range, this numerically demonstrates that the retailer profit function is convex in k .

the two national brands are horizontally undifferentiated. The undifferentiated two national brands can be represented by setting $\varepsilon \rightarrow 0$. Further, assume that the national brand 1's intrinsic quality is $k \geq 1$ times that of the national brand 2 ($\alpha_1 = k\alpha_2$), and that the store brand's intrinsic quality is a fraction ($0 < x \leq 1$) of that of the national brand 2 ($\alpha_p = x\alpha_2$). For the store brand to have a positive demand, we require $\gamma_{1p} < (2x/(1+k))$. By setting $y < 2/(1+k)$ this inequality can be converted to $\gamma_{1p} = yx$. Therefore, for a given value of x , y is a surrogate for the horizontal differentiation parameter γ_{1p} (i.e., the smaller is y , the more differentiated the store brand is from the national brands). Although the profit function is unwieldy, its surface graph shows that smaller y increases the retailer's total profit.

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