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Behavioral Explanations for Asymmetric Price Competition

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Behavioral Explanations for Asymmetric Price Competition

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For many consumer packaged goods, researchers have shown that competition among products of different quality within a category is asymmetric: price promotion by a higher quality brand draws significant share from lower quality brands, whereas price promotion by a lower quality brand has much less effect on higher quality brands.

Researchers have proposed three behavioral explanations for this well-known phenomenon: (1) heterogeneity in consumer preference (i.e., an asymmetric pattern of competition arises when the choices of individuals are aggregated), (2) income effect (i.e., consumers' preference shifts toward higher quality brands when their purchasing power is increased due to temporary price reduction), and (3) loss-aversion effect (i.e., the same price cut is perceived to be more favorable for high quality brands than for low quality brands).

Despite the interest in asymmetric price competition by the marketing community, no attempt has been made to compare the three explanations and draw an inference on which one is most likely.

In this study, author Makoto Abe re-examines the first two explanations, which have not been followed up through replication studies. His analyses, replicated across four categories of consumer packaged goods, fail to detect an appreciable asymmetric price effect attributable to either heterogeneity or income effect. The implication is that these influences are small. Such results, combined with extensive evidence obtained from previous laboratory and field research on loss aversion, suggest that the observed asymmetric pattern of competition arises mainly from loss aversion working on price and quality.

Managerial Implications and Future Research

The behavioral explanation for asymmetric competition has important managerial implications. With the heterogeneity or income effect, price promotion has a short-term influence on consumers and hence on competition. When price reverts to its regular level, the share returns to its prepromotional level.

With the loss-aversion effect, on the other hand, the impact of price promotion is long term. This is because the perception of loss is measured against the consumer's reference point, which is formed over time through his or her exposure to the marketing environment and experience with products. Thus, this research sug-

gests that the impact of price promotion is long term, beyond a trial-and-repeat factor, and that managers must act accordingly when planning promotion.

Many questions remain to be addressed. Does frequent use of promotion undermine its effectiveness by lowering the reference point of price and quality? Does an everyday-low-price policy have a negative impact on a brand by lowering the reference point? What is the most effective frequency for promotion in the long term?

Practitioners do not agree on such issues, as is evident from the wide variety of pricing policies currently in use by manufacturers and retailers. Identifying the loss-aversion effect as the reason for asymmetric competition is only the beginning, and much work remains to be done by academic researchers. In the meantime, managers, when planning promotion, should be aware of the potential importance of the long-term effect on reference formation.

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Introduction

For many consumer packaged goods, researchers have shown that competition among products of different quality within a category is asymmetric: price promotion by a higher quality brand draws significant share from lower quality brands, whereas price promotion by a lower quality brand has much less effect on higher quality brands (Sivakumar and Raj 1997). Carpenter et al. (1988) and Russell and Bolton (1988) demonstrated asymmetric competition empirically by using aggregate share and sales models. The DEFENDER model by Hauser and Shugan (1983) infers an asymmetric competitive pattern by assuming a Lancaster-type tradeoff among product attributes that are uniformly distributed across consumers. However, competition is limited to adjacent products in the attribute-per-dollar perceptual map (Shugan 1987; Waarts, Carree, and Wierenga 1991). Kamakura and Russell (1989) observed an asymmetric pattern between national brands and private-label brands of detergent. Blattberg and Wisniewski (1989) showed asymmetric competition between different price-tier brands with an econometric model using store-level sales data.

Though such asymmetric patterns might be a result of several forces at work simultaneously, they can be classified into two groups: supply-side and demand-side factors. The supply-side factors are associated with asymmetry in the efficacy of marketing activities by sellers. For example, many high quality, high priced brands (e.g., Coke, Tide, Tropicana) are sold by leading national manufacturers that have more market power, money, and resources than their competitors. The fact that such firms can obtain better information about the market, provide better control over channels and retailers, and conduct more effective promotion and advertising leads to asymmetric competition.

The demand-side factors are associated with buyer behavior. To understand the underlying buyer behavior that is responsible for asymmetric competition, descriptive studies using aggregate sales data offer little insight. Because competition is a macro-level phenomenon caused by purchases of individual consumers, micro-level analysis of consumers' brand choice behavior, either with household-level disaggregate data or by laboratory experiment, is warranted. Three behavioral explanations have been proposed:

1. Heterogeneity in consumer preference: Blattberg and Wisniewski (1989) postulated a utility-based model of individual consumer choice with heterogeneous preference, whereby an asymmetric pattern of competition could arise when choices of individuals are aggregated. From the asymmetric pattern of competition observed with an aggregate sales model, they conjectured the shape of the preference distribution across consumers.

2. Income effect: On the basis of microeconomic theory, Allenby and Rossi (1991) proposed that consumers' preference shifts toward higher quality brands when their purchasing power is increased due to temporary price

reduction (i.e., the income effect). Such a shift results in asymmetric switching whereby switching up to high quality brands is more likely than switching down. The researchers formulated a choice model using a rotating indifference curve to capture the brand-specific income effect, and validated the model with scanner panel data.

3. Loss-aversion effect: Prospect theory (Kahneman and Tversky 1979) postulates that consumers perceive losses from a reference point to be larger than gains of the same amount. Hardie, Johnson, and Fader (1993) suggested that, under loss-aversion for price and quality, the slope of an indifference curve (for price and quality) depends on whether it is evaluated in the region of a gain or loss in price and quality relative to the consumer's reference point. In particular, the amount of quality traded for a given level of price reduction is larger for superior brands (located in the quality-gain and price-loss region relative to a reference brand) than for inferior brands (located in the quality-loss price-gain region relative to a reference brand). Its implication is that the same price cut is perceived to be more favorable for high quality brands than for low quality brands, offering a psychological explanation for asymmetric switching. Using scanner panel data, the researchers calibrated a choice model that demonstrated loss-aversion effect on price and quality attributes.

These explanations have been offered independently by different researchers using different types of data with different methodology. Both income and loss-aversion effects posit asymmetric brand switching at the individual level (a micro-phenomenon). As a result, when individual purchases are aggregated, sales (a macro-measure) also exhibits an asymmetric pattern. In contrast, the heterogeneity effect asserts that even though brand switching at the individual level is symmetric, aggregation of purchases by heterogeneous consumers leads to an asymmetric pattern. The difference is summarized as follows:

	Micro-phenomenon (brand switching)	**Macro-phenomenon (competition)**
Income effect	asymmetric	asymmetric
Loss-aversion effect	asymmetric	asymmetric
Heterogeneity effect	*symmetric*	asymmetric

The issue also has important managerial implications. With the loss-aversion effect, the impact of price promotion is long term because it affects consumers' reference points, which are formed over time through consumers' exposure to the marketing environment and experience with products. With the heterogeneity and income effects, in contrast, the impact is short term. Therefore, suitable promotion strategy might be different depending on which effect is primarily responsible for asymmetric competition. Despite the clear difference in underlying mechanisms and their marketing implications, no attempt has been made to compare the three explanations and draw an inference as to which one is most likely.

Study in psychology, which started the stream of reference price research in marketing, demonstrated the reference and loss-aversion effects repeatedly for single and multiple attributes through experimentation (Kahneman and Tversky 1979; Tversky and Kahneman 1991). In marketing, the loss-aversion effect for price and quality as well as the asymmetric switching phenomenon were supported by both laboratory experiments (O'Curry and Lovallo 1996) and field study using scanner panel data (Bronnenberg and Wathieu 1996). The latter researchers not only reconfirmed the existence of the reference and loss-aversion effects in the framework of Hardie, Johnson, and Fader (1993), but also investigated additional conditions that competing brands must satisfy in order to exhibit the asymmetric pattern that favors higher quality brands. Furthermore, numerous field studies using scanner panel data confirmed the reference and loss-aversion effects for a single attribute of price (Kalyanaram and Little 1994; Kalwani et al. 1990; Lattin and Bucklin 1989; Mayhew and Winer 1992; Winer 1986). These converging results from various studies with high internal and external validity ensure the empirical generalizability of the loss-aversion explanation for asymmetric competition.

What about the heterogeneity and income explanations? Apparently, no studies either supporting or rejecting those explanations have been reported. Therefore, the current research was undertaken to re-examine whether the heterogeneity and income effects can be plausible reasons for asymmetric competition.

The heterogeneity explanation is supported by the fact that price elasticity predicted by heterogeneous choice models, such as latent segment and random coefficient logit models whose choice elasticity within a homogeneous segment is symmetric, is no longer symmetric when segments are aggregated.[1] Blattberg and Wisniewski (1989) conjectured that heterogeneity in consumer preferences must have a bimodal shape for the asymmetric pattern to be consistent with price-tier competition, whereby higher-priced brands have a stronger influence on lower priced brands than vice visa. In the current research, I estimate the shape of a preference distribution directly from household-level choice data using a nonparametric method. The results from four product categories suggest that it is single modal, and thus the heterogeneity effect cannot explain asymmetric competition. The methodology to estimate the shape of a preference distribution by itself is of interest to academic researchers. Many choice models make use of consumer heterogeneity on the basis of a certain distributional assumption (typically a uniform distribution), which drives the result and hence the marketing implication of these studies (Hauser and Shugan 1983; Raju, Srinivasan, and Lal 1990; Rao 1991; Sethuraman 1996).

A motivation to re-evaluate the income explanation comes from an innocuous question: Will a price cut of 20 to 30 cents change consumers' preference? In marketing, "preference" is one measure of buyer attitude, which is considered to be enduring and persistent over time—something that does not change readily by temporary price promotion (Churchill 1995, p. 454; Kotler 1988, p. 190; Lilien, Kotler, and Moorthy 1992, p. 27). In economics, the income effect is often applied in the context of consumption shift from one product category to another, such as from bread/potato to meat as income goes up. Can we apply the standard

income effect formulation of microeconomic theory to brand choice of consumer packaged goods? The nonhomothetic model of Allenby and Rossi (1991) assumes that goods are infinitely divisible, whereas packaged goods are actually purchased in discrete units. Because utility (which is inferred from an observed choice) is specified as a product of the marginal utility and quantity in their model, an infinitely divisible formulation of quantity may adversely affect the estimate of the marginal utility for a brand. This could in turn lead to an incorrect prediction of the income effect characterized by the marginal utility. A modified model based on a discrete quantity formulation fails to detect an appreciable presence of the income effect when calibrated with scanner panel data from four categories.

The next two sections investigate the heterogeneity and income effect explanations. In each section, the rationale for the original explanation is reviewed, its limitation is described, and then the effect is re-examined with actual scanner panel data. The final section summarizes the conclusions and discusses the managerial implications.

The Heterogeneity Explanation

Heterogeneity Effect on Asymmetric Pattern of Competition

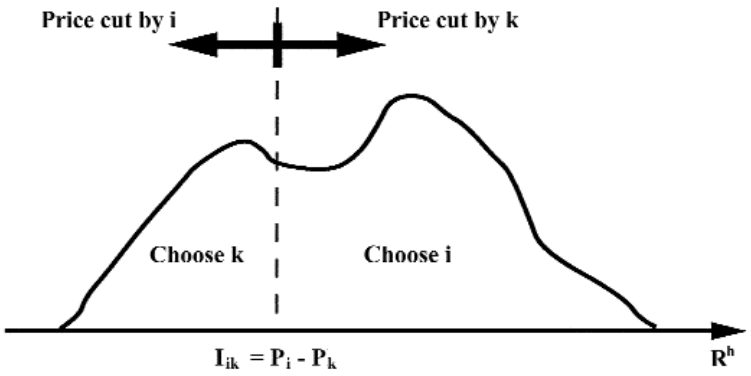
Blattberg and Wisniewski (1989) explained how heterogeneity in price-quality tradeoff across consumers produces an asymmetric pattern of competition. In their notation, utility of brand i for consumer c, U^c_i, is

$$(1) \qquad U^c_i = \theta^c q^c_i - p_i$$

where q^c_i is consumer c's perceived quality of brand i, p_i is the actual price, and $\theta^c > 0$ is consumer c's willingness to pay for quality. θ^c can be interpreted as the importance weight on overall quality relative to an importance weight of 1 on price. The model is widely adopted in utility theory and economics, and it is a basic formulation of a utility function in a multinomial logit model of discrete choice.

In comparing two brands i and k, consumer c chooses brand i if $U^c_i > U^c_k$ and chooses brand k if $U^c_k > U^c_i$. Define $R^c \equiv \theta^c (q^c_i - q^c_k)$ as consumer c's relative preference for brand i over brand k. Then consumer c chooses brand i if $R^c > (p_i - p_k)$ and brand k if $R^c < (p_i - p_k)$. The consumer is indifferent toward brands i and k if $R^c = (p_i - p_k) \equiv I_{ik}$, which is called the point of indifference. Because R^c is consumer specific, depending on the consumers' tradeoff between quality and price, consumers whose relative preference is larger than $(p_i - p_k)$ would choose brand i whereas consumers whose relative preference is smaller than $(p_i - p_k)$ would choose brand k. If the distribution of relative preference R^c for the population is known, the shares of brands i and k can be obtained for given prices of brands i and k, as illustrated in Figure 1. Change in share due to brands' price promotion can be inferred readily from the figure because price cut by brand i (k) would shift the point of indifference, I_{ik}, to the left (right). Therefore, the shape of the distribution will determine the pattern of price competition by the two brands.

Figure 1. Relative Preference Distribution and Point of Indifference



The area to the right (left) of the point of indifference, I_{ik}, corresponds to the share of brand i (brand k). Price cut by brand i (brand k) would shift I_{ik} to the left (right).

Blattberg and Wisniewski (1989) conjectured the shape of the relative preference distribution to be bimodal and the point of indifference to be located toward the lower quality end of the distribution on the basis of an aggregate sales pattern of asymmetric price-tier competition. However, they did not estimate the distribution explicitly.

Though their important work demonstrated asymmetric competition and provided valuable insights about the phenomenon, the drawbacks to their approach are threefold. First, the utility theory for asymmetric competition was developed at the individual level but tested at the aggregate level. Furthermore, the aggregate model provided sales elasticity rather than share elasticity, which is more compatible within the context of brand switching by individual consumers. Second, the observed pattern of competition depended on the classification of products into different price-tier groups. In many categories, the price range of products is continuous. Hence, the number and boundaries of the classifications (e.g., premium, moderate, and generic) are often difficult to define. Third, it is a conjecture, as Blattberg and Wisniewski (1989) stated, "Little is known empirically about the shape of this relative preference distribution or its underlying components, the distributions of θ^c and $(q^c_i - q^c_k)$." Without actually estimating the utility-based model, the validity of their conjecture on the preference distribution is difficult to assess. Indeed, probability theory alone suggests that a bimodal shape for the distribution of relative preference, $R^c = \theta^c (q^c_i - q^c_k)$, is unlikely. The reason is that the probability distribution of a sum (difference) of two random variables with any distributions tends to be concentrated in the middle—a key phenomenon used to derive the central limit theory. For example, the difference of two uniform independent identically distributed variables is distributed as a symmetric triangular shape.

Estimation Method for Heterogeneity Distribution

Estimating the relative preference distribution directly from scanner panel data on household brand choice provides insight into Blattberg and Wisniewski's (1989) conjecture. The distribution is estimated nonparametrically in order to capture the shape to the smallest detail by avoiding influence from the underlying parametric assumption. A basic idea behind the nonparametric approach is to regard the distribution as a histogram of relative preferences of individual households. As the number of households in the sample increases, the empirical distribution of household-specific relative preferences approaches the population distribution.

While the theoretical model of Blattberg and Wisniewski (1989) considers deterministic utility, for robust estimation of parameters we use stochastic utility of a logit model to account for various uncertainties inherent in empirical applications, such as unobserved attributes, measurement errors, and imperfect information. The relative preference of a single household can be obtained from parameter estimates of its constituents, θ^c, q^c_i, and q^c_k, using only that household's purchases. A common problem with this approach is that for many households, the number of purchases may not be sufficient to provide a reliable estimate of household-specific parameters. In scanner panel data covering a period of one year, a typical household makes at most 25 to 30 purchases in a category. It is not unusual to observe households with fewer than 5 purchases, depending on the product category.

To overcome that problem, a Bayesian approach to estimating household parameters (Rossi and Allenby 1993) is introduced. Bayesian estimation combines the likelihood function and a prior, which is based on the standard MNL estimate of the pooled sample across households, to avoid the sample-size problem that can arise in classical estimation methods such as maximum likelihood. The prior is assumed to be normally distributed, and the strength of the prior information can be controlled by a parameter that represents the equivalent sample size of the prior. The mode of the posterior distribution is used as the household-specific parameter estimate. Because the posterior distribution is concave, the mode is unique and can be searched easily by a standard optimization method.

One issue that requires careful attention in Bayesian approaches is the choice and strength of the prior. As the preceding statistical argument suggests, relative preference $R^c \equiv \theta^c (q^c_i - q^c_k)$ tends to be concentrated in the middle regardless of the shape of the distribution of brand constant q^c_i. Hence, obtaining the exact distribution of q^c_i is not critical for the purpose of estimating the distribution of R^c. Nevertheless, we want to ensure that the assumed prior can still reproduce the underlying shape of the distribution of q^c_i correctly. A simulation study was conducted to verify that a bimodal distribution of model parameters is indeed recovered with the shape (normal) and strength (equivalent sample size of 10) of the prior chosen for the study (Abe 1996).

Now, a multinomial logit model of brand choice is expressed as

$$(2) \qquad P_{iht} = \frac{\exp(V_{iht})}{\sum_j \exp(V_{jht})}$$

where P_{iht} is the choice probability and V_{iht} is the systematic utility of brand i for household h at the t-th purchase. Following the formulation of (1), utility V_{iht} is specified as

$$(3) \qquad V_{iht} = q_{hi} - \alpha_h \mathrm{PRICE}_{iht} + \sum_m \beta_{mh} X_{ihtm},$$

where q_{hi} is a brand constant of brand i for household h, PRICE_{iht} is a price of brand i faced by household h at the t-th purchase occasion, α_h (>0) is a price parameter for household h, X_{ihtm} is the m-th covariate of brand i faced by household h at the t-th purchase, and β_{mh} is a parameter of the m-th covariate for household h. Note that all parameters are household specific and thus have subscript h.

In the model of Blattberg and Wisniewski (1989), for two alternative brands i and k, household h chooses brand i at the t-th purchase if $V_{iht} > V_{kht}$ and chooses brand k otherwise. This condition can be rewritten in terms of the relative preference for household h, R^h, and the point of indifference, I_{ikht}, as choosing brand i if

$$(4) \qquad R^h > I_{ikht},$$

where:

(5) $R^h = (q_{hi} - q_{hk})/\alpha_h$ and

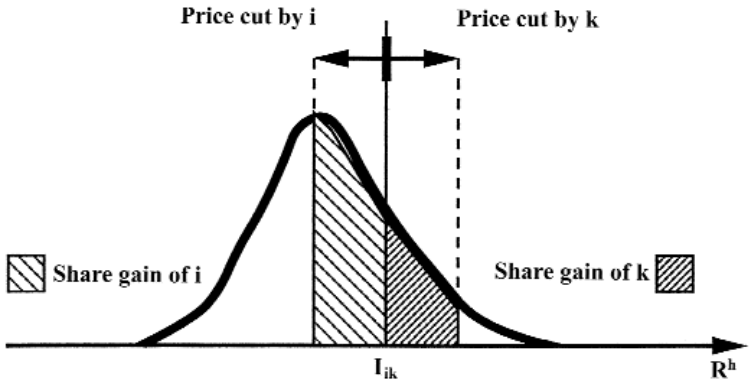
(6) $I_{ikht} = (PRICE_{iht} - PRICE_{kht}) - \sum_m \beta_{mh}/\alpha_h \cdot (X_{ihtm} - X_{khtm})$.

In the current formulation, the additional covariates X are nonprice promotion variables whose role is to reduce the adverse impact of nonprice promotions on other parameter estimates. Because our main concern is to investigate the effect of price promotion on brand switching at the regular price, we consider movement of the indifference point about a reference location that corresponds to the absence of price and nonprice promotions. Hence, the point of indifference at the regular prices without nonprice promotions (X = 0), I_{ik}, is expressed as $I_{ik} = (REGPRICE_i - REGPRICE_k)$ by dropping subscripts h and t.

The *posterior* distribution for the relative preference of each household, R^h, can be computed by repeated draws of q_{hi}, q_{hk}, and α_h from the joint posterior distribution to account for their correlation. Households with short purchase strings tend to have a diffuse posterior whereas those with long purchase strings tend to have a concentrated posterior, thereby providing the accuracy measure for the Bayesian estimate. Finally, the *empirical* distribution of the relative preferences for the sample households is obtained by summing the posterior distributions across households and normalizing it. The variance of the posterior distribution for each household, while offering the estimation accuracy, operates like a kernel under the aggregation to produce a smooth empirical distribution even if the number of households are small.

The point of indifference I_{ik}, a regular price difference between brands i and k, can be superimposed on the distribution. In the two-brand situation, households to the right of the indifference point choose brand i whereas those to the left choose brand k. Hence, the area under the curve to the right (left) of the indifference point represents the market share of brand i (brand k). Price promotion by brand i (brand k) shifts the indifference point to the left (right), thereby increasing the market share of brand i (brand k). The plot, as shown in Figure 2, allows visual examination of the pattern of competition from the distribution. The region bounded by the regular-price and promotional-price indifference points indicates the share gain due to the price cut. If there is a large difference in the areas of the two regions (identified by different shades), the competition is asymmetric. In contrast, a small difference between the two areas implies symmetric competition.

Figure 2. Implication of the Relative Preference Distribution of Asymmetric Price Competition



The region bounded between regular-price and promotional-price indifference points indicates the share gain due to the price promotion. If there is a large difference in the areas of the two regions identified by the different shades, competition is asymmetric. A small difference between the areas implies symmetric competition.

Description of Scanner Panel Data

The estimation was conducted with households' brand choice data for two product categories. One category was refrigerated orange juice (64-oz. carton) consisting of six brands: regional brand, Citrus Hill, Minute Maid, private label, Tropicana Regular, and Tropicana Premium. These brands accounted for more than 80 percent of the category share at the time. The scanner panel data contained 2,307 purchases made by 200 households at five stores in a small midwestern city over a period of 78 weeks beginning in mid-1983. The number of purchases per panelist ranged from 2 to 73. The average number of purchases for each quartile group of panelists was 2.4, 3.9, 10.3, and 30.5, respectively. Thus, the data represented panelists with diverse lengths of a purchase string.

The second category was regular ground coffee in six brands and sizes: three brands—Butternut, Folgers, and Maxwell House—each with two package sizes, one pound and three pounds. Again, these brands accounted for more than 80 percent of the category share. The scanner panel data contained 3,776 purchases made by 167 households at four stores in a small midwestern city over a period of 65 weeks in the early 1980s. The number of purchases per panelist ranged from 10 to 70, representing diverse purchase frequency.

Descriptive statistics (share, average price, and promotion frequency) for the two categories are reported in Table 1. The only nonprice promotion covariate available in both databases was the presence of advertising feature. Therefore, parameters of the MNL model included five alternative-specific constants (one of the six was set to zero as a reference alternative), price, and feature. Because the study was descriptive, all data points were used to estimate the parameters for maximum degrees of freedom. The Bayesian estimation produced 200 and 167 sets of parameter estimates for orange juice and ground coffee, respectively, each corresponding to a single household.[2]

Table 1. Descriptive Statistics for the Two Databases

ORANGE JUICE DATABASE

Brand	Share (% of purchases)	Average Price ($)	Feature (% of purchases)
Regional brand	15.4	1.82	45.8
Citrus Hill	32.9	1.86	17.8
Minute Maid	22.5	2.03	37.6
Private label	11.7	1.47	7.0
Tropicana Regular	13.7	1.81	49.0
Tropicana Premium	3.9	2.38	2.4

GROUND COFFEE DATABASE

Brand/Size	Share (% of purchases)	Average Price ($/lb.)	Feature (% of purchases)
Butternut 1 lb.	18.8	2.98	34.6
Butternut 3 lb.	4.1	2.95	62.5
Folgers 1 lb.	41.8	3.11	44.3
Folgers 3 lb.	10.1	3.15	44.9
Maxwell House 1 lb.	18.6	3.01	36.1
Maxwell House 3 lb.	6.5	3.03	39.7

Estimation Results of the Heterogeneity Distribution

Figure 3 shows the estimated relative preference distributions for the orange juice data. For six brands, there are 15 possible pairs of brands for the relative preferences. None of the distributions have the bimodal shape hypothesized by Blattberg and Wisniewski (1989). All are single modal with close resemblance to a normal distribution. The vertical line in each plot indicates the location of the point of indifference—a regular price difference between the two brands ($p_1 - p_2$). Households to the right of the point choose the first brand over the second, whereas households to the left choose the second brand.

Figure 3. Relative Preference Distributions for Orange Juice

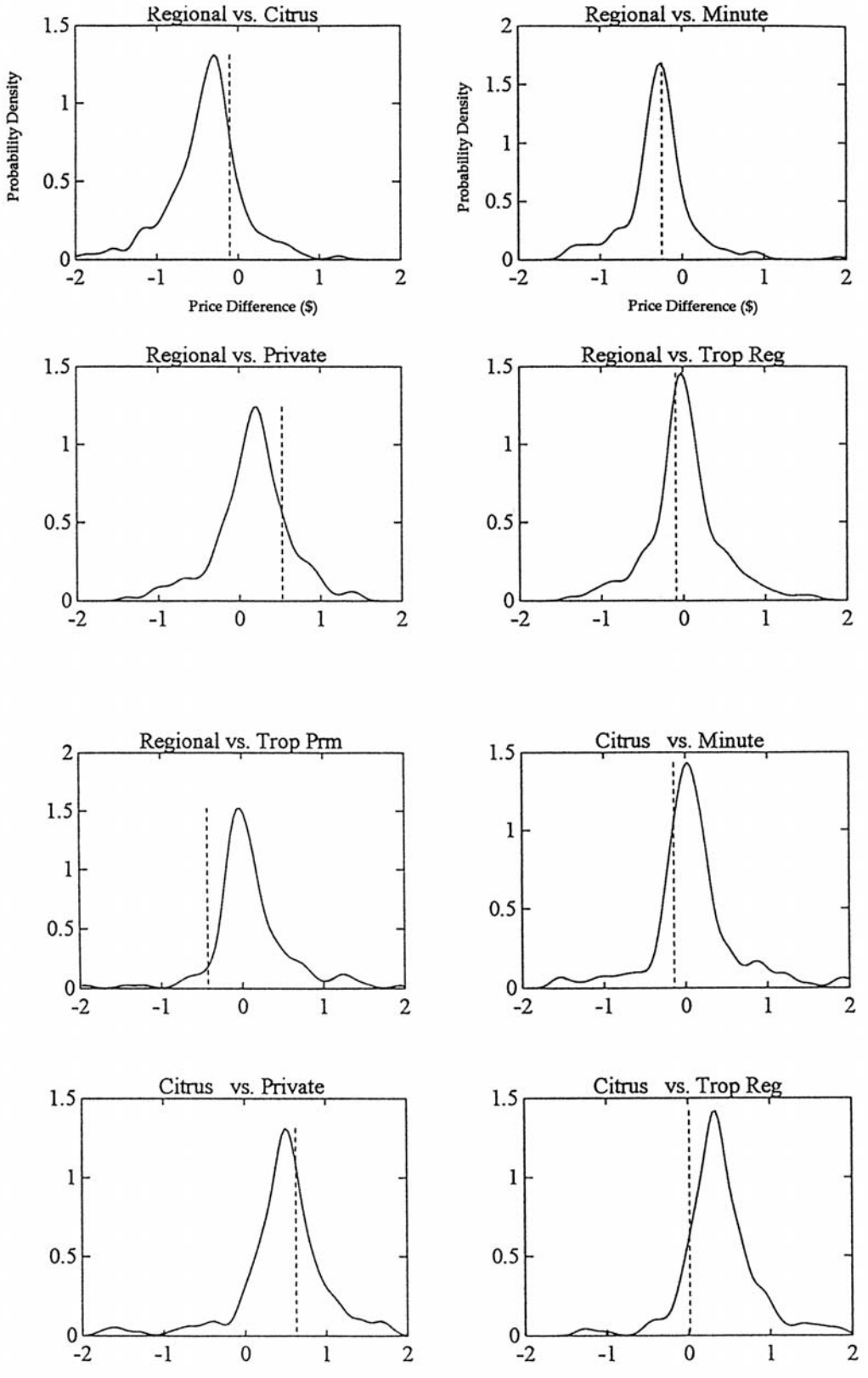


Figure 3 (continued). Relative Preference Distributions for Orange Juice

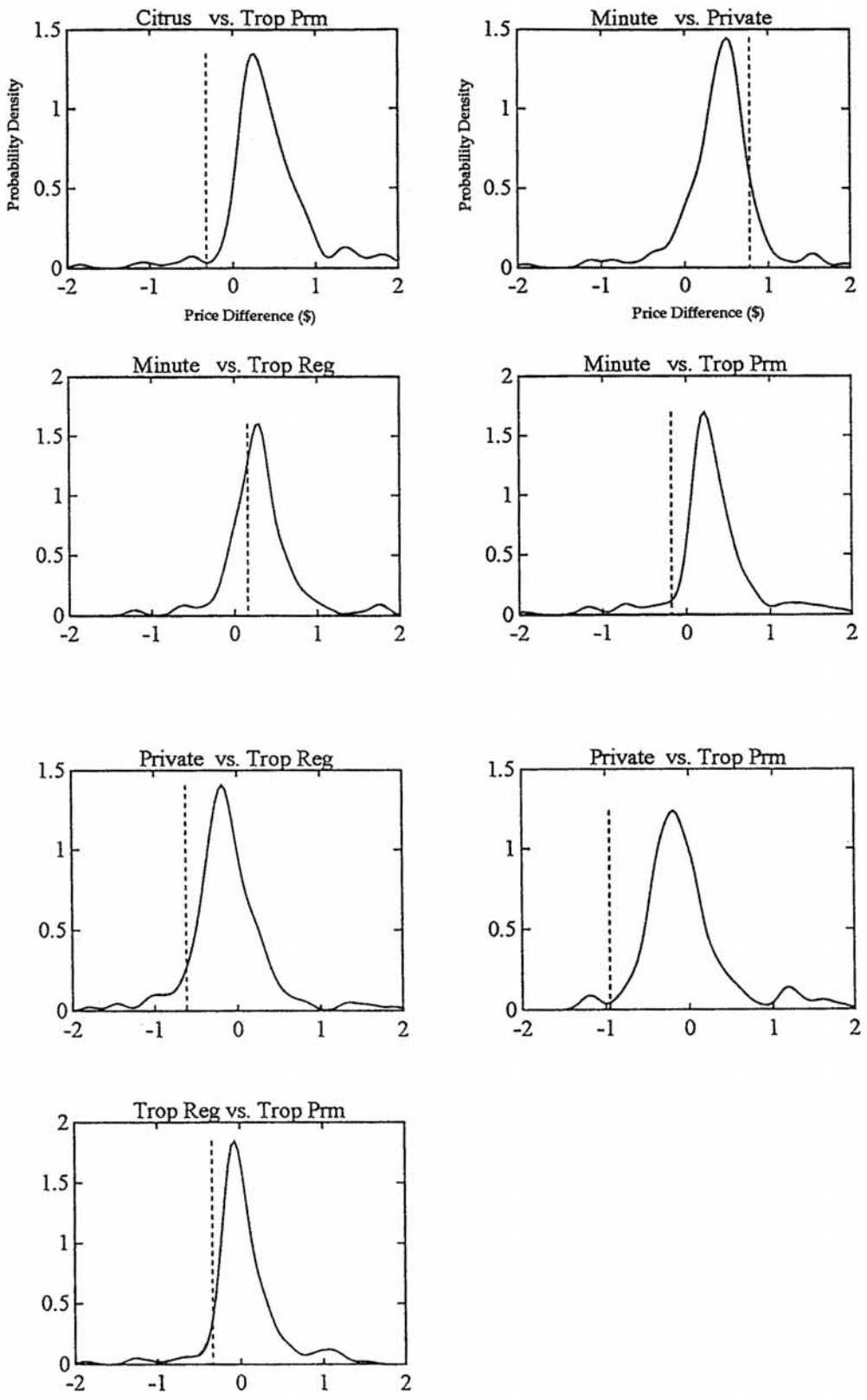


Figure 4 shows the estimated relative preference distributions for the coffee data. Again, there are 15 pairs of brands/sizes. Though the shapes are more detailed—perhaps because of the longer purchase strings of the sample panelists—all the distributions still have a single major mode. Similar results were obtained from two additional categories, detergent and ketchup, but are not reported here for brevity. Therefore, at least in these categories, it seems reasonable to conclude that relative preference distributions have a single mode and strongly resemble a normal distribution. This observation is consistent with the previous argument based on probability theory that the distribution of a difference of two random variables tends to be concentrated in the middle regardless of the variables' distributions.

The implication of the single-modal distribution of relative preference is that for the same price cut, a smaller share brand is more effective than a larger share brand in stealing share away from the other brand. This can be illustrated in Figure 2. If brand i has a smaller share than brand k, the point of indifference is located to the right of the single mode. Price cut by brands i and k would shift the indifference point to the left and right, respectively, and changes in the areas would result. Comparison of the two areas indicates that promotion of brand i is more effective than promotion of brand k. The reverse situation arises if brand i has a larger share than brand k, in which case the point of indifference is located to the left of the single mode. Though the plot depicts a two-brand case, the result can be generalized to a case of more than two brands. Intuitively, promotion of a smaller brand draws more share than similar promotion of a larger brand, simply because the smaller brand has a larger pool of potential customers and is less prone to the saturation effect. Therefore, while the preference heterogeneity might contribute to the saturation effect of asymmetric brand competition, it cannot explain price-tier asymmetric competition.

Figure 4. Relative Preference Distributions for Ground Coffee

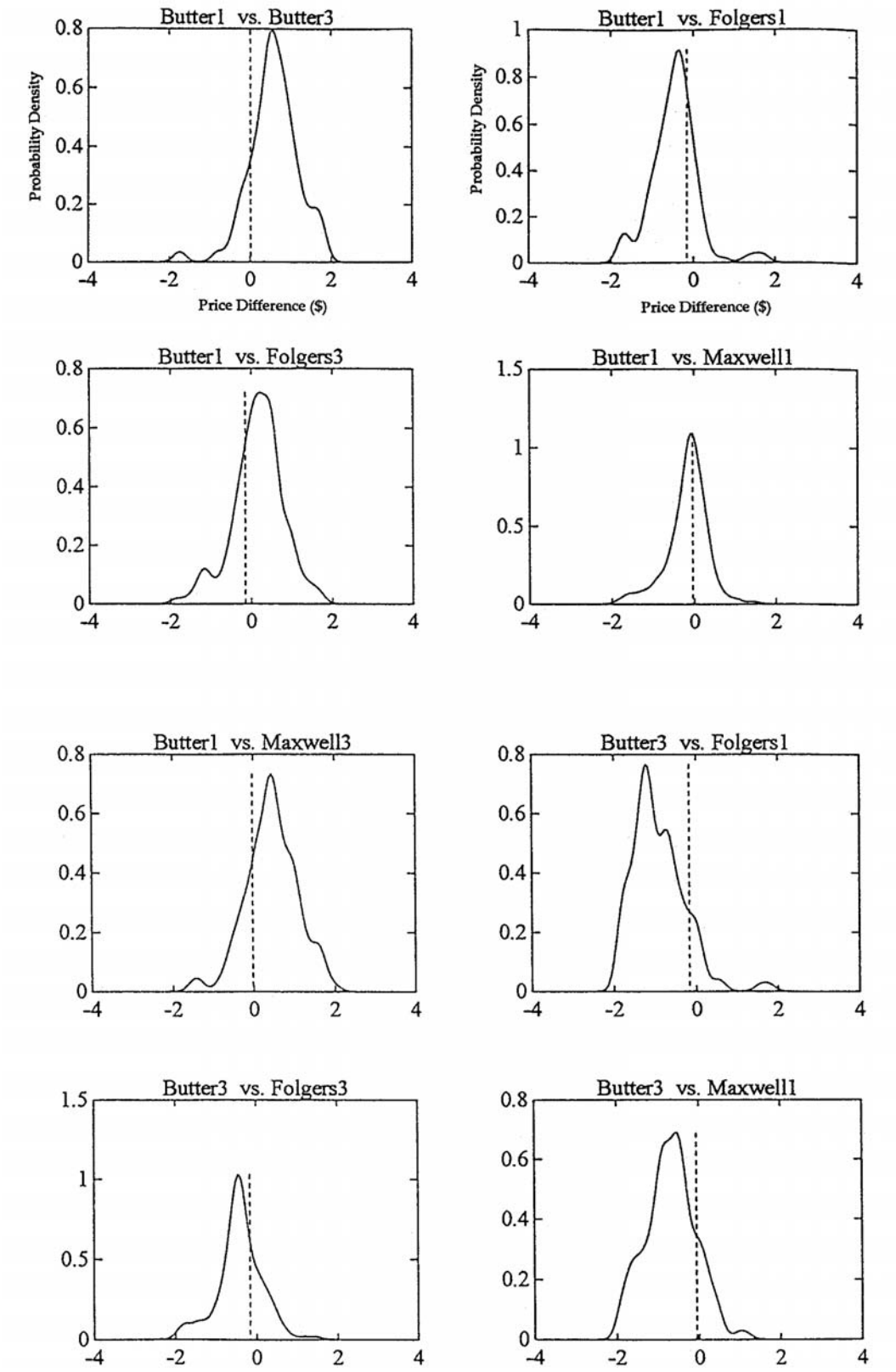
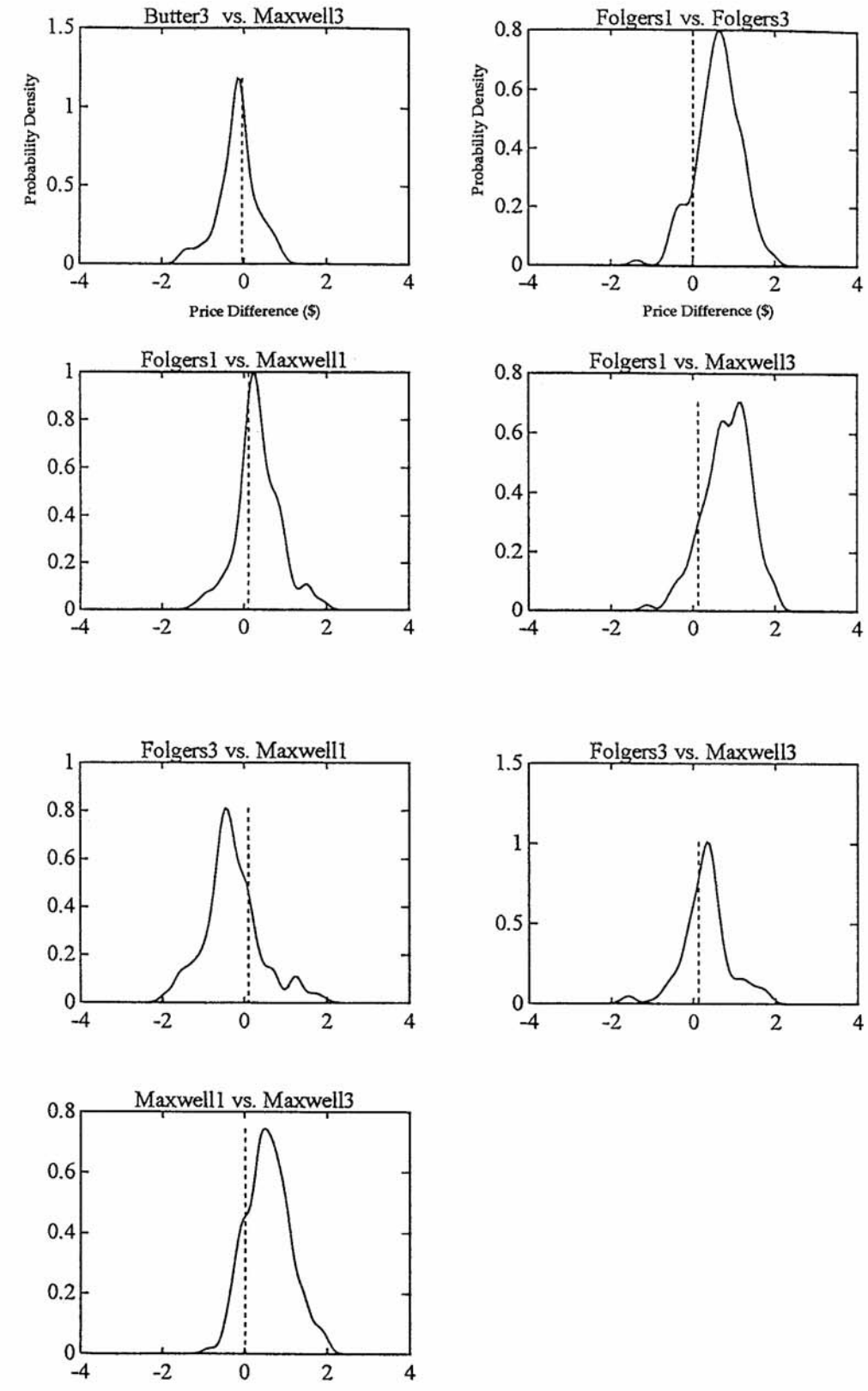


Figure 4 (continued). Relative Preference Distributions for Ground Coffee



The Income Explanation

Income Effect on Asymmetric Pattern of Competition

Microeconomic theory posits that when the price of a good falls, the change in its demand is affected in two ways characterized by the Slutsky equation: the substitution effect and the income effect. The substitution effect refers to the fact that a good is now relatively cheaper than substitute goods, so consumers demand more of it by replacing the substitutes. This effect is always negative—that is, opposite to the direction of the price change. The income effect refers to the change in demand for a good due to the fact that the consumers' purchasing power has been increased by a decrease in the good's price. When the demand for a good goes up by a greater proportion than income (utility), the good is referred to as a luxury good, whereas if the demand goes up by a lesser proportion than income, it is referred to as a necessary good. Thus, consumers' preference shifts from necessary to luxury goods as their income increases even if the relative prices of the goods remain the same. This phenomenon, which is often applied to reallocation of product categories consumed (e.g., from bread/potato to meat), is referred to as nonhomothetic preference and characterized by the nonlinear income offer curve (Varian 1993, p. 100).

Allenby and Rossi (1991) proposed that the brand-specific income effect could explain asymmetric brand switching by consumers in favor of higher quality brands. They introduced brand-specific marginal utility (utility per unit quantity) that depended on the total utility level to capture the shift in brand preference as income changes. Their choice model implied that a consumer chooses a brand with the highest utility expressed as

(7) Utility of brand i (i = 1, . . . , J): $u_i = MU_i \times x_i$

where:

(8) $MU_i = \exp(\alpha_i - k_i u_i)$ is the marginal utility of brand i,

(9) $x_i = v/p_i$ is the quantity of brand i purchased,

v is a category budget, p_i is the price of brand i, and α_i and k_i are parameters.

The marginal utility depends on the level of utility u_i, and parameter k_i ($k_i > 0$) specifies how preference changes with utility. Consistent with the diminishing return predicted by economic theory, the marginal utility decreases at the higher level of utility for all brands but with a brand-specific rate. Allenby and Rossi (1991) postulated that the rate of the decrease is slower for high quality than for lower quality brands, thereby causing asymmetry in brand switching. The quantity was a category budget, v, divided by the price. When calibrated on scanner panel data, the model was shown to perform better than benchmark logit models. With the assumption that the higher the quality, the slower the rate of decrease in marginal utility, estimated parameter k_i provided the objective measure of brand quality.

Though Allenby and Rossi's (1991) ingenious approach resulted in a model that is consistent with microeconomic theory, it has one disadvantage. The quantity term, x_i, is continuous (infinitely divisible), whereas most consumer packaged goods are purchased in discrete quantities. Equation 9 implies that a price cut of 20 percent leads to a 25 percent increase in the quantity purchased on a particular occasion. In reality, price promotion induces consumers to change package sizes or switch brands (Gupta 1988).[3] If consumers were stockpiling, quantity should increase by the unit of package size (e.g., one pound for margarine) rather than by fractional amounts, so that the increase would be 100 percent, 200 percent, and so on. Kalyanam and Putler (1997) point out general problems associated with the use of infinitely divisible choice models in packaged goods, and introduce an alternative approach called the indivisible alternatives formulation.

Because utility in Equation 7 is estimated from actual consumer brand choices, an infinitely divisible formulation may adversely affect the estimation result of the other term, the marginal utility, and thus the value of k_i in particular. That is, the marginal utility may be overestimated (underestimated) for a higher (lower) priced brand to compensate for the divisible formulation whereby the quantity becomes smaller (larger), despite the fact that in reality the quantity remains the same regardless of the price. As a result, the estimate of k_i tends to be confounded with the price of brand i.

Modified Nonhomothetic Choice Model

We propose to make a minor modification to their nonhomothetic choice model so that the quantity purchased is always one if the brand is chosen by following the consumer purchase behavior.[4] The utility is a sum of the utility derived from consumption of a unit quantity of a product (i.e., marginal utility) and the monetary saving arising from the purchase (i.e., $v - p_i$). A consumer chooses a brand that provides the highest combined utility, where:

(10) Utility of brand i ($i = 1, \ldots, J$): $u_i = MU_i + f(v - p_i)$,

(11) $MU_i = \exp(\alpha_i - k_i u_i)$, is utility from consuming brand i, as before, and

(12) $f(\cdot)$ = utility arising from the monetary saving ($f' > 0$ and $f'' < 0$).

The second term $f(v - p_i)$ represents a composite good—utility from other goods—with the usual diminishing return. Kalyanam and Putler (1997), in their indivisible alternatives framework, also adopt this formulation, which is fairly standard in microeconomics. Now, it is insightful to interpret the linear approximation of Equation 10 as:

(13) $u_i \cong 1 + \alpha_i - k_i u_i - f'(v)p_i + f(v)$.

Note that the income effect can still be accommodated in (13) via k_i. Solving for u_i results in

(14) $$u_i = \frac{1+\alpha_i + f(v)}{1+k_i} - \frac{f'(v)}{1+k_i} p_i .$$

Notice the usual linear-in-parameters utility function in a logit model—the sum of a brand dummy and a price term—but the price coefficient, $f'(v)/(1 + k_i)$, is brand specific. Thus, k_i would be different from brand to brand if and only if the estimates of these price coefficients differ by brands. Brand specific k_i implies nonhomothetic preference, resulting in asymmetric switching.

We now calibrate the modified nonhomothetic model of Equation 14 with real data to examine the presence of the brand-specific income effect. We test the null hypothesis of equal price coefficients across brands by two nested specifications of a multinomial logit model: one with a single price coefficient common across brands and the other with brand-specific price coefficients. Rejection of the null hypothesis by the likelihood ratio test would imply that the income effect is brand specific, thereby implying nonhomothetic preference.

Table 2 reports the estimation results from the databases for ground coffee and orange juice. For generalization, two different operationalizations of a loyalty variable, those of Guadagni and Little (1983) and Allenby and Rossi (1991), were used. The results from the first one are given here because of their superior fit. Estimates of the price coefficients are similar across brands in both data sets. Indeed, the null hypothesis of equal magnitudes could not be rejected at $\alpha = .10$ for either the coffee or orange juice data. The models also failed to reject the null hypothesis using the other operationalization of a loyalty variable. Furthermore, brand-specific income effect was not observed with the additional two categories, detergent and ketchup. In sum, for these four databases, the income effect cannot explain price-tier asymmetric competition because k_i was not brand specific.[5]

Table 2. Estimation Results of the MNL Logit Models

(The t-values are in parentheses)

COFFEE DATA

Variable	Single price	Brand-specific price
Price	-1.45 (-8.83)	-
Price1	-	-1.37 (-3.84)
Price2	-	-1.68 (-2.77)
Price3	-	-1.80 (-5.85)
Price4	-	-1.39 (-2.75)
Price5	-	-1.29 (-4.82)
Price6	-	-1.23 (-3.23)
Loyalty	3.84 (33.3)	3.85 (33.3)
Feature	1.86 (21.3)	1.87 (21.2)
Log likelihood: L(β)	-1822.88	-1821.58
ρ^2	0.479	0.479
Adjusted ρ^2	0.476	0.475
BIC	-1853.18	-1870.83

ORANGE JUICE DATA

Variable	Single price	Brand-specific price
Price	-2.69 (-11.1)	-
Price1	-	-3.22 (-7.2)
Price2	-	-2.01 (-2.7)
Price3	-	-2.36 (-6.2)
Price4	-	-4.50 (-4.6)
Price5	-	-2.23 (-4.1)
Price6	-	-2.49 (-3.1)
Loyalty	3.70 (26.2)	3.70 (25.9)
Feature	0.58 (4.6)	0.65 (5.0)
Log likelihood: L(β)	-875.61	-871.92
ρ^2	0.552	0.554
Adjusted ρ^2	0.548	0.547
BIC	-903.59	-917.39

Conclusions

Three behavioral explanations—the heterogeneity effect, the income effect, and the loss-aversion effect—have been proposed to account for asymmetric patterns of competition between high priced, high quality brands and low priced, low quality brands. Loss aversion for price and quality attributes, which is responsible for asymmetric competition, has been observed in various field and laboratory studies. Furthermore, loss aversion for a monetary attribute (i.e., price) has been studied extensively with scanner panel data as well as in laboratory setting in both marketing and psychology. In contrast, little research has been conducted to investigate the heterogeneity and income effects. The study here re-examined those two effects using households' brand choice data to provide insight into the issue of asymmetric competition.

Blattberg and Wisniewski (1989) suggested that an asymmetric pattern could arise from consumer heterogeneity in the tradeoff between price and quality. They conjectured that the shape of the distribution must be bimodal to be consistent with the pattern of competition observed in their econometric study using aggregate sales data. However, estimating the distribution directly from household-level disaggregate data by a nonparametric method suggested that the shape was single modal for four categories studied. Probability theory and the simulation study also supported this result. The implication of the single-modal distribution is that heterogeneity in consumer preference, while influencing brand competition through the saturation effect of share, does not appear to produce the asymmetric pattern observed in price-tier competition.

Allenby and Rossi (1991) postulated the income effect, suggesting that consumers' preference shifts from low to high quality brands when their purchasing power is increased by price promotion. The effect was captured by a choice model that supported such a preference shift through brand-specific income effect. However, the infinite divisibility assumption of the model, in which quantity purchased was specified as a category budget divided by the price, poses difficulty in modeling the discrete purchase unit for consumer packaged goods. A minor modification provided a model that accommodated a discrete quantity formulation while accounting for the income effect. When the proposed model was calibrated with households' choice data from four product categories, the statistical test showed that the income effect was not brand specific. The result suggested the absence of the preference shift, and therefore the income effect could not explain asymmetric competition, either.

The conclusion is that an asymmetric pattern of competition that favors higher quality brands seems to arise primarily from the loss-aversion effect for price and quality rather than from the heterogeneity or income effect. Though the empirical analysis is limited to several categories studied here, theoretical and logical rationale also supported the conclusion. Future research could strengthen our results through cross-category analysis. One testable hypothesis for the loss-aversion expla-

nation is that categories with higher loss aversion for quality as well as price tend to exhibit stronger asymmetry between high priced, high quality brands and low priced, low quality brands. Another direction is to investigate the heterogeneity and income effects through controlled laboratory study with high internal validity.

The behavioral explanation for asymmetric competition has important managerial implications. With the heterogeneity or income effect, price promotion has a short-term influence on consumers and hence on competition. When price reverts to its regular level, the share returns to its prepromotional level. This is not the case with the loss-aversion effect because it involves a reference point that is formed over time through consumers' exposure to the marketing environment and experience with products. The finding of this research suggests that the impact of price promotion is long term, beyond a trial-and-repeat factor, and that managers must act accordingly when planning promotion.

Many questions remain to be addressed. Does frequent use of promotion undermine its effectiveness by lowering the reference point of price and quality? Does an everyday-low-price-policy have a negative impact on a brand by lowering the reference point? What is the most effective frequency for promotion in the long term? Practitioners do not agree on such issues, as is evident from the existence of a wide variety of pricing policies currently in use by manufacturers and retailers (from hi-low pricing of Kmart and semi-hi-low pricing of Sears, to every-day-low pricing of Wal-Mart). Academic research in marketing has a long way to go in addressing these issues. Investigating the best operationalization for reference formation, whether to use the last brand purchased, exponential smoothing, or some other approach, is likely to provide a partial answer (Kalyanaram and Winer 1995). Identifying the loss-aversion effect as the reason for asymmetric competition is only the beginning, and much work remains to be done. In the meantime, managers, when planning promotion, should be aware of the potential importance of the long-term effect on reference formation.

Notes

1. Researchers of latent segment and random coefficient logit models are well aware that when segments are aggregated, the share is no longer restricted to IIA even though choices within a homogeneous segment are constrained by IIA.
2. The prior sample sizes of 10 and 5 were chosen in the Bayesian estimation for the orange juice and ground coffee databases, respectively (Abe 1996).
3. Gupta (1988) found that 84 percent, 14 percent, and 2 percent of the sales increase due to price promotion are attributable to brand switching, purchase acceleration, and stockpiling, respectively, for the ground coffee category he studied.
4. Multiple-unit purchases were rare, and more than 95 percent of the purchases were for a single unit in the data analyzed. The observation is consistent with the study of Kalyanam and Putler (1997).
5. Allenby and Rossi (1991), in the margarine category they analyzed, found brand-specific price coefficients to be statistically significant.

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