Asymmetric Promotion Effects and Brand Positioning

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Abstract

Several studies have shown that promotions of national brands yield more effect than those of store brands (e.g., Allenby and Rossi 1991, Blattberg and Wisniewski 1989). However, the evolution of price-quality data available from *Consumer Reports* over the last 15 years seems to reveal a reduction of the quality gap between store brands and national brands, while price differences remain substantial. Simultaneously, the share of private label brands has increased (*Progressive Grocer* 1994). In this context, we study whether we can maintain a view of the world where national brands may easily attract consumers from store brands through promotions, whereas store brands are relatively ineffective in attracting consumers from national brands by such means.

We analyze consumer reactions to price discounts in a parsimonious preference model featuring loss aversion and reference-dependence along dimensions of price and quality (Hardie, Johnson, and Fader 1993, Tversky and Kahneman 1991). The key result of our analysis is that, given any two brands, there is an asymmetric promotion effect in favor of the higher quality/higher price brands if and only if the quality gap between the brands is sufficiently large in comparison with the price gap. Thus, the direction of promotion asymmetry is not unconditional. It depends uniquely on the value of the ratio of quality and price differences compared to a category specific criterion, which we call Φ. If the ratio of quality and price differences is larger than this criterion, the usual asymmetry prevails; if such is not the case, the lower quality/lower price brands promote more effectively.

More precisely, our model predicts that cross promotion effects depend on two components of brand positioning in the price/quality quadrant. First, we define a variable termed "positioning advantage" that indicates whether, relative to the standards achieved by another brand, a given brand is underpriced (positive advantage) or overpriced (negative advantage). Promotion effectiveness is increasing in this variable. Second, cross promotion effects between two brands depend on their distance in the price/quality quadrant. This variable impacts promotion effectiveness negatively and symmetrically for any pair of brands. "Positioning advantage" and "brand distance" are orthogonal components of brand positioning, irrespective of the degree of correlation between available price and quality levels in the market.

Empirically, we investigate the role of brand positioning in explaining cross promotion effects using panel data from the chilled orange juice and peanut butter categories. We compute the independent positioning variables, "positioning advantage" and "brand distance," from readily available data on price and quality positioning after obtaining our estimates of Φ. We next measure promotion effectiveness by estimating choice share changes in response to a price discount, using a choice model that does not contain any information about quality/price ratios. Finally, we test the relation between the two positioning variables and the promotion effectiveness measures.

The data reveal that in the orange juice category lower quality/lower price brands generally promote more effectively than higher quality/higher price brands. In the peanut butter data the opposite asymmetry holds. In both cases, inter-brand promotion patterns are well explained by the positioning variables. An attractive feature of our model is that, in addition to the direction of promotion asymmetries, it also explains the extent of those asymmetries.

A further interesting aspect of this approach is that we go beyond a categorization of brands into price tiers. For instance, lower tier brands in our data may promote more effectively than one national brand but less effectively than another. Consistent with our theoretical predictions, the data presented here seem to confirm that such cases occur because the lower tier brand offers a favorable trade-off of price and quality differences compared with one national brand and a less favorable trade-off compared with the other.

The content of this paper is potentially relevant for brand managers or retailers concerned with predicting the impact of their promotions. The paper is of particular interest to marketing scientists who study the performance of store brands versus national brands and may also appeal to those who wish to explore the marketing implications of behavioral decision theory.

Finally, our investigation does not reject Blattberg and Wisniewski's (1989) finding, shared by Allenby and Rossi (1991) and Hardie, Johnson, and Fader (1993), that national brands have a *principle* advantage in promotion effectiveness. Rather, it formalizes when this principle advantage is overruled by positioning disadvantages of such brands.
(*Promotion; Brand Choice; Brand Positioning; Loss Aversion; Reference-dependence*)

1. Introduction

Consider two brands competing in a given market. One brand offers high quality at a relatively high price, while the other offers lower quality at a lower price. Which brand will find it easier to attract customers of the other brand with a price promotion? Several studies have shown that promotion effectiveness is generally not symmetric and that promotions of higher quality brands have a disproportionate impact (e.g., Allenby and Rossi 1991, Blattberg and Wisniewski 1989, hereafter called B&W).[1] Apparently, consumers primarily regard price promotions as a chance to buy quality brands which they usually consider too expensive.

However, the evolution of price-quality ratings available from *Consumer Reports* over the last 15 years seems to reveal a reduction of the quality gap between store brands and national brands, while price differences remain substantial (see Appendix 1). The market share of store brands is concurrently increasing, which confirms that their quality is perceived to improve (*Progressive Grocer* 1994). In such a context, can we maintain a view of the world where customers of store brands are eager to obtain a discount on national brands while customers of the latter barely think about switching down? Is the asymmetric promotion effect in favor of higher quality brands robust to such changes in brand positioning?

This paper provides a theoretical and empirical answer to these questions by exploring the link between short-run promotion effects and brand positioning along both price and quality dimensions. Our analysis builds on multi-attribute utility theory in the presence of reference-dependence and loss aversion (Tversky and Kahneman 1991). We will show that there is an asymmetric promotion effect in favor of the higher quality brand if and only if its quality advantage is sufficiently large, in comparison with its price premium.

This result can be explained intuitively. Consumers who consider switching down from a higher quality brand to a lower quality brand must balance a *loss in quality* against a *gain in price*. A discount offered by the lower quality brand can help to induce switching down. However, a large discount will be necessary if the qual-

ity difference between the two brands is large (assuming a given price difference), while a relatively small discount will suffice if the quality difference is small.

In contrast, consumers who consider switching up from a lower quality brand to a higher quality brand are trading off a *gain in quality* against a *loss in price*. In this case, consumers can be attracted by a relatively small discount, if the quality difference is large enough, but a larger discount needs to be offered when the quality gap is small.

Thus, for a given price difference, a relatively large quality difference favors the promotions offered by higher quality brands, while it threatens the success of promotions offered by lower quality brands. Conversely, a small enough quality difference will reverse the asymmetry, in favor of lower quality brands.

Though the above reasoning is intuitive, it assumes that consumers use a historic reference point from which other alternatives are assessed in terms of the gains and losses. This is why a theoretical framework based on reference-dependence is adopted here.[2]

Note that switching up to a higher quality brand implies a loss along the price dimension, while switching down to a lower quality brand implies a gain. Therefore, under loss aversion, consumers of lower quality brands should *in principle* be relatively more sensitive to price reductions. This insight, hinted by Hardie, Johnson, and Fader (1993, hereafter called HJF), corresponds well to the conjecture of B&W that consumers of lower quality brands are more price sensitive. However, the implications of reference-dependence and loss aversion for comparative promotion effectiveness are more involved. Our contribution precisely serves to establish the joint role of (1) the relative brand positioning in terms of price and quality, (2) the degree of loss aversion along both dimensions, and (3) the relative weight given to price and quality attributes. Fortunately, these elements nicely combine into a simple condition on relative brand positioning.

Many empirical studies (e.g., B&W) take price as a proxy for quality, i.e., implicitly assume a fixed relation

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[1] A more complete list can be found in the survey by Blattberg, Briesch and Fox (1995).

[2] See Kahneman, Knetsch, and Thaler (1991) for a survey of experimental evidence about loss aversion and reference-dependence, and Hardie, Johnson, and Fader (1993) and Winer (1986) for applications in consumer choice.

between price and quality. As we seek to acknowledge variations in the price-quality relation, we face the practical problem that quality and price are generally correlated. However, an interesting outcome of our analysis is a decomposition of the concept of brand positioning into two orthogonal measures, which we call "positioning advantage" and "brand distance."

Since we characterize product differentiation more finely than by a price-tier membership index, we can also go beyond predicting the direction of asymmetric promotion effects. We will propose that "positioning advantage" and "brand distance" can be jointly used as independent predictors of the *extent* of these asymmetries.

Our empirical analysis will show that the direction of promotion asymmetry is indeed not unconditional and that our framework has significant support. From a cross validation of our results, we confirm that brand positioning (decomposed into "positioning advantage" and "brand distance") is a valid predictor of promotion effectiveness.

The next section reviews the literature on asymmetric promotion effects. Section 3 introduces our model of preference formation under loss aversion and reference-dependence based on Tversky and Kahneman's (1991) formulation. In §4, we characterize the link between brand positioning and asymmetric promotion effects. Then, in §5, we show how brand positioning can further be used to explain and predict comparative promotion effectiveness. In §6, we report the results of our empirical analysis in two product classes: chilled orange juice and peanut butter. The last section concludes.

2. Literature Review

The literature is almost unanimous that promotions of higher quality brands are more effective than promotions of lower quality brands. Several explanations have been offered for this phenomenon. Originally, B&W argued that the equilibrium distribution of consumer types must be such that the consumers of lower quality brands are more price sensitive than the consumers of higher quality brands. Hence, when a lower quality brand promotes, it attracts customers of similar or lower price brands, but not those who were quality-sensitive enough to buy a high quality brand in the first place.

B&W's primary concern was to give an ex post characterization of the distribution of preferences that would be consistent with the reported promotion advantage of higher quality brands.

Allenby and Rossi (1991) relied on recent advances in consumer economics to predict that, regardless of the distribution of consumer types, we should expect that higher quality brands will have a promotion advantage. They suggested that the higher quality brands can be regarded as superior goods, and the lower quality brands as inferior goods. Therefore, the substitution pattern between these brands may only be understood when both price and wealth effects are taken into account. A promotion has a positive wealth effect that favors superior goods, and therefore switching up is more likely than switching down. Thus, this theory always gives the advantage to promotions of the higher quality brand.

In their work on loss aversion in a multi-attribute context, HJF proposed that promotions by higher quality brands are particularly attractive because they reduce the loss faced by potential switchers along the price dimension. Similar to the previous contributors, HJF's concern was to rationalize the empirical regularity, and they did not account for the role of brand positioning.

The effect suggested by HJF will be characterized here in a parsimonious way and be linked to the logic of both B&W and Allenby and Rossi (1991). However, our analysis of the role of brand positioning will also reveal the precise conditions of a reversal of the asymmetric promotion effect.

Recently, two experimental studies questioned the result that higher quality brands always have a promotion advantage. Nowlis and Simonson (1995) analyzed the moderating effect of the existence of a medium price tier. Heath and Chatterjee (1995) showed that under certain distributions of consumer types the standard asymmetry may be reversed (this argument is in line with B&W, p. 307). Our approach is distinct, not only by the type of data that we use, but also by the nature of the underlying theory that we seek to establish.

3. Consumers' Preferences

The purpose of this section and the next one is to extract the essence of what reference-dependence and loss

Figure 1   Indifference Curves and Symmetric Promotion Effects
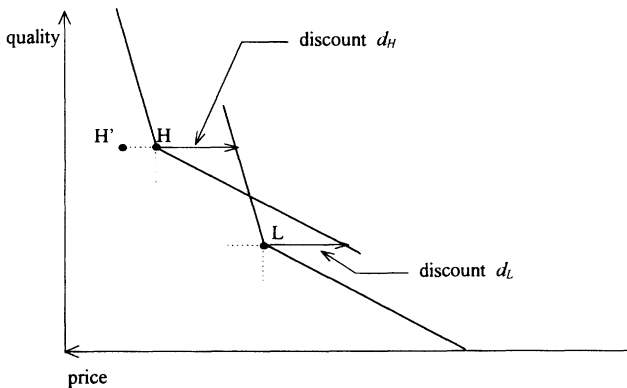
aversion imply concerning asymmetric promotion effects. In order to keep focus, the model only accounts for a very limited set of utility determinants. Some of the omitted relevant aspects of consumer brand choice (e.g., brand name effects) will be reintroduced in the empirical part. We make four basic assumptions:

• *Two dimensions*. We focus on a market where all brands share two attributes: price and quality. Quality is taken here as a generic term to designate the positively valued attribute of the product category.

• *Reference-dependence*. Consumers evaluate each available brand by comparing its price and quality with the price paid and the quality experienced on the last purchase occasion.

• *Loss aversion*. A given quality (price) difference has more impact when it is a loss in comparison with the reference point than when it is a gain. Combined with reference-dependence, loss aversion generates a status quo bias in favor of the last brand purchased, as documented by Samuelson and Zeckhauser (1988).

• *Homogenous parameters*. All consumers have identical sensitivity to changes along both dimensions. Yet, the perception of the value of each brand, and the resulting choice behavior, is conditioned by the reference point. Hence, as the last purchase determines each consumer's decision frame, we obtain a segmentation of consumers depending on what they bought last.

A feeling of (dis)satisfaction (dominated by an aversion towards losses) is stimulated by any change of price paid or quality experienced across purchase occasions. Consumers anticipate such feelings and com-

bine them to form a valuation (utility) for any contemplated brand.

Formally, all consumers are represented by the same additive utility model with constant loss aversion, as axiomatized by Tversky and Kahneman (1991). Each brand i ($i = 1, \ldots, N$) is defined as a two-attribute coordinate (p_i, q_i), describing its regular price and its quality. Denoting the reference brand by r, the utility function is written

$$U_r(i) = u_r(p_i) + u_r(q_i), \quad \text{with}$$

$$u_r(p_i) = \begin{cases} \beta_p(p_r - p_i) & \text{if } p_i \le p_r, \\ \alpha_p(p_r - p_i) & \text{if } p_i > p_r, \end{cases}$$

$$u_r(q_i) = \begin{cases} \beta_q(q_i - q_r) & \text{if } q_i \ge q_r, \\ \alpha_q(q_i - q_r) & \text{if } q_i < q_r, \end{cases} \quad (1)$$

and $\alpha_p > \beta_p \ge 0$, $\alpha_q > \beta_q \ge 0$ (loss aversion).

Figure 1 features typical indifference curves. Any brand located on the line kinked at H is regarded as indifferent to H when H is the reference brand. Any brand located on the line kinked at L is regarded as indifferent to L when L is the reference brand. Any brand located on the right of these curves is preferred to the corresponding reference brand. As can be seen, reference-dependence departs from usual consumer economics in that it allows the indifference curves of an individual consumer to cross.

We now turn to the comparison of promotion effects in such a context.

4. Asymmetric Promotion Effects

In this section, we address the question posed in the introduction: "Which brand will find it easier to attract the customers of the other brand?" For this purpose, we focus on an arbitrary pair of brands: a higher quality/higher price brand, denoted by H, and a lower quality/lower price brand, denoted by L, as in Figure 1.

We first need to determine the necessary discount that each brand has to offer in order to attract a customer of the other brand. Then, if the necessary discount that H has to offer (d_H) is smaller than the one that L has to offer (d_L), we will say that there is an asymmetric promotion effect in favor of H. Conversely, if L finds it cheaper to attract a customer of H, we will say that there is an asymmetric promotion effect in favor of L.

The necessary discounts are determined by solving for the discounts that would make a consumer indifferent between staying with the last purchased (reference) brand or switching. Using our notation:

$$U_L(p_H - d_H, q_H) = 0 \quad \text{and} \quad U_H(p_L - d_L, q_L) = 0.$$

Substituting expression (1), these two equations correspond to, respectively,

$$\alpha_p(p_L - (p_H - d_H)) + \beta_q(q_H - q_L) = 0 \quad \text{and}$$

$$\beta_p(p_H - (p_L - d_L)) + \alpha_q(q_L - q_H) = 0,$$

from which we finally obtain explicit values as follows:

$$\begin{cases} d_H = p_H - p_L - \dfrac{\beta_q}{\alpha_p}(q_H - q_L) = -U_L(H)/\alpha_p, \\[2mm] d_L = p_L - p_H - \dfrac{\alpha_q}{\beta_p}(q_L - q_H) = -U_H(L)/\beta_p. \end{cases} \quad (2)$$

For illustration, Figure 1 features a case where $d_L = d_H$.

From (2) it is immediately apparent that in case of "well-balanced" positioning (i.e., when customers of H do not have stronger inclination to switch than consumers of L and vice-versa), loss aversion implies an asymmetric promotion effect in favor of the higher quality brand. More formally:

REMARK. *In case of symmetric attractiveness, i.e., if $U_H(L) = U_L(H)$, then there is an asymmetric promotion effect in favor of H.*

Thus we can say that, *in principle*, loss aversion implies that a price promotion improves the attractiveness of H more than the attractiveness of L. This can be seen as a formalization of HJF's argument.

In the context of this remark, we can suggest a formal equivalence between the existing explanations of an asymmetric promotion effect in favor of H. Similar to B&W, our remark (and the conjecture of HJF) implies that consumers of L behave as if they were more economy seekers than the consumers of H, when a promotion is offered by the other brand. Graphically, the slope of the indifference curve at H when L is consumed is steeper than the slope of the indifference curve at L when H is consumed (see Figure 1). This explanation is also shared by the nonhomothetic utility model with rotating indifference curves of Allenby and Rossi

(1991), which inherently features brand-specific slopes (p. 192). While the underlying mechanisms evoked by these theories are different, they formally refer to similar brand-specific trade-offs between price and quality.

However, complementary to these arguments, taking brand positioning into account implies that H does not have an advantage in general. If we seek to identify from (2) what determines the fact that d_H is smaller than d_L, we find the following result after some simple algebra:

PROPOSITION 1. *There is an asymmetric promotion effect in favor of H if $(q_H - q_L)/(p_H - p_L) > \Phi$ and an asymmetric promotion effect in favor of L if $(q_H - q_L)/(p_H - p_L) < \Phi$, where $\Phi = 2\alpha_p\beta_p/(\beta_p\beta_q + \alpha_p\alpha_q)$.*

Thus, the steepness of the relative positioning in the price/quality quadrant ultimately dictates the direction of asymmetry.

Also, more sensitivity to changes in quality (either larger α_q or larger β_q) reduces Φ and makes an asymmetry in favor of H more likely. On the contrary, more sensitivity to changes in price increases Φ. In fact, the above condition synthesizes the role played by (1) the relative positioning of brands, (2) the degree of loss aversion (size of the α's *ceteris paribus*: more loss aversion in price favors L, more loss aversion in quality favors H) and (3) the relative weight given to the price and quality attributes.

The next result shows that there always exists a set of positions for L (given any H) such that it has a promotion advantage, and the same holds true for H (given any L). Our claim that the asymmetry can be both ways is thus not empty.

PROPOSITION 2. *Asymmetric promotion effects in either direction are always possible.*

PROOF. By (2), neither H nor L is dominated (i.e., $d_H \geq 0$ and $d_L \geq 0$) if and only if

$$\frac{\alpha_p}{\beta_q} \geq \frac{q_H - q_L}{p_H - p_L} \geq \frac{\beta_p}{\alpha_q}.$$

It is easy to check that, under loss aversion, $\alpha_p/\beta_q > \Phi > \beta_p/\alpha_q$. Therefore, by Proposition 1, it is always possible that two nondominated brands H and L are positioned such that there is an asymmetric promotion effect in favor of either H or L. $\square$

In the next section, we turn to an operational formulation of the concept of brand positioning, and to a transition from the deterministic utility framework to a setting where we allow for stochasticity in consumer choice.

5. Determinants of Promotion Effectiveness

This section makes a transition from the theoretical framework towards our empirical analysis, which cannot rely on exactly the same assumptions as the former. In particular, the parsimonious notion of a "necessary discount that each brand has to offer in order to attract a customer of the other brand," is only legitimate in a world where promotions are "ineffective" below a certain discount and "effective" above that discount. If we turn to the real world, even if there is only one type of reference-dependent utility, we would normally face some stochasticity in consumer choice due to unobserved variables or deviations in perceptions of qualities. As a result, we need to transform our theoretical discussion of "how large is *the* effective discount?" into an empirical discussion of "how effective is any given discount likely to be?" This transformation is made by assuming that if L has a lower necessary discount to attract a consumer from H than vice versa in a deterministic setting, then L is more likely to attract a consumer from H than vice versa at a given discount, in a stochastic consumer environment.

From Equation (2), we know that the differences in price and quality between H and L determine their relative promotion effectiveness. Because price and quality differences are presumably related, it is not possible to use them as orthogonal variables in a specification of the impact of positioning on promotion effectiveness. We overcome this problem by rewriting Equation (2) in a way that gives us two orthogonal and meaningful covariates. After some algebra, we obtain:

$$d_H = -X_{HL} + \gamma Y_{HL} \quad \text{and} \quad d_L = -X_{LH} + \gamma Y_{LH} \quad (3)$$

where $X_{HL} = -X_{LH} = p_L - p_H - (q_L - q_H)/\Phi$, $Y_{HL} = Y_{LH} = q_H - q_L$, Φ is the bound identified in Proposition 1, and $\gamma = (\alpha_p \alpha_q - \beta_p \beta_q)/2\alpha_p \beta_p$. These expressions have a very simple interpretation.

First, when the slope between L and H is equal to Φ (as in Figure 1), note that $X_{HL} = X_{LH} = 0$, as implied by the definition of Φ in Proposition 1. In this case, cross promotion effects between H and L are symmetric. By (3), d_H and d_L are both equal to $\gamma(q_H - q_L)$, i.e., the discounts would be proportional to the absolute quality *distance*, denoted by Y_{HL}. Indeed we predict that, in contrast with utility models without loss aversion (e.g., the model of B&W), switching among neighboring brands in the price-quality quadrant is easier to induce than switching among distant brands (for an example see, e.g., the data in Kamakura and Russell 1989, p. 385).

Second, when the higher quality brand is positioned at H' in Figure 1, then its necessary discount *increases* by $H' - H$, and the necessary discount of L *decreases* by the same amount. These changes are captured by $-X_{HL}$ and $-X_{LH}$ in expression (3). We call X_{HL} the *positioning (dis)advantage* of H since it refers to a deviation from a "neutral" price/quality standard. In the $H' - L$ case, the positioning disadvantage of H' determines an asymmetric promotion effect in favor of L.

In sum, it is hypothesized that each brand i's capacity η_{ij} to draw consumers from brand j with a given discount is an *increasing* function of the positioning advantage of i, X_{ij}, and a *decreasing* function of the distance Y_{ij}. Formally,

$$\eta_{ij} = f(X_{ij}, Y_{ij}) \quad (4)$$

where $X_{ij} = p_j - p_i - (q_j - q_i)/\Phi$, $Y_{ij} = |q_j - q_i|$. The sign and extent of promotion asymmetry is determined by X_{ij}, while overall cross promotion effects are driven both by the measurable covariates X_{ij} and Y_{ij}. Because $X_{ij} = -X_{ji}$ while $Y_{ij} = Y_{ji}$, the two determinants are orthogonal *by construction*.

It is finally noted that X_{ij} depends on brand i's relative price and quality positioning *rescaled* by a constant Φ that synthesizes information about the consumers' sensitivity to price and quality. Thus, though this theory seeks to link supply-side brand positioning and promotion effectiveness, it is obviously necessary to describe positioning in a way that incorporates some knowledge about demand. For instance, it is impossible to state that a brand is overpriced given its quality without having some knowledge about consumers' way of trading off price against quality. In our framework, this sufficient knowledge is contained in one number, Φ.

6. Empirical Analysis

6.1. Introduction

The purpose of this empirical section is to test our Proposition 1 about the direction of the promotion advantage and to show that the positioning of brands is a strong determinant of promotion effectiveness. We work with two different data sets, described in §6.2. In order to calculate the "positioning advantage" values (X_{ij}'s), we first need an estimate of the bound Φ. Such estimate is determined in §6.4, using the distribution of the response parameters to changes in quality and price (obtained in §6.3). In §6.5, we test the correspondence between promotion effectiveness and our brand positioning variables. In §6.6, we go one step further and test the predictive validity of our model through a cross validation.

Our approach to promotion effectiveness measurement is to estimate the impact of price changes inherent to a standard Guadagni and Little (1983) logit model, as Kamakura and Russell (1989) did in a similar context. In the absence of quality measures, such a model does not imply a relation between slopes in the price-quality quadrant and direction of asymmetry, as we seek to work with "theory-neutral" estimates of promotion effectiveness. We define and use *two* measures of promotion effectiveness. Our theoretical developments have been concerned with the effects of a given *absolute* discount (as opposed to a *percentage* discount). Hence, the natural measure of promotion effectiveness in the present context, termed "promotion impact," is the percentage share change per 10 cents discount. A more traditional measure, cross elasticity, will also be used, as our predictions are presumably robust to this change of dependent variable (see Appendix 2).

6.2. Data

We use two data sets. The first one contains choice data from the chilled orange juice category as originally used by Hardie, Johnson, and Fader (1993). The second data set consists of choice data from the peanut butter category. Both data sets have 6 brands. The orange juice data set contains 3,745 choices from the period 1984–1986, while the peanut butter data set contains 3,758 choices from the period 1991–1993. Both sets have been matched with sensory quality measures drawn from *Consumer Reports* for the relevant time periods. The

quality proxies for orange juice are described in HJF. For peanut butter, we use average ratings from *Consumer Reports* (1990). A description of the data sets, including the available brands and their positioning in the price-quality quadrant, is provided in Table 1.[3] In both sets, approximately one third of the data is used for initialization purpose.

The *Consumer Reports* measures are likely to be good proxies for qualities, at least for the two *mature* categories under investigation where consumer knowledge about qualities may reasonably be assumed. Possible systematic biases in quality perception (e.g., due to price or to brand labels) will be handled through adding relevant brand specific terms in the utility specification. Finally, from a product positioning standpoint, we can also presume that a somewhat objective measure of quality is the relevant variable to consider.

6.3. Measuring the Response Parameters of Price and Quality

To estimate the response parameters contained in the bound Φ of Proposition 1, we estimated a logit model similar to the one of Hardie, Johnson, and Fader (1993). The deterministic part of household k's utility for brand i at occasion t contains gains and losses in price and quality, i.e.,

$$Q\text{-LOSS}_{it}^k = \begin{cases} q_i - q_{rt}^k & \text{if } q_i < q_{rt}^k, \\ 0 & \text{if } q_i \geq q_{rt}^k, \end{cases} \quad \text{and}$$

$$Q\text{-GAIN}_{it}^k = \begin{cases} q_i - q_{rt}^k & \text{if } q_i \geq q_{rt}^k, \\ 0 & \text{if } q_i < q_{rt}^k, \end{cases} \tag{5}$$

$$P\text{-LOSS}_{it}^k = \begin{cases} p_{rt}^k - p_{it}^k & \text{if } p_{it}^k > p_{rt}^k, \\ 0 & \text{if } p_{it}^k \leq p_{rt}^k, \end{cases} \quad \text{and}$$

$$P\text{-GAIN}_{it}^k = \begin{cases} p_{rt}^k - p_{it}^k & \text{if } p_{it}^k \leq p_{rt}^k, \\ 0 & \text{if } p_{it}^k > p_{rt}^k, \end{cases} \tag{6}$$

where the reference point, r, is defined by the last price paid and the last quality purchased.

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[3] The peanut butter data set also contains coupons. Because only redeemed coupons may be observed, estimates of price response will be exaggerated (e.g., Erdem and Keane 1996, Keane 1996). Hence prices in our data are net of any coupon redemption. We restrict our interpretations to price discounts other than coupons.

Table 1 Description of the Data[a]

	Price [$]	Quality	Promotion Intensity[b]	Availability	Discount [$]	Choice Share[c]
Chilled Orange Juice						
Tropicana Premium	2.27	0.487	0.118	0.812	0.23	0.043
Minute Maid	1.99	0.474	0.247	0.998	0.44	0.244
Citrus Hill	1.88	0.395	0.209	0.979	0.26	0.285
Tropicana Regular	1.83	0.303	0.331	0.828	0.36	0.143
Regional Brand	1.82	0.254	0.151	0.816	0.26	0.156
Store Brand	1.39	0.114	0.224	0.368	0.12	0.129
Peanut Butter						
Smuckers	2.28	0.733	0.000	0.993	0.00	0.089
Jif	1.94	0.786	0.144	1.000	0.14	0.304
Skippy	1.93	0.714	0.189	1.000	0.22	0.311
Peter Pan	1.92	0.390	0.084	1.000	0.28	0.131
Store Brand	1.68	0.386	0.026	0.938	0.14	0.115
Generic Brand	1.51	0.100[d]	0.003	0.850	0.18	0.050

[a] Reported data are averages across purchase occasions in the estimation samples; prices are in 64 oz. equivalents in the chilled orange juice category and 16 oz. equivalents in the peanut butter category.

[b] Number of promoted occasions divided by the number of occasions the brand is available.

[c] Not corrected for availability.

[d] Value assumed.

We further specify the deterministic part of the utility function as:

$$V_{it}^k = \alpha_p \cdot P\text{-LOSS}_{it}^k + \beta_p \cdot P\text{-GAIN}_{it}^k + \alpha_q \cdot Q\text{-LOSS}_{it}^k$$
$$+ \beta_q \cdot Q\text{-GAIN}_{it}^k + \beta_f \cdot \text{FEATURE}_{it}^k$$
$$+ \beta_d \cdot \text{DISPLAY}_{it}^k + \beta_i \cdot \text{LOYALTY}_{it}^k, \qquad (7)$$

where loyalty is defined as in Guadagni and Little (1983) and is specified to have brand specific coefficients. Brand loyalty, in the context of our study, is measured as the tendency to remain with the same brand *net* of the resistance to changes in quality and price caused by loss aversion and *net* of other marketing mix activity. The estimation of a single Guadagni and Little loyalty parameter is considered inadequate in the context of this study because it captures an overall notion of conservatism which we precisely wish to dissect.[4] For

[4] For a similar critism, see Erdem and Keane (1996), who argue that the G&L loyalty measure awards equal loyalty to promoted and non-promoted purchases which makes the loyalty variables a function of marketing mix variables.

this reason, we model the loyalty variables to also have brand specific smoothing variables, i.e.,

$$\text{LOYALTY}_{it}^k = \lambda_i \cdot \text{LOYALTY}_{it-1}^k$$
$$+ \begin{cases} 1 - \lambda_i & \text{if } i \text{ was chosen at } t - 1, \\ 0 & \text{else,} \end{cases} \qquad (8)$$

and we estimate these brand-specific coefficients, λ_i, by the procedure detailed in Fader, Lattin, and Little (1992). The closer the brand-specific smoothing coefficient is to 1.0, the less the purchase of a brand will carry over into the formation of loyalty to that brand. Thus, this measure of loyalty has the realistic feature that a brand which is often chosen but exclusively for reasons linked to temporary deals, may still receive little loyalty. For each household, the initial value of the loyalty variables is set equal across brands (see Fader, Lattin, and Little 1992). The initial value of reference price and reference quality is set according to the first observed choice.

The estimation results of the logit model are presented in Table 2. Three remarks are in order. First, as suggested before, there exists a strong positive correla-

Table 2   Estimation of the Structural Parameters[a,b]

		Chilled Orange Juice		Peanut Butter	
		Parameter	Std. Errors	Parameter	Std. Error
Marketing Mix					
Q-Gain	β_q	-0.657^c	0.735	1.884	0.450
Q-Loss	α_q	3.102	0.657	3.454	0.357
P-Gain	β_p	1.016	0.234	1.927	0.249
P-Loss	α_p	3.366	0.212	2.661	0.241
Feature	β_f	0.737	0.074	0.616	0.120
Display	β_d	$-^d$	$-$	0.195^c	0.114
Loyalty					
Brand$_1$	β_1	4.578	0.460	4.879	0.259
Brand$_2$	β_2	4.423	0.374	4.154	0.330
Brand$_3$	β_3	5.834	0.537	5.648	0.581
Brand$_4$	β_4	3.697	0.483	7.018	0.646
Brand$_5$	β_5	2.681	0.268	4.579	0.321
Brand$_6$	β_6	3.411	0.396	4.719	0.541
Smoothing					
Brand$_1$	λ_1	0.635	0.071	0.551	0.055
Brand$_2$	λ_2	0.909	0.020	0.774	0.034
Brand$_3$	λ_3	0.953	0.012	0.891	0.024
Brand$_4$	λ_4	0.950	0.019	0.871	0.026
Brand$_5$	λ_5	0.819	0.047	0.694	0.045
Brand$_6$	λ_6	0.877	0.036	0.589	0.084
LL		-1953		-2020	
U^2		0.442		0.529	
$\bar{U}^2$		0.437		0.525	
Number of Parameters		17		18	

[a] For orange juice the indices of the loyalty and smoothing variable refer to 1–Tropicana Premium, 2–Minute Maid, 3–Citrus Hill, 4–Tropicana Regular, 5–Regional Brand, 6–Store Brand. For peanut butter the six brands are: 1–Smuckers, 2–Jif, 3–Skippy, 4–Peter Pan, 5–Store Brand, 6–Generic.

[b] Parameters are significant at 0.01 unless noted differently. The parameters of the smoothing constants are all different from 1 at the 0.01 significance level.

[c] Parameter is insignificant.

[d] Display data are not available for this category.

tion between the brand-specific smoothing constant and the promotion intensity in Table 1 (pooled across the two categories, $r = 0.85$, $t = 5.19$). Second, in the orange juice category, there is no appreciation for quality gains relative to the reference point. Consumers are, however, sensitive to relative quality losses. Third, while price and quality data may be correlated across brands, multicollinearity seems absent. Across both data sets, the average absolute correlation among response parameters to price and quality is 0.207.

6.4. Estimating Φ

Since we do not measure the four response parameters to price and quality, i.e., α_p, β_p, α_q and β_q, without error, the estimator of Φ does not simply obtain as a function of the parameter estimates but needs to reflect their covariance structure as well. We compute $\hat{\Phi}$ by generating $K = 15{,}000$ draws from the joint distribution of the estimates of the four parameters. This joint distribution is constructed by post-multiplying a $K \times 4$ matrix of i.i.d. $N(0, 1)$ draws by the upper-triangular Cholesky

Table 3   Promotion Impact in the Chilled Orange Juice and Peanut Butter Data[a]

	Chilled Orange Juice					
	Tropicana Premium	Minute Maid	Citrus Hill	Tropicana Regular	Regional Brand	Store Brand
Tropicana Premium		0.971	0.855	0.953	1.197	0.430
Minute Maid	4.442		3.333	3.243	3.717	1.309
Citrus Hill	5.067	4.041		3.823	4.287	2.039
Tropicana Regular	3.424	2.180	2.821		1.810	3.293
Regional Brand	3.897	2.852	2.575	2.568		0.942
Store Brand	5.248	4.090	3.360	4.492	6.483	

	Peanut Butter					
	Smuckers	Jif	Skippy	Peter Pan	Store Brand	Generic
Smuckers		0.689	0.655	0.777	0.959	1.037
Jif	2.392		2.437	2.758	3.064	2.907
Skippy	2.332	2.488		2.981	2.934	3.106
Peter Pan	1.127	1.157	1.224		1.399	1.461
Store Brand	1.253	1.182	1.155	1.418		1.914
Generic	0.628	0.542	0.588	0.694	0.916	

[a] Promoted brands are in the first column, i.e., promotion impacts of a given promoting brand are in rows.

decomposition of the correlation matrix of the four estimated response parameters, and by transforming each column to the same mean and variance as the estimates of the four response parameters. Finally, Φ is calculated for all K rows of the matrix, and its distributional properties can be identified. The estimator of Φ is 0.753 (s^2 = 0.0986) in the case of orange juice and 0.804 (s^2 = 0.0092) in the case of peanut butter.

We have explored the robustness of our estimates of Φ under three alternative specifications of loyalty (see Equation 8). We varied the initialization rule (either an equal value for all brands or the rule proposed by Guadagni and Little 1983) and we constrained the smoothing parameter to be common for all brands. Our estimates of Φ are all within one-and-a-half standard deviation around any measure. Subsequent results relying on the estimates are robust in all cases explored. The selected specification was best according to the Bayesian Information Criterion (BIC).

6.5. The Relation between Promotion Effectiveness and Brand Positioning

Estimates of cross elasticities and promotion impacts were obtained by changing the price of each brand by

1% (cross elasticities) or by 10 cents (promotion impacts), given availability. For the same occasions, we computed the percentage change in the average predicted choice probability of the other brands using the parameter estimates of the standard operationalization of the logit model. The results of this analysis are provided in Tables 3 and 4.

We present three types of analyses on these promotion effectiveness measures. For the first test, based on Proposition 1, we compare the best fitting linear relation between price and quality with the corresponding estimated value of Φ, and we predict the overall direction of asymmetry. This case is an interesting benchmark, but it assumes that price and quality are linearly related. Second, relaxing this restrictive assumption, we test Proposition 1 by testing the hypothesized effects of positioning advantage, X_{ij}, and distance, Y_{ij}, on promotion effectiveness for *any given H-L pair* of brands. Finally, in order to stress the contribution added by our finer characterization of brand positioning, we benchmark our results against the use of a price-tier membership variable.

The Overall Direction of Asymmetry. Using a regression on the price-quality data in Table 1, we obtained

Table 4   Cross Elasticities in the Chilled Orange Juice and Peanut Butter Data[a]

	Chilled Orange Juice					
	Tropicana Premium	Minute Maid	Citrus Hill	Tropicana Regular	Regional Brand	Store Brand
Tropicana Premium		0.216	0.197	0.218	0.263	0.106
Minute Maid	0.874		0.650	0.648	0.730	0.281
Citrus Hill	0.963	0.769		0.755	0.812	0.405
Tropicana Regular	0.603	0.395	0.497		0.343	0.539
Regional Brand	0.694	0.500	0.452	0.461		0.190
Store Brand	0.696	0.581	0.473	0.611	0.887	

	Peanut Butter					
	Smuckers	Jif	Skippy	Peter Pan	Store Brand	Generic
Smuckers		0.157	0.152	0.182	0.219	0.236
Jif	0.467		0.483	0.551	0.596	0.573
Skippy	0.455	0.488		0.596	0.572	0.607
Peter Pan	0.223	0.232	0.247		0.276	0.290
Store Brand	0.218	0.204	0.200	0.247		0.328
Generic	0.098	0.086	0.092	0.111	0.142	

[a] Promoted brands are in the first column, i.e., cross elasticities of a given promoting brand are in rows.

the best fitting lines describing the actual positioning of brands in each data set. Steepness of the line is 0.467 in the case of orange juice, which is smaller than $\hat{\Phi}_{\text{orange juice}} = 0.753$. We obtain 0.827 in the case of peanut butter, which is larger than $\hat{\Phi}_{\text{peanut butter}} = 0.804$. By Proposition 1, we expect that, overall, the promotion effectiveness of *L*-type brands is higher than *H*-type brands in the orange juice data set, whereas for the peanut butter data set the reverse will hold.

To test this prediction, we construct an *H-L* dummy for all pairs of brands. Negative correlations between promotion effectiveness measures and this dummy indicate that typically there is an asymmetric promotion effect in favor of *L*, and positive correlations indicate that the asymmetry is in favor of *H*. Consistent with Proposition 1, in the orange juice category, the correlation is −0.571 ($t = -3.680$) for promotion impact and −0.451 ($t = -2.674$) for cross elasticity. In the peanut butter category, the correlation is 0.384 ($t = 2.201$) for promotion impact and 0.444 ($t = 2.622$) for cross elasticity.

A Richer Prediction: The Direction and Extent of Promotion Asymmetries. We compute the positioning mea-

sures, positioning advantage X_{ij} and distance Y_{ij}, defined in §5, from the price-quality data in Table 1. These are subsequently used to explain the promotion effectiveness of brand i in attracting consumers from brand j. To test Proposition 1, and because of its pivotal role in the analysis of promotion asymmetry, we first look at the relation between positioning advantage X_{ij} and promotion effectiveness alone. In Figure 2, we have plotted the computed values of X_{ij} against the promotion impact of Table 3 for the orange juice and the peanut butter categories, respectively.

The correlation between these two variables is strongly positive: 0.885 ($t = 10.058$) for the orange juice data, and 0.756 ($t = 6.111$) for the peanut butter data.[5] To highlight that Proposition 1 accurately indicates promotion asymmetry for a *given pair* of brands, we plotted the positioning of the Regional Brand, Minute Maid,

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[5] From Table 1 it can be deduced that we *assumed* the quality of the generic brand in the peanut butter data. Disregarding the 10 pairs of brands which involve the generic brand, reveals that the strength of the relation remains identical ($r = 0.733$), i.e., is not driven by our choice regarding the quality of the generic brand.

Figure 2   The Relation Between Positioning Advantage (X_{ij}) and Promotion Impact[a,b]
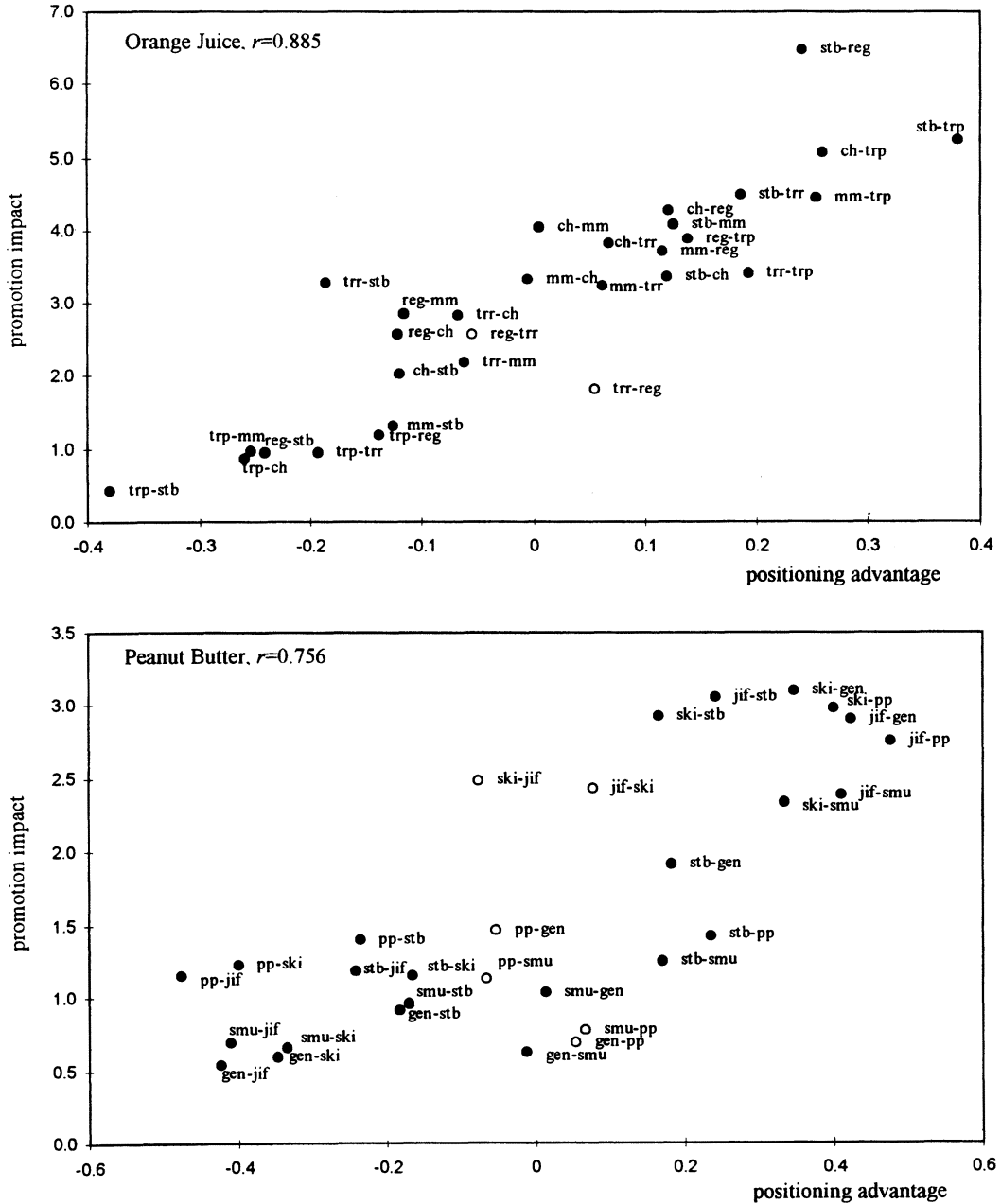
[a] Brand names are abbreviated; for the orange juice data, in the top graph, the following abbreviations were used: trp–Tropicana Premium, mm–Minute Maid, ch–Citrus Hill, trr–Tropicana Regular, reg–regional brand, stb–store brand. For the peanut butter data, the abbreviations are: smu–Smuckers, jif–Jif, ski–Skippy, pp–Peter Pan, stb–store brand, gen–generic. The promoting brand is the first brand in any given pair of brands.

[b] Solid bullets indicate pairs of brands for which asymmetry is correctly classified; empty bullets indicate pairs of brands for which asymmetry is incorrectly classified.
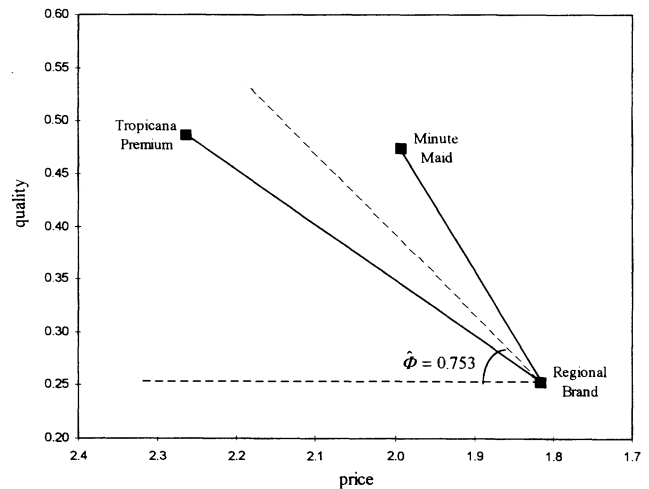
and Tropicana Premium in Figure 3. Focusing on the Regional Brand, the ratio of quality and price differences with Tropicana Premium is 0.520 and smaller than $\hat{\Phi}_{orange\ juice} = 0.753$, while it is 1.246 and larger than $\hat{\Phi}_{orange\ juice}$ with Minute Maid (see Figure 3). Proposition 1 predicts that the regional brand promotes more effectively than Tropicana Premium, but less effectively than Minute Maid. As can be seen from Table 3, this is true. In total, 14 out of 15 directions of asymmetry are correctly classified by Proposition 1. Similarly, for Peanut Butter 12 out of 15 directions of asymmetry are correctly classified. The misclassifications across the two categories are concentrated in the center of the graphs of Figure 2, i.e., are cases where neither brand has a real advantage (X_{ij} tends to be close to 0).

Figure 3 stresses the importance of the inclusion of *multiple* attributes in an analysis of promotion effectiveness. Merging price and quality into one construct (e.g., by taking price as a proxy for quality) will always give the restrictive prediction that the asymmetry is either *always* in favor of L or *never*, for all pairs of brands. The example in Figure 3 shows that this is not generally the case. It is in fact, the *deviations* from a perfectly linear relationship between price and quality that allow for the actual promotion patterns illustrated in Figure 3 and observed more generally in Tables 3 and 4. Such information is not present in any single attribute theory of promotion effectiveness.

To finally test the joint explanatory power of X_{ij} and Y_{ij}, we regressed these variables onto the two measures of promotion effectiveness. The regression results are in Table 5 under the row headings "Total." As predicted theoretically, the positioning advantage parameter is positive and significant for both data sets and both promotion effectiveness measures. The sign of distance is negative, but the parameters are not consistently significant.[6] Table 5 further illustrates that the explanatory

Figure 3   Asymmetric Promotion Effects in the Orange Juice Category

power of our positioning measures in explaining differences in promotion effectiveness is good.

Finally, we constructed a dummy indicating price tier membership. The amount of variation that this dummy can explain is modest compared to the descriptive power of covariates proposed here (see the last column of Table 5).

6.6. Predictive Validity of the Positioning Variables

Since positioning advantage X_{ij} depends, through $\hat{\Phi}$, on utility parameters that need to be estimated, it can be said to be sample dependent. In a descriptive sense this poses no problem, since our aim was to show a correspondence between brand positioning and promotion effectiveness. In a predictive sense, however, the explanatory power of our independent variables needs to be established out of sample. For this reason, we perform a cross-split-half validation. We estimate the utility parameters in each subsample, compute the sample specific estimator of Φ with the procedure outlined above, and use this to generate the independent measures. Next, we investigate the capacity of these independent measures to explain the sample specific promotion effectiveness measures from the other sample. The results of this analysis are included in Table 5 under the row headings "Sample 1" and "Sample 2."

The results indicate that positioning advantage, X_{ij}, and distance, Y_{ij}, predict promotion effectiveness accurately. Whereas, across the 8 out-of-sample replications

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[6] Our method of measuring cross elasticity and promotion impact can be said to load the dice against finding significant results for distance. The distance effect emerges theoretically from the fact that the iso-utility curves are kinked (see also Tversky and Kahneman 1991). The logit model that Kamakura and Russell used, and that we use here, does not allow for such a nonlinearity. Redefining the promotion effectiveness in a logit model conditional on prior purchase (which would pick up "local" switching), makes the distance measure more significant.

Table 5   Analysis of the Promotion Effectiveness Measures

Data	Dependent Variable	Sample[a]	Constant[b]	Positioning Advantage	Distance	R^2	F^c	$R^2_{\text{price tier}}$
Orange Juice	Impact	Total	3.109 (0.26)*	7.195 (0.73)*	−0.672 (1.29)	0.785	49.19	0.099[d]
		Sample 1	3.338 (0.26)*	7.090 (0.70)*	−0.962 (1.30)	0.794	51.98	0.065
		Sample 2	2.899 (0.29)*	6.463 (0.73)*	−0.299 (1.41)	0.743	39.09	0.137
	Elasticities	Total	0.607 (0.04)*	1.059 (0.12)*	−0.459 (0.22)‡	0.746	39.61	0.007
		Sample 1	0.649 (0.05)*	1.019 (0.13)*	−0.523 (0.24)‡	0.718	34.40	0.000
		Sample 2	0.569 (0.05)*	0.939 (0.12)*	−0.388 (0.24)†	0.688	29.81	0.027
Peanut Butter	Impact	Total	1.683 (0.20)*	2.333 (0.39)*	−0.243 (0.52)	0.576	18.32	0.221
		Sample 1	1.630 (0.27)*	2.598 (0.54)*	0.321 (0.71)	0.466	11.77	0.331
		Sample 2	1.786 (0.18)*	2.343 (0.36)*	−0.686 (0.47)†	0.624	22.38	0.096
	Elasticities	Total	0.329 (0.04)*	0.455 (0.08)*	−0.057 (0.11)	0.551	16.54	0.319
		Sample 1	0.323 (0.06)*	0.506 (0.11)*	0.060 (0.15)	0.440	10.60	0.409
		Sample 2	0.345 (0.04)*	0.455 (0.07)*	−0.149 (0.09)†	0.611	21.17	0.186

[a] The results labeled "Total" refer to the descriptive analysis in §6.5. The results labeled "Sample 1" and "Sample 2" refer to the results of the cross validation in §6.6.

[b] Standard errors in parentheses; significance levels (one-sided) are indicated as follows: *$p < 0.01$, ‡ $p < 0.05$, † $p < 0.10$.

[c] All regression models are significant at the 0.01 level.

[d] The coefficient of explained variance of price tier membership. The correlation of price tier membership and promotion effectiveness is negatively signed for orange juice and positively signed for peanut butter. Price tiers are defined in terms of national brands vs. other brands.

of our analysis, the mean predictive power of the price-tier variable equals $R^2 = 0.156$ (0.057 for orange juice; 0.256 for peanut butter), the mean predictive power of our two variables is $R^2 = 0.636$ (0.736 and 0.536, respectively). The results further suggest that promotion impact is indeed better predicted than cross elasticities (mean R^2 out-of-sample: 0.657 and 0.614, respectively) as theoretically justified above, but the difference is not substantial.

In conclusion, we find support for the fact that brand positioning explains an important part of the variation in cross elasticities and promotion impact. The theory and its operationalization in two orthogonal descriptors of brand positioning seem, within the confines of our empirical results, to have higher predictive power than the relation between promotion effectiveness and price tier membership.

7. Conclusion

Drawing from the implications of a simple theory of individual preferences, we studied the effect of brand positioning on promotion asymmetry. Our theoretical anal-

ysis serves to generalize the framework previously proposed by Blattberg and Wisniewski (1989) and others. While higher quality/higher price brands may have a promotion advantage in principle, the precise relative positioning of all brands may reverse this principle advantage and determine the direction and the *extent* of promotion asymmetries in any pairwise comparison of effectiveness.

We do not try merely to provide an empirical exception to the general rule proposed by B&W: we believe that the changing pattern of brand positioning, as store brands improve their quality (see Appendix 1), can have a significant impact on future regularities regarding promotion advantages. The empirical findings show that a relation between positioning and promotion asymmetry indeed exists and that it goes beyond the significance of a price-tier membership variable as in B&W. Our theory explains not only the promotion effects across price tiers but also within these price tiers and does so rather successfully within the confines of the data presented here. A unique aspect of our analysis is that we can discuss the comparative promotion effectiveness of any pair of brands, without requiring a price-

tier categorization of brands. We conclude that it is necessary to take brand positioning into account when evaluating promotion asymmetry and that its implications may contradict the extant theories of promotion asymmetry.

An attractive aspect of our theory is that all the knowledge about consumers that is necessary to characterize brand positioning is contained in a summary number, Φ. We have shown how to estimate this number for any specific category. Although it is not exactly in the spirit of this research, we may suggest some heuristics that can be used in the case where a prediction would be needed in the absence of the necessary resources to compute Φ. First, from the remark in §4, it perhaps comes naturally that there would be an asymmetric promotion effect in favor of the higher quality brand when the compared brands have equal market share (a manifestation of equal attractiveness). A significant market share advantage for the lower quality brand would indicate, on the contrary, the presence of an asymmetric promotion effect in its favor. The second heuristic rule would be to try to "guess" (perhaps through consumer surveys) the degree of loss aversion in price and quality present in the concerned category, and the relative weight of price and quality attributes. From there, one may use the comparative statistics outlined after Proposition 1 in order to assess the chances that the asymmetry goes in one direction or the other.

However, as argued in §5, it is impossible to state that a quality brand is "overpriced" given its quality without having some knowledge about consumers' way of trading off price against quality. The rule that we have theoretically established to make such determination proved to be tractable and empirically meaningful.[7]

Appendix 1. Price and Quality Positioning According to Consumer Reports 1980–1994

We analyzed the steepness of the price-quality positioning by examining *Consumer Reports'* price-quality ratings for product categories for which data were available across multiple consecutive five-year periods between 1980 and 1994. Five categories with consistent measurements of price-quality data over multiple periods exist: dishwashing liquids, dishwashing detergents, paper towels, glass cleaners, and peanut butter. We do not strictly require measurements of "the" quality of a brand but rather consistent measurements of an attribute that is positively valued by consumers. As can be seen from Appendix 3, the quality measures of *Consumer Reports* are adequate for this purpose. Price is measured as the average price paid for a given brand by the *Consumer Reports* shoppers.

For each of the available categories and time periods regressions were run using price as the independent variable to obtain estimates of the slopes of the quality/price relationship. We corrected for category differences by standardizing the price-quality data for each first available period. Pooling the data, we found that the average difference of the positioning slope between five-year time periods is -0.178 ($t = -3.62$, $n = 9$). This suggests that the price-quality relationship has become flatter over the last 15 years. While these empirical results are of anecdotal nature, categories with widening quality/price gaps were not found present.

Second, without any exception, the relation between price and quality becomes less strong (in terms of R^2) over time. This observation implies that it becomes less and less valid to devise an argument about promotion effectiveness involving absolute price levels *alone* (as in Blattberg and Wisniewski 1989), or involving product quality *alone* (as in Allenby and Rossi 1991).

Appendix 2. Asymmetric Promotion Effects Based on a Comparison of Percentage Discounts

If we re-define "necessary discount" in terms of "necessary percent discount," we find that Φ becomes

$$\Phi' = \frac{\alpha_p \beta_p (p_L + p_H)}{\beta_p \beta_q p_L + \alpha_p \alpha_q p_H}$$

in the context of Proposition 1.

The following remarks are in order:

(1) If there is an asymmetric promotion effect in favor of H when comparison is based on the effect of dollar discounts, then there is an asymmetric promotion effect in favor of H when comparison is based on the effect of percentage discounts (this result is obtained by comparing Φ and Φ').

(2) It is easy to check that, under loss aversion,

$$\frac{\beta_p}{\alpha_q} < \frac{\alpha_p \beta_p (p_L + p_H)}{\beta_p \beta_q p_L + \alpha_p \alpha_q p_H} < \frac{\alpha_p}{\beta_q},$$

and thus Proposition 2 holds.

(3) Given the coordinates of L, Φ' decreases as p_H increases, and tends towards β_p / α_q as $p_H \to \infty$. Thus, the requirement that the quality difference must be sufficiently large, in comparison with the initial price difference (to ensure that there is a promotion advantage in favor of H, in terms of the effects of percentage discounts) becomes weaker as the price difference gets larger.

Appendix 3. *Consumer Reports* Quality Measures

Consumer Reports quality measures are derived from one of three different methods depending on the category at hand: (1) lab tests, (2) composite measures, and (3) sensory quality measures.

(1) *Laboratory tests* produce the most objective quality measures of the three methods. For example, the quality of the dish washing liquids reported in Appendix 1 is assessed by taking equal concentrations of dishwashing liquid in water for all brands and subsequently testing the capacity of the mixture to absorb amounts of a standard mix of flour, animal, and vegetable fats. The maximum amount (in weight) that can be absorbed (dissolved) is an objective standard against which the quality of dishwashing liquids can be compared across brands as well as across time.

(2) *Composite quality measures* are composed of ratings of brands on a number of objectively measurable dimensions. Only categories with the same dimensions across five-year periods were selected. We coded each dimension and brand score on these dimensions and took the sum of the scores per brand as a composite quality measure. Dimensions on which brands are rated can all be objectively measured. For instance, in the paper towel category, the following dimensions are used: (1) wet strength—how much lead shot a wet towel could support, (2) absorbency—the amount of water a towel can absorb, (3a) absorption rate—how fast the towel absorbs oil, (3b) absorption rate—how fast the towel absorbs water, (4) linting—the amount of flecks left behind on a cleaned surface.

(3) *Sensory quality measures* are based on flavor and taste. Typically, this method of quality assessment involves groups of judges who rate the products on various, well-defined criteria. The measures are reasonably comparable over time, because the quality assessment is relative to a fixed reference point. (In the case of the chilled orange juice category this reference point is the taste of freshly squeezed orange juice, whereas in the case of peanut butter it is the taste of roasted peanuts.) Sometimes the measures of quality will be cross validated by a procedure in which three samples of the category are given. Of these three samples, two are similarly rated in quality and a third one is of different quality. Larger groups of nonexpert subjects are asked to single out the deviant sample. This procedure is sometimes done on a test-retest basis.

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