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Empirical Generalizations in Patterns of Cross-Price Elasticities

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<Abstract>

The broad objective of this paper is to enhance our knowledge about patterns in cross-price elasticities observed in the real world. Specially, we draw upon theories on competitive promotion effects and develop hypotheses which relate brand price and market share differences to differences in cross-price elasticities We then test the empirical generalizability of these hypotheses through a meta-analysis of 1030 cross-price elasticities on 280 brands estimated with 75 product-store data sets from 15 studies

The key empirical generalizations based on average cross-price elasticities are:

1 Strong asymmetric price effect in favor of the high-priced brand is observed when the high-priced brand has equal or higher market share compared to the low-priced brand. However, weak and reverse asymmetry (in favor of the low-priced brand) is observed when the high-priced brand has lower market share.

2. There is a strong "neighborhood" price effect - brands compete more intensely with its immediately higher and lower priced brands than with other brands.

The implications of these are discussed.

교차 가격탄력성의 실증적 일반화

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이 논문의 목표는 실제로 관찰되는 교차 가격탄력성에 대한 이해를 높이고자 하는 것이다 특히 경쟁적 촉진효과에 대한 이론을 이끌어 냈으며 상표가격과 시장점유율차이를 교차 가격탄력성의 차이와 연관시킨 가설들을 검증하였다 15 연구들로부터의 75 제품-상점 자료로부터 추정된 280 상표의 1030 개의 교차 가격탄력성을 이용하여 가설들의 실증적 일반화를 검증하였다 평균 교차 가격탄력성에 기초한 주요 실증적 일반화는 다음과 같다

1 고가격상표가 저가격상표보다 같거나 보다 높은 시장점유율을 가지고 있을 때 강한 비대칭가격효과가 고가격상표에 유리한 쪽으로 관찰되어진다. 그러나 고가격상표가 보다 낮은 시장점유율을 가지고 있을 때는 약한 비대칭가격효과가 저가격상표에 유리한 쪽으로 관찰되어진다.

2. 강한 근접가격효과가 존재한다. 즉 상표들은 가격이 바로 근접하여 낮거나 또는 높은 가격의 상표와 그렇지 않은 상표보다 더 경쟁한다

이 들 결과의 시사점이 토의되어진다.

Empirical Generalizations in Patterns of Cross-Price Elasticities

In their comprehensive book on Sales Promotion, Blattberg and Neslin (1990, p 373) observed that "the key issue that still needs to be addressed is the analysis of cross-elasticities to understand competitive effects of deals." Short-term cross-price elasticities measure the effect of a brand's temporary price change on a competitor brand's sales They are useful in understanding market structure and developing competitive discount strategies

Over the last decade, there has been considerable growth in research on competitive deal effects First, several theories have been put forward which suggest specific patterns in cross-price elasticities (e g , Allenby and Rossi 1991, Blattberg and Wisniewski 1989 Bronnenberg and Wathieu 1996) Second, better methods have been developed for estimating cross-price elasticities (e g. Bucklin and Srinivasan 1991 Carpenter et al 1988 Kamakura and Russell 1989) Third, as a result of these methodological developments and due to increased interest in price promotions the empirical literature on cross-promotion effects has grown Several studies have reported empirical literature on cross-price elasticities for a large number of products and brands.

Our objective in this paper is to bring the theoretical and empirical literature together and develop some empirical generalizations in patterns of cross-price elasticities. As Bass (1995) notes, the building block of science (in marketing) is empirical generalizations defined as a pattern of regularity that repeats over different circumstances. In particular, we are interested in knowing whether differences in brand prices and market share relate to differences in cross-price elasticities.

We focus on brand prices and market share because (i) theories on cross-promotion effects can be easily related to the two variables, (ii) data are readily available for testing, and (iii) the findings can be useful to managers of high-priced brands and low-priced brands, and large (share) brands and small (share) brands. We focus on cross-price elasticities (% change in sales or market share of a brand 1% change in price of a competitor's brand) because, as Cooper (1988) states, cross-elasticities provide important linkages for marketing scholars and practitioners in at least two major ways. First, they provide the language which links much of marketing theory to marketing models and practice. Second, elasticities serve as measures of competition-indicators of market structure. Accordingly, our study is similar in spirit to other empirical generalization studies on marketing mix effects (Assmus, Farley and Lehmann 1984; Bolton 1989; Sethuraman and Tellis 1991, Tellis 1988) in that we also meta-analyze marketing mix (cross-price) elasticities

First, we draw upon the theoretical literature and derive hypotheses about patterns in cross-price effects. In particular, these theories raise some interesting questions

1. Asymmetric price effect: Are high-priced brands more "effective" in drawing sales from low-priced brands than vice versa?

2. Neighborhood price effect: Are cross-promotion effects greater between brands priced closer to each other than brands priced further apart?

Then, We test the empirical generalizability of the hypotheses by meta-analyzing 1030 cross-price elasticities on 280 brands from 75 grocery product data sets drawn from 15 studies. Empirical generalizations on promotion effects have been recently studied by Blattberg, Briesch and Fox (1995). With respect to cross-promotion effects, they identify the following empirical generalization. Cross-promotion effects are asymmetric and promoting higher quality brands impacts lower-quality brands disproportionately. Our paper extends their study in the following two important ways

1 Blattberg, Briesch and Fox (1995) have uncovered one empirical generalization related to asymmetric cross-promotion effect. In this paper, we test the empirical generalizabilty of a number of additional questions related to asymmetric and neighborhood cross-promotion effects.

2 Blattberg et al. define an empirical generalizations as one where the sign of the effect is consistent with the phenomenon in at least three different studies. As they rightly point out they use this less stringent, more qualitative generalization approach because (i) the area of promotions is relatively new and there are few replications and (ii) promotion effects are reported using different measures and it is difficult to conduct meta-analysis. In our paper, we have a large number of studies reporting estimates of cross-price elasticities So, it is possible for us to conduct stronger test of empirical generalization using meta-analytic approaches suggested by Farley and Lehmann (1986)

3. The paper is divided as follows First, we discuss the theories and derive the hypotheses. Then we describe the data and our analysis Finally, we discuss our findings and conclude by stating the limitations and providing some future research direction

Research Questions/Hypotheses

We describe the theories and derive hypotheses relating cross-promotion effects to brand prices and market shares under two headings Asymmetric Cross-Promotion Effects and Overall Cross-Promotion Effects.

Asymmetric Cross-Promotion Effects

We define asymmetric promotion effect between two brands i and j in terms of cross-price elasticities as $\eta_{i->j} - \eta_{j->i}$. $\eta_{i->j}$ is the effect of price change (discount) of brand i on the sales or market share of brand j - specifically, the percentage change in sales of brand j for % change in price of brand i $\eta_{j->i}$ is defined likewise.

Blattberg and Wisniewski (1989) were perhaps the first to highlight the asymmetric price-tier effect which can be stated as follows: When the high-quality (high-price) brands price promote, consumers of the low-quality (low-priced) switch to the promoted high-quality brand However, when the low-quality (low-priced) brands price promote, few consumers of the high-quality brands will switch to the promoted low-quality brand because they would perceive a large quality difference.

Two other theories which support asymmetric price-tier effect are due to Allenby and Rossi (1991) and Hardie, Johnson and Fader (1993). Allenby and Rossi (1991) proposed a non-homothetic preference model that allows for switching due to income effects. When a brand reduces its price, the attainable utility for a given budget increases. This is equivalent to giving the consumer more money (income). When the attainable utility increases (s/he becomes richer), the relative value placed on quality increases and consumers prefer the superior (high-quality) brand. Hence, as high-priced superior brand becomes relatively cheaper, there is a greater attraction towards that brand than when the low-price inferior brand becomes cheaper.

Hardie, Johnson and Fader (1993) based their explanation on Behavioral Decision Theory - specifically on loss aversion prescribed by Prospect theory For a consumer of a high-priced/high-quality brand (A), the low-priced/low-quality brand (B) represents a loss in quality and gain in price For a consumer of brand B, brand A represents a gain in quality but loss in price. So, when A discounts, consumers of B reduce their (quality) loss When B discounts, consumers of A increase their (price) gain. By loss aversion, reducing losses carries more weight than increasing gain. So, the high-priced brand A benefits more by discounting.

As Blattberg, Briesch and Fox (1995) note, several empirical studies have validated the price tier effect (e.g., Blattberg and Wisniewski 1989, Kamakura and Russell 1989; Mulhern and Leone 1991). Hence the theoretical and empirical support for the asymmetric price effect is strong. If cross-price elasticity patterns are consistent with the conventional asymmetric price effect hypothesis, then we should observe the following.

H1. Overall, the cross-price elasticity measuring the effect of a discount for a High-Priced (HP) brand on the sales of a Low-Priced (LP) brand, $\eta_{HP \to LP}$ should be greater than the cross-price elasticity of a discount of a low-priced brand on the sales of a high-priced brand, $\eta_{LP\to HP}$. In other words, $\eta_{HP\to LP} - \eta_{LP\to HP} > 0$.

While earlier support for the theory has been strong, recent experimental and empirical evidence have suggested that the conventional asymmetric price or quality-tier effect may not be always valid (Heath et al. 1996, Sethuraman 1995) One of the first theoretical reasoning for why the price-tier effect may not be observed, and may even be reversed, is due to Bronnenberg and Wathieu (1996) The essence of Bronnenberg and Wathieu theory and its distinction from the other three theories described above can be understood using the following simple framework.

Consider two brands with different prices We denote the price of the High-Priced (HP) brand as P_H and the price of the Low-Priced (LP) brand as P_L. We denote their quality levels as Q_H and Q_L, respectively Bronnenberg and Wathieu (996) consider three types for relative positions for the two brands.

1. "Balanced" Positioning The price differential $(P_H - P_L)$ is commensurate with the quality differential $(Q_H - Q_L)$ or the ratio $(Q_H - Q_L)/(P_H - P_L)$ is such that the two brands are asymmetrically (equally) attractive
2 Positioning Advantage for High-Priced Brand The price differential $(P_H - P_L)$ is low in comparison with the quality differential $(Q_H - Q_L)$ or the ratio $(Q_H - Q_L)/(P_H - P_L)$ is relatively high so that the high-priced brand is perceived by consumers to have a better position
3 Positioning Advantage for Low-Priced Brand The price differential $(P_H - P_L)$ is high in comparison with the quality differential $(Q_H - Q_L)$ or the ratio $(Q_H - Q_L)/(P_H - P_L)$ is relatively low so that the low-priced brand is perceived by consumers to have a better position

The earlier three theories implicitly or explicitly assume a fairly strong correlation between quality and price Thus, their theory or conjecture can be stated to be related to case 1 (Balanced positioning) Bronnenberg and Wathieu (1996) consider the other two cases ass well Their theory incorporates loss aversion like Hardie et al. (1993) as well as reference dependence (consumers compare current brand with the brand last purchased as the reference) in a linear utility model. Algebraically, they show that the asymmetry depends on the positioning advantage defined as $(Q_H - Q_L)/(P_H - P_L)$. When HP and LP brands have "balanced" positioning (case 1) or when HP brand has a positioning advantage (case

2), then conventional asymmetry will be observed. That is, high-priced brand will be more "effective" than the low-priced brand in drawing sales. However, if the low-priced brand has a positioning advantage (case 3), then reverse asymmetry may be observed - the low-priced, low-quality brand will be more "effective."

Bronnenberg and Wathieu (1996) show that this result holds for cross-price elasticities and validate their theory with panel data on two products. Their theory, in Bass (1995) terminology, can be called a higher order explanation because it helps refine the conventional price-tier theory which becomes a special case of their model.

How does their theory translate in terms of brand prices and market shares? The translation is fairly intuitive. Other things equal, we expect two brands that have "balanced" positions with respect to price and quality (case 1) to have "similar" market shares ($S_{HP} ≒ S_{LP}$). When the high-price brand has a positioning advantage (case 2), it is likely to have a larger market share compared to the low-priced brand. In these cases, conventional asymmetry will be observed. When the high-priced brand has a positioning disadvantage (case 3), it will have a smaller market share compared to LP brand. Allenby and Rossi (1991) also state that one of the reasons a high-priced brand may have small market share is because it is not perceived as high in quality. In this case, conventional asymmetry may not be observed or even reverse asymmetry may be observed. Thus, relative market share could moderate the price-tier effect and patterns in cross-price elasticities as hypothesized below:

H2. Conventional asymmetric price-tier effects as prescribed in H1 (i.e. $\eta_{HP\to LP} - \eta_{LP\to HP} > 0$) will hold when the market share of HP brand is similar to or greater than the market share of LP brand (i.e. $S_{HP} \geq S_{LP}$). However, weaker asymmetry or even reverse asymmetry (i.e. $\eta_{HP\to LP} - \eta_{LP\to HP} \leq 0$) may be observed if the share of HP brand is smaller than the share of LP brand (i.e. $S_{HP} < S_{LP}$)

In support of this hypothesis, Sethuraman (1995) finds that the asymmetric effect between high-priced national brands and low-priced store brands is moderated by market share.

Overall Cross-Promotion Effect

In this section, we are interested in understanding which pair of brands compete with each other the most. Hence, we measure overall promotion effect between two brands i and j in terms of cross-price elasticities as $(\eta_{i->j} + \eta_{j->i})/2$.

Bronnenberg and Wathieu (1996) show analytically that the impact of a discount of a brand on the sales of another brand is inversely proportional to the quality distance $(Q_H - Q_L)$ between the two brands. That is, brands which are similar in quality should compete the most. In general, brands which are similar in quality are likely to be similar in price. Hence, promotion intensity must be the highest between brands which are closest in price. Earlier empirical observations have also alluded to this "neighborhood" promotion effect. Rao (1991) observed in three product categories that brands with the highest price typically discounted just below the price of the brand with the next highest price and so on, suggesting that brands compete most with its neighboring-priced brand. Sethuraman (1995, 1996) also finds that the cross-price effect is likely to be higher when two brands are closer to each other in price.

Based on the above theoretical and empirical support, we state the following hypothesis which we call the neighborhood price effect:

H3 The overall cross-promotion effect between two brands i and j $[(\eta_{i->j} + \eta_{j->i})/2]$ will be higher when the prices of brands i and j are closer to each other and lower when their prices are further apart.

We now proceed to the empirical analysis for testing these hypotheses.

Empirical Analysis

First, we describe the data used for empirical generalization and the analysis.

Data

We identified all published studies which (i) reported unconstrained short-term cross-price elasticity matrix at the market level (not just within segments) for all brands analyzed and (ii) provided price and market share information. Fifteen studies met this standard.[1] Several studies analyzed multiple products from multiple stores or grocery chains In particular the 15 studies analyzed 35 grocery products, some from different chains/stores for a total of 75 data sets. If the same data set was used in different studies (e.g., sethuraman 1995; 1996) but there was no duplication in cross-elasticities, we included both studies. Where the authors provided multiple estimates of elasticities using different functional forms, the best functional form as identified by the authors was chosen. Where the best functional form was not identified, we chose the best functional form based on model fit. If the best-fit model had many cross-price elasticity estimates with unexpected (negative) signs, we selected the next best functional form, if available.

Following this procedure, we obtained 1060 cross-price elasticity estimates. In general, we expect a price cut (decrease in price) by a brand to decrease the sales of a competing brand, or the cross-price elasticity to be non-negative. The theory and the hypotheses are relevant only under such conditions. In about 8% of the observations, the cross-price elasticity was negative but non-significant. In the inclusive spirit of this paper, we set them zero. Similar procedure has been adopted in previous meta-analysis (e.g., Sethuraman and Tellis 1991). In about 3% of the observations, the cross-price elasticity was negative, large and significant. So, we could not include these observations. We also deleted two extreme observations with cross-price elasticity over 10 when all other cross-elasticities were below 6 Thus, we have 1030 cross-price elasticity observations on 280 brands from 75 product-store data sets for our meta analysis. The cross-elasticities range form 0 to 5.6. The average cross-price elasticity = .6 (s.d. = .72) About 80% of the cross-elasticities are between 0 and 1 and the rest 20% are between 1 and 6.

First, we assess if patterns of cross-price elasticities are consistent with asymmetric and neighborhood price effect hypotheses 1-3 comparing relevant group means. Finally, we test the robustness of our results with some additional analysis.

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[1] The studies are Allenby (1989); Allenby and Lenk (1994); Bemmaor and Mouscheau (1991); Blattberg and Wisniewski (1989); Bolton (1989); Bronnenberg and Wathieu (1996), Bucklin and Srinivasan (1991); Carpenter, Cooper, Hanssens and Midgley (1988), Chintagunta (1993); Cooper (1988); Kamakura and Russell (1989), Kim, Blattberg and Rossi (1995); Sethuraman (1995, 1996). Two studies – Bolton (1989) and Sethuraman (1995) – did not report all the cross-price elasticities in their paper. The estimates were obtained from the authors.

Analysis of Asymmetric/Neighborhood Effects-Comparison of Means

Hypotheses 1 and 2 relate to high-priced (HP) brands and low-price (LP) brands. Therefore we have to first classify brands as HP and LP brands Earlier theoretical and empirical works (e.g., Blattberg and Wisniewski 1989; Mulhern and Leone 1991, Sethuraman 1995) categorized national brands as high-priced brands and store brands as low-priced brands. Such categorization is somewhat arbitrary because a national brand can also be a low-priced brand. More recent theory and empirical works (Bronnenberg and Wathieu 1996; Sethuraman 1996) suggest that any two brands with different prices (and quality) can be viewed as high and low priced brands in relation to each other. Accordingly, for each brand-pair i, j we call brand i (j) as the high-priced brand if the reported average price of brand i (j) is greater than the price of brand j (i). If the prices are equal, then such brand-pairs are not considered in the asymmetric price effect analysis

There are 499 HP-LP brand-pairs for testing the overall asymmetric price effect (H1). The average cross-price elasticity of discount of a high-priced brand on sales of low-priced brand, $\eta_{HP\to LP}$ = .65 (s d = 77, n = 499) The average cross-price elasticity of discount of a low-priced brand on sales of a high-priced brand, $\eta_{LP\to HP}$ = 53 (s d = .67, n = 499) The difference (.112) is significantly greater than zero (t_{966} = 2.66, $p < .01$). Thus, overall pattern of cross-price elasticities is consistent with asymmetric price effect.

Hypothesis 2 suggests that asymmetric price effect will be strong when the market share of high-priced brand is equal to or higher than the share of the low-priced brand and weaker when the market share of high-priced brand is lower. Figure 1A depicts the interaction effect. When the share of the high-priced brand is higher ($S_{HP} \geq S_{LP}$), the asymmetric price effect is strong. The difference in mean cross-price elasticity is 31 and significantly greater than zero When the share of high-priced brand is smaller ($S_{HP} < S_{LP}$), the asymmetric price effect is weak and even reversed. The difference in mean is -.07 and not statistically significant Thus patterns in cross-price elasticities suggest that asymmetric price effect is moderated by relative market share

For testing neighborhood price effect (H3), we define a brand j as a price neighbor of brand i if the price j is equal to, immediately below, or immediately above the price of brand i. For example, suppose brands are arranged in ascending order of prices such that rank 1 brand is the highest-price brand, rank 2 brand is the next highest priced brand, and so on. Then, for rank 1 brand, rank 2 brand is the neighbor. For rank 2 brand, rank 1 and rank 3 brands are neighbors. More generally, for rank i brand, rank i-1 and rank i+1 brands are neighbors.

There are 232 such neighboring brand-pairs in our 464 cross-price elasticities. The mean cross-price elasticity of these neighboring brand-pairs is .80 (s.d. = .87, n = 464). Then mean cross-price elasticity of the non-neighboring brand pairs is .44 (s.d. = .52, n = 566). The difference in mean (.36) is significantly greater than zero (t_{1028} = 7.78, $p < .01$). Thus patterns in cross-price elasticities appear to be consistent with neighborhood price effect hypotheses.

The matrix of mean cross-price elasticities arranged by price rank (Table 1) offers more detailed information on asymmetric and neighborhood price effects. Table 2 converts the elasticity matrix into asymmetric and overall promotion effects for all brand-pairs i, j. The lower-diagonal elements represent the asymmetric effect, $\eta_{i\to j} - \eta_{j\to i}$. By hypothesis 1, we expect them to be positive and find that to be the case in 11 out of 15 elements The upper diagonal elements represent overall promotion intensity $[(\eta_{i\to j} + \eta_{j\to i})/2]$. By H3, the magnitude should be the highest with its neighboring rank brand(s) which we find to be the case for all brands except one (rank 5 brand) Thus asymmetric and neighborhood price effects are both validated.

A closer look at Table 1 offers further insights into neighborhood price effect The highest-priced (Rank 1) brand has maximal elasticity impact on the next-highest priced (Rank2) brand ($\eta_{1\to2}$ = 1.17). Rank 2 brand affects Rank 3 brand strongly ($\eta_{2\to3}$ = .75), though it affects Rank 5 brand also strongly. Rank 3 brand affects rank 4 brand the most ($\eta_{3\to4}$ = .89). Rank 5 brand affects Rank 6 brand the most ($\eta_{5\to6}$ = .62). These patterns indicate that, on average, each brand affects its immediately lower-priced brand the most. This occurrence can be explained in our framework as arising from a combination of neighborhood and asymmetric price effects. For an i'th ranked brand, neighborhood effect hypothesis states that discount impact with neighboring price brands ($\eta_{i\to i+1}$ and $\eta_{i\to i-1}$) should be greater

than the effect on its non-neighboring brands ($\eta_{i->i-k}$ and $\eta_{i->i+k}$, $\forall$ k>1). The asymmetric effect suggests that a brand hurt its lower priced (higher rank) brand more than its higher priced brand. Hence $\eta_{i->i+1} > \eta_{i->i-1}$ Taken together, $\eta_{i->i+1}$ will in general be the highest or a brand affects its next highest price brand the most In support of this, the mean cross-price elasticity
(.880)is the highest among all possible i, j pairs [Mean($\eta_{i->i+1}$) > Mean($\eta_{i->i+k}$, $\forall$ k $\neq$ 1)].

Note further from Table 1 that rank 1 brand affects Rank 6 brand the least ($\eta_{1->6}$ = .38) and is least affected by the lower-priced brand (e.g., $\eta_{6->1}$ = 28). Rank 2 brand also appears to have relatively less impact on the lower-priced brand ($\eta_{2->6}$ = 36) and not much affected by it either ($\eta_{6->2}$ = .30). These findings have market structure implications. Perhaps, as Allenby (1989) suggests, high-priced brands and low-priced brands form different segments They compete more within their segment than with members of the other segment

Do cross-price effects vary when there are market share differences? One can extend the theory of Bronnenberg and Wathieu (1996) to understand asymmetries when prices are only slightly different (more or less similar) but there are market share differences. According to their theory, asymmetry favors the brand with positioning advantage In this case, it would be the higher quality brand whose price is nearly equal to the lower-quality brand The brand with positioning advantage is likely to have a larger share Hence, asymmetry will favor the High-Share brand. If this logic holds for cross-price elasticities, then we should observe asymmetric share effect similar to the asymmetric price effect. Chintagunta (1993) finds that large-share brands tend to be more "effective" than small share brands when they promote.

To test the asymmetric share effect, we classify the brands as High-Share (HS) brands and Low-Share (LS) brands in the same way as we did for price For each brand-pair i, j we classify brand i (j) as the high-share brand if the reported average market share of brand i (j) is greater than the market share of brand j (i) If the shares are equal, then such brand-pairs are not considered in the asymmetric share effect analysis

There are 510 HS-LS brand-pairs for testing the overall asymmetric share effect The average cross-price elasticity of discount of a high-share brand on sales of low-share brand, $\eta_{HS\to LS}$ = .71 (s.d. = .82, n = 510). The average cross-price elasticity of discount of a low-share brand on sales of a high-share brand, $\eta_{LS\to HS}$ = .49 (s.d =.59, n = 510). The difference (.22) is significantly greater than zero (t_{1018} = 4.89, $p < .01$). Thus, patterns in cross-price elasticities indicate an asymmetric share effect as well.

Analysis of Asymmetric/Neighborhood Effects - Regression Approach

We jointly estimate the asymmetric and neighborhood effects using an ANOVA or regression model. The dependent variable is the cross-price elasticity or effect of brand i's price change on brand j's sales, $\eta_{i\to j}$. We attempt to explain some of the variation in $\eta_{i\to j}$ with asymmetric/neighborhood effects and available covariates. Hypothesis 1 suggests an overall asymmetric price effect. Hypothesis 2 suggests that the asymmetric price effect is moderated by relative market share. Empirical findings and arguments based on Bronnenberg and Wathieu (1996) theory suggest that asymmetry in cross-price elasticity could occur simply due to market share differences. Hence we estimate the following asymmetric effects: main price effect, main share effect, and an interaction effect due to price and market share differences.

Hypothesis 3 suggests a neighborhood price effect. Though not hypothesized, we also include neighborhood share effects: main price effect, main share effect, and an interaction effect due to price and market share differences.

In addition, we test if there are systematic differences in cross-price elasticities due to study "design" factors as suggested by Farley and Lehmann (1986). The fifteen studies analyzed different grocery products. However, not much information was provided in several of these studies except to indicate whether the product in question belongs to the food or non-food category. Accordingly, we incorporate a variable to assess if there is a difference in cross-price elasticities between food and non-food products. The studies also differed in the type of data (store vs. panel data) and functional form (e.g., linear, attraction, Logit) and whether the dependent variable is sales or market share. However, we could not include all these variables as independent factors because of confounding (in some sense perfect collinearity). For instance, all panel data studies employed some form of Logit estimation procedure and produced market share elasticities.

Hence, in the model, we include only differences due to functional form. We also include number of brands as a covariate.

Based on the above discussion, the model we estimate is as follows

(1) $\eta_{i->j} = f(ASYMP_{ij}, ASYMS_{ij}, ASYMP_{ij} * ASYMS_{ij}, NEIBORP_{ij}, NEIBORS_{ij}, NEIBORP_{ij} * NEIBORS_{ij}, PROD, FUNCORM, NBRAND)$, where

$\eta_{i->j}$: cross-price elasticity representing effect o brand i's price change on sales or market share of brand j.

$ASYMP_{ij}$ variable measuring asymmetric price effect = 1 if $P_i > P_j$ and 0 if $P_i < P_j$.

$ASYMS_{ij}$ variable measuring asymmetric share effect = 1 if $S_i > S_j$ and 0 if $S_i < S_j$

$ASYMP_{ij} * ASYMS_{ij}$ interaction effect asymmetric price and market share.

$NEIBORP_{ij}$ variable measuring neighborhood price effect =1 if P_j is immediately above or immediately below P_i, and 0 otherwise

$NEIBORS_{ij}$ variable measuring neighborhood share effect =1 if S_j is immediately above or immediately below S_i, and 0 otherwise

$NEIBORP_{ij} * NEIBORS_{ij}$: interaction effect between neighborhood price and share.

PROD variable measuring differences due to product characteristic = 1 if non-food and 0 if food product.

FUNCORM set of dummy variables measuring differences due to functional forms

NBRAND total number of brands in the product category (data set)

Table 3 provides the regression results. There are 988 observations The R^2 for the model is .19 ($F_{12, 975}$ = 18.9, $p < .01$) This figure, though somewhat lower, compares favorably with those from prior meta-analyses - Sethuraman and Tellis (1991) .20, Tellis (1988) .28, Assmus, Farley and Lehmann (1984) .36. The regression results indicate a strong and significant ($p < .01$) asymmetric price and share main effects. The asymmetric price*share interaction effect is significant at the 7% level The neighborhood price main effect is significant ($p < .01$) These findings validate hypotheses 1-3. In addition, non-food products have significantly higher cross-price elasticity than food products. Compared to estimates from a Logit model, the cross-price elasticities are higher for attraction model and lower for semi-log and log-log models. Cross-price elasticities are higher when there are fewer brands in the market.

Additional Analysis

Alternate Tier Specification. In our analysis so far, we have classified a brand as high-priced (high-share) brand if its price (market share) is higher than the price (market share) of the competing brand. In this way, we were able to study all brand-pairs with different prices in the context of competition between high-priced and low-priced brands. However, the pioneering work of Blattberg and Wisniewsk (1989) perceived brands as belonging to different price "tiers." In line with this perspective, we classified brands as belonging to different price tier using the following procedure. We arranged the brands from lowest to highest priced brand. Any brand to the right of the mid-point or closer to the highest priced brand [i.e., price of the brand greater than p_l + R/2, where R = highest price (p_H) - lowest price (p_L) of the brands] is classified as high price-tier brand. We classify a brand as low price-tier brand if its price is relatively closer to the lowest-priced brand. 162 of 280 brands were classified as high price-tier brands and 118 as low price-tier brands.

If all brands have equal share, then the market share (0%) in a market with n brands should be 100/n. We take those brands with market share more than 100/n as high share-tier brands, those brands with market share less than 100/n are taken as low share-tier brands. 126 of 280 brands were classified as high share-tier brands and 154 as low share-tier brands.

The average cross-price elasticity of a discount of a high price-tier brand on sales of low price-tier brand, $\eta_{HPT\text{->}LPT}$ = .66 (n = 275), is significantly higher than the average cross-price elasticity of discount of a low price-tier brand on sales of high price-tier brand, $\eta_{LPT\text{->}HPT}$ = .44 (n = 275). The advantage of the tier-based classification is that it allows us to test asymmetric price-tier effect within similar share brands (same share tier) and among brands in different share tiers. Figure 1B depicts the asymmetric price*market share interaction effect. For similar share brands (same share tier), and when the high-priced brand is a low-share brand, weekly reverse asymmetry is observed.

For testing neighborhood price effect (H3), we compare brands in the same price-tier with brands in different price-tier The mean cross-price elasticity of brands in the same price-tier ("neighboring" brands) is .66 (n = 480) which is significantly greater than the mean cross-price elasticity of brands in different price-tier which is .55 (n = 550) Thus, patterns in cross-price elasticities appear to be consistent with asymmetric and neighborhood price effect hypotheses 1-3, with tier-based classification as well

Discussion of Results and Conclusions

First, we summarize and discuss our findings related to generalizable patterns in cross-price elasticities Then we specify the limitations and directions for future research

Empirical Generalizations in Cross-Price Elasticities

The empirical generalizations are organized along the same lines as the hypotheses Asymmetric Cross-Promotion Effects and Overall Cross-Promotion Effects

<u>Asymmetric Cross-Promotion Effects</u>. Price is Proportionate Power, but Market Share Moderates

On average, across all observations, high-priced brands draw relatively higher proportion of sales or market share from low-priced brands when they discount, while low-priced brands draw relatively smaller proportion of sales from the high-priced brands. The asymmetric price effect is clearly observed after accounting for market share differences (Table 3) and when brands have similar market shares (Figure 1B) This finding lends credence to the conventional price-tier theory advanced by Blattberg and Wisniewski (1989) An interesting additional insight from our meta-analysis is that such asymmetric effect need not occur only when brands are in different price-tiers. They are observed even among brands which are relatively closer to each other in price

The basic explanation for this occurrence is that, in general, discounts by high-priced/high-quality brands are perceived by regular consumers of low-priced brands to be quite attractive, hence they switch. Whereas, discounts by low-priced/low-quality brands are not perceived by consumers of high-priced brands to be as attractive because of the quality difference (Allenby and Rossi 1991; Hardie, Johnson, and Fader 1993). By way of managerial implications, it would appear that, when proportionate draw is the objective, discounting should favor the high-priced brands. More research is needed to understand the marketing implications in greater detail.

Market share moderates the asymmetric price effect. Asymmetry favors the high-priced brand when the brand has the same or higher market share than the low-priced brand. But the asymmetric effect is weak and even reverses in magnitude when the high-priced brand has smaller market share than the low-priced brand. This finding refines the conventional price-tier theory as it pertains to asymmetries in cross-price elasticities - not all high-priced brands have proportionate power, only those with same or higher share than the low-price brands. One possible explanation for this result is from the model of Bronnenberg and Wathieu (1996). They suggest and analytically show that the attractiveness of a discount does not depend only on the quality difference (Q_H - Q_l), but on the quality difference relative to the price difference, which they call the positioning advantage ($(Q_H - Q_l)/(P_H - P_l)$). If this ratio is such that the high-priced brand is symmetrically attractive (in some sense, similar market share) or is more attractive than the low-priced brand (higher market share), then conventional asymmetry will be observed. If this ratio is low such that the low-priced/low-quality brand has a positioning advantage, then reverse asymmetry may be observed.

In addition, we observe an asymmetric share main effect- High-share brands draw greater portion of low-share brand sales than vice versa. This share "power" can be due to their positioning advantage (Bronnenberg and Wathieu 1996) or due to their higher awareness level (Hauser and Wenerfelt 1989) -more reputed, large-share brands are likely to be included by more consumers in their consideration set. So, when they discount, more consumers switch to these brands.

<u>Overall Cross-Promotion Effect</u>. Neighbors compete more intensely than distant brands.

We find a strong neighborhood price effect - brands compete more intensely with their immediately higher and lower priced brands with others. The intuitive reasoning is that consumers probably switch the most among brands of similar quality. Brands of similar quality are likely to be close to each other in price, hence promotion intensity is higher among these brands. Bronnenberg and Wathieu (1996) formalize this intuition by showing that the cross-price effect is inversely proportional to the quality distance (Q_H - Q_L). As a further refinement to the neighborhood price effect, we also find that the patterns in cross-price elasticities are such that, on average, each brand affects its immediately lower-priced brand the most.

These findings have market structure and discount strategy implications. Price orderings appear to be a reasonable basis for structuring the market. Similar-priced brands (same price-tier) appear to compete more among each other than with brands in different price-tier From a strategy standpoint, each brand should watch its neighboring brands' discount strategy closely and develop effective counter strategies. They should be especially wary of discounts by their immediately higher-priced brands since such brands are the ones which are likely to affect their sales the most

Limitations and Future Research Directions

We discuss the limitations/future research directions in three broad areas· Developing marketing implications, Analyzing measures besides elasticity, Investigating other issues in promotional effects

Developing Managerial Implications. Our finding of asymmetric price effect broadly suggests that discounting should favor the high-priced brands. Our findings of neighborhood price effect broadly suggest that brand managers should closely watch their neighboring brands' discount strategies and develop counter strategies if needed. More work is needed from a strategy point to translate these empirical generalizations into competitive discount strategies for manufacturers and retailers. For instance, what are the implications of asymmetric/neighborhood effects on depth and frequency of discounting for manufactures, and for promotion scheduling for retailers? We believe analytical models involving retailers and manufacturers should offer insights into the discount implication of asymmetric and neighborhood promotion effects.

Developing/Investigating Alternate Measures besides Elasticity. The objective of this paper has been to identify empirical generalizations in patterns of cross-price elasticities (percentage change in sales or market share). The importance of cross-price elasticities as a basis for understanding competitive promotion effects and market structure has been underscored by several researchers (Allenby 1989; Bucklin and Srinvasan 991, Cooper 1988). Furthermore, elasticities are dimensionless and can be easily compared across brands. Most empirical works of promotion effects report cross-price elasticities. The theory of Bronnenberg and wathieu (1996), on which our hypotheses are predominantly based, has been shown by them to hold for cross-price elasticities. Hence, we have meta-analyzed cross-elasticites. Accordingly our findings have to be interpreted in terms of proportionate changes.

However, studies dealing especially with Logit models have suggested measures other then cross-price elasticities such as market share movements and slope coefficients for measuring promotional effects (Mela, Gupta and Lehmann 1997, Sivakumar 1997). Future research should identify other measures for studying cross-promotion effects and investigate if asymmetric, overall, and aggregate promotion effects are validated with alternate measures.

Investigating Other Issues in Promotion Effects. We have tested the empirical generalizability related to some aspects of cross-promotion effects. There are a number of other promotion effects whose generalizability can be tested in future research For instance, future generalization research can address the effect of price promotion on category expansion (Sivakumar 1997) and the long term effect of promotions (Mela, Gupta, and Lehmann 1997).

Table 1

Cross-Price Elasticities ($\eta_{i->j}$) by Price Rank

	1	2	3	4	5	6
1	.97 (n=16)	1.17 (n=88)	.71 (n=58)	.55 (n=30)	.41 (n=18)	.38 (n=8)
2	.71 (n=88)	58 (n=4)	.75 (n=59)	.65 (n=30)	75 (n=18)	.36 (n=9)
3	.59 (n=58)	.87 (n=59)	.94 (n=8)	.89 (n=32)	.49 (n=15)	40 (n=8)
4	.52 (n=30)	.50 (n=30)	73 (n=32)	--	.49 (n=15)	.34 (n=8)
5	37 (n=18)	.56 (n=18)	.52 (n=15)	59 (n=15)	--	62 (n=9)
6	.28 (n=8)	.30 (n=9)	.62 (n=8)	.21 (n=8)	47 (n=9)	--

Note Rank 1 is the highest-priced brand Rank 2 is the next highest, and so on. Brands with equal prices given same ranks Sample sizes in parentheses. Data for Rank 7-12 brands not reported due to small sample sizes

Row is i and Column is j.

Table2

Asymmetric Overall Promotion Effect by Price Rank

	1	2	3	4	5	6
1	--	.89	65	.54	.39	.33
2	46	--	.81	.58	66	.33
3	.12	-.12	--	81	51	.51
4	.03	15	.16	--	.54	28
5	04	.19	- 03	-.10	--	.55
6	10	.06	- 22	.13	15	--

Note. Asymmetry = Lower Diagonal ($\eta_{j->i}$ - $\eta_{i->j}$)

Overall Promotion = Upper Diagonal ($\eta_{i->j}$ + $\eta_{j->i}$)/2

Table 3

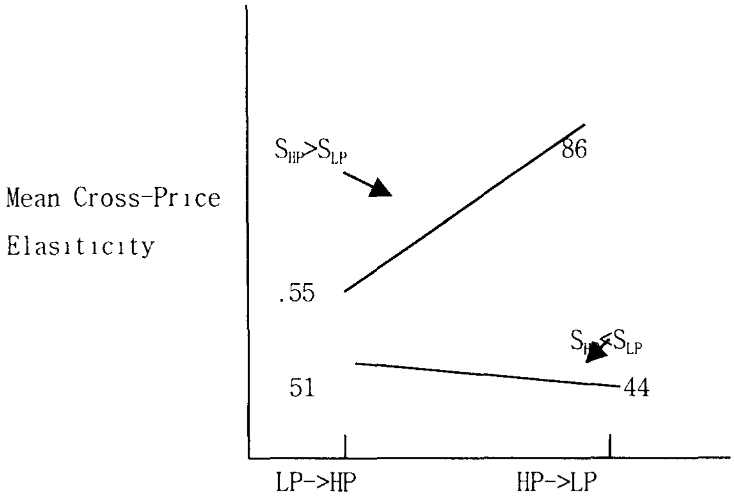
Regression Results - Asymmetric and Neighborhood Effects

		Hypothesis		Estimate
Variable	Notation	Level	Expected Sign	(std. Error)
Asymmetric Price Effect	ASYMP	HP->LP LP->HP	+ base	.16(.06)** -
Asymmetric Share Effect	ASYMS	HS->LS LS->HS	+ base	.27(.06)** -
Asymmetric Price*Share Interaction Effect	ASYMP* ASYMS	HP->LP* HS->LS	+	.13(.08)*
Neighborhood Price Effect	NEIBORP	Price neighbor Other	+ base	.21(.07)** -
Neighborhood Share Effect	NEIBORS	Share neighbor Other	? base	.11(.07) -
Neighborhood Price*Share Interaction Effect	NEIBORP* NEIBORS		?	.06(.09)
Product Type	PROD	Non-Food Food	? base	09(05)*
Functional Form	FONCFORM	Linear Semi-Log Log-Log Attraction Logit	? ? ? ? base	-.01(.07) -.19(07)** -.15(.08)* 18(.11)* -
Number of Brands	NBRAND	Raito scale	?	-.09(.015)**

Note ** Significant at 1% level. * Significant at 7% level. Where the sign of the coefficient is expected/hypothesized, one-tailed test is used Otherwise two-tailed test is used.

Figure 1A

Asymmetric Price*Share Interaction Effect (Rank Classification)



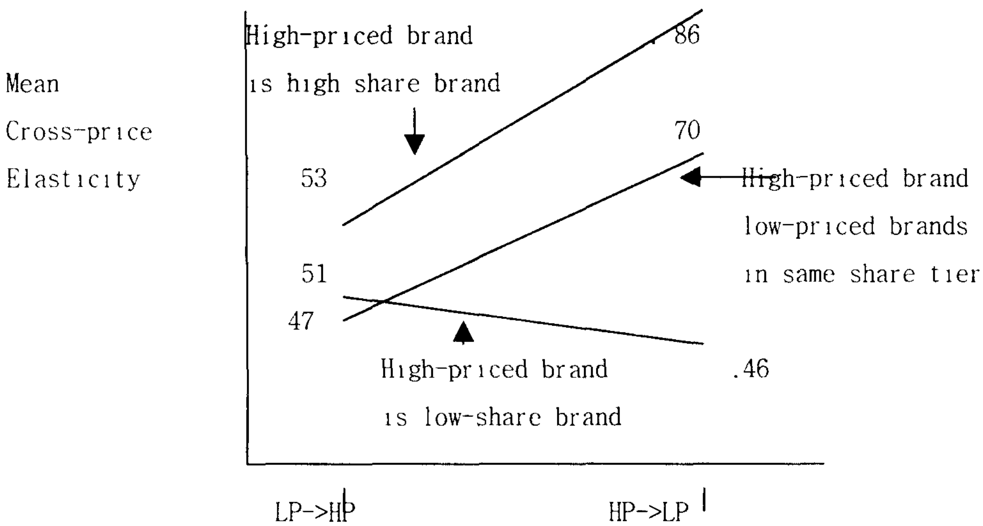
Note SHP: Share of high-priced brand; SLP: Share of low-priced brand

LP->HP Effect of price change of low priced brand on sales of high priced brand

HP->LP Effect of price change of high priced brand on sales of low priced brand

Figure 1B

Asymmetric Price*Share Interaction Effect (Tier Classification)



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