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On the Competitive Interaction Between Private Label and Branded Grocery Products

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Abstract

Recent research in marketing has focused on cross-category variation in the *market share* of private label products, while recent work in the economics and industrial organization literature has focused on the determinants of firm *price* setting behavior. In this paper, the authors develop a framework for estimating market share and price reaction equations simultaneously in an attempt to understand the nature of competitive interaction in the market for private label and branded grocery products. Empirical findings support the author's premise that consumer response to price and promotion decisions (demand) and the factors influencing firm pricing behavior (supply) *jointly* determine observed market prices and market shares. More specifically, the authors find a positive relationship between share and price on the supply side reflecting market power influences *and* a traditional negative relationship between share and price on the demand side. Finally, when oligopolistic interdependence is measured by specifying brand share, brand Herfindahl, and local retail market structure measures, results indicate that branded price is higher in markets dominated by national brands.

Keywords: Private Labels; Pricing; Competitive Strategy; Promotion

I. Introduction

The nature of competition between manufacturer "branded" products and retailer "private labels" is a primary concern of marketing managers in the food industry. Understanding the different factors that determine the competitive dynamics between national brands and private labels has taken on greater urgency over the past decade. In this vein, a 1994 survey of retailers expected a 14% increase in unit sales over the course of the 1994/1995 calendar years for store brands versus just 4% growth for national brands (*Advertising Age*, 4/25/94). More recently, private label sales have declined in some categories as national brands have effectively responded to private label competition (*BrandWeek*, 5/29/95, *New York Times* 6/11/96). Managing and understanding the nature of the competitive interaction between national brands and private labels has become an increasingly challenging task for brand managers and retailers.

Recent research in marketing has focused on variation in the *market share* of private label products across categories (Sethuraman 1992; Sethuraman and Mittelstaedt 1992; Hoch and Banerji 1993; Narasimhan and Wilcox 1994). A number of factors have been identified in the literature to explain the variation in private label market share across different product categories. Sethuraman (1992), for example, identifies twelve marketplace factors as potential determinants of private label success. These factors include retail sales volume, average retail price, price differential between the private label and national brands, retail private label price promotion and brand promotion.

A consistent yet surprising finding across cross-category studies is that there is a negative relationship between national brand-store brand price differential and store brand market share (McMaster 1987; Raju and Dhar 1991; Sethuraman 1992). Thus, the larger the price differential between national brands and private labels, the lower the private label share. Analytically, Raju, Sethuraman and Dhar (1995a) demonstrate that cross-category analysis may be inappropriate for assessing the true relationship between private label share and price differential, suggesting that analysis of within category data is more

appropriate.¹

While the focus in marketing studies has primarily been on *market share* relationships, recent work in the economics and industrial organization literature has focused on the determinants of firm *price* setting behavior. In particular, researchers have suggested an important link between market price and product differentiation, industry concentration, the use of market power, and market share (Schmalensee 1978; Deneckere and Davidson 1985; Weiss 1989). Conceptually, the nature of manufacturer-retailer competition in any given market will affect both the within channel power and the incentives for stocking and promoting store brands. The price setting behavior of both manufacturers and retailers will depend upon cost and demand considerations, as well as the nature of strategic interaction between competitors, including the potential use of market power by manufacturers and/or retailers. It is well established that factors that increase market power (such as increased concentration and market share) result in higher market prices (Weiss 1989).

We maintain that developing a complete understanding of the nature of the competitive interaction between national brands and private labels requires an understanding of the determinants of both market share and strategic pricing decisions by firms. Consumer response to price and promotion decisions (demand) and the factors influencing firm pricing behavior (supply) jointly determine observed market prices and market shares. There are three principal reasons why addressing both share and price simultaneously is important for understanding the competitive interaction between national brands and private labels:

1) Conceptually, share and price interact on both the demand and the supply side. As an example, recent price cuts in the ready-to-eat cereal category by Post and Nabisco resulted in a consumer response that increased its market share from about 16 percent to over 20 percent, while decreasing private label shares. In response, Kellogg's announced a 20 percent across the board price cut due to declining shares of its major brands (*New York Times*, 6/11/96). General Mills and Quaker Oats also reduced prices. Clearly share responds to price, while price setting is influenced by changes in share. Examining either

¹ Research in marketing parallels work in economics in this regard. Early research in economics found a positive "interbrand" relationship between the market share of individual brands and their price (Wills 1985). However, recent developments (Haller and Cotterill 1996) have demonstrated that, with appropriate demand side analysis, the "intra-brand" share-price relationship is negative.

share or price alone would provide an incomplete picture of the interaction between brands in this category.

2) It is well known that OLS applied equation by equation to jointly endogenous variables (e.g., price as a function of share and share a function of price as explained above) will produce inconsistent parameter estimates (see, e.g., Intriligator 1978 or Judge, 1985). In fact, it is not unusual for OLS to produce incorrect signs for certain parameters (see, e.g., Intriligator 1978). Simultaneous equation approaches to estimation have a long history in marketing (Bass 1969; Schultz 1971; Hanssens, Parsons and Schultz 1990; Neslin 1990).

3) The unexpected negative relationship between private label share and branded-private label price differential (or, equivalently, a positive relationship between own price and share) addressed in Raju, Sethuraman and Dhar (1995a) is the combination of two *separate* effects—one resulting in a positive relationship between share and price and the other resulting in a negative relationship. In recent work on Bertrand pricing models in a dominant-firm differentiated oligopoly, Haller (1994) and Haller and Cotterill (1996) have shown that a *positive* relationship between price and share is an *interbrand* relationship. Brands with larger market shares have higher prices than smaller share brands due to the market power that results from the higher share (Deneckere and Davidson 1985; Wills 1985). This is a supply side relationship that reflects the nature of interbrand competition and the use of market power. Alternatively, recent work by Baker and Bresnahan (1985, 1988), Bresnahan (1989), Cotterill and Haller (1994) and Haller and Cotterill (1996) suggests that over time and across markets, there is a *negative intrabrand* share-price relationship reflecting a traditional demand response—for any brand, an increase in its price lowers its share due to a decrease in demand. In short, there are two separate (and opposite) relationships between share and price—higher share affords a firm a higher degree of market power, enabling it to raise prices, while a higher price lowers demand for the product, thereby lowering its share. Thus, in order to properly understand the relationship between share and price, *both* interbrand supply and intrabrand demand relationships must be estimated in order to disentangle the two effects. Indeed, the empirical results below support our assertion that the supply side relationship is positive, while the demand side relationship is negative.

In the empirical analysis, we estimate a system of market share and price equations simultaneously in order to examine i) the determinants

of consumer's response to firm's pricing and promotion decisions and ii) the determinants of pricing behavior. Using market level data for 143 product categories, we develop a model that captures the variation in private label-national brand share and pricing across categories and markets.

In the next section, we describe the theoretical model that guides the empirical specification and the selection of variables. We specify a demand model based on the LA/AIDS model (Deaton and Muellbauer 1980b) and supply-side oligopoly price reaction equations that capture oligopolistic interdependence between the national brands and private labels. Next, we present the empirical framework to be used in estimation and discuss the estimation methodology. The results of the empirical analyses are then discussed in detail, followed by a discussion of the managerial implications.

II. Theoretical Framework

To keep the framework simple, we begin with a category-level model of a duopoly consisting of two firms, one producing a national "branded" product and the other producing a "private label" product. Both products compete in a specific geographic area with price the sole strategic variable.²

Define the following set of variables:

P_{ij}^1 = the price per pound of the national brand in category i and city j.

P_{ij}^2 = the price per pound of the private label in category i and city j.

Q_{ij}^1 = the quantity of the national brand sold in category i and city j.

Q_{ij}^2 = the quantity of the private label sold in category i and city j.

D_{ij} = a vector of demand shift variables for category i and city j.

W_{ij}^1 = a vector of supply-side cost shift variables for the national brand in category i and city j.

² We have not explicitly focused on channel issues in an attempt to keep the model tractable. Thus, we have made some simplifying assumptions regarding the strategic interaction between manufacturer and retailer. In the framework presented, imagine that the retailer controls the private label retail price, and that the manufacturer controls the national brand net retail price through a variety of measures such as trade promotions and on-pack prices. Thus, the price reaction system developed below is derived from retailer and manufacturer profit maximization in a Bertrand (price) differentiated oligopoly.

W_{ij}^2 = a vector of supply-side cost shift variables for the private label in category i and city j.

Define the demand functions for branded and private label products as:

$$Q_{ij}^1 = Q^1(P_{ij}^1, P_{ij}^2, D_{ij}) \quad (1)$$

$$Q_{ij}^2 = Q^2(P_{ij}^1, P_{ij}^2, D_{ij}) \quad (2)$$

The quantity of the national and private label products demanded are function of their prices and, following Hoch, Kim, Montgomery and Rossi (1995), a set of demand shift variables that will include per capita expenditures in category i and city j, family income level in city j, the percent of the population that is Hispanic in city j, and median family age in city j. Following standard demand theory (Deaton and Muellbauer 1980a), we hypothesize that own (cross) price is negatively (positively) related to quantity. Similarly, define the cost functions for branded and private label products as:

$$C^1(Q_{ij}^1, W_{ij}^1) \quad (3)$$

$$C^2(Q_{ij}^2, W_{ij}^2) \quad (4)$$

The total cost of producing Q_{ij}^2 is a function of Q_{ij}^2 and a vector of supply side cost shift variables. This vector will include a measure of package size to capture the hypothesis that smaller package sizes have higher costs per pound.

In a Nash Bertrand game where price is the strategic variable, the profit maximizing problems for the two firms are:

$$\text{MAX} \prod_1 = [P_{ij}^1 Q_{ij}^1(P_{ij}^1, P_{ij}^2, D_{ij}) - C^1(Q_{ij}^1, P_{ij}^1, P_{ij}^2, D_{ij}), W_{ij}^1] \quad (5)$$

$$\text{MAX} \prod_2 = [P_{ij}^2 Q_{ij}^2(P_{ij}^1, P_{ij}^2, D_{ij}) - C^2(Q_{ij}^2, P_{ij}^1, P_{ij}^2, D_{ij}), W_{ij}^2] \quad (6)$$

The first order conditions for these maximization problems results in the following two equations:

$$\frac{\partial \prod_1}{\partial P_{ij}^1} = g(P_{ij}^1, P_{ij}^2, D_{ij}, W_{ij}^1) = 0 \quad (7)$$

$$\frac{\partial \Pi_2}{\partial P_{ij}^2} = h(P_{ij}^1, P_{ij}^2, D_{ij}, W_{ij}^1) = 0 \quad (8)$$

From the first order condition for national brands, we can solve for the national brand price P_{ij}^1 as a function of the other variables:

$$P_{ij}^1 = R_1(P_{ij}^2, D_{ij}, W_{ij}^1) \quad (9)$$

Similarly, using the first order condition for private label price, P_{ij}^2 , one obtains:

$$P_{ij}^2 = R_2(P_{ij}^1, D_{ij}, W_{ij}^2) \quad (10)$$

These last two equations are the price reaction equations for the Nash-Bertrand model. They give each firm's profit maximizing price as a function of the other firm's price, exogenous demand and cost shift variables. The two products are said to be strategic complements if the reaction function is positive and strategic substitutes if the reaction function has a negative slope (Bulow, Geanakoplos, and Klemperer 1985; Tirole 1989). We hypothesize that the price reaction curves have positive slopes with regard to the other firms price (Deneckere and Davidson 1985); products are often strategic complements in price (Tirole 1989). In short, firms often demonstrate price followship behavior: a firm responds to a rival's price increase with a price increase of its own. Thus, an increase in the price of the national brand (private label) should lead to a strategic increase in private label (national brand) price. These coefficients capture the oligopolistic interdependence between national brands and private labels.

This model of national brand-private label interaction has four equations (two demand equations and two price reaction equations) and four endogenous variables (the two quantities and two prices). Since we also have a set of exogenous variables and this system is, in general, identified, and we can use simultaneous equation estimation techniques to estimate parameters and test hypotheses.

II.a. Choice of Functional Form

Demand analysis and functional form specification has been well developed in the economics literature (see, e.g., Deaton and Muellbauer 1980a or Philips 1983). Numerous forms have been proposed that are theoretically superior to a linear specification including the Linear Approximate Almost Ideal Demand System, or

LA/AIDS (Deaton and Muellbauer 1980b). The reasons for its superiority include the fact that it is derived from the underlying choice axioms in utility theory, individual behavior can be aggregated to consistently estimate demand parameters from market level data, and that it gives a first-order approximation to any "true" demand system functional form (Deaton and Muellbauer, 1980b). Hausman, et al. (1994) and Cotterill (1994a) have used the LA/AIDS framework to estimate brand level demand curves, while Cotterill, Franklin and Ma (1996) have incorporated oligopoly price reaction curves.

The general LA/AIDS functional form for the demand equation and the corresponding price reaction equation for the aggregate national brand manufacturer's brand (brand 1) are:³

$$S_{ij}^1 = \alpha_{10} + \alpha_{11} \ln P_{ij}^1 + \alpha_{12} \ln P_{ij}^2 + \alpha_{13} \ln(E_{ij}/P_{ij}) + \alpha_{14} D_{ij} \quad (11)$$

$$\ln P_{ij}^1 = \beta_{10} + \beta_{11} \ln P_{ij}^2 + \beta_{12} D_{ij} + \beta_{13} W_{ij} \quad (12)$$

where:

S_{ij}^1 = the dollar market share of the national brand in category i and city j,

E_{ij} = total per capita expenditure on category i in city j, and

P_{ij} = Stone's price index⁴ = $S_{ij}^1 \ln P_{ij}^1 + S_{ij}^2 \ln P_{ij}^2$.

The ratio of per capita expenditure and Stone's price index is a deflated (real) measure of per capita expenditures. Thus, its coefficient gives an estimate of the impact of changes in expenditures on demand for a given product. Following Green and Alston (1990), an estimate of the national brand's own price elasticity of demand is:

$$\eta^{11} = -1 + \frac{\alpha_{11}}{\bar{S}^1} + \alpha_{13} \quad (13)$$

Cross-price elasticity (here, with respect to private label price) is:

$$\eta^{12} = \frac{\alpha_{12}}{\bar{S}^1} + \alpha_{13} \frac{\bar{S}^2}{\bar{S}^1} \quad (14)$$

where \bar{S}^1 and \bar{S}^2 are sample average market shares or any other market

³ Note that there are four equations in total, two share equations and two price equations. For a detailed derivation, see Cotterill, Franklin and Ma (1996).

⁴ See Deaton and Muellbauer (1980a, 1980b) for an explanation of Stone's index.

share value. Note that these demand elasticities vary as market shares vary. Thus they are local or point estimates of the elasticities. The expenditure elasticity is given by the following formula:

$$\eta^{13} = 1 + \frac{\alpha_{13}}{\bar{S}^1} \quad (15)$$

The elasticities for variables, d^k , in the D vector of exogenous demand shift variables are:

$$e^k = \frac{\alpha_{14}^k \bar{d}^k}{\bar{S}^1} \quad (16)$$

where $k = 1 \dots m$ is the index for the number of variables in the D vector and \bar{d}^k is the average value of d^k .⁵ The price reaction elasticity for national brands, which gives the present change in brand price for a one percent change in private label price, is β_{11} in equation 12. The corresponding equations and elasticity formulae for private label are analogous to the branded equations presented above (equations 11 to 16).

Taking the anti-log of equation 12 gives the price reaction function for national brands:

$$P_{ij}^1 = e^{\beta_{10}} \cdot D_{ij}^{\beta_{12}} \cdot (W_{ij}^1)^{\beta_{13}} \cdot (P_{ij}^2)^{\beta_{11}} \quad (17)$$

Note that the slope of the price reaction function depends on the values of the exogenous variables in the system and their parameter estimates. Since all these variables are positive, the slope of the reaction is positive if and only if β_{11} is positive.

Finally, note that market share can be included in equations (12) and (17) to capture the effect of oligopolistic interdependence upon profit maximizing prices. Specifying share in the price reaction equation makes the model fully simultaneous as opposed to recursive in nature. Now brand price can have a negative (demand relationship) with share in the brand demand equation. However, a reverse relationship (share positively related to price) can occur in the price reaction curve capturing the power of brands *vis à vis* a small, weak private label sector.

⁵ If some variables are expressed in logarithmic form, then this elasticity formula has the inverse of d^k rather than d^k on the right hand side.

III. Empirical Framework

With any theory and data set, the transition from the theoretical model to empirical specification entails the need for careful variable selection. Consequently, we specify three nested empirical models below. Using nested hypothesis tests, we then select the "best" of the three specifications given the available data. In the first model ("Price Model"), we begin by presenting the simplest model implied by the theory presented above. Market share is not included in the price reaction equations, as in equations (12) and (17), making the model recursive in nature. We then expand this "base" specification by including market share in the price reaction functions, thereby creating a fully simultaneous system ("Market Power Model"). Finally, we expand this to include all promotion variables on both the demand and supply sides ("Full Power and Promotion Model"). *A priori*, since prior work in economics has demonstrated the importance of variables measuring market power, and prior work in marketing has shown the importance of promotion variables, we expect that the final "full" model will be preferred.

III.a. Empirical Specification I - Base Specification ("Price Model")

The model developed here is called the "Price Model" since the price variables are the main conjectural variables included in the analysis. This model includes only price, expenditure, as well as certain demand and cost shift variables. The four-equation Price Model specification is as follows (variable definitions for this and the other two specifications can be found in Chart 1):⁶

⁶ Consistent with previous work in marketing on private labels, aggregate private label and national brand variables were created for share, price and price reduction. Private label (national brand) share is sum of all private label (national) brands in the *i*th market, *j*th category. Private label (national brand) price is the volume-weighted average price of all private labels (national brands) in the *i*th market, *j*th category. The two price reduction variables are volume-weighted percent price reduction for all private label and branded products, respectively. Thus, for price and share, we have four aggregate variables: total branded share, total private label share, volume-weighted average price of national brands, and the volume-weighted average price of private label products.

Chart 1. Definitions for Variables Used in the Analysis

BRSHARE	Aggregate share of category expenditure for branded products in the <i>i</i> th market, <i>j</i> th category
PLSHARE	Aggregate share of category expenditure for private label products, <i>i</i> th market, <i>j</i> th category
BRPRICE	Natural log of the price of the branded product in the <i>i</i> th market, <i>j</i> th category
PLPRICE	Natural log of the price of the private label product in the <i>i</i> th market, <i>j</i> th category
EXPENDITURE	Natural log of per capita category expenditures deflated by Stone's price index
BRFEATURE	Percent of branded products sold with feature advertising in the <i>i</i> th market, <i>j</i> th category
BRDISPLAY	Percent of branded products sold with displays and POS promotion, <i>i</i> th market, <i>j</i> th category
PLFEATURE	Percent of private label products sold with feature advertising in the <i>i</i> th market, <i>j</i> th category
PLDISPLAY	Percent of private label products sold with displays and POS promotion
INCOME	Natural log of average household income in the local market
HISPANIC	Percent of population in the local market of Hispanic decent
AGE	Average age of the local market population
PLDISTN	Private label average distribution in the <i>i</i> th market, <i>j</i> th category
BRPRICEREDN	Weighted percent average price reduction, branded products, <i>i</i> th market, <i>j</i> th category
PLPRICEREDN	Weighted percent average price reduction, private label products, <i>i</i> th market, <i>j</i> th category
BRVOLPUN	Natural log of average volume (weight) per package unit sold for branded product
PLVOLPUN	Natural log of average volume (weight) per package unit sold for private label
HERFINDAHL	Herfindahl index of brand concentration in the <i>i</i> th market, <i>j</i> th category
GROCCR4	Percentage of all grocery sales by the top four grocery chains in the <i>i</i> th market, <i>j</i> th category

Note that the choice of variables was influenced by data availability. For example, no coupon or national advertising information was available. Also, average age, income and percent Hispanic were the only local demographic variables available.

$$\begin{aligned}
 \text{BRSHARE} &= \alpha_{10} + \alpha_{11} \text{BRPRICE} + \alpha_{12} \text{PLPRICE} + \alpha_{13} \text{EXPENDITURE} \\
 &+ \alpha_{16} \text{PLDISTN} + \alpha_{19} \text{INCOME} + \alpha_{110} \text{HISPANIC} + \alpha_{111} \text{FAMAGE} \\
 &+ \epsilon_1 \\
 \text{PLSHARE} &= \alpha_{20} + \alpha_{21} \text{BRPRICE} + \alpha_{22} \text{PLPRICE} + \alpha_{23} \text{EXPENDITURE} \\
 &+ \alpha_{26} \text{PLDISTN} + \alpha_{29} \text{INCOME} + \alpha_{210} \text{HISPANIC} + \alpha_{211} \text{FAMAGE} \\
 &+ \epsilon_2 \\
 \text{BRPRICE} &= \beta_{10} + \beta_{11} \text{PLPRICE} + \beta_{12} \text{BRPRICEREDN} + \beta_{13} \text{BRVOLPUN} \\
 &+ \beta_{17} \text{EXPENDITURE} + \beta_{112} \text{PLDISTN} + \beta_{113} \text{INCOME} \\
 &+ \beta_{114} \text{HISPANIC} + \beta_{115} \text{FAMAGE} + \omega_1 \\
 \text{PLPRICE} &= \beta_{20} + \beta_{21} \text{BRPRICE} + \beta_{22} \text{PLPRICEREDN} + \beta_{23} \text{PLVOLPUN} \\
 &+ \beta_{27} \text{EXPENDITURE} + \beta_{212} \text{PLDISTN} + \beta_{213} \text{INCOME} \\
 &+ \beta_{214} \text{HISPANIC} + \beta_{215} \text{FAMAGE} + \omega_2
 \end{aligned}
 \tag{18}$$

Note this framework is used as a base model for the hypotheses tests to follow. The missing numbers in the coefficient sequences above ($\alpha_{10}, \alpha_{11}, \alpha_{12}, \alpha_{13}, \alpha_{18}, \dots$) reflect the fact that the Price Model is a restricted version of the more general models presented below.

III.b. Empirical Specification II - Relaxing the Bertrand Assumption ("Market Power Model")

The Price Model can be extended in two ways to provide more insight into private label and national brand pricing. We begin first by concentrating on the supply-side effects of differences in market power (hence the term "Market Power" model), and then further expand the analysis and specification to include all demand-side promotion variables (hence the term "Full Power and Promotion Model").

We begin here by relaxing the Bertrand assumption, i.e., the assumption that each duopolist assumes that the other does not change price when it changes price. This seems reasonable given that the price reaction equations explicitly predict that profit maximizing firms will price conditional upon the other firm's price, and that firms observe that other firms react to their price changes. Oligopolistic interdependence in the generalized Bertrand model is captured by the level of the price conjectures. If firms follow each other's price moves completely (perfect tacit collusion) each firm's price conjecture has a value of one rather than zero as assumed in the Bertrand model. As the conjectural variation increases, the slope of the corresponding price reaction curves increases (Liang 1987).

Price conjectures cannot easily be measured because they are behavioral antecedents to observed market activity. However, following Cowling and Waterson (1976) and Kwoka and Ravenscraft (1986), their values are hypothesized to be functions of observable market structure. We specify national brand market share and the

brand level Herfindahl index in each logarithmic price reaction equation to capture the effect of changes in oligopolistic interdependence upon profit maximizing prices.⁷ National brand market share is, by definition, the sum of all national brand shares. As discussed in the introduction, it is hypothesized to have a positive impact upon branded price levels because as it increases, the market power of national brands increases due to reduced private label presence in the category.

The brand level Herfindahl index is defined as the sum of the square of all individual brand market shares.⁸ As such, when introduced jointly with national brand market share, it measures the size dispersion of brands. For example, branded share may sum to .80 (80 percent), while there may be only two brands each with .40 share. In this case, the brand level Herfindahl index equals .32. However, if there are 80 brands each with .01 market share (much like the breakfast cereal category), then the brand Herfindahl is only .008. Since the brand level Herfindahl index measures the degree of product differentiation via brand proliferation, we hypothesize that it will be negatively related to the prices of branded products. Segmentation and multiple brand strategies in a category tend to elevate the prices of all national brands (Willig 1991; Levy and Reitzes, 1993; Werden and Rozanski 1994).

The relationship between the brand level Herfindahl and price is likely to be different for private label products, however. One might expect that elevated national brand prices in markets with low brand Herfindahls would allow private labels to also increase price. However, Schmalensee's (1978) analysis of brand proliferation as a barrier to entry suggests that the impact of the brand Herfindahl upon private label prices may be positive. As leading firms in these markets build portfolios of brands with small shares, it is harder for private labels to enter with a me-too brand. For example, many successful

⁷ Deneckere and Davidson (1985) and Willig (1991) demonstrate that market share may be positively related to price even in Bertrand models because larger share brands are able to unilaterally raise price. This suggests that our empirical model measures unilateral as well as coordinated market power effects. Others, however, have disputed the existence of a positive share price relationship within the Bertrand model (Werden and Froeb 1996). See Willig (1991, pp. 299-305) for a discussion of the ability of market share to predict price levels in differentiated product markets.

⁸ Note that the brand Herfindahl index is not the company Herfindahl index. The brand level Herfindahl in breakfast cereal, for example, is very low but the company level Herfindahl is very high because each of the top three companies sells many brands. Company Herfindahls are not available for inclusion in this study.

children's cereal brands capture only .006 (.6%) of the cereal market. A private label brand can hope at best to capture one third of this. The resulting volume is not sufficient to sustain production and distribution. Therefore, we hypothesize that private label price is positively related to the brand level Herfindahl index. We also specify the retail grocery four firm concentration ratio in the price reaction curves to capture the increased oligopolistic interdependence in cities where a few supermarket chains account for most of the sales. Both branded and private label prices are hypothesized to be higher in more concentrated local markets.

A second extension of the Price Model addressed in the Market Power Model is the inclusion of trade promotion variables in the price reaction function. These promotion variables are: short term percent price reduction, percent of volume sold on display, and percent of volume sold with a local newspaper feature ad. While one could model these as additional strategic variables to create a multi-dimensional game, this would generate six more reaction equations and prevent estimation of the system due to insufficient exogenous cost shift variables in those equations to identify them. We specify these variables as exogenous strategic factors that each duopolist uses to determine price levels and/or shift demand. Since IRI reported prices are net of promotional price reductions, the level of price reduction is clearly one determinant of reported price. Thus, percent price reduction for national brands (private label) are specified in the branded (private label) price reaction equation. Similarly, display and feature and programs are strongly tied to shelf price reduction strategies and may effect demand primarily via changes in retail prices. This formulation implies specifying the national brand feature and display variables only in the branded price reaction equation and the private label feature and display variables only in the private label price reaction equation. Thus, the Market Power model is specified as follows:

(19)

$$\begin{aligned}
 \text{BRSHARE} &= \alpha_{10} + \alpha_{11} \text{BRPRICE} + \alpha_{12} \text{PLPRICE} + \alpha_{13} \text{EXPENDITURE} \\
 &\quad + \alpha_{16} \text{PLDISTN} + \alpha_{19} \text{INCOME} + \alpha_{110} \text{HISPANIC} + \alpha_{111} \text{FAMAGE} \\
 &\quad + \epsilon_1 \\
 \text{PLSHARE} &= \alpha_{20} + \alpha_{21} \text{BRPRICE} + \alpha_{22} \text{PLPRICE} + \alpha_{23} \text{EXPENDITURE} \\
 &\quad + \alpha_{26} \text{PLDISTN} + \alpha_{29} \text{INCOME} + \alpha_{210} \text{HISPANIC} + \alpha_{211} \text{FAMAGE} \\
 &\quad + \epsilon_2 \\
 \text{BRPRICE} &= \beta_{10} + \beta_{11} \text{PLPRICE} + \beta_{12} \text{BRPRICEREDN} + \beta_{13} \text{BRVOLPUN} \\
 &\quad + \beta_{14} \text{BRSHARE} + \beta_{15} \text{HERFINDAHL} + \beta_{16} \text{GROCCR4} \\
 &\quad + \beta_{17} \text{EXPENDITURE} + \beta_{18} \text{BRFEATURE} + \beta_{19} \text{BRDISPLAY} \\
 &\quad + \beta_{112} \text{PLDISTN} + \beta_{113} \text{INCOME} + \beta_{114} \text{HISPANIC}
 \end{aligned}$$

$$\begin{aligned}
& + \beta_{115} \text{FAMAGE} + \omega_1 \\
\text{PLPRICE} = & \beta_{20} + \beta_{21} \text{BRPRICE} + \beta_{22} \text{PLPRICEREDN} + \beta_{23} \text{PLVOLPUN} \\
& + \beta_{24} \text{BRSHARE} + \beta_{25} \text{HERFINDAHL} + \beta_{26} \text{GROCCR4} \\
& + \beta_{27} \text{EXPENDITURE} + \beta_{28} \text{BRFEATURE} + \beta_{29} \text{BRDISPLAY} \\
& + \beta_{212} \text{PLDISTN} + \beta_{213} \text{INCOME} + \beta_{214} \text{HISPANIC} + \beta_{215} \text{FAMAGE} \\
& + \omega_2
\end{aligned}$$

III.c. Empirical Specification III ("Full Power and Promotion Model")

A third model, the full power and promotion model, specifies the four promotion variables (branded feature, branded display, private label feature, and private label display) in each demand and price reaction equation. This allows the promotion variables to have a direct share expanding effect as well as the indirect effect via prices that was addressed in the previous model. This specification corresponds with the standard conceptualization of end-aisle displays and feature ads increasing sales even if there is no price promotion. This implies the following specification:

(20)

$$\begin{aligned}
\text{BRSHARE} = & \alpha_{10} + \alpha_{11} \text{BRPRICE} + \alpha_{12} \text{PLPRICE} + \alpha_{13} \text{EXPENDITURE} \\
& + \alpha_{14} \text{BRFEATURE} + \alpha_{15} \text{BRDISPLAY} + \alpha_{16} \text{PLDISTN} \\
& + \alpha_{17} \text{PLFEATURE} + \alpha_{18} \text{PLDISPLAY} + \alpha_{19} \text{INCOME} \\
& + \alpha_{110} \text{HISPANIC} + \alpha_{111} \text{FAMAGE} + \epsilon_1 \\
\text{PLSHARE} = & \alpha_{20} + \alpha_{21} \text{BRPRICE} + \alpha_{22} \text{PLPRICE} + \alpha_{23} \text{EXPENDITURE} \\
& + \alpha_{24} \text{BRFEATURE} + \alpha_{25} \text{BRDISPLAY} + \alpha_{26} \text{PLDISTN} \\
& + \alpha_{27} \text{PLFEATURE} + \alpha_{28} \text{PLDISPLAY} + \alpha_{29} \text{INCOME} \\
& + \alpha_{210} \text{HISPANIC} + \alpha_{211} \text{FAMAGE} + \epsilon_2 \\
\text{BRPRICE} = & \beta_{10} + \beta_{11} \text{PLPRICE} + \beta_{12} \text{BRPRICEREDN} + \beta_{13} \text{BRVOLPUN} \\
& + \beta_{14} \text{BRSHARE} + \beta_{15} \text{HERFINDAHL} + \beta_{16} \text{GROCCR4} \\
& + \beta_{17} \text{EXPENDITURE} + \beta_{18} \text{BRFEATURE} + \beta_{19} \text{BRDISPLAY} \\
& + \beta_{110} \text{PLFEATURE} + \beta_{111} \text{PLDISPLAY} + \beta_{112} \text{PLDISTN} \\
& + \beta_{113} \text{INCOME} + \beta_{114} \text{HISPANIC} + \beta_{115} \text{FAMAGE} + \omega_1 \\
\text{PLPRICE} = & \beta_{20} + \beta_{21} \text{BRPRICE} + \beta_{22} \text{PLPRICEREDN} + \beta_{23} \text{PLVOLPUN} \\
& + \beta_{24} \text{BRSHARE} + \beta_{25} \text{HERFINDAHL} + \beta_{26} \text{GROCCR4} \\
& + \beta_{27} \text{EXPENDITURE} + \beta_{28} \text{BRFEATURE} + \beta_{29} \text{BRDISPLAY} \\
& + \beta_{210} \text{PLFEATUE} + \beta_{211} \text{PLDISPLAY} + \beta_{212} \text{PLDISTN} \\
& + \beta_{213} \text{INCOME} + \beta_{214} \text{HISPANIC} + \beta_{215} \text{FAMAGE} + \omega_2
\end{aligned}$$

Since the Full Power and Promotion Model includes both the demand and supply side effects of promotion, as well as the relevant variables influencing market power, we expect that hypothesis tests will support this model over the Price Model and the Market Power Model. Chart 2 summarizes our maintained hypotheses.

Note that our nine hypotheses are not all-inclusive. A few of the coefficient signs are not predicted by our theory. Examples include the

Chart 2. A Summary of Maintained Hypotheses.

Hypotheses	Rationale
HI1: $\alpha_{11}, \alpha_{22} < 0; \alpha_{12}, \alpha_{21} > 0$	Standard economic theory predicts negative own-price elasticities and positive cross-price elasticities for substitute goods. Further, effects should be asymmetric (Blattberg and Wisniewski 1989).
HI2: $\alpha_{14}, \alpha_{15}, \alpha_{27}, \alpha_{28} > 0$ $\alpha_{17}, \alpha_{18}, \alpha_{24}, \alpha_{25} < 0$	Increased own promotions have a positive impact on own sales and a negative impact on the rival's sales.
HI3: $\alpha_{19} > 0, \alpha_{29} < 0$	As per capita income increases, branded share increases and private label share decreases. The former is a luxury and the latter a necessity.
HI4: $\alpha_{16} < 0, \alpha_{26} > 0$ $\beta_{112} < 0; \beta_{212} > 0$	As more supermarkets in a local market carry private labels (increased private label distribution), the share and price of national brands decrease (due to the increased competition), and the share and price of private labels increase.
HI5: $\beta_{11}, \beta_{21} > 0$	The slope of the price reaction curves are positive (Deneckere and Davidson 1985).
HI6: $\beta_{13}, \beta_{23} < 0$	Increasing average package size lowers cost, thereby lowering market price.
HI7: $\beta_{14} > 0$	Increasing national brand share increases the market power of branded products, increasing the ability of national brand manufacturers to raise price (Deneckere and Davidson 1985, Wills 1985, Haller 1993, Haller and Cotterill 1996).
HI8: $\beta_{15} < 0; \beta_{25} > 0$	Decreasing brand Herfindahl due to product proliferation increases the market power of incumbents by creating entry barriers and raising national brand prices (Schmalensee 1978, Levy and Reizes 1993).
HI9: $\beta_{16}, \beta_{26} > 0$	Increases in grocery firm local market concentration increase prices due to increased market power at the retail level (Marion et al. 1979, Weiss 1989, Cotterill and Harper 1995).

effects of age, deflated per capita category expenditures, and the percent Hispanic on own market shares.

IV. Empirical Estimation

The data used in this study are annual IRI market-level data on food products across 59 geographic markets and 211 categories for 1991 and 1992. Categories were excluded from the analysis if they contained missing data, or if they were categories where private labels have not been introduced. This left 143 categories in the sample and 7,197 observations for an average coverage of 50 out of 59 possible cities for a typical category. National brand share averaged .783, while private label share was .217 in 1992.

These data are merged with independent data from *Progressive Grocer* on the demographic characteristics of the IRI geographic markets. Thus, we have two principal dimensions on which the data vary, across categories and across geographic markets. Consistent with previous work in the private label area (e.g., Sethuraman and Mittelstaedt 1992; Hoch and Banerji 1993; Raju, Sethuraman and Dhar 1995b), aggregate branded and private label variables were created for the 143 product categories and 59 markets. Brand price, feature, display, and price reduction variables are volume as opposed to dollar market share weighted averages. IRI reports corresponding aggregate private label variables for all categories and local markets.

In estimating cross-category price equations, it is important to note that cross-category analysis precludes the use of price levels. One cannot compare the price of a pound of cheese to the price of canned soup. Following Kelton and Weiss (1989), we will estimate the first difference form of our model. The parameters estimated in the first difference model are identical to those in equations 18-20 and thus can be used to compute elasticities. In the following sections, all reported estimates use the annual difference rather than the level of the variable for 1991 to 1992. For example BRSHARE is 1992 BRSHARE minus 1991 BRSHARE and BRPRICE is the 1992 ln BRPRICE minus the 1991 ln BRPRICE. Changes in the natural logarithm of price from 1991 to 1992 are percent price changes which can be analyzed across categories.

Estimating a first difference model is also attractive because it controls for first order fixed effects due to excluded local market and

category variables in level regressions.⁹ Further, to the extent that private label quality is constant from 1991 to 1992, estimating a first difference model eliminates the need for the inclusion of a category private label quality measure—an assumed constant level of quality drops out of the analysis when we difference. This is particularly important since quality measurement is such a difficult task (Hoch and Banerji 1993 and Narasimhan and Wilcox 1994).

Although our model has four equations, one of the demand equations is redundant for estimation purposes. Since the market shares of national brands and private labels sum to one, any loss of branded share due to changes in any variable, e.g. private label price, must go to private label share. This general adding up property of a demand system means that we can recover the estimated coefficients and standard errors (t-ratios) for the dropped equation. We drop the private label demand equation and estimate the remaining 3 equations with three stage least squares. We do not impose the homogeneity and symmetry restrictions of demand theory because they would restrict the four own price and cross price coefficient to a common value in this aggregate two-good demand system.

V. Results

Results are reported in Tables 1 through 4. Since traditional R^2 measures are not bounded between zero and one in three stage least squares, Carter and Nagar's (1977) multiple coefficient of correlation for simultaneous systems, R_w^2 , is used here and reported in Tables 1 through 3.¹⁰ Since the model structure represented by the three models was nested, zero parameter restrictions were tested via an analog of the likelihood ratio test (Gallant and Jorgenson 1979; Kiviet 1985; Judge 1985). We tested two sets of zero parameter restrictions—the first set of restrictions being $\beta_{14}, \beta_{15}, \beta_{16}, \beta_{18}, \beta_{19}, \beta_{24}, \beta_{25}, \beta_{26}, \beta_{28}$, and β_{29} all equal zero, and the second set adds the α_{14} ,

⁹ Hausman and Taylor (1981) argue that excluded local market variables in panel data of this type can bias estimation results for level regressions. They show that this can be avoided by specifying a set of city binary variables. These drop out of the model when one takes the first difference. This is also true for specifying a set of category binary variables in level regressions to control for excluded variables in individual categories.

¹⁰ R_w^2 has a usual R^2 interpretation. Specifically, it measures the percent of system-wide variation in the exogenous variables explained by all independent variables in the system. It is bounded by zero and one.

α_{15} , α_{17} , α_{18} , α_{24} , α_{25} , α_{27} , α_{28} , β_{110} , β_{111} , β_{210} and β_{211} all equal to zero. The test statistic T^0 , distributed as a chi-square (see Gallant and Jorgenson 1979), leads us to strongly reject both sets of zero parameter restrictions.

Since the inclusion of all market power and promotion variables are supported by the nested hypotheses tests, we will discuss only the Full Power and Promotion Model below. For completeness, Table 1 reports estimation results for the Price Model, while Table 2 reports estimation results for the Market Power Model. Note that parameters and t-ratios are recovered for the private label demand equations as well.¹¹

Table 3 presents estimation results for the Full Power and Promotion Model. In Chart 2, nine hypotheses were presented, with a total of 27 predicted signs. All 27 of the estimated coefficients were of the predicted signs, with 24 of the 27 coefficients significant at the 5% level or better. We now turn to a discussion of the hypotheses presented in Chart 2.

V.a. Price and Share Effects

After estimating both share and price reaction equations simultaneously, the share-price relationship becomes clear. An increase in the price of a national brand decreases its share, a standard demand-side effect. The same is true for private label products. Conversely, a one percent increase in branded share increases the price of branded products by over four percent, a supply-side effect caused by a higher degree of market power. An increase in private label share does not result in a higher price for private label products presumably because of the fact that the market power of private labels (even with increases in share) is quite small. As discussed in the introduction, higher prices lower share, while higher share increases the ability of branded manufacturers to raise prices.

The own and cross price coefficients in the demand equations (H1) have the hypothesized signs and are significant at the 1 percent level. The direction and significance levels of the expenditure effects indicate that national brands are viewed as luxuries and private labels as necessities (in an economic sense). As expenditures on a category

¹¹ The adding up condition of the demand system requires that all coefficients on a particular variable to sum to zero. With only two demand equations in the system, the recovered private label coefficients and t-ratios are the negative of the corresponding national brand values. For example, if a unit increase in the national brand price reduces national brand market share by five percentage points, private label market share must fall by a corresponding percentage points.

Table 1. Estimation Results for Price Model

	Demand Equations		Price Reaction Equations	
	Branded Share	Private Label Share	Branded Price	Private Label Price
Branded Price	-0.0127	0.0127		0.0849
Private Label Pr	0.0071	-0.0071		
BR Price Reduction	(-3.413)**	(3.413)**	(17.00)**	(9.647)**
PL Price Reduction	(2.294)*	(-2.294)*	(-13.31)**	(-17.19)**
BR Volume/Unit			(154.8)**	
PL Volume/Unit			(31.60)**	(-129.4)**
Expenditure	0.0589	-0.0589	(4.883)**	0.0951
PL Distribution	-0.1921	0.1921	(10.04)**	-0.0434
Income	0.0186	-0.0186	(-3.110)**	0.0442
Hispanic	0.0554	-0.0554	(-6.004)**	0.0249
Family Age	-0.0027	0.0027		-0.0437

** significant at the 1% level.

* significant at the 5% level.

Number of Observations = 7197; $R_w^2 = .750$

increase, more goes to national brands than to private labels. This is consistent with recent work on category expenditure (Putsis and Dhar 1996). Increases in household income (H3) behave like increases in category per capita expenditures—income gains significantly increase (decrease) branded (private label) share. Private label distribution measures the proportion of supermarkets that sell private labels in a given market. As expected (H4), private label penetration has a strongly significant negative (positive) relation to branded (private label) share.

Each price reaction equation has a positive and significant slope with regard to the other price as hypothesized (H5). The estimated elasticities, however are not high. A one percent increase in private label prices elicits only a .1308 percent increase in national brand price, while a one percent increase in national brand price elicits only a .1076 percent increase in private label price. Price followship between private labels and national brands is positive, as conjectured earlier, but it is not strong. The volume per unit (H6) variables behave as hypothesized and are highly significant. Branded prices are significantly lower in cities with a larger percent of the population that is Hispanic.

V.b. Market Power and Promotion Effects

In terms of the market structure variables in the price reaction equations, an increase in national brand share has a significant positive impact on national brand prices (H7), suggesting that national brands can profitably raise price when private label competition is weak. The brand Herfindahl coefficients (H8) have the hypothesized sign: categories with many brands (low Herfindahl) have higher national brand prices. As suggested by Schmalensee (1978) and Levy and Reitzes (1993), brand proliferation elevates all brand prices and makes it more difficult for private label to compete. Retail grocery four firm concentration (H9) has the hypothesized market power effect—increases in the share of the top four supermarkets in a city elevates retail prices, although this result is not significant in the branded price equation.

The four feature and display variables, as expected (H2) are highly significant in the demand equations. Branded display and feature strongly increase national brand share and decrease private label share. Private label feature and display have the same expected effect for private labels. The results suggest that the promotions-share effects are asymmetric. Branded promotions have a greater effect on branded share than that of private label promotions on private label share.

In the branded price reaction equation, national brand feature and

Table 2. Estimation Results for the Market Power Model

	Demand Equations		Price Reaction Equations	
	Branded Share	Private Label Share	Branded Price	Private Label Price
Branded Price	-0.0348	0.0348	0.0997	0.1042
Private Label Pr	(-9.508)**	(9.508)**	(17.10)**	(12.02)**
BR Price Reduction	0.0257	(-8.490)**	-0.0924	-0.1744
PL Price Reduction				
BR Volume/Unit			-0.8500	-0.8536
PL Volume/Unit				(-98.26)**
Branded Share			-0.1978	-0.7709
Brand Herf.			-0.1016	0.4414
Grocery CR4			0.0352	0.0568
Expenditure	0.0587	(-19.88)**	0.1780	0.1573
Br Feature			-0.2128	
Br Display			-0.3666	
PL Feature				-0.1645
PL Display	-0.1908	(-36.61)**	-0.0090	-0.2484
PL Distribution	0.0196	(2.870)**	0.1233	-0.1376
Income	0.0446	(0.622)	-0.4580	0.0831
Hispanic	-0.0036	(-0.245)	-0.1482	-0.2247
Family Age				(-2.587)**

** significant at the 1% level.

* significant at the 5% level.

Number of Observations = 7197; $R_w^2 = .794$

Table 3. Estimation Results for Full Power and Promotion Model

	Demand Equations		Price Reaction Equations	
	Branded Share	Private Label Share	Branded Price	Private Label Price
Branded Price	-0.0139	0.0139	0.1308	0.1076
Private Label Pr	0.0133	-0.0133	-0.0713	(6.222)**
PL Price Reduction			(4.227)**	(-7.814)**
BR Volume/Unit			(-3.682)**	(-23.64)**
PL Volume/Unit			(-56.81)**	(0.604)
Branded Share			4.1124	0.9672
Brand Herf.			(3.483)**	0.2432
Grocery CR4			(-2.314)*	0.0546
Expenditure			0.0253	(2.792)**
Br Feature	0.0549	-0.0549	(1.663)	0.0523
Br Display	0.1077	-0.1077	(-1.038)	(-0.723)
PL Feature	0.1332	-0.1332	(-5.739)**	(-1.258)
PL Display	-0.0372	0.0372	(-7.323)**	(-1.776)
PL Distribution	-0.0867	0.0867	(3.785)**	(-0.930)
Income	-0.1902	0.1902	(3.596)**	(0.641)
Hispanic	0.0185	-0.0185	(3.847)**	0.1714
Family Age	0.0205	-0.0205	(0.516)	0.0430
	-0.0149	0.0149	(-2.498)*	-0.2400
			(-1.532)	(-1.384)

** significant at the 1% level.

* significant at the 5% level.

Number of Observations = 7197; $R_w^2 = .829$

display have a strong negative estimated coefficient. When price cuts occur, feature advertising and point of sale (POS) displays occur more frequently, advertising the price cuts. However, the private label display and feature have an interesting and opposite effect in the national brand price equation. When private label display and feature ads are active, branded prices are higher. Retailers promote private labels to consumers when national brand prices are high. Recent experience in the breakfast cereal industry is consistent with this strategy (Gejdenson and Schumer 1995, 1996; Angrisani, 1996; Cotterill 1996; Kahn 1996). Although the four feature and display variables have strong effects on national brand prices, they have no significant effect on private label prices. Retailers seem to have an "everyday low" private label price that they stress via promotion when national brand prices get out of line.

V.c. Demand Elasticities and Convergence with Previous Research

Recall from the theoretical section that we can recover demand (quantity) price elasticities from the share equations within the LA/AIDS framework for both private label and branded products. Table 4 presents estimated demand elasticities for all three models. It was reassuring to note that the estimated elasticities are extremely robust with respect to specification. Although the market power and promotion variables add to the explanatory power of the model, the estimated demand elasticities are almost identical in the full and restricted models. The estimated own price elasticities for branded product and private label cluster around unitary elasticity, somewhat higher than previous studies of category level elasticities (Neslin and Shoemaker 1983; Tellis 1988) and somewhat lower than previous studies of individual brand elasticities (Neslin and Shoemaker 1983; Tellis 1988; Mulhern and Leone 1991). Results here suggest that national brands and private labels, as a group, are maximizing the revenue from their sales. The cross price elasticities confirm our earlier analyses. Branded price does have a significant positive effect on private label sales in all three models. Private label price variations, however, have negligible effects on national brand sales. This is consistent with most of the work on asymmetric price competition and price tiers (Blattberg and Wisniewski 1989; Allenby and Rossi 1991); the estimated cross-price elasticity in the Full Power and Promotion Model is .26, within one standard deviation of the mean cross-price elasticity reported in Sethuraman (1995).

The expenditure elasticities are above 1.0 in all three models for national brands and below 1.0 in all three models for private labels. Household income elasticities (mean household income in 1992 was

Table 4. Estimated Demand Elasticities

	Price Model		Power and Promotion Model		Full Power and Promotion Model	
	Branded Quantity	Private Label Quantity	Branded Quantity	Private Label Quantity	Branded Quantity	Private Label Quantity
Branded Price	-1.0751 (-190.943)**	0.2716 (13.331)**	-1.1030 (-198.048)**	0.3729 (18.501)**	-1.0726 (-192.046)**	0.2628 (13.004)**
Private Label Price	-0.0073 (-1.803)	-0.9737 (-66.749)**	0.0165 (4.166)**	-1.0598 (-73.800)**	0.0019 (0.4814)	-1.0068 (-71.800)**
Expenditure	1.0751 (286.449)**	0.7282 (53.618)**	1.0719 (285.193)	0.7290 (53.451)**	1.0700 (293.763)	0.7467 (56.655)**
BR Feature					0.0085 (7.496)**	-0.0308 (-7.496)**
BR Display					0.0189 (14.025)**	-0.0685 (-14.025)**
PL Feature					-0.0027 (-4.298)**	0.0097 (4.298)**
PL Display					-0.0122 (-15.870)**	0.0440 (15.870)**
PL Distribution	-0.1864 (-37.021)	0.6745 (37.020)	-0.1852 (-36.614)**	0.6699 (36.614)**	-0.1846 (-37.971)**	0.6678 (37.971)**
Income	0.603e-06 (2.732)**	-0.218e-05 (-2.732)**	0.637e-06 (2.870)**	-0.230e-05 (-2.870)**	0.602e-06 (2.811)**	-0.218e-05 (-2.811)**
Hispanic	0.0057 (0.777)	-0.0205 (-0.777)	0.0046 (0.622)	-0.0165 (-0.622)	0.0021 (0.297)	-0.00757 (-0.297)
Family Age	-0.0001 (-0.180)	0.0004 (0.180)	-0.0001 (-0.245)	0.0005 (0.245)	-0.0006 (-1.046)	0.0021 (1.046)

** significant at the 1% level. * significant at the 5% level

\$39,358) in Table 4 indicate that an increase in household income has a very small but significant positive impact on branded volume and a very small but significant negative impact on private label volume. This suggests that higher income implies a lower level of private label consumption, i.e., it is an inferior good. The fact that both income elasticities are less than one implies that food is a necessity and, as income increases, a smaller portion of the budget is allocated to it.

VI. Conclusion—Discussion and Implications

Analysis of panel data such as the IRI Supermarket Review data studied here combined with consideration of both demand and supply side influences provide considerably more insight into competitive strategies than do single-equation cross sectional studies. Previous single equation studies have found a positive price-share relationship (share as a function of price). When market share and price reaction equations are estimated simultaneously (including market power variables), it becomes clear that the share-price relationship is multi-dimensional. Specifically, there are two relationships, the negative demand side relationship and the positive impact of share in the price reaction equations.

Once we address the multi-dimensional nature of the share-price relationship, certain implications for brand managers and retailers become clear:

- Brand managers should expect to face traditional demand relationships regardless of whether they are managing a national brand or a private label—an increase in the price of a national brand (private label) lowers national brand (private label) share. There are no free lunches here—a higher price means a lower share, *ceteris paribus*.
- Promotions increase share, while rival promotions lower share. Further, promotion effects are asymmetric. For branded products, a 10% increase in POS display activity, for example, increases share by about 1.3%. In contrast, a similar 10% increase in POS display activity for private label products increases its share by only 0.87%.
- Branded prices are higher in categories with extensive product proliferation. Private labels have greater difficulty competing in these categories, and lower prices in an attempt to compete. However, the cross price elasticities suggest this is a meager way to capture volume from national brands. Feature and display promotion appear to be much more effective ways of gaining share

in such categories.

- An increase in retail concentration increases both branded and private label price, but the advance in private label prices is nearly twice as large as national brand price increases. This suggests that leading supermarket chains are able to establish at least some brand loyalty for their own brands and can effectively narrow the price differential between national brands and private labels by elevating prices to improve profitability.
- Display and feature promotion activities increase sales as expected and private label display and promotion are positively related to national brand price levels. This suggests that a retail strategy of promoting private labels when branded prices are high can be successful in taking share away from high priced national brands.
- Cross price elasticities are decidedly asymmetric with national brand price having a major impact on private label sales, whereas private label price has very little impact on branded sales. This is consistent with the work on asymmetric competition and price tiers (Blattberg and Wisniewski 1989; Allenby and Rossi 1991).
- Managers responsible for private labels operating in markets with higher per capita income or categories with a higher level of expenditure will have a more difficult time penetrating the market.

As discussed in the introduction, insights into the effectiveness of competitive strategies for branded and private label grocery products entails an understanding of not only the effectiveness of various strategies on the demand side, but an understanding of the competitive interaction between national brands and private labels as well. In order to assess the viability of such strategies, it is important to differentiate between the direct demand side effect and the likely response of rival firms. The present research represents a initial attempt to address these issues. In doing so, we expand on previous work that has found a negative relationship between private label share and the branded-private label price differential by suggesting that the share-price relationship is multi-dimensional. Further, we demonstrate that even in a cross-category analysis, appropriate share-price relationships can be estimated by employing the appropriate empirical specification.

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