Size Does Matter: Analyzing Brand-Size Competition Using Store Level Scanner Data

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We investigate the pattern of competition at the brand-size level and examine how the marketing-mix elasticities differ at brand-size level from those at the aggregate brand level. We propose and test alternative hierarchical market structure classifications based on brand sizes using scanner data for the potato chips and peanut butter categories in two cities. Important and relevant managerial implications are obtained from estimation at the brand-size level as compared to aggregate brand level. We show how the analysis can aid in category / brand management decisions and in channel interactions between retailers and manufacturers.

INTRODUCTION

A significant trend in the food industry is the proliferation of brands, sizes, and varieties (Totten, 1994; Cooper, Klapper, and Inoue, 1995). This explosion in SKUs within each brand has important implications for retailers who have to decide which brands, sizes, and varieties to carry as well as how to coordinate pricing, promotion and shelf space among these items. It is important for retailers to recognize that consumers may display differen-

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tial price sensitivity effects towards the different brand-sizes. Guadagni and Little (1983) note that "...different sizes of the same brand are clearly different products from both the retailer's and customers point of view" (p. 213). In fact, they and Kannan and Wright (1991) show that consumers are more brand loyal to brand-sizes rather than brands. Also, Guadagni and Little (1983) and Fader and Hardie (1996) have found brand and brand-sizes to be the first and second most important product attributes in consumer decision making.

Households may be loyal to brand-sizes rather than brands because of several reasons. Larger households may buy bigger pack sizes. The nature of the consumption occasion may also dictate the purchase of the brand-size. For example, smaller pack sizes may be bought for use as single servings for packed lunches while bigger sizes may be used for consumption during parties and in-home use. Proctor & Gamble's introduction of the pocket size (lunch size) package of Pringles may have been to target the lunch occasion. Conceivably, in the same purchase occasion, one can buy the bigger size for consumption at home and smaller size for lunch to take to office or to school. Households may also try out a smaller pack-size first when considering switching to a new brand before moving on to their usual pack-size purchase later. Given this, these brand-sizes may well have differential price and promotional sensitivities even within each brand. Thus, retailers will need to formulate pricing and promotional strategies at the brand-size level, rather than at the brand level.

Currently, it does not seem that retailers are taking differential brand-size level effects into account while setting pricing and promotional strategies. Even in cases where promotions are apparently at brand-size level, they are done without any detailed technical analysis.[1] A brand-size level analysis can provide retailers with the price elasticity information required to formulate differential pricing and promotional strategies for the different brand-sizes. Further, manufacturers can develop strategic promotional programs for individual chains. For instance, manufacturers can use the brand-size data at the retail chain level to develop promotional programs tailored to meet the needs of the retailers. Clearly then, important information can be obtained if the analysis is carried out at the brand-size level, rather than at the brand level.

Despite its importance to the retailer, most of the research in marketing so far has been on store choice, store traffic, and store switching behavior (Walters and Rinne, 1986; Iyer, 1989; Moriarty, 1985; Bawa, Landwehr, and Krishna, 1989). Bucklin and Lattin, (1992) develop a disaggregate model to investigate category-specific store competition among grocery retailers. While their research is concerned with the nature and structure of competition among grocery retailers for sales within a prespecified product class, our research deals with the nature and structure of competition across different brand-sizes within a product class and its implications for the retailer. Also, the issue of brand-size level analysis and its implications has not received much attention in the marketing literature. Some researchers have suggested the need for model estimation at individual brand-size levels (Guadagni and Little, 1983; Gupta, 1988; Blattberg and Wisniewski, 1989). In addition, Neslin et. al. (1994) and Fader and Hardie, (1996) have addressed the issue of "...what should be the basic unit of analysis." Fader and Hardie (1996) estimate an individual level choice model in which they try to find out consumer preferences for different SKU attributes. Cooper et. al. (1996) use a three-mode factor analytic procedure to group UPCs with similar responsiveness to marketing instruments. We take each individual brand-size as the basic unit of analysis in this study.

However, brand-size level analysis is a formidable task because of the estimation of marketing mix elasticities and cross-elasticities at the brand-size-variety levels. In empirical work using scanner data, researchers are faced with the problem of estimating a large number of parameters. To avoid this problem, they have aggregated across brand sizes. This means that marketing strategies can be devised only at the brand level and not at the brand-size level. Another solution to reduce the number of estimable parameters is to find some structure in the market and recognize the fact that all brand-sizes may not compete equally with one another. Instead, there may be patterns of competition in the product category where one can classify brand-sizes in several groups with the notion that brand-sizes within a group compete more intensely than with other brand-sizes which are not part of the same group. We take the latter approach in this article and do the analysis in a market structure framework. For a detailed review of the measures used to characterize competition in the analysis of market structure, see (Allenby, 1989; Kannan and Sanchez, 1994; Elrod and Keane, 1995).

We propose and test alternative hierarchical market structure classifications based on brand sizes in which each individual brand-size is taken as a brand in itself. We use the Rotterdam model formulation (Clements and Selvanathan, 1988; Vilcassim, 1989) as the basis to estimate the models and test for the validity of these market structure classifications. The plan of the article is as follows. Next we explain the model and estimation issues followed by data description, hypotheses and statistical tests. Then empirical results are presented followed by a discussion of research and managerial implications.

MODEL AND ESTIMATION ISSUES

In this section, we present a brief and intuitive explanation of the Rotterdam model. For a more detailed description, see Clements and Selvanathan (1988).

The Rotterdam Model employs a system-wide approach in which demand equations for all n goods are estimated simultaneously. This is because all brands in a relevant market compete to varying degrees for an extra dollar of the consumer's expenditure, the demand for each brand should be modeled in the context of a system of competing brands. This model is applicable for both individual level or aggregate data (Kiefer, 1984).

Vilcassim (1989) uses the Rotterdam model to test multilevel hierarchical market structures at the brand-form level using coffee data. He defines the hierarchical market structure in the form of different groups of coffee: caffeinated, decaffeinated, regular, instant etc., and aggregates across all sizes of a brand within each group. The focus in this article is to look at market structure based on brand-sizes. As discussed in the introduction, this classification is intuitive from a behavioral standpoint as well, because a household does allocate its budget to the brand-sizes of the same brand depending on their purchase situation, characteristics and consumption behavior.

The ith aggregate demand equation of the model can be derived as (for detailed explanation see Clements and Selvanathan, 1988):

$$\bar{w}_{it}Dq_{it} = \theta_i DQ_t + \sum_{j=1}^{n} \gamma_{it}Dp_{jt} \tag{1}$$

where,

$$w_{it} = \frac{p_{it}q_{it}}{\sum_j p_{jt}q_{jt}}$$, p_i, q_i denote price and quantity of good i

$$\bar{w}_{it} = \frac{1}{2}(w_{it} + w_{i,t-1}),$$

$$Dq_{it} = log\ q_{it} - log\ q_{i,t-1},$$

$$DQ_i = \sum_{i=1}^{n} \bar{w}_{it}Dq_{it}$$ = Divisia volume index of the category, and,

$$Dp_{jt} = log\ p_{jt} - log\ p_{j,t-1}.$$

w_{it} is the budget share of i, parameter θ represents the conditional marginal share of good i with respect to the group, while γ_{ij} is a scaled measure of the conditional price elasticity of demand of good i with respect to good j. The own-price and cross-price elasticities of good i are:

$$e_{ij} = \gamma_{ii} / w_i, \quad e_{ij} = \gamma_{ii} / w_i$$

Equation (1) deals with the demand for all n goods (categories). The analysis can be further extended to determine demand within a category. If all the items (brand-sizes) in a category be divided into g mutually exclusive sub-groups, $S_1,\ldots,S_g$, then we can write the demand equation for brand-size i (given the demand for the group as a whole) as:

$$For \quad i \subset S_g, \quad Dq_{it} = \theta_t^g DQ_{gt} + \sum_{j \subset S_g} \gamma_{ij}^g Dp_{jt}, \tag{2}$$

The first term is the marginal share of i within subgroup S_g adding up to one. The conditional marginal share answers the question, if income increases by \$1, resulting in a certain additional amount spent on the group S_g, what is the proportion of this additional amount that is allocated to brand-size i? The second set of coefficients are the conditional price elasticities, i.e., the elasticity of q_i with respect to the absolute price p_j.

The model is made operational by representing the demand for brand-size i as :

$$Y_i = \mathbf{X}_i\beta_i + \xi_i,$$

where, Y_i is the vector of the dependent variable and X_i is the matrix of independent variables for brand-size i in the model. The variables are constructed as shown in appendix. The system of equations for N brand-sizes (or groups) can be represented as :

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_N \end{bmatrix} = \begin{bmatrix} X_1 & & & \\ & X_2 & & \\ & & \ddots & \\ & & & X_N \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_N \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_N \end{bmatrix}$$

More compactly, we can write the above equation in a vector form as:

$$\mathbf{Y} = \mathbf{X}\beta + \varepsilon$$

The system-wide estimation was done by using the Seemingly Unrelated Regression (SUR) technique available in the PROC MODEL procedure in SAS.

DATA AND HYPOTHESES

Data

The data used in the analysis are the IRI store level data for potato chips and peanut butter. The data were available for 131 weeks (Sept. 1991-Apr. 1994) over three cities for 20 stores for a major grocery chain. The variables available in the dataset are price, volume, base price, base volume, feature and display. Of these, we include prices and volumes for each brand-size in our analysis.[2]

TABLE 1

Summary Statistics

		Potato Chips Data			
#	*Brand*	*Code*	*Unit Share*	*$ Share*	*Avg Pr ($)*
1.	PRINGLES 6-8 OZ	PGL68	0.359	0.284	1.38
2.	PRINGLES 9-12 OZ	PGL912	0.019	0.030	2.74
3.	PRINGLES 13-16 OZ	PGL1316	0.017	0.028	2.74
4.	FRITO-LAY 6-8 OZ	FLY68	0.072	0.061	1.48
5.	FRITO-LAY 9-12 OZ	FLY912	0.093	0.103	1.93
6.	FRITO-LAY 13-16 OZ	FLY1316	0.171	0.223	2.27
7.	EAGLE 6-8 OZ	EGL68	0.022	0.021	1.69
8.	EAGLE 9-12 OZ	EGL912	0.128	0.133	1.79
9.	EAGLE 13-16 OZ	EGL1316	0.037	0.054	2.55
10.	PVT. LABEL 6-8 OZ	PLB68	0.045	0.025	0.96
11.	PVT. LABEL 13-16 OZ	PLB1316	0.035	0.037	1.85

TABLE 1A

Summary Statistics

			Peanut Butter Data					
			City 1			City 2		
#	Brand	Code	Unit Share	$ Share	Avg Pr ($)	Unit Share	$ Share	Avg Pr ($)
1.	JIF 12 OZ	JIF12	0.031	0.025	2.05	0.015	0.013	2.05
2.	JIF 18 OZ	JIF18	0.263	0.237	2.29	0.288	0.261	2.23
3.	JIF 28 OZ	JIF28	0.101	0.147	3.72	0.075	0.119	3.91
4.	JIF 40 OZ	JIF40	0.042	0.087	5.30	0.036	0.082	5.52
5.	SKIPPY 18 OZ	SKP18	0.104	0.091	2.28	0.115	0.105	2.32
6.	SKIPPY 28 OZ	SKP28	0.016	0.023	3.75	0.011	0.019	4.14
7.	SKIPPY 40 OZ	SKP40	0.007	0.015	5.34	0.009	0.021	5.85
8.	PETER PAN 12 OZ	PTP12	0.014	0.013	2.33	0.014	0.012	2.14
9.	PETER PAN 18 OZ	PTP18	0.026	0.024	2.40	0.057	0.051	2.27
10.	PETER PAN 28 OZ	PTP28	0.014	0.021	3.80	0.005	0.010	4.28
11.	REESES 18 OZ	RES18	0.054	0.048	2.34	0.040	0.038	2.45
12.	REESES 28 OZ	RES28	0.016	0.023	3.73	0.013	0.019	3.84
13.	PVT. LABEL 12 OZ	PLB12	0.019	0.011	1.37	0.013	0.008	1.62
14.	PVT. LABEL 18 OZ	PLB18	0.176	0.114	1.65	0.247	0.159	1.58
15.	PVT. LABEL 28 OZ	PLB28	0.068	0.062	2.47	0.044	0.054	3.13
16.	PVT. LABEL 40 OZ	PLB40	0.040	0.051	3.26	0.011	0.018	4.18

Potato Chips

We chose city number one for our study and aggregated data over all the eight stores in the city for which data were available. We kept eleven brand-size combinations out of a total of twenty five in the category. These brand-sizes accounted for 90% of the total market share. These brand-sizes were sold under three major brand names (Pringles, Eagle, and Frito-Lay) and one store private label brand. The other brand-sizes were excluded either because they had very small shares or because their associated data had many missing values. Although each brand came in a variety of sizes and flavors, the price lines tended to be: 6–8 oz, 9–12 oz, 13–16 oz and 16 oz+.

Peanut Butter

We chose city 1 and city 2 for our study. We kept sixteen brand-sizes out of a total of twenty five in the product category. These brand-sizes accounted for 95% of the total market share. These brand-sizes were sold under four national brand names (Jif, Skippy, Peter Pan, and Reeses) and one store private label brand in 12, 18, 28, and 40 oz sizes. The other brand-sizes were excluded either because they had very small shares or because their associated data had many missing values.

Summary statistics on market share and average price (over all weeks) of all brand-sizes included in the study for both products are shown in Table 1 and 1A.

TABLE 2 3

Brand Groups Under Different Hypotheses & Categories

Group #	Potato Chips Category	
	Hypothesis H2	Hypothesis H3
1.	PGL68, FLY68, EGL68, PLB68	PGL68, PGL912, PGL1316
2.	PGL912, FLY912, EGL912	FLY68, EGL68, PLB68
3.	PGL1316, FLY1316, EGL1316, PLB1316	FLY912, EGL912
4.	-	FLY1316,EGL1316, PLB1316
	Peanut Butter Category	
1.	JIF12, PTP12, PLB12	-
2.	JIF18, SKP18, PTP18, RES18, PLB18	-
3.	JIF28, SKP28, PTP28, RES28, PLB28	-
4.	JIF40, SKP40, PLB40	-

Hypotheses

The research question is whether this product category can be further subdivided into brand-size groups, such that the brands-sizes within a group are similar and exhibit a high degree of competition, while brand-sizes across groups are distinct and compete less intensely. Hence, the extent of competition between two brand-sizes in different groups is determined largely by the degree of competition between the two groups. Table 2 provides the brand-size groupings that have been hypothesized for both the datasets. Within a group, the demand for any brand-size is estimated using the conditional demand equation of the model. The explanatory variables in each equation are the prices and quantities of the brand-sizes in the group and total expenditure allocated to the group. We propose and test the following set of hypotheses along the lines of Vilcassim (1989).

H0: *Both the potato chips and peanut butter markets are unstructured and the model system is unconstrained.*

Under H0, every brand-size of potato chips (peanut butter) potentially competes with all other brand-sizes. The competition between these brand-sizes is direct and on an equal footing. The estimating equation under H0 is the same as equation (1).

H1: *Both the potato chips and peanut butter markets are unstructured but the model system is symmetric (the cross price elasticities are equal) and homogeneous, i.e., the constraints are: $\gamma_{ij} = \gamma_{ji}$ and $\sum\gamma_{ij} = 0$, where γ is the price elasticity.*

Here, H1 is a nested version of H0. Hence it is a straightforward test of linear restrictions.

H2: Potato chips: *The structure of the market for potato chips can be described in terms of the three size-groups as shown in Table 2 (i.e., group 1: 6–8 oz brand sizes, group 2: 9–12 oz and group 3: 13–16 oz).*

Peanut butter: *The structure of the market for peanut butter data can be described in terms of the four size-groups as shown in Table 2 (i.e., group 1: 12 oz brand-size, group 2: 18 oz, group3: 28 oz and group 3: 40 oz).*

Under H2, the three groups (four, for peanut butter) are treated as separable subsets. The demand, then, for any brand-size, conditional on the total demand for potato chips (peanut butter) is given by equation (2). Like H1, H2 is also a restricted version of hypothesis H0. Hence, by testing the statistical significance of these restrictions (for each brand-size), we can determine the plausibility of H2 vis-à-vis H0.

H3: Potato chips: *The structure of the market for potato chips can be described in terms of the four size-groups as shown in Table 2(i.e., group 1: Pringles all sizes, and all the other brands are divided in groups as in H2 i.e., group 2: 6–9 oz, group 3: 9–12 oz and group 4: 12–16 oz).*

The rationale behind this structure is as follows. Pringles, manufactured by Proctor and Gamble, is made from a potato paste and hence can be baked into a uniform shape. This enables it to be sold in a better quality package that is stiffer than the packages of its competitors. P&G is perhaps positioning Pringles as a premium brand in the potato chips category. Hence, it is possible that Pringles may not directly compete with the other brands and instead carve out its own niche in the marketplace separate from others. The test would allow us to know whether this indeed is the case. The estimating equations under H3 can be derived along the lines of previous hypothesis. There is no H3 hypothesized for the peanut butter data as there are no significant differences in packaging among the brands in this category.

Our final hypothesis was that the market can be characterized by an aggregated brand structure, i.e., competition occurs only at the brand level and *not* at the level of the brand-size. The brands were formed after aggregating the brand-sizes of the respective brands.

H4: Potato chips: *The market is structured only in terms of the four aggregate brands (PGL, EGL, FLY and PLB) for potato chips.*
Peanut butter: *The market is structured only in terms of the five aggregate brands (JIF, PTP, SKP, RES and PLB) for peanut butter.*

H4 was tested against the 'winner' of H2 and H3 for potato chips. And for peanut butter, H4 was tested against H2.

Hypotheses Tests

The steps involved in testing these alternative hypotheses is described below :

1. Test the hypotheses that the market for potato chips (peanut butter) is unstructured and unconstrained according to H0 versus the alternative hypothesis that the market is unstructured but symmetric and homogeneity constrained H1. If we reject H1, then we test for the validity of H0 against two other alternative hypotheses, H2 and H3. Note that H3 is not hypothesized for peanut butter.
2. Test H2 against H0 for both datasets. If H0 is rejected for the peanut butter market, we conclude that the four group structure best describes the market. On the other hand, if H0 is accepted, then we conclude that the peanut butter market is unstructured.

Steps 3 to 7 are only for the potato chips market.

3. Test H3, the four group structure against no structure H0.
4. If we reject H2 in step 2 but fail to reject H3 in step 3 , then we conclude that among the hypotheses considered, the four group structure is the best descriptor of the market for potato chips.
5. If we reject H3 in step 3 but fail to reject H2 in step 2, then we conclude that the three group structure is the best descriptor of the market for potato chips.
6. If we reject H2 in step 2 and also reject H3 in step 3, then we conclude that the market for potato chips is unstructured.
7. If we fail to reject both H2 and H3, then it will be necessary to test the two hypotheses against each other. And, as H2 and H3 are mutually non-nested, they can be compared via a non-nested test procedure. The accepted hypothesis will then give us the final market structure.
8. Finally, we compare the accepted structure in step 7 with the aggregate brand structure (Hypothesis H4).
9. For peanut butter, H2 and H4 are tested against H0 as they are nested.

TABLE 3

Tests of Hypotheses About Structure

Full Model	*Restricted Model*	*# of Restriction*	SSE_U	SSE_R	$\lambda = SSE_R - SSE_U$	$\chi^2 0.05$	Outcome
			Potato Chips – City 1				
H0	H1	45	1180	1332	152	61.6	Reject H1
H0	H2	53	1180	1216	36	70.9	Fail to reject H2
H0	H3	52	1180	1211	31	69.8	Fail to reject H3
			Peanut Butter – City 1				
H0	H1	105	1695	1854	159	129.9	Reject H1
H0	H2	130	1695	1780	85	157.9	Fail to reject H2
H0	H4	214	1695	1961	266	251.9	Reject H4
			Peanut Butter – City 2				
H0	H1	105	1695	1934	239	129.9	Reject H1
H0	H2	130	1695	1794	99	157.9	Fail to reject H2
H0	H4	214	1695	2252	557	251.9	Reject H4

Statistical Tests

We use a test with asymptotic validity to determine the statistical significance of restrictions imposed under the null hypotheses. Under the assumption that the errors are normally distributed, the test statistic for all the nested tests is the difference λ in the sum of squared residuals from the restricted (SSE_R) and unrestricted (SSE_U) systems which has a Chi-square (χ^2) distribution (Judge et. al. 1985).

For non-nested tests (when we test H2 against H3 for potato chips), we use the J - Test proposed by Davidson and Mackinnon (1981). The intuition behind the J test is that the two non-nested equations are artificially nested using a parameter δ. Inferences about acceptance/rejection are then made by checking whether δ is significantly different from zero. This test is also only asymptotically valid.

RESULTS AND DISCUSSION

Hypothesis Tests: Potato Chips Market

Table 3 reports the results of the tests of the four hypotheses about the postulated market structures in the potato chips market. We conclude with 95% confidence that the unstructured unconstrained model under H0 is a better descriptor of the market for potato chips than the unstructured, homogeneity and symmetry constrained model under H1. Similarly, we fail to reject both H2 and H3 and conclude that both the three group structure and the four-group structure describes the potato chips market better than the structure under H0.

Now, since we accept both H2 and H3, it becomes necessary to test both these models against each other to choose the best structure of the market. Since they are non-nested, we resort to the J -Test, and obtain the estimates of δ as 0.7959 (std. err = 0.0696). Thus, we reject H2 in favor of H3 and conclude that the four-group structure under H3 is a better descriptor of the potato chip market than the three-group structure under H2.

Finally, we compare the accepted structure, H3 with H4 (the aggregate brand structure). As in the previous case, we use the J-test since models H3 and H4 are non-nested. The results of the test show that we reject H4 in favor of H3 at the 0.05 level ($\delta = 0.12213$, std. error = 0.0174) and conclude that the market is structured in terms of four brand-size groups (H3). This validates our hypothesis that Pringles stands out as a separate group because of its distinct packaging.

Hypothesis Tests: Peanut Butter Market

Table 3 reports the results of the tests of the four hypotheses about the postulated market structures for both cities. For both city 1 and city 2, we conclude that the unstructured

TABLE 4

Group Marginal Share

Potato Chips (1.00)					
H2		*H3*		*H4*	
6-8 oz	0.40	Pringles	0.43	Pringles	0.46
9-12 oz	0.18	6-8 oz	0.07	Frito Lay	0.26
13-16 oz	0.42	9-12 oz	0.14	Eagles	0.18
-	-	13-16 oz	0.36	Pvt Label	0.10

Peanut Butter (1.00)							
H2				*H4*			
City 1		*City 2*		*City 1*		*City 2*	
12 oz	0.02	12 oz	0.02	Jif	0.50	Jif	0.46
16 oz	0.72	16 oz	0.77	Skippy	0.30	Skippy	0.12
28 oz	0.16	28 oz	0.17	Peter Pan	0.03	Peter Pan	0.05
40 oz	0.10	40 oz	0.04	Reeses	0.04	Reeses	0.03
-	-	-	-	Pvt Label	0.13	Pvt Label	0.34

unconstrained model under H0 is a better descriptor of the market for peanut butter than the unstructured, homogeneity and symmetry constrained model under H1.

As we fail to reject H2, we conclude that the four group structure under H2 describes the market better than the structure under H0. Similarly, we reject H4 in favor of H0 and conclude that the aggregated five-group structured market under H4 is *not* a better descriptor of the market for peanut butter than the unstructured and unconstrained model under H0.

Now, since we reject H1 and H4 against H0 and accept only H2 against H0, we conclude that the four group brand-size structure is the best descriptor of the peanut butter market.

Parameter Estimates: Potato Chips Market

The discussion is concerned with the accepted four-group structure. Table 4 shows the group level marginal shares and Table 4A displays the price elasticities of the different brand sizes under structure H3. Under H3, the $\bar{R}^2$ values for all the brand-sizes in all the groups are consistently higher than the values under structure H2. This provides further support to our test results that H3 is a better descriptor of the market than H2.

The group level marginal shares in Table 4 are interpreted as follows: If $1.00 is spent on the potato chips category, $0.43 goes to the group 1 consisting of the Pringles brand-sizes, $0.07 goes to group 2 containing the other brands (Frito-Lay, Eagle, Private Label) in the 6–8 oz size-group, $0.14 goes to group 3 which consists of the other brands in the size-group 9–12 oz and $0.36 goes to group 4 consisting of other brands in the size-group 13–16 oz.

The elasticity estimates in Table 4A have the following interpretation. Looking at the first row (Group 1), we see that if PGL68 cuts price by 1%, then its own share increases by 0.3418%. For the same price-cut, the marginal share of PGL1316 decreases by 0.5184%. Comparing the brand-sizes PGL68 and PGL1316, it is evident that PGL1316 is more sen-

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TABLE 4A

Estimates Under Final Structure H3 Conditional On The Demand For Group Potato Chips - City 1

GROUP 1	$\bar{R}^2$	*MG. SH.*	*PGL68*	*PGL912*	*PGL1316*
PGL68	0.98	0.80	-0.3418	0.2657[a]	0.5184
PGL912	0.41	0.09	0.1607	-0.0155[a]	-0.1480[a]
PGL1316	0.35	0.11	0.1810	-0.2502[a]	-0.3703
GROUP 2	$\bar{R}^2$	*MG. SH.*	*FLY68*	*EGL68*	*PLB68*
FLY68	0.90	0.15	-0.6290	0.0269[a]	0.0221[a]
EGL68	0.61	0.20	0.1409	-0.1901	-0.0128[a]
PLB68	0.63	0.65	0.4880	0.1632	-0.0002[a]
GROUP 3	$\bar{R}^2$	*MG. SH.*	*FLY912*	*EGL912*	
FLY912	0.84	0.63	-0.3541	0.2414	
EGL912	0.65	0.37	0.3541	-0.2414	
GROUP 4	$\bar{R}^2$	*MG. SH.*	*FLY1316*	*EGL1316*	*PLB1316*
FLY1316	0.94	0.71	-0.3878	0.1233	0.4777
EGL1316	0.35	0.13	0.1325[a]	-0.1447	-0.0292[a]
PLB1316	0.50	0.16	0.2552	0.0214[a]	-0.4485

Note: [a]estimates are not significant at 0.05 level.

sitive to a cut in price of PGL68 than vice-versa. Because the package price of PGL1316 is higher than that of PGL68, promoting PGL1316 is a better strategy for a retailer or category manager than promoting either PGL68 or PGL912 in order to maximize sales or profits.[2] Also, just by looking at elasticities, one may not think PGL912 has much effect in this group since its cross-price elasticities are insignificant. However, if cross-price elasticities are low, then it might be a candidate for promotion since other brand-sizes would experience a lesser effect and total sales would be higher. This is exactly what we found in our analysis in the implication section, which again underscores the benefit of analysis at the brand-size level.

In Group 2, PLB68 has the highest marginal share and is also insensitive to its own price cuts. This is perhaps due to the fact that, being a private label brand, its price is already low and further price cuts may not gain additional sales. The competition among the brands in this group seems to be about equal, though FLY68 gains more from PLB68 than what EGL68 gains from PLB68. In group 3, FLY912 is the dominant brand and as there are only two brands in this group, their elasticities complement each other, as the shares have to add up to one. But, FLY912 always gains more from EGL912 than what EGL912 gains from FLY912.

Parameter Estimates: Peanut Butter Market

Table 4B & 4C displays the elasticity estimates for both cities. It is evident that the 18 oz and 28 oz sizes are most popular among peanut butter consumers—the 18 oz size domi-

TABLE 4B

Estimates Under Final Structure H2 Conditional On The Demand For Group Peanut Butter - City 1

GROUP 1	$\bar{R}^2$	*MG. SH*	*JIF12*	*PTP12*	*PLB12*		
JIF12	0.39	0.36	-0.0151[a]	0.0099[a]	-0.0002[a]		
PTP12	0.51	0.46	-0.0011[a]	-0.0218	0.0030[a]		
PLB12	0.19	0.18	0.0162[a]	0.0118	-0.0028[a]		
GROUP 2	$\bar{R}^2$	*MG. SH*	*JIF18*	*SKP18*	*PTP18*	*RES18*	*PLB18*
JIF18	0.78	0.35	-1.2275	0.3515	0.0130[a]	0.0950[a]	0.3277
SKP18	0.65	0.49	0.8121	-0.5438	0.0962[a]	0.2443	0.5148
PTP18	0.36	0.02	0.0475	0.0220[a]	-0.0664	0.0172[a]	-0.0044[a]
RES18	0.49	0.06	0.2093	0.0880	-0.0238[a]	-0.4393	-0.0121[a]
PLB18	0.62	0.08	0.1586	0.0822	-0.0191[a]	0.0828	-0.8260
GROUP 3	$\bar{R}^2$	*MG. SH*	*JIF28*	*SKP28*	*PTP28*	*RES28*	*PLB28*
JIF28	0.68	0.42	-0.2716	0.0265[a]	0.0226[a]	0.0483[a]	0.1763
SKP28	0.32	0.08	0.0665	-0.0875	0.0178[a]	0.0186[a]	0.0109[a]
PTP28	0.26	0.05	0.0264[a]	0.0213[a]	-0.0627	-0.0064[a]	0.0131[a]
RES28	0.26	0.06	0.0383[a]	0.0590	0.0152[a]	-0.0659	0.0133[a]
PLB28	0.69	0.39	0.1402	-0.0192[a]	0.0072[a]	0.0054[a]	-0.2137
GROUP 4	$\bar{R}^2$	*MG. SH*	*JIF40*	*SKP40*	*PLB40*		
JIF40	0.75	0.63	0.0517[a]	-0.0753	0.1049		
SKP40	0.11	0.07	-0.0185[a]	-0.0145[a]	0.0366[a]		
PLB40	0.55	0.30	-0.0332[a]	0.0899	-0.1415		

Note: [a]estimates are not significant at 0.05 level.

nates the category in both cities followed by the 28 oz size (see the marginal shares in Table 4). This is consistent with intuition because most households would perhaps find these sizes to be ideal size given the trade-off between perishability and less-frequent visits to the grocery store. Not surprisingly, these size groups are also the most competitive. Private label brands are a factor only in the larger size groups - 28 oz and 40 oz. Again this is expected since, in most food categories, private label brands are sold only in large pack sizes.

SKP and JIF are the two major players in the 18 oz size with the latter brand being the most price sensitive. It is evident that SKP gains more share from JIF and PLB by reducing its price than vice-versa. The findings in both this and 28 oz size-group also provide an interesting illustration of the price-tier theory proposed by Blattberg and Wisniewski (1989) that price reductions in the national brands (SKP and JIF) draw disproportionate market share from private labels.

The results for city 2 almost mirror the findings for city 1. Again the 18 and 28 oz size groups dominate the others. PLB has larger marginal shares in this city in all the size groups—not a surprising finding because the store chain sponsoring the private label brand is headquartered in this city.

The results show the benefits and importance of doing the analysis at the individual brand-size level rather than at the aggregate brand level. Information such as asymmetric

TABLE 4C

Estimates Under Final Structure H2 Conditional On The Demand For Group Peanut Butter - City 2

GROUP 1	$\bar{R}^2$	*MG. SH*	*JIF12*	*PTP12*	*PLB12*		
JIF12	0.06	0.06	-0.0066[a]	0.0029[a]	-0.0027[a]		
PTP12	0.83	0.86	-0.0400[a]	-0.0098	0.0171		
PLB12	0.14	0.08	0.0333[a]	0.0069	-0.0143		
GROUP 2	$\bar{R}^2$	*MG. SH*	*JIF18*	*SKP18*	*PTP18*	*RES18*	*PLB18*
JIF18	0.90	0.50	-0.6405	0.3744	0.2201[a]	0.0097[a]	0.5269
SKP18	0.67	0.15	0.2418	-0.5191	0.0198[a]	0.0033	0.1136
PTP18	0.35	0.04	0.0733	0.0185[a]	-0.1904	0.0236[a]	0.0322
RES18	0.28	0.03	0.0393	0.0373	-0.0086[a]	-0.1111	0.0451
PLB18	0.88	0.28	0.2859	0.0889	-0.0583[a]	0.1006	0.7179
GROUP 3	$\bar{R}^2$	*MG. SH*	*JIF28*	*SKP28*	*PTP28*	*RES28*	*PLB28*
JIF28	0.91	0.60	-0.3103	0.1324	0.0002[a]	-0.0153	0.1016
SKP28	0.49	0.04	0.0393	-0.1333	-0.0048[a]	0.0022[a]	0.0080[a]
PTP28	0.02	0.01	0.0019[a]	0.0015[a]	0.0044	-0.0011[a]	0.0038[a]
RES28	0.37	0.07	0.0441	-0.0315	0.0127	-0.0697	0.0211
PLB28	0.78	0.28	0.2249	0.0309	-0.0125	0.0839	-0.1345
GROUP 4	$\bar{R}^2$	*MG. SH*	*JIF40*	*SKP40*	*PLB40*		
JIF40	0.88	0.72	-0.0707	-0.0405[a]	0.1239		
SKP40	0.36	0.18	0.0598	-0.0358[a]	0.0040[a]		
PLB40	0.40	0.10	0.0108[a]	-0.0047[a]	-0.1219		

Note: [a]estimates are not significant at 0.05 level.

elasticity effects, is lost when brand-sizes are aggregated. For example, this analysis provides a starting point for determining which brand-sizes should be promoted in order to maximally increase the marginal shares both within the group as well as for the category. There is a strong case for retailers to offer price-promotions at the brand-size level, rather than at the brand level. Our analysis also has significant implications for category and brand management that are discussed next.

IMPLICATIONS FOR BRAND AND CATEGORY MANAGEMENT

Our study shows the differences in price sensitivities between brand-sizes, even within the same brand. Thus, the key implication of our study is that it would be prudent for a retailer to devise promotional strategies at the brand-size level, rather than at the brand level. The following discussion, using the potato chips data, reinforces this point by providing new insights from a brand-size level analysis.

In our study, if we were to do the analysis at the category level (with all the brand-sizes aggregated into brands), as is traditionally done, we would have four brands-PGL, FLY, EGL and PLB. We did this system-wide estimation at the category level under H4 and calculated the overall change in the category demand for each brand's price reduction, taken

TABLE 5

Net Change in Overall Group Demand Induced by Each Brand's 1% Price Cut

Category Level (Aggregated Brands)	*Manufacturer Level (Pringles Only)*	*Retailer Level (Pringles + others)*
PGL -0.38	PGL68 -0.22	PGL68 1.00
FLY 0.28	PGL912 0.14	PGL912 0.31
EGL -0.36	PGL1316 0.07	PGL1316 1.09
PLB 0.42	-	-

one at a time, from equation (2) and estimated coefficients. Table 5 shows the net change in total group demand induced by a 1% cut in each brand. As can be seen from the first column, the maximum net change in category demand is produced when PLB is promoted. Thus the retailer maximizes the category demand when the private label brand-sizes are promoted. This may seem counterintuitive or against the price-tier theory. But this is plausible if PLB is quite strong in the market and also in the context of our system-wide estimation. First, from our tests Pringles does not belong in the same group as other brands and we had rejected this structure under H4 in favor of H3. Second, as seen from Table 4A, PLB is quite strong as compared to other brands in the group and Pringles is in a separate category by itself. And when we aggregate across brand-sizes then the PLB effects dominate driving up the category demand. This once again emphasizes the need for the brand-size level analysis.

In contrast with the retailer's perspective, the manufacturer (say, P&G) is interested in maximizing demand for its brand (Pringles) only, and not the category. The manufacturer may also like to know which of the following two strategies brings higher demand - promoting at the brand-size level or at the brand level.[3] Unfortunately, a category level analysis with aggregated brands cannot provide an answer. We have already carried out this analysis under our accepted structure H3. We again calculate the total group demand by equation (2) (results shown in the second column of Table 5). Here, the maximum increase in the total group demand for Pringles occurs when PGL912 is promoted. P&G's strategy should be, therefore, to push the retailer to promote PGL912.[4]

Now, we again look at the problem from a retailer's or a category manager's viewpoint. The retailer has received an offer from P&G to promote PGL912. Assuming that the retailer does not have an alternative offer from any other manufacturer, he has to decide whether to promote PGL912 or some other brand-size. Leaving differential gross margins aside, the retailer's objective is to promote the brand/brand-size that maximizes the overall category demand. It is of less concern to him whether the demand for the PGL group is maximized or not. Our analysis can help the retailer make a decision. We did the system-wide estimation involving all the brand-sizes of Pringles along with other groups in the whole category. Table 5 shows that, in this case, promoting PGL1316 maximizes the category demand. Hence, from a retailer's perspective, PGL1316 should be promoted and not PGL912.

Thus, analysis at the brand-size level is also able to provide insights into aspects of channel conflict. Both the retailer and manufacturer draw different inferences depending on their objectives. Also from Table 5, we see that results are different depending on what groups and brand-sizes are in the system-wide estimation. For example, price change in PGL68 produces markedly different results in the demand. In the second column, the demand is comprised only of all Pringles brands whereas in the third column the demand is comprised not only of Pringles brand-sizes but other brands too in the category. Clearly, analysis with aggregated brands does not provide us with the complete picture; it also does not provide the flexibility of analyzing the model from different perspectives as is possible with a brand-size level analysis. Strategically, there are relevant channel applications in developing manufacturer's promotional program strategies at the category level tailored to meet the needs of the retailer.

DISCUSSION

We show that a brand-size level analysis provides comprehensive insights into the true nature of competition in the marketplace than a brand level analysis. Using the Rotterdam model formulation we analyze the market structure for two categories. A comparison of the results across the two product categories in two cities reveal some interesting commonalties and differences. Both the peanut butter and the potato chip market can be better structured in terms of brand-sizes and not aggregated brands. Our study also supports the notion that, for the potato chips market, Pringles is a specially packaged brand of potato chips and hence has its own distinct positioning and submarket. For example, Pringles can also be positioned as a competitor to other snack foods and placed on the snack food aisle.[5] However, there are no packaging differences among brands in the peanut butter market. In both product categories, certain brand-sizes dominate the category. As discussed earlier, these results can be intuitively explained as being the sizes that are most convenient for consumers, on the "visibility" of the product category, purchase situation, demographic characteristics, etc.

One of the limitations of this type of analysis is that there is a large increase in the complexity of estimation as the number of brand-sizes and marketing mix variables increase. Another limitation is the non-availability of information on costs and "pass-through." Neither retailer nor manufacturer strategy seems likely to be revealed without gross margin data and conclusions were based only on sales data.

There are other issues, which may provide possible avenues for future research in this area. Using our approach, we can test if submarkets, based on different flavors of the same brand or a combination of flavors and brand-sizes, exist. We can also study cross-category competition to determine if there are any differences in price and promotion responses across categories. One could also examine feature and display elasticities along with price elasticities with possible omitted variable biases. Sales response to brand-sizes could be correlated to demographics. Retail competition could be introduced by including data from multiple chains.

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NOTES

1. Information obtained from conversations with a local food broker, Mr. Chris DeRose of DeRose Food Brokers and Mr. Bruce Bailey, former Marketing Director, Freezer Queen. Currently, retailers do not seem to be taking different brand-size level effects into account while devising their pricing and promotion strategies. This is because they do not have ready access to brand-size elasticities; their software is geared to look only at elasticities at the brand level. Besides, their decisions cover a wide variety of grocery categories and it is simpler for them to make pricing and promotional decisions at the brand level. However, in our discussions with retail managers, we found that they are willing to consider making decisions at the brand size level if it helps them improve their bottom line.

2. We did initially include feature advertising and display as variables in our analysis, but found that they were not significant for most brand-sizes, perhaps because feature and display were highly correlated among themselves as well as with price. Hence, we decided to exclude them in our subsequent analysis. However, the model is general enough to include all marketing mix variables.

3. Ideally, we need cost information to compute profits. Since we did not have it, our comparisons and inferences are based on sales data.

4. Since such push typically requires some kind of discount, the cost of the discount must also be considered. It might be less expensive (require a smaller discount) to promote a product which would be of greater interest to the retailer.

5. An example of this can be seen in the toothpaste category in recent weeks where "teeth cleaning chewing gums" are being shelved in the toothpaste aisle.

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