A Cross-Category Analysis of Shelf-Space Allocation, Product Variety, and Retail Margins

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Abstract

Retailers' allocation of shelf space as well as the breadth of variety offered varies across categories. Many researchers have developed heuristics for determining what retailers should do with regard to these decisions. We explore how these constructs are actually related in practice. We utilize data obtained from Marsh Supermarkets, a large Indianapolis-based grocery retailer, to explore the relationships between these variables. The results of this analysis are a set of raw facts concerning the relationship between some of grocery retailers' more important category-level decisions.

Key words: cross-category analysis, retailing, shelf space

Introduction

Grocery product retailers face a very large and highly complex set of marketing decisions. The average grocery product retailer carries 45,000 separate SKUs and for each of these products must make a host of decisions ranging all the way from whether a given item should be stocked to what the promotional strategy should be for an item. In the highly competitive world of grocery product retailing, the proficiency with which these decisions are made ultimately determine the success or failure of the retailer.

Improving the decisions of grocery product retailers has gained considerable research attention in both the marketing and decision science literatures. This attention has focused both on measuring consumer response to changes in the marketing mix (Guadagni and Little, 1983; Gupta, 1988) as well as building decision models to aid managers (Borin, Farris, and Freeland, 1994; Bultez and Naert, 1988, 1989). We take a different tact with this research. Instead of focusing on consumer reaction to a specific change in the marketing mix, we explore the relationship between some of the key decisions that are made by grocery product retailers. Specifically, we examine the relationship between retail margins, category shelf-space allocation, and the variety of products offered within a particular category in the hopes of shedding light on the relationship between some of the more important category-level decisions made by retailers. The results of this analysis will...
be a set of raw facts about the relationship among these decisions. Hence, this research attempts to begin the process of making cross-category empirical generalizations about the complex decisions retailers face.

**Cross-category studies**

Certainly the most comprehensive study on cross-category differences in category structural and promotional variables is Fader and Lodish (1990). This work documents certain clusters of categories that are similar in their promotional strategy. This article is strictly descriptive in nature; no attempt is made to isolate any causal relationship between the structural and promotional variables. Other studies have focused directly on the cross-category differences in consumer price sensitivity. Litvack, Calatone, and Warshaw (1985) describe these differences in price sensitivities as arising from a category’s ability to be stockpiled, while Bolton (1989) uses category and brand-level structural variables to explain these differences. Narasimhan, Neslin, and Sen (1996) broaden the scope of these price-sensitivity studies to include perceptual data, including the propensity of consumers to purchase an item on impulse, and examine a larger number of categories (108). Finally, recent works by Narasimhan and Wilcox (1995) and Wilcox and Narasimhan (1996) document the cross-category differences in retailers’ promotional strategies, including retailers’ incentives to introduce private labels. What is clear is that while cross-category generalizations would be very useful to retailers and academics alike, markedly little research has been done in this area.

**Description of the data**

**Sources**

We obtained data on shelf-space allocation, number of SKUs stocked, retail margins, as well as several other category-level variables on 231 categories of frequently purchased grocery items. The data were obtained through cooperation with Marsh Supermarkets, a large Indianapolis-based grocery retailer. The data were the result of a year-long study undertaken by Marsh during calendar year 1990. We also conducted consumer surveys (measured on seven-point agree-disagree scales) to collect data on whether a category was a necessity, on self-reported category-level brand loyalty, and on consumers’ propensity to stock up on items in a given category if a sale price is observed. Each questionnaire contained questions on ten or fewer categories. We discarded some completed questionnaires because the respondents indicated that they were not the primary shopper for their household. Ultimately, we received 126 completed and usable questionnaires. These generated four or more category-level observations for each question for 209 categories. Thus, merging the Marsh data set with the survey data set yielded 209 categories with observations on all the variables of interest.

We define the following variables:
Space = the average number of linear feet of shelf-space allocated to a given category,

Variety = the average number of SKUs stocked in a given category,

Margin = the average category retail margin, expressed as a percent of price,

Sales = the average weekly dollar sales in a given category,

Need = a measure of consumers’ perception of the necessity of a category (low values indicate the category is less of a necessity, while high values indicate a greater necessity),

Loyalty = a measure of consumers’ perception of their own brand loyalty within a category (low values indicate little loyalty, while high values indicate high brand loyalty),

Stockup = a measure of consumers’ propensity to purchase additional product in a given category given that a sale price is being offered (low values indicate low propensity, and high values high propensity),

Storable = a dummy variable taking on the value 1 if the item is not perishable and 0 otherwise, and

Size = the average number of additional linear feet of shelf-space that would be required to stock an additional one item in the given category.

Descriptive statistics

Here we describe the data, highlighting the interesting and sometimes counterintuitive relationships between the constructs. We begin by presenting simple box plots of the retailer’s decision variables, pointing out the categories that are the most extreme outliers (see Figure 1 and Table 1).

While margins are approximately normally distributed across categories, both product variety and shelf-space allocation measures are characterized by large numbers of categories with relatively little space and limited product variety with a few exceedingly high outliers.

Next, a correlation matrix including all variables is examined in Table 2. Several things stand out from the data. First, one might reasonably conjecture that retailers allocate more shelf-space and offer greater product variety in categories where they have higher margins. The data do not support this conjecture. Shelf-space allocation and variety offered are both negatively correlated with retail margin (the correlation coefficients are \(-0.31\) and \(-0.22\) respectively). Scatterplots of the relationship between Margin and Space as well as Margin and Variety indicate that while these negative relationships do exist, there is considerable cross-category heterogeneity in the relationships between these constructs (see Figures 3A and 3B).

We were concerned that these counterintuitive negative relationships might arise because retailers might be competing heavily on some “staple” product categories, categories where retailers might be forced because of consumer price vigilance to take smaller margins in spite of offering considerable product variety and shelf space. We also examined separate scatterplots of these relationships for categories consumers indicated were a necessity as well as those consumers indicated were not. The negative relationships
persisted in both cases. Second, the constructs Variety and Space are highly correlated (.69). This is quite intuitive. If a retailer wants to offer additional product variety, he must either decrease the on-shelf inventory of the other items in that category and/or increase shelf space. The data are consistent with the argument that the variety decision drives the space decision, with the space decision ultimately affecting sales. Simple path analysis suggests that since the correlation between Variety and Space is .69, the correlation between Space and Sales is .67, and the correlation between Variety and Sales is .34, Figure 2 is a reasonable way to depict the relationship between these constructs.

Finally, the consumer survey measures of Need, Loyalty, and Stockup are all highly positively correlated. This suggests, among other things, that consumers are more willing, in the presence of a sale, to stock up in categories where they have a definitive favorite brand and that category is viewed as a necessity.

Table 1: Outliers.

<table>
<thead>
<tr>
<th></th>
<th>Highest</th>
<th>Lowest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space</td>
<td>Alcoholic beverages (513.28 linear ft.)</td>
<td>Pomengranites (1 linear ft.)</td>
</tr>
<tr>
<td>Variety</td>
<td>Cosmetics (1,861 SKUs)</td>
<td>10% of the categories (1 SKU)</td>
</tr>
<tr>
<td>Margin</td>
<td>Rutabaga (69%)</td>
<td>Poultry (−.09%)</td>
</tr>
</tbody>
</table>
Table 2. Correlation matrix.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\text{SALES}$</th>
<th>$% \text{MARGIN}$</th>
<th>SIZE</th>
<th>SPACE</th>
<th>VARIETY</th>
<th>NEED</th>
<th>LOYAL</th>
<th>STOCKUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{SALES}$</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$% \text{MARGIN}$</td>
<td>$-.38^*$</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIZE</td>
<td>.05</td>
<td>$-.02$</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPACE</td>
<td>.67*</td>
<td>$-.31^*$</td>
<td>$-.06$</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VARIETY</td>
<td>$.34^*$</td>
<td>$-.22^*$</td>
<td>$-.07$</td>
<td>$.69^*$</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEED</td>
<td>$.29^*$</td>
<td>$-.21^*$</td>
<td>$-.04$</td>
<td>$.25^*$</td>
<td>$.18^*$</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOYAL</td>
<td>$.27^*$</td>
<td>$-.32^*$</td>
<td>$-.10$</td>
<td>$.30^*$</td>
<td>$.32^*$</td>
<td>$.67^*$</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>STOCKUP</td>
<td>$.30^*$</td>
<td>$-.26^*$</td>
<td>$.02$</td>
<td>$.37^*$</td>
<td>$.25^*$</td>
<td>$.75^*$</td>
<td>$.72^*$</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Predictors of category-level decisions

Finally, we wanted to make a preliminary attempt to discover to what extent some of these important category-level decisions could be predicted from the perceptual data we collected. To this end we regressed each of the retailer’s decision variables on some of the other constructs that we believed might impact these decisions. A brief summary of each regression equation and the reasons we chose to include some of the constructs follows.

The margin regression includes the following variables:

- *Sales* Wilcox and Narasimhan (1996) showed that retailers take a smaller margin in categories where sales are high.
- *Loyalty* We conjecture that in categories where brand loyalty is high, manufacturers will appropriate a greater proportion of the channel profit and hence leave retailers with a small margin.4
- *Stockup* Retailers may be less inclined to offer attractive prices (lower margins) in categories where consumers are likely to forward buy in the presence of a sale.5

The shelf-space regression includes the following:

- *Margin* For reasons mentioned earlier.
- *Sales* Retailers have to allocate additional shelf space to meet on-shelf inventory requirements in categories where demand is high.
- *Variety* This decision is highly related to the space decision, and hence we must control for it.

![Figure 2](image-url)
Figure 3a. Margin versus space scatterplots.

- Storable: Holding on-shelf inventory of perishable items is more costly and hence less attractive for retailers.

The variety equation includes the following:

- **Sales**: We conjecture that retailers will be more willing to offer greater product variety in categories with a greater level of sales.
- **Space**: For reasons previously mentioned.
- **Need**: Many of the categories that consumers’ might consider a necessity are staple food products (such as milk, eggs, and flour), which are difficult to differentiate and offer little prospect for product innovation.
- **Loyalty**: If consumers are more brand loyal, they will be less likely to purchase a substitute item in a given category if their preferred brand is not available. They may instead choose to purchase this, and perhaps other items, at another store. Hence the retailer has a greater incentive to have a good selection of brands are available in the category.
- **Size**: All else equal, products that are larger require additional shelf-space.

Table 3 indicates Space and Variety can be predicted reasonably well ($R^2$ of .69 and .53, respectively) by using category perceptual variables in conjunction with the some of the
other decisions retailers make as predictors. Some of the key relationships are highlighted between these constructs are highlighted below.

Summary of empirical findings

- Most categories have relatively little space allocated to them and have relatively limited product variety. There are a few outlier categories that can be characterized as having a very large space allocation and/or a high degree of product variety.
- The variety decision appears to drive the space decision (Table 2 and Figure 2).
- Retailers allocate less shelf space to categories that have higher average margins (Table 3). This may be at least partially explained by the fact that retailers have a greater incentive to compete intensely on categories consumers purchase often in order to try to influence these consumers’ store choice decision.
- Consistent with the theoretical model of Lal and Narasimhan (1996), retailers take a lower margin on categories where consumers brand loyalty is relatively high (Table 3).
- Category dollar sales and size of the assortment offered with a given category are good predictors of the amount of shelf space allocated to a category (Table 3).
- All else equal, storable items are given more shelf space than perishable items (Table 3).
Table 3. Standardized regression coefficients.

<table>
<thead>
<tr>
<th></th>
<th>Margin</th>
<th>Space</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin</td>
<td>.016 (.401)</td>
<td>.511 (13.139)</td>
<td>1397,300 (12.241)</td>
</tr>
<tr>
<td>Space</td>
<td></td>
<td>.479 (12.094)</td>
<td>−16,300 (3.387)</td>
</tr>
<tr>
<td>Variety</td>
<td></td>
<td>−.230 (2.550)</td>
<td>−9827,100 (1.542)</td>
</tr>
<tr>
<td>Sales</td>
<td>−.313 (4.737)</td>
<td>.000 (.001)</td>
<td>26483,000 (3.202)</td>
</tr>
<tr>
<td>Need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loyalty</td>
<td></td>
<td>.083 (2.132)</td>
<td></td>
</tr>
<tr>
<td>Stockup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>−.044 (1.202)</td>
<td>.084 (.271)</td>
<td>.529</td>
</tr>
<tr>
<td>R²</td>
<td>.190</td>
<td>.690</td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.178</td>
<td>.684</td>
<td>.520</td>
</tr>
</tbody>
</table>

Note: t-statistics are in parentheses.

- While the simple correlation between Sales and Variety is positive (Figure 2), retailers appear to offer less product variety in categories where dollars sales are high once we control for the amount of shelf space allocated (Table 3).
- Retailers offer greater product variety in categories where consumers indicate that they are loyal to a particular brand (Table 3 and Figure 2).

Conclusion

This research has discovered some useful facts about the relationship between some key category-level decisions that retailers make. It is intended as a preliminary examination of these phenomena. This research has several limitations. First, the data are derived from a study conducted by one retailer. This type of analysis should be replicated for a number of retailers to discover the generalizability of these results. Second, the data are strictly cross-sectional. Since we do not have time-series observations for each category, it is difficult to make statements about any cause-and-effect relationships that might exist among the constructs. Finally, this study is restricted to examining decisions for grocery products. These types of cross-category decisions are also made in many other retail formats as well as in many direct marketing concerns. Broadening the scope of this analysis to other formats would result in richer empirical generalizations about both consumer behavior and management decisions. We hope that these preliminary findings will spark additional interest in developing the broader empirical generalizations that are now becoming possible.

Acknowledgments

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Notes

1. The average margin was computed by using a weighted average of the individual margins of the SKUs within a given category.
2. Approximately 75 percent of categories have a space allocation of fewer than 60 linear feet, and 75 percent of the categories are characterized by fewer than seventy two SKUs stocked. A histogram confirming that margins are approximately normally distributed is available from the authors.
3. The data were divided such that all categories characterized by a mean measure of four or less were grouped together and all categories characterized by a mean measure of four or greater were assigned to another group.
4. For a theoretical development of this argument, see Lal and Narasimhan (1996).
5. For theoretical and empirical evidence of this argument, see Wilcox and Narasimhan (1996).

References


