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Using Scanner Data To Test for Elasticity Differences Among Higher and Lower Income Shoppers: A Socioeconomic Approach for Breakfast Cereals

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ABSTRACT

Scanner data are used to estimate demand elasticities for breakfast cereals in two socioeconomic areas. Five groups of cereals are identified and the own-price elasticities for four of these are negative, statistically significant, and in the elastic range. Snack cereals, an identified category, show statistically insignificant elasticities and impulse buying is offered as the explanation. Lower-income shoppers are more inclined to purchase the lowest-priced products within a product group; they are also more predisposed to select purchases from lower-priced product groups. Lower-income shoppers purchase private label cereals with twice the frequency of higher-income shoppers.

KEYWORDS: Cereals, demand elasticities, gross margins, socioeconomic areas, lower-income shoppers, higher-income shoppers.

Introduction

Consumer response to food prices is increasingly being measured with the aid of supermarket scanning data. For example, agricultural economists have estimated demand elasticities for products ranging from meat and potatoes to full lines of produce and grocery (Capps and Nayga; Capps; Carmen and Figueroa; McLaughlin and Lesser; Jourdan). With few exceptions, these studies have involved one retail chain, with the analysis focused at the firm level as opposed to the store level. That is, important demographic and income variations which might influence purchases among stores have not been incorporated into the analyses. Additionally, these studies have been void of cost data which would allow for testing price-markup differences among stores and/or price-markup differences among product sizes.

This study represents an improvement over previous approaches as it is focused at the store-level and it incorporates demographic and income information about stores. Specifically, this study addresses cereal purchases and product prices among six stores, three of which are in higher income areas and three in lower income areas (Table 1). Differences in demographic factors, such as age and educational attainment, are apparent among these areas. Objectives of the study are to test the hypotheses that (1) demand elasticities for ready to eat cold cereals, hot cereals, and snack-related cereals differ by income area; (2) quantity purchases among various product categories or product groups differ by income area; and (3) gross markup margins on products are directly related to package size.

Results revealed from tests of these hypotheses are expected to be of particular interest to supermarket managers, economists and food shoppers. Supermarket managers are likely to gain insights from the study which can aid

Table 1. Socioeconomic Characteristics of Two Socioeconomic Areas

Store Location	Census-Tract Data							Weekly Store-Level Data				
	Population	Race (Percent) White	Race (Percent) Other	Median Age	Average Family Income	Education (Percent) High School	Education (Percent) College	Average Store Sales	Sales Per Sq. Feet	Average Cereal Sales	Average Customer Count	Average Consumer Purchase
Higher Income												
Store 1	4,487	96	4	43.0	$70,641	41	55	$387,821	$6.34	$13,313	18,827	$20.56
Store 2	11,199	96	4	32.2	$56,031	47	45	$346,956	$8.23	$10,635	16,813	$20.62
Store 3	3,539	96	4	33.0	$50,712	55	36	$545,943	$9.72	$19,488	22,986	$23.78
Average	9,742	96	4	36.1	$59,128	48	45	$426,906	$8.10	$14,465	19,542	$21.65
Lower Income												
Store 4	7,754	89	11	32.8	$27,689	58	7	$403,649	$6.85	$10,873	19,163	$20.99
Store 5	6,582	95	5	33.2	$27,301	50	3	$324,082	$9.58	$10,151	13,759	$23.55
Store 6	4,682	84	16	32.3	$27,433	59	7	$386,910	$9.18	$10,562	23,696	$16.28
Average	6,399	89	11	32.8	$27,474	55	6	$355,496	$8.54	$10,356	18,728	$20.27

Sources: Bureau of the Census, 1990 Census of Population and Housing: Census Tracts Data on CD-Rom. Columbus, Ohio Standard Metropolitan Statistical Area, U.S. Department of Commerce, July, 1992; and A National Supermarket Chain Store.

them in developing marketing and management decisions at the firm and store level (Wolfe). Likewise, as economists are often called upon to make marketing, management, and public policy recommendations to entrepreneurs and policymakers, these findings should enrich the knowledge base which undergird their recommendations. Finally, information on product prices and product values (margins or markups) is expected to help shoppers and/or household decisionmakers become more efficient purchasers of food commodities.

Theoretical Considerations

Several theories have developed which suggest that supermarket prices are likely to differ among areas which are nonhomogeneous in population and income (Narasimhan; Gerstner and Hess). These theories imply that merchants are aware of the underlying income and demographic characteristics and they utilize marketing and management practices which reflect these characteristics. The pricing practices which are suggested by the aforementioned theories are not expected to hold in this study because the retail chain uses zone pricing.[1] Yet, comparable prices among stores with heterogenous populations could reveal price elasticities which suggest that a nonoptimal pricing strategy is utilized.

Although zone pricing leads to comparable prices among stores, effective prices paid by consumers are undoubtedly influenced by coupons. Because 25 to 50 percent of all cereals are purchased with coupons, effective prices are likely to be lowest in those stores with the highest rate of coupon redemption (McCallum). Based on the concept of opportunity cost, one would expect to find the highest rate of coupon redemption in lower income stores because of the lower value of shoppers' time. Yet, many studies have found coupon-prone shoppers to be those with higher incomes and higher levels of education (Bawa

and Shoemaker; Levedahl; Nielsen). Further, studies have shown coupons to be more readily available for the higher-priced products which are more likely to be purchased by higher-income shoppers (Bawa and Shoemaker; Levedahl). With data unavailable on the rate of coupon redemption by store, no a priori hypotheses are advanced regarding the expected effects of coupons on price elasticities. However, because private label cereals are purchased almost exclusively without coupons, this product group should provide a set of price elasticities which are free of coupon effects. Indeed if cost savings are important to consumers, lower income consumers are expected to purchase larger quantities of private label cereals.

Although few, if any, products are purchased with the level of coupon intensity as cereals, store-level studies have been conducted for other products (Mclaughin and Lesser; Carmen and Figueroa). Mclaughlin and Lesser found demand elasticity differences for fresh potatoes among stores and concluded that supermarkets profits possibly could be enhanced through store-level pricing as opposed to zone pricing. Carmen and Figueroa found greater variation in store sales from the first to the last week of the month for stores serving mainly lower income customers than for stores serving primarily higher income customers. Further, they found supermarket sales to be influenced by nonprice variables such as holidays, paydays and advertising. Relative to breakfast cereals, these studies suggest that different levels of inventories and stocking patterns are likely to be warranted to achieve economic efficiency and optimal profitability.

Previous studies suggest that age-related demographics have a major impact on cold cereal purchases (Dussere, 1977; Wolfe, 1989). By extension, other socioeconomic characteristics may be hypothesized to be related to

cereal purchases. Lacking data on individual shoppers, a general premise of this study is that cereal purchases are likely to be influenced by shoppers' income and other demographic factors with respect to store locations. Based on theoretical arguments and previous empirical results, differences in demand elasticities are hypothesized to exist across the two socioeconomic areas. This study is intended to provide quantitative measures of these demand elasticities.

The Cereal Industry and Product Consumption

Breakfast cereals[2] are an important component of supermarkets' merchandising programs. Cereal specials are used frequently to stimulate sales in supermarkets because, next to soft drinks, cereals are the second largest-selling branded-food item (Gibson). Nielsen's tracking studies report a retail value of cold cereals of $6.7 billion for 1991 (Gibson). With cold cereals representing 85 percent of total cereal sales (Weinstein, p. 52), the retail value of 1991 cereal sales is roughly $7.76 billion. A few large firms control most of the market for hot and cold cereals. In 1990, the top four firms in the cold cereal sector controlled 80 percent of the market, a decline of 11 percentage points from their 1970 market share of 91 percent (Harris).

In addition to the role of coupons in cereal purchases, media advertising is another major factor in cereal promotions. The advertising-sales ratio for cold cereals increased from 7.2 percent in 1975 to a 1990 ratio of 13.1 percent (LNA/Arbitron). Ward et al. argue that advertising expenditures often represent attempts by manufacturers to differentiate their products and create a unique product image in the minds of consumers. Thus, if cereal advertising is effective, it could diminish price sensitivity and lead to considerable brand loyalty. Among households with small children,

Dusssere argues that exposure to cereal advertising leads children to consume many of the sugar-coated cereals.

Consumption of cereal products has changed considerably over the past twenty years. In 1970, per capita consumption of breakfast cereals was 10.3 pounds; by 1990, this total had increased to 15.0 pounds. The composition of this total in 1990, however, was considerably different from that of 1970. Health oriented cereals, especially bran and oats-based cereals, represented more than 45 percent of the 1990 total cereal consumption, as compared to less than 2 percent of the 1970 cereal consumption. Indeed sales of oat-bran cold cereals increased 245 percent (from $70 million to $241 million) between 1988 and 1989, and sales of oats-based cold cereal increased 60 percent (from $432 million to $631 million) during the same period (Best). The top four cereal producers were slow to enter this fast-growing health segment of the market, partly explaining their loss of market shares (Margulis, 1989).

Demographic and Income Information by Store Locations

Important demographic and income data for six stores selected from the Columbus (Ohio) metropolitan area are shown in Table 1. This table represents a combination of 1990 census data and store-level data by location. Census tract data are used to characterize store locations and this tract data, in some instances, represent overlapping tracts. For example, one store was contiguous to three tracts and served shoppers within all three tracts. Thus, data describing the store location reflect all three tracts.

Stores 1, 2 and 3 are located in higher-income suburban areas, but within close proximity of the central city of Columbus. The farthest distance between any two of the six stores is roughly 15 miles, or approximately 25 minutes of travel time by car. Average family income in the higher income

areas is more than twice that for lower income areas. Store sales in the higher income area average about 13 percent above those for the lower income area. Cereal sales, as a percentage of store sales, are also highest for the higher income areas. For all stores, cereal sales average just above 3 percent of store sales.

As shown in Table 1, Store 5 of the lower income stores would appear to be a higher income store based on average consumer purchases. However, census data confirm that this store is located in a lower income area and the unusually high purchases per customer is undoubtedly due to its urban/rural base. That is, the store is located right on the fringe of a rural community, and it draws shoppers from both urban and rural areas. High purchases per customer for this store, relative to the other lower income stores, suggest that rural residents make fewer shopping trips and larger purchases per trip than their urban counterparts.

A very pronounced educational disparity is revealed for the two income areas. If indeed a positive relationship exists between income/education and coupon redemption, stores in the higher income areas are expected to receive many more coupons than their lower income counterparts. Moreover, given the prevailing view that coupons are issued more readily for higher-priced products frequently purchased by higher-income shoppers, then the mix of products purchased are likely to vary considerably between the two income areas (Bawa and Shoemaker; Levedahl). That is, products purchased will reflect differences in consumer preferences.

Data Description

A national supermarket chain with significant market shares in the Columbus metropolitan area (more than 25%) provided the cereal scanning data

for this study. Store-level data are for the period of February 4, 1990 through February 16, 1991. However, cereal sales were unavailable for one of the six stores during 12 weeks of July 22, 1990 through October 20, 1990, leaving 42 weeks of comparable observations across all stores. Each store carried approximately 175 different cereal products, but an average of 455 products when products are enumerated by brands, sizes and flavors. Weekly observations were for Sunday through Saturday. No advertising expenditures were available, but the data did include a code indicating whether a product was promoted during a given week. This promotion was in the form of media advertising, merchandising, price reductions, or some combination of two or more of these activities.

With 42 weeks of usable data on an average of 455 products per store, approximately 19,110 data entries were available per store. To make these data entries manageable, cereal products were classified into product groups. Five product groups are identified: (1) private label cold cereals; (2) top ten brands of cold cereals; (3) all other brands of cold cereals (OBRD); (4) instant or hot cereals; and (5) snack-related cereals. The top ten brands represent those brands with the highest market shares as measured by dollars sales for 1989. For example, Cheerios was the leading brand with a market share of 4.8 percent; Kellogg Frosted Flakes was second with a market share of 4.6 percent; etc. It should be emphasized that Chex cereals, the seventh leading brand in 1989, consists of many product varieties: Bran Chex, Corn Chex, Rice Chex, etc. (see Table 7). Under the delineated classification system, product distributions for the five groups are 4.0, 10.5, 38.0, 16.2 and 31.2 percent, respectively. That is, private label cereals constituted 4.0 percent of cereal items sold, or roughly 758 of the 19,110 items sold.

This classification system, however, should not be confused with expenditures per product category or quantities (ultimately measured in ounces) per product category.

Model Development and Estimation Procedures

The model used in this study follow the general framework outlined by Holdren and the specific model used by Capps. The specifications are dynamic, with distinct short- and long-run elasticities, Specifically, the model is specified as:

(1) $Q_{it} = f(P_{it}, P_{jt}'s, HOL, PAY, TEXP_t, PROM_{it}, GRW_t, Q_{it-1})$,

where Q_{it} is total ounces of product group i in week t, i = 1,...,5, t = 1,...,42; P_{it} is a weighted-average price of product group i in week t; $P_{jt}'s$ represent weighted-average prices for competing product groups in week t; HOL is a zero-one variable for calendar holidays; PAY is a zero-one variable measuring nearness to payday (PAY = 1 for weeks including the 1st or 15th of each month; 0 otherwise); $TEXP_t$ represents total expenditures on cereal products in week t (intended as a proxy for consumer income); $PROM_{it}$ reflects the number of promoted products within group i during week t; GRW_t is a trend variable expressed from 1 to 42, intended to capture growth of cereal sales; and Q_{it-1} is total ounces of product group i purchased during the previous week. Descriptive statistics for quantities, prices, expenditures, promotions and unit costs are provided in Table 2.

Prices are determined by expressing each product sale as a ratio of all product sales within a given product group. Specifically, weighted price for product group i in each time period is:

(2) $P_i = \Sigma_J W_{ij} P_{ij}$, where $W_{ij} = (P_{ij}\ Q_{ij})/(\Sigma_J P_{ij}\ Q_{ij})$ and j denotes the products in the same group. Because each product group is a potential

substitute or complement of other product groups, all product groups are included in each equation. Equation (1) leads to 30 regression equations and these equations are estimated using seemingly unrelated regression because of potential gains in efficiency (Pindyck and Rubinfeld). With 12 weeks of missing observations, the first observation immediately following the missing time period is omitted to properly align current and lagged values of the dependent variables.

Because store-level demand elasticities are the primary focus of this analysis, each equation is specified in its double logarithmic functional form to give direct demand elasticities. Since previous studies have indicated a link between demographics and cereal sales, it is hypothesized that stores in lower income areas will show more price sensitivity to cold cereal products than stores in higher income areas (Bawa and Shoemaker; Wolfe). That is, demand for cold cereals is likely to be more price inelastic in higher income areas than it is in lower income areas. Further, it is hypothesized that stores in lower income areas will show a stronger propensity toward consumption of private label and hot cereals than stores in higher income areas. This assumption stems from the lower prices of these product categories, as shown in Table 2. With many of the health-related bran and oats-based cereals included in the other brands category, it is hypothesized that higher income areas will show less price sensitivity toward these products. These elasticities differences are expected to prevail among stores because studies have shown that consumers not only do not compare prices among stores (Cox and Foster) but they shop within a fairly restricted geographic area (Cotterill).

Empirical Results

Tables 3 and 4 provide the direct price and expenditure elasticities for the system of equations. Results pertaining to cross-price elasticities and other nonprice variables are not reported because of the large number of parameters and statistics associated with the system of equations.[3] Weighted R^2's for the system of equations in six stores ranged from 0.86 for Store 2 to 0.97 for Store 3. Based on the Durbin h-test, serial correlation is not a problem for any of the 30 equations.

Relative to some of the unreported estimates, cross-price elasticities show private label cereals to be strong substitutes for other branded cereals (OBRD). Other branded cereals, however, were weak substitutes for private label cereals. Ignoring results from the six snack cereal equations temporarily, all of the remaining 24 equations have at least one statistically significant product category which is either a complement or substitute. However, no consistent pattern of substitutability or complementarity emerged among two or more product categories. Given the high coupon redemption rate for cereals, the lack of consistent substitutes or complements for cereals would tend to support the argument advanced by Bawa and Shoemaker that coupon-prone consumers are less likely to be brand loyal. Accepting this argument with respect to coupons, however, calls into question the argument that high levels of advertising by cereal manufacturers create brand loyalty and firm-level market power.

As shown in Table 3, if results from the snack-cereal equations are ignored, all own-price elasticities but one are statistically significant and in the elastic range. Consistent with economic theory, these elasticities show an inverse relationship between price and quantity. Looking across these

elasticities, it is not readily apparent that these elasticities differ by income area or that the underlying socioeconomic characteristics unique to store locations have an impact on purchasing behavior. To examine this possible relationship, two statistical tests are used to determine if there are differences in consumer purchasing behavior between the two income areas.

The first test involved a simple pair-wise comparison of own-price elasticities between every high and low income store using the Z-test. This test is valid on the condition that the elasticities are calculated from normally distributed, randon variables. It is used here because the cross-model correlation matrix showed the equations to be independent. That is, the correlation coefficients suggested that the covariance between the dependent variables of any two equations was zero. Given this observation, equality of elasticities for a high and low income store could be tested by treating the elasticities as the equivalent of population means. Tests for differences in the elasticities for high and low income stores showed a statistically significant difference for 32 of the 36 pair-wise tests (no tests were conducted on the elasticities for snack cereals). For example, the twelve pair-wise tests of the elasticities for low-income Store 5 with those of high-income Stores 1, 2, and 3 showed all elasticities to be statistically significant at the .01 level or better (Table 5). Eleven of the twelve tests for Store 6 versus Stores 1, 2, and 3 were statistically significant at the .10 level or better. Finally, nine of the twelve tests for low-income Store 4 versus high-income stores 1, 2, and 3 were statistically significant at the .10 level or better.

Looking down the columns of the first set of Z-values in Table 5, it is apparent that lower income stores have a more elastic demand for private label

cereals, save for one comparison. Invariably, higher income stores have a more elastic demand for all other brands (OBRD) of cereals. Mixed results are shown for instant cereals and the top ten brands. Indeed these mixed results among product categories prompted a second mean-difference test to examine differences in purchases within product categories. That is, the objective of the test was to determine whether lower-income shoppers purchased product combinations which differed from those purchased by higher-income shoppers.

This test involved an analysis of prices paid per ounce for each product category within four stores. Four stores were used because there are only four for which total cereal purchases were shown to be comparable: Stores 2, 4, 5 and 6 (Table 5). That is, means sales for the 42-week period were basically equal for Stores 2, 4, and 6. These equalities allow for testing a basic premise of this research that the behavior of consumers in higher income areas differ from that of consumers in lower income areas. To serve as a benchmark for the validity of these tests, Store 5 is also included. That is, because cereal sales in low-income Store 5 are statistically insignificant from those in low-income Store 6, findings from the tests of two low-income stores can then be compared with those for low-high income stores.

Comparisons of prices paid for cereals in higher income Store 2 versus lower income Store 4 and higher income Store 2 versus lower income Store 6 show a revealing set of results. For these three stores, it can be seen from Tables 2 and 5 that shoppers in the higher income Store 2 purchase more expensive products in four of the five categories. No statistically significant difference in prices paid are found for a fifth category of cereals, other branded products. These differences in prices paid between higher-lower income stores are particularly striking when compared to

differences in prices paid between lower-lower income stores. Except for private label cereals, shoppers in lower income Store 4 versus Store 6, and Store 5 versus Store 6 are shown to purchase product combinations which are similarly priced.

From Tables 2 and 5, it can also be seen that even though total cereal sales in Store 4 are statistically different from those of Store 5, prices paid within product categories for these two lower income stores show purchase patterns which are consistent with those reported for the aforementioned comparisons of lower income stores. Additionally, differences in prices paid within higher income Store 2 as compared to lower income Store 5 are reasonably consistent with those reported for other higher-lower store comparisons. Observed differences in prices paid for private label cereals among lower-lower income stores could reflect the fact that private label cereals are the least expensive of the five product categories. That is, these relatively lower-priced products might afford consumers more discretion in their purchase selection.

Although these mean difference tests are an indirect test of elasticity differences, they suggest a distinct difference in the purchasing behavior of higher and lower income shoppers. That is, if all shoppers have equal exposure to the same bundle of commodities, some similarity in prices paid may be expected when one controls for quantities purchased. Relative comparisons of higher-lower income shoppers show higher income shoppers purchasing more of the higher-priced products within each product category. By contrast, relative comparisons of lower-lower income shoppers (Stores 4, 5, and 6) show similar purchasing patterns across product categories, save for the lowest priced category of private label cereals. Although total purchases within a

given product category differ among stores, differences in the purchasing behavior of higher-lower income shoppers cannot be explained simply by uneven purchases within a given product category. For example, it would be unreasonable to argue that differences in prices paid between higher-lower income areas are due to larger volumes of the higher-priced products within the higher income stores. Clearly if the distribution of product sales for the top ten brands in Stores 2 and 6 were equal, prices paid in Store 2 should be lower than those paid in Store 6 because the volume of top ten purchases are greater for Store 6. Yet, Tables 2 and 5 show that higher income shoppers paid a statistically significant higher price.

Relative to the expenditure elasticities, it can be seen from Table 4 that they are all positive and statistically significant. These elasticities indicate a propensity for consumers to purchase more of all product categories with increased cereal expenditures. More revealing than the elasticities themselves, however, are the expenditure proportions shown in the lower part of Table 4. Based on average product prices as shown in Table 2, it seems reasonable to expect lower income shoppers to purchase higher proportions of the lower-priced cereals relative to those purchased by higher income shoppers. That is, based on average product prices alone, lower income shoppers would be expected to purchase greater proportions of private label cereals, instant cereals and snack-related cereals. Similarly, higher income shoppers would be expected to purchase higher proportions of the top ten brands and other branded cereals.

To further test for differences in purchases between higher and lower income areas, a two-way analysis of variance test is conducted on each product category. More specifically, a General Linear Model (GLM) is used because of

the unbalanced design of the analysis. The two-way design is used to control for differences in both income and sales. While Table 1 clearly delineate high and low income stores, closer observation will show that Stores 1, 2, 5 and 6 can be characterized as low sales stores, while Stores 3 and 4 can be described as high sales stores. Using a design of two classes of income and two classes of sales, 42 weeks of sales data for each of the five product categories are analyzed. Results from the GLM procedure are shown in Table 6.

As reflected by the F-values, the results in Tables 6 support the premise that cereal consumption is influenced by socioeconomic factors. Statistically significant differences in the purchase behavior of higher and lower income shoppers are found for all five product categories. Although lower income stores are shown to purchase a relatively larger proportion of the top ten brands of cold cereals (Table 4), it is apparent from Table 2 that they purchased the lower-priced products within this category. The fact that this higher priced category of cereals was highly preferred by lower-income shoppers could speak to the socioeconomic makeup of these households. For example, factors such as average age of household, household size, number of children in household, and the relative distribution of pre-sweetened cereals within the product category could account for the fact that lower income household purchase a larger proportion of cereals among the top ten brands.

Purchases of cereals in three of the other four categories are consistent with hypothesized relationships. It is likely that the snack cereal category can be discounted because of impulse buying for snack products. Higher income shoppers clearly purchase a greater proportion of other branded cereals and both sales and income are statistically significant. For private label cereals, income is a statistically significant determinant

of product purchases, but sales alone is statistically insignificant. Yet, the interaction of sales and income is statistically significant. This suggest that differences in store-level sales can explain some of the variation in the proportion of product purchases for private label cereals, but income is clearly a more important determinant of product purchases. For instant cereals and other branded cereals, income, sales and the interaction of sales are all statistically significant determinants of product purchases within the product categories. These results not only speak to the appropriateness of the two-way design, but they support the premise that socioeconomic factors are important determinants of product purchases. It is of interest to note that many of the supposedly healthy, high-fiber, oats-based cereals are in the other branded category. Higher purchases of this product category among higher income shoppers could suggest a difference in the health-consciousness or awareness of higher and lower income persons.

Margins and Product Sizes

Another key element of this study involves the hypothesis that gross markup margins on products are directly related to package size. Results reported here are independent of the econometric findings discussed heretofore, but they are an integral part of the information consumers need to make rational purchase decisions. Gross margins are expected to be directly related to package size because of the determinants of cost for a box of cereal. For example, since a large part of the cost for a box of cereal is actually related to packaging and advertising (McCallum), actual cost to the manufacturer and subsequent wholesale price should be a decreasing function (cost per ounce) of product size. As such, the retailer could add a relatively large markup on larger packages and yet maintain proportional or

reasonable price spreads among smaller, medium, and larger packages. Consistent with the practices of the retail food industry, margins are specified in this study as the ratio of price minus cost, divided by price.

This hypothesis was tested by using the top 10 brands of cold cereals and the 13 private label products which were consistently carried in all stores (Table 7).[4] It should be emphasized that only two private label cereals were offered in alternative sizes. From Table 7, ten products are shown to have markup margins (MU%) that are statistically different by size. These markups represent the average for the 42-week sample period and the test statistic is a t-test of mean differences. For these ten products, four of them have higher margins on the larger sizes and the remaining six have higher margins on the smaller sizes. Two of the four products with higher margins on the larger sizes, Kellogg Corn Flakes and Nabisco Shredded Wheat, have lower consumer cost per ounce than those of a smaller size. This pricing behavior does not suggest a pattern in which supermarkets charge either higher prices on larger packs or higher prices on smaller packs. Noticeably, when three alternative sizes of a manufacturer's brand exist, the retailer generally promotes the midsize brand with margin reductions. That is, there is considerably more week-to-week price variations on the mid-size package than there is on the smaller or larger packages. This suggests that lower and higher income customers are equally as likely to be attracted to a midsize package. Thus, boxed cereals do not appear to be a product that reflect a systematic pricing bias toward smaller or larger packages.

Relative comparisons of private label cereals with the top ten brands show private label cereals to have an average markup that is 23 percent higher, but an average consumer cost per ounce that is 31.6 percent lower

(Table 7). Additional tests (not reported in Table 7) using three groups of 13 national brands (selected somewhat randomly) show similar markup and consumer cost differences between national brands and the 13 previously mentioned private label products. Assuming no quality differentials among private label cereals and national brands, consumers can obviously minimize their expenditures on cereals by purchasing private label products. Although supermarkets receive a higher profit margin for private label cereals, product turnovers for the national brands relative to private label cereals suggest that direct product profits (DPP) are likely to be higher for national brands. For example, sales of private label Raisin Bran (20 oz.) averaged 10.6 boxes per week, as compared to 91.4 boxes per week for the national brand (20 oz.). These sales and profit differentials among private label and national brands are likely to account for much of the product proliferation of cereals in supermarkets.

Summary and Conclusions

A total of 30 equations were estimated for this study. The F-statistic showed all equations to be statistically significant and, with the exception of snack cereals, all own-price elasticities were consistent with economic theory. Socioeconomic factors were shown to be statistically significant with respect to product selection within a given product category as well as product selection among categories. That is, relative to higher income shoppers, lower income shoppers not only purchased lower-priced products within a given product category, but they purchased products more readily from the lower-priced categories. Simply put, lower income shoppers demonstrated little, if any, irrational purchase behavior.

Significant findings of the study are: (1) major differences do exist in

the purchasing behavior of higher and lower income shoppers; (2) lower income customers are more inclined than higher-income customers to purchase private label, the top ten brands, and instant cereals; (3) higher-income customers are more inclined to purchase other branded cereals, a category which includes many high-fiber, bran and oats-based cereals; (4) demand for instant and cold cereals is price elastic; (5) markup margins on products for this chain are not set with respect to demand elasticities; and (6) store prices for this chain are not set with respect to demographics and the income level surrounding a store's location. With respect to these last two points, statistical tests of elasticities clearly show a more elastic demand for all other brands of cereals in higher-income stores than in lower-income ones. Lower-income stores, by contrast, are shown to have a more elastic demand for private label cereals. Such findings would suggest that markup margins and store prices should reflect socioeconomic characteristics with respect to location.

From a practical viewpoint, it is likely that the pricing behavior observed for the stores in this study reflect the fact that efficient management of a group of stores generally require uniform prices across products and across stores. However, as scanner data are integrated with demographic data to reveal more information about consumer purchasing behavior, it is likely that price variation among stores and among product sizes will become more commonplace as supermarket managers recognize the profits to be gained from a more optimal pricing strategy.

TABLE 2. DESCRIPTIVE MEANS OF RELEVANT VARIABLES

	STORE 1	STORE 2	STORE 3	STORE 4	STORE 5	STORE 6	ALL STORES
DEPENDENT VARIABLES[a]				(Mean Values)			
PRIVATE LABEL	1387	1955	3220	3254	3081	3342	2706
TOP TEN BRANDS	19663	16031	28641	18017	18003	19044	19900
OTHER BRANDS	31240	23264	44648	24216	21105	22028	27750
INSTANT CEREALS	7117	5423	8897	6598	7135	8370	7256
SNACK CEREALS	8214	8236	13676	6596	6536	5484	8124
PRICE VARIABLES[b]							
PRIVATE LABEL	2.07	2.18	2.22	2.18	2.19	2.08	2.15
TOP TEN BRANDS	3.13	3.12	3.21	3.05	3.03	3.04	3.09
OTHER BRANDS	3.30	3.31	3.35	3.31	3.29	3.29	3.31
INSTANT CEREALS	2.72	2.67	2.71	2.51	2.49	2.36	2.58
SNACK CEREALS	2.27	2.26	2.27	2.25	2.24	2.21	2.25
PROMOTION VARIABLES[c]							
PRIVATE LABEL	2.14	2.14	2.48	2.19	2.14	2.19	2.25
TOP TEN BRANDS	5.52	5.43	6.37	5.45	5.40	5.59	5.75
OTHER BRANDS	15.59	15.35	17.48	15.47	15.50	15.64	16.32
INSTANT CEREALS	6.90	7.02	8.57	6.93	6.93	6.86	7.43
SNACK CEREALS	13.71	15.11	17.00	14.64	14.95	15.09	15.45
EXPENDITURES[d]							
PRIVATE LABEL	188	270	449	434	425	437	367
TOP TEN BRANDS	3563	2869	5153	3094	3052	3246	3496
OTHER BRANDS	6615	4949	9502	5216	4528	4737	5924
INSTANT CEREALS	1018	777	1252	858	909	1097	985
SNACK CEREALS	1928	1767	3052	1270	1237	1045	1716
UNIT PURCHASE PRICE[e]							
PRIVATE LABEL	13.65	13.88	13.99	13.51	13.86	13.21	13.68
TOP TEN BRANDS	18.13	17.94	18.18	17.31	17.04	17.09	17.62
OTHER BRANDS	21.19	21.35	21.37	21.61	21.55	21.53	21.43
INSTANT CEREALS	14.52	14.73	14.15	13.18	12.86	13.12	13.76
SNACK CEREALS	23.46	21.49	22.39	19.32	19.04	19.10	20.80
OTHER VARIABLES							
CUSTOMERS[f]	18827	16812	22985	19163	13759	23696	19207

[a] Ounces per week; [b] Dollars per box of cereal; [c] Number of products promoted; [d] Dollar sales per week; [e] Cents paid per ounce of cereal; [f] Number of customers.

Table 3. Own Price Elasticities

	Private Label	Top Ten Brands	All Other Brands	Instant Cereals	Snack Cereals
Higher Income					
Store 1	-.90 (1.64)	-1.72* (-2.94)	-2.80* (-4.46)	-2.98* (-5.32)	-.22 (-.37)
Store 2	-1.39* (-2.34)	-1.74* (-3.01)	-2.95* (-5.11)	-2.39* (-3.88)	.02 (.03)
Store 3	-1.49* (-3.68)	-2.22* (-4.55)	-3.39* (-7.89)	-2.94* (-5.07)	-.27 (-.36)
Lower Income					
Store 4	-1.45* (-3.28)	-2.07* (-3.39)	-2.32* (-4.92)	-3.79* (-4.67)	.37 (.90)
Store 5	-1.72* (-3.75)	-1.42* (-3.48)	-2.44* (-5.15)	-2.67* (-4.54)	.08 (.15)
Store 6	-1.25* (-2.49)	-1.18** (-1.70)	-2.11* (-3.75)	-2.72* (-3.01)	.34 (.45)

* Indicates statistical significance at the .01 level.
** Indicates statistical significance at the .10 level.
T-ratios are in parentheses.

Table 4. Expenditure Elasticities and Expenditure Proportions by Product Groups

	Private Label	Top Ten Brands	All Other Brands	Instant Cereals	Snack Cereals
Higher Income		Expenditure Elasticities			
Store 1	.70*	.67*	.99*	1.07*	1.33*
	(2.74)	(4.07)	(8.99)	(3.55)	(10.4)
Store 2	.73*	1.01*	.82*	1.31*	1.14*
	(3.00)	(5.14)	(6.26)	(4.41)	(7.36)
Store 3	.53*	1.00*	1.00*	.75*	1.21*
	(3.69)	(9.71)	(15.02)	(3.73)	(9.51)
Lower Income					
Store 4	.85*	.93*	1.02*	1.06*	1.28*
	(6.30)	(6.02)	(11.34)	(3.67)	(8.65)
Store 5	.82*	.95*	.96*	1.44*	1.07*
	(5.31)	(7.33)	(8.70)	(6.11)	(6.54)
Store 6	.62*	.92*	.99*	1.19*	1.18*
	(4.65)	(7.16)	(12.6)	(5.22)	(7.43)
		Expenditure Proportions			
Higher Income					
Store 1	1.41	26.76	46.69	7.65	14.48
Store 2	2.54	26.98	46.54	7.31	16.62
Store 3	2.31	26.70	48.86	6.44	15.69
Average	2.09	26.82	48.45	7.09	15.55
Lower Income					
Store 4	3.99	28.46	47.97	7.89	11.68
Store 5	4.19	30.06	44.61	8.96	12.18
Store 6	4.14	30.74	44.85	10.38	9.89
Average	4.12	29.91	45.84	8.92	11.21

* Indicates statistical significance at the .01 level.

TABLE 5. Statistical Tests of Own-Price Elasticities and Unit Prices

Store Location	Private Label	Top Ten Brands	All Other Brands	Instant Cereals	Snack Cereals
	Mean Tests of Own-Price Elasticities (Test statistics are Z-values)[a]				
Store 1 vs 4	4.99*	2.66*	-3.91*	5.26*	NA[&]
Store 2 vs 4	.52	2.51*	-1.88**	8.79*	NA
Store 3 vs 4	-.43	-1.22	-10.74*	5.45*	NA
Store 1 vs 5	7.33*	-2.72*	-2.92*	-2.44*	NA
Store 2 vs 5	2.80*	-2.90*	-4.36*	2.10**	NA
Store 3 vs 5	2.40*	-8.04*	-9.50*	-2.09**	NA
Store 1 vs 6	3.00*	-3.83*	-5.24*	-1.56**	NA
Store 2 vs 6	-1.14	-3.86*	-6.67*	1.93**	NA
Store 3 vs 6	-2.37*	-7.84*	11.59*	-1.31**	NA
	Mean Tests of Unit Prices (Test Statistics are Z-Values)				
Store 2 vs 4	2.04**	2.74*	-1.18	6.46*	9.16*
Store 2 vs 5	.18	4.06*	-0.87	7.49*	9.53*
Store 2 vs 6	3.95*	4.15*	-0.79	6.55*	9.99*
Store 4 vs 5	-1.77**	.60	.25	.31	.20
Store 4 vs 6	1.56**	1.04	.37	.31	.87
Store 5 vs 6	3.54*	-0.25	.09	-1.26	-.22

[a] A minus sign for a Z-value indicates a more elastic demand for the higher-income store.
[&] Tests are inappropriate since none of the elasticities are statistically significant.
* Indicates statistical significance at the .01 level.
** Indicates statistical significance at the .10 level.

TABLE 6. ANALYSIS OF VARIANCE TESTS FOR DIFFERENCES IN CEREAL PURCHASES BY PRODUCT CATEGORY

	PRIVATE LABEL CEREALS		TOP TEN BRANDS		OTHER BRANDED CEREALS		INSTANT CEREALS		SNACK CEREALS	
CLASS[@]	SS III[&]	F-VALUE	SS III	F-VALUE	SS III	F-VALUE	SS III	F-VALUE	SS III	F-VALUE
INCOME	236.32	1653.42*	515.64	342.90*	333.49	228.20*	183.09	470.84*	1111.8	2061.52*
SALES	.32	2.25	69.28	46.07*	208.67	142.79*	91.26	234.69*	8.19	15.19*
INCOME*SALES	4.01	28.10*	44.60	29.66*	102.64	70.23*	12.34	31.74*	4.31	7.99*
STORE (INCOME *SALES)	27.48	96.16*	12.59	4.19*	201.95	69.10*	38.91	50.04*	210.17	194.85*
WEEK	56.67	10.83*	2016.63	32.71*	3561.44	59.44*	2058.60	129.12*	401.90	18.18*
INCOME*WEEK	12.57	2.08*	253.64	4.11*	193.85	3.24*	109.96	6.90*	31.97	1.45*
SALES*WEEK	5.16	.88	50.15	.81	62.97	1.05	21.38	1.34	18.43	.83
INCOME*SALES *WEEK	5.62	.96	62.25	1.01	74.30	1.24	54.77	3.44*	15.62	.71
MODEL F-VALUE=	15.63*		13.38*		21.02*		43.74*		21.20*	

[@] Note that there are only two class variables. Week is the unit of measurement and the other variables are just interacted with the two class variables and week.

[&] SS III are often referred to as partial sums of squares. In GLM they are computed by constructing an estimated hypothesis matrix L and then computing the SS associated with the hypotheses $L\beta=0$.

* Indicates statistical significance at the .001 level.

Table 7. Markup Margins By Product Sized for 13 Private Label Products and the Top 10 Branded Products

Product Description	Size (Ounces)	Avg. Gross MU% (Price-Cost/Price)*100	Avg. Consumer Cost Per Ounce (cents)
Private Label Brands			
Toasted Oats	10	38.89	16.18
Toasted Oats	15	34.63[a]	13.92
Wheat Puffs	6	36.03	18.48
Wheat Puffs	18	34.54[a]	14.80
Corn Flakes	18	29.38	9.70
Oat Bran Flakes (40%)	20	33.04	11.14
Oat Bran Flakes (100%)	16	21.43	7.66
Crispy Rice	13	39.44	15.54
Honey Nut Toasted Oats	14	31.30	17.05
Sugar Frosted Flakes	20	34.69	14.57
Fruit Ring Cereals	15	29.04	12.41
Raisin Bran	20	34.19	13.95
Rice Puffs	6	35.76	18.48
		Avg. 33.26	14.14
Top Ten Brands			
Cheerios	10	24.57	24.30
Cheerios	15	13.69[a]	19.16
Cheerios	20	18.88[b]	19.68
Kellogg Frosted Flakes	15	20.36	18.19
Kellogg Frosted Flakes	20	21.38	17.03
Kellogg Frosted Flakes	25	20.94	16.55
Kellogg Corn Flakes	12	20.18	14.08
Kellogg Corn Flakes	18	7.93[a]	10.10
Kellogg Corn Flakes	24	26.57[b]	11.78

Table 7. (continued)

Product Description	Size (Ounces)	Avg. Gross MU% (Price-Cost/Price)*100	Avg. Consumer Cost Per Ounce (cents)
Kellogg Raisin Bran	20	14.43	15.09
Kellogg Raisin Bran	25.5	26.26[a]	16.60
Kellogg Rice Krispies	10	24.77	22.99
Kellogg Rice Krispies	13	17.65[a]	18.06
Kellogg Rice Krispies	19	22.75[b]	19.31
Honey Nut Cheerios	14	30.15	24.60
Honey Nut Cheerios	20	27.30[a]	23.50
Capn Crunch	15	19.95	17.88
Capn Crunch	18	27.10[a]	19.93
Capn Crunch	20	30.12	18.38
Double Chex	13.75	28.56	20.21
Double Chex Bonus	13.75	35.68	19.67
Bran Chex	16	25.66	17.05
Bran Chex Bonus	16	30.61	17.50
Corn Chex	12	29.19	22.79
Rice Chex	12	28.07	24.10
Wheat Chex	16	27.48	17.42
Oat Chex	14	35.33	22.79
Honey Nut Oat Chex	16	25.78	19.22
Honey Graham Chex	14	47.97	18.54
Nabisco Shredded Wheat	19.5	29.10	18.33
Nabisco Shredded Wheat	26	30.68[a]	16.88
Kellogg Bran Flakes	16	28.63	16.75
Kellogg Bran Flakes	20	25.86[a]	15.66
		Avg. 25.56	18.61

[a] Indicates a .01 statistically significant difference between the margins on this package size and the preceding smaller size.

[b] Indicates a .01 statistically significant difference between the margins on this package size and the preceding two package sizes.

Endnotes

1. Zone pricing is a type of pricing in which a firm employs uniform prices across a given geographic area. Even though this type of pricing allows firms to reflect customer differences among zones, it does not allow for differences within a particular zone.
2. Breakfast cereals are defined by Prepared Foods to include cold cereals, hot cereals, and snack bars such as granola. These are the products used in this study.
3. Although not reported, these results are available from the author upon request.
4. Each store carried UPC's for 18 private label products, but consistently stocked only 13 of these during the 42 weeks of this data period. Also, not all of the products listed in Table 7 are offered in alternative sizes. Chex cereals, for example, is a brand offered as an extensive product line as opposed to alternative package sizes. Moreover, some of the listings in Table 7 are provided to compare average markup margins between private label and the top ten brands of cereals.

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