

# Demand elasticities and price-cost margin ratios for grocery products in different socioeconomic groups

## *Poptávkové elasticity a rozpětí mezi cenou a náklady u potravinářských produktů v různých socioekonomických skupinách*

C. AKBAY<sup>1</sup>, E. JONES<sup>2</sup>

<sup>1</sup>*Department of Agricultural Economics, University of Sutcu Imam, Kahramanmaraş, Turkey*

<sup>2</sup>*Department of Agricultural, Environmental and Development Economics, Ohio State University, Columbus, Ohio, USA*

**Abstract:** In this paper, the demand elasticities and the size of price cost margin (PCM) ratios were investigated for private and national branded products using scanner data from a large supermarket chain in Ohio, USA. Demand elasticities and PCM ratios were measured for 32 national branded and 14 private label products for 9 food categories by using Almost Ideal Demand System. According to the results, lower-income shoppers were more prices sensitive than higher-income shoppers and the average price elasticities were ranged between  $-1.96$  (Snacks) and  $-3.33$  (ice-cream). According to the results, non-collusive case gave smaller PCM than the Bertrand case and the average PCM ratios ranged from 27% for ice cream to 54% for chips.

**Key words:** price competition, AIDS model, food, elasticity, private and national brand

**Abstrakt:** Práce se zabývá zkoumáním poptávkové elasticity a velikostí rozpětí mezi cenami a náklady (PCM) u produktů se soukromou a národní značkou s využitím skenovaných údajů velkého řetězce supermarketů v Ohio, USA. Poptávkové elasticity a PCM byly měřeny pro 32 produktů s národní značkou a 14 produktů se soukromou značkou pro 9 kategorií potravinových výrobků za použití AIDS (Téměř dokonalého poptávkového systému). Z výsledků výzkumu vyplývá, že nízkopříjmové skupiny kupujících reagovali citlivěji na změny cen než vysokopříjmové skupiny a že průměrná cenová elasticita poptávky se pohybovala mezi  $-1,96$  (u tzv. snacků) až po  $-3,33$  (u zmrzlin). Dále výsledky ukazují, že PCM nabývalo nižších hodnot u nekolusivních případů ve srovnání s Bertrandovými a průměrné PCM se pohybovalo od 27 % pro zmrzlinu po 54 % pro chipsy.

**Klíčová slova:** cenová konkurence, AIDS model, potraviny, elasticita, soukromé a národní značky zboží

Managers of product categories within supermarkets constantly face the challenge of stocking the appropriate variety of products as well as maximizing sales and profits for each product category. One strategy for maximizing sales and profits is to minimize the unnecessary inventory, but to keep the inventory at a sufficient level to avoid out-of-stock on store shelves. Price elasticities of demand play a major role in the selection of products for promotion, but income elasticities are also important. For example, most category managers decide to promote a product combination and/or depth of a product line based on

hypothesized elasticities of demand. The weakness of this approach, of course, is that demand elasticities are seldom known. Another important issue is the PCM that measures a firm's power to raise price above its marginal costs. This is particularly useful in conducting market research and performance studies. Price-cost-margin is a good indicator whether an industry is price competitive. It measures how much the prices in the industry deviate from manufacturing costs.

Non-competitive pricing can be observed based on the measure of each brand's own-price elasticity. For the representative firm, the higher the own-price

elasticity, the higher the degree of competition and the lower the level of market power (Parker, Kim 1997). This paper examines the tradition that has been termed the “New Empirical Industrial Organization” (Bresnahan 1989), which focuses on estimating the PCM ratios and marginal costs without observing actual costs. Using estimates of the demand parameters, one can estimate the PCM without actual costs. This procedure is called observed approach (Nevo 1997). PCM estimated with this approach is defined as the negative inverse of the observed own price elasticity. The assumption that underlies this approach is that a brand manager maximizes his/her brand profits independent of other brand managers in his company. Thus, joint profit maximizing is not assumed under this approach (Ma 1997; Cotterill, Samson 2002).

In the light of the above discussion, the first objective of this study is to investigate the demand for selected food categories and to estimate econometric food demand model. Store level weekly scanner data are used to determine whether the price elasticities are significantly different from the previous estimates based on the aggregate market level data. To accomplish this objective, we first estimate price elasticities of sub-categories (brands) of each selected food commodity, then calculate aggregate price elasticities for each brand of food commodities. Food categories are defined at the sub-category level of fresh milk, ice cream, cooking oil, breakfast cereals, chips, salad dressing, mayonnaise, spaghetti, and frozen vegetables. The second objective of this study is to estimate price-cost margin ratio for each food category that does not need cost data. This method uses scanner data to drive the price cost margin ratios that have been traditionally used for the homogeneous good markets to construct the Lerner Index that measure the degree of competition.

Finally, this study compares results with respect to lower-income (LI) and higher income (HI) consumers. Since consumers at LI store locations differ from consumers at HI store locations, consumption patterns of these two-socioeconomic groups would be different. However, the previous literature has not fully addressed differences in demand elasticities and the PCM of branded grocery products in LI and HI area stores.

Recently, a number of studies have addressed price cost margin and markup in food industries in detail. Ma (1997) calculated the PCM ratios for 48 food and 456 manufacturing industries and found that the average PCMs were 32.6% for food industries and 31.0% manufacturing industries. According to his calculation, cereal and breakfast foods industry had the largest PCM (67.2%). Some of other calculated

PCMs were 48.9% for salad dressing, 47.5% for potato chips, 49.2% for cookies and crackers, 43.1% for spaghetti, 66.4% for soft drinks, and 42.1% for canned fruit and vegetables. In another study, Lopez et al. (2001) estimated PCMs for different food industries. Some of the PCMs that they calculated were 50.3% for macaroni and spaghetti, 41.7% for fats and oil, 18.2% for cereal and breakfast foods, 20% for fluid milk and 10% for ice cream and deserts.

Vicker et al. (2000) estimated market power and pricing conduct for private label (PL) and national brands (NBs) for the frozen vegetable market. Kinoshita et al. (2001) estimated own and cross brand price elasticities and price-cost margin ratios by using Japanese dairy store level scanner data. They found that price-matching case was inappropriate but non-collusive case appeared more realistic for dairy market in Japan. He concluded that Japanese retail milk markets were relatively competitive. Nevo (2001) investigated market power in the ready-to-eat cereal industry and concluded that prices in the industry were consistent with non-collusive pricing behavior despite the high price cost margin. Cotterill and Samson (2002) analyzed the brand level demand system for American cheese products to evaluate unilateral and coordinated market power strategies by using the LA/AIDS model and found that all price-cost margins for brands of cheese products are above 25%. Most of these studies, however, aggregated the PL and NBs. We used the disaggregated weekly store level scanner data to capture any temporal and cross-sectional variations in estimation of parameters. The disaggregated time series data is critical in measuring brand level behavior (Vicker et al., 2000).

## MATERIAL

The data used in this study are weekly store level scanner data on nine food products across six supermarket stores in Columbus, Ohio in the USA from June 1998 to September 2000. Three stores are chosen in HI locations and three stores in LI locations. Food categories are defined at the sub-category level of fresh milk, ice cream, cooking oil, breakfast cereals, chips, salad dressing, mayonnaise, spaghetti and frozen vegetables. Table 1 presents the names of product categories and brands within each category. Nine food product categories are subdivided into total 32 NB products as well as the 14 PL products. These 32 NBs are the mostly leading brands in each product categories.

According to the census tract data, the average of 12.9% of residents in HI area have less than \$20,000

annual income, and 52.6% of residents have more than \$50,000 income. By contrast, these numbers for lower-income areas are 27.2% and 28.1%, respectively. In terms of education, the average of 59.5% of higher income residents graduated from college. However, the average of just 29.3% of lower income residents also graduated from college

## METHODS

### Estimation of demand elasticities

In this study, the linearized form of the Almost Ideal Demand System (LA/AIDS) model is used to estimate demand elasticities because it provides a complete set of demand parameters for the food groups specified for this study. Moreover, the expenditure function from which the AIDS is derived is a flexible form and thus provides a reasonable approximation to the true unknown expenditure function. This model allows for testing and imposition of homogeneity and symmetry conditions and also gives an arbitrary first-order approximation to any demand system, which satisfies the axioms of choice exactly (Deaton, Muellbauer 1980). The LA/AIDS model of this type has previously been shown to describe demand and price interaction between PLs and NBs extremely well (Cotterill, Putsis 2001). The stochastic version of the AIDS budget share demand model can be written as:

$$w_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \log p_j + \beta_i \log \left( \frac{x}{P} \right) + e_i \quad (1)$$

where  $w_i$  denotes average expenditure share for good  $i$ ,  $x$  is the total food expenditure of  $n$  goods,  $p_j$  and  $q_j$  represents the price and quantity of  $j^{\text{th}}$  good,  $\alpha_i$ ,  $\gamma_{ij}$ , and  $\beta_i$  are the parameters to be estimated  $e_i$  is the stochastic error term and  $P$  is the Laspeyres price index defined by

$$\ln P_t^L = \sum_{i=1}^n w_i^0 \ln(p_{it}) \quad (2)$$

where  $w_i^0$  is the expenditure of good  $i$  in the base period,  $p_{it}$  is the price of good  $i$  in the period  $t$  (Moschini 1995). The log-linear analogue to a Laspeyres price index is used for this study to estimate the demand parameters in the LA/AIDS model. Furthermore, Laspeyres price index avoids the problem of endogeneity in the model. Since normalization of prices makes the parameter estimates consistent, prices of all goods are normalized to unity (Asche, Wessels 1997).

Sufficient regularity conditions for the system can be formulated in the terms of linear parameter re-

strictions which are: (1) adding-up,  $\sum_i \alpha_i = 1$ ,  $\sum_i \gamma_{ij}^* = 0$ ,  $\sum_i \beta_i = 0$ ; (2) homogeneity,  $\sum_j \gamma_{ij}^* = 0$ ; (3) Slutsky symmetry,  $\gamma_{ij} = \gamma_{ji}$ . Negativity at the sample mean was verified by examining the eigenvalues of Slutsky matrix in each observation.

Uncompensated price and expenditure elasticities are derived as recommended by Green and Alston (1990). Expenditure, own-price and cross-price elasticities are calculated by the following formulas:

$$\begin{aligned} e_i &= 1 + (\beta_i / W_i) \\ e_{ii} &= -1 + \left( \frac{\gamma_{ii}}{W_i} \right) - \beta_i \\ e_{ij} &= \left( \frac{\gamma_{ij}}{W_i} \right) - \left( \frac{\beta_i}{W_i} \right) W_j \end{aligned} \quad (3)$$

The model will be estimated consistently by using Zellner's iterative seemingly unrelated regression (SUR) method so that contemporaneously correlated errors are accounted for and the cross-equation parameter restriction can be imposed. The adding-up restriction is automatically satisfied when one equation is excluded from the system. However, homogeneity and symmetry restrictions are imposed in estimation.

### Estimation of price-cost margin

Estimates of the demand elasticities from first part of this paper are used to compute the PCM of each brand without observing actual costs. Magnitude of the markup over marginal cost depends on the three factors: Level of concentration in the sector, elasticity of demand for food commodity and type of market conduct. Let a retailer face the following aggregate inverse market demand curve, total revenue and marginal revenue:

$$P_t = p(Q_t, Z_t) \quad TR_t = Q_t p(Q_t, Z_t)$$

and

$$MR_t = f(Q_t, Z_t) + Q_t p_{Qt} \quad (4)$$

where  $Q$  is quantity,  $Z$  is the other factors that affect demand such as income and the price of substitutes,  $p_Q = \partial P / \partial Q$  and  $t$  is the time period. When the non-competitive industry is in equilibrium, marginal revenue equals marginal cost, and retailers face the following supply relationship:

$$P = \Theta(P_t - MR_t) + MC_t(.)$$

and

$$MR(\Theta) = P + \Theta p_Q Q = MC(Q; W) \quad (5)$$

where,  $\Theta$  is the demand parameter to be estimated,  $W$  is the various exogenous factor that affects costs such as weather and factor prices. In general,  $\Theta$  can be measured as the differences between price and marginal cost (Perloff 1991):  $P - MC = -\Theta p_Q Q$  and in the linear example:  $\Theta = -(P - MC)/(\varepsilon_1 Q)$ .

In the light of the above discussion, suppose  $Q$  is the total firms output in a non-competitive industry,  $C$  is the cost of the firm and  $Q^j$  is the output of the  $j^{th}$  firm. As it is well known, the Lerner's Index ( $L$ ), derived from taking first order condition and upper appropriate aggregation conditions of maximized firm profit function, is the difference between price and marginal costs as a proportion of price as developed by Appelbaum (1982). The Lerner index gives an aggregate estimate of gross contribution for the industry (Lerner 1934). This index is a proxy for profitability and ranges between 0 and 1. All other factors held constant and high values of  $L$  imply high levels of market power. It measures the relative market price distortion and calculated with the following equation:

$$L = \frac{P - MC}{P} = -\frac{\Theta P_Q Q}{P} = -\Theta / \eta = -\Theta^j / \eta = \Theta^j \varepsilon \quad (6)$$

where  $\Theta$  is the  $j^{th}$  firm's conjectural elasticity,  $\eta$  is the elasticity of market demand and  $\varepsilon$  is the inverse demand elasticity.

The oligopoly measure is  $0 \leq L = \Theta \varepsilon \leq 1$ . Furthermore, under perfect competitive industry  $\Theta^j = 0$ , then  $L = 0$  (competitive industry – Bertrand outcomes). Therefore, in perfect competition, the markup is zero (Price = Marginal Cost). Under pure monopoly industry,  $\Theta^j = 1$  where  $Q = Q^j$  then  $L = \varepsilon$  (perfect market power). In the special case of Cournot behavior,  $\partial Q / \partial Q^j = 1$  and  $\Theta^j$  (conjectural or perceived elasticity) is simply the output share of the  $j^{th}$  firm. Then, markup for cournot behavior is  $-Q / \eta$ . If contact is less competitive, then Cournot,  $0 < \Theta \leq (1/Q) - 1$  and upper bound on Markup is  $-1/\eta$ . Therefore, under oligopoly power, by using the Lerner Index, one can write the PCM such as:

$$PCM = -1/\eta_i = -1/[(\partial Q_i / \partial P_i) P_i / Q_i] \quad (7)$$

$$PCM = -1/\eta_i = -1/\left[ (\partial Q_i / \partial P_i) + \sum_{j \neq i} \left( (\partial Q_i / \partial P_j) \left( \partial P_j / \partial P_i \right) \right) (P_i / Q_i) \right] \quad (8)$$

$$PCM = -1/\eta_i = -1/\left[ e_i^{ow} + \sum_{j \neq i} \left( e_{ij}^{cr} e_{ij}^{cw} \right) \right] \quad (9)$$

where  $e_i$  is the perceived own price elasticity,  $e_i^{ow}$  is the partial own-price elasticity  $e_{ji}^{cy}$  is the cross price elasticity, and  $e_{ji}^{cv}$  is the conjectural variation elasticity (Kinoshita et al. 2001). Since  $e_{ji}^{cv} = \Theta$  is not incorporated our demand system, for this paper we assume two different cases for this value:  $\Theta = 0$  (the original Bertrand case-perfect competitive) and  $\Theta^j = -1$  (Cournot- a non-collusive case).

## EMPIRICAL RESULTS

### Descriptive statistics of food categories

The first important results found in this study relate to price per ounce and expenditure share of each brand of product categories in two income groups. The results support the hypothesis that consumption patterns differ substantially for the LI and HI shoppers.

As revealed from Table 1, the shares of the premium and super premium ice cream are higher for HI shoppers. For example, focusing on ice cream prices, it is quite apparent that LI shoppers purchase the lower-priced brands from all the product classes. For two PL ice cream brands, LI shoppers' expenditure share is 56.6% as compared to 27.1% for HI shoppers. For the higher-priced brands of Haagen-Dazs super premium ice cream, LI consumers' expenditure share is just 1.52%, as compared to 4.5% for HI consumers. The regular ice cream is the most frequently purchased class for LI consumers, but they often trade up to the premium class. By contrast, the premium ice cream is the most frequently purchased class for HI consumers and when they trade up, it is often to the super premium brands such as Haagan Dazs.

In the case of cooking oils, LI shoppers consume more vegetable oil but less canola oil (57.4% and 13.8%) than HI shoppers (44.3% and 22.6%). Of course, affordability becomes an issue since HI groups can obviously better afford to purchase higher priced oils. Given this higher price, economic theory would suggest higher consumption for HI groups. Therefore, the results are as expected and support the hypothesis that LI shoppers are likely to consume lower proportions of expensive cooking oils.

Purchasing patterns for cereal seem to be dictated more by preference than by price. Indeed, based on prices paid, PL prove to be less expensive than the NBs. LI consumers purchased a larger proportion of lower priced cereals and HI consumers purchased a larger proportion of higher-priced brands. The average PL cereal prices are between 9.9 and 14.1 cents while the NB cereal prices are between 18.0 and 25.7

Table 1. Price paid and expenditure share of each brand in product categories in the lower- and higher-income groups

	Brands of products	Price per ounce (cents)	Expenditure share (%)	
			lower-income	higher-income
Breakfast cereal	GM Cheerios	24.60	42.13	48.23
	GM Wheaties	22.46	12.59	14.21
	Kell Corn Flakes	25.71	12.27	15.14
	Kell Rice Krispies	18.24	22.15	13.41
	Corn Flakes (private)	9.90	7.66	5.68
Ice cream	Wheat Flakes (private)	14.14	3.20	3.31
	Private Label 1	3.99	25.24	14.49
	Private Label 2 (CC)	2.86	31.36	12.63
	Breyers	6.34	15.93	27.79
	Eddy's	6.12	15.83	24.58
Salad dressing	UDF	7.18	10.11	16.00
	Haagan Dazs	19.05	1.52	4.50
	Private	6.86	21.31	11.78
	Kraft	9.76	30.24	38.87
	Kens	10.87	4.87	7.84
Cooking oil	Marz	9.58	15.16	17.71
	Wishbone	10.19	28.42	23.80
	Private Corn oil	4.98	4.14	4.04
	Private vegetable	5.69	57.42	44.30
	Wesson Canola oil	6.20	13.79	22.63
Chips	Mazola corn	6.61	5.12	7.04
	Wesson oil	5.95	19.52	21.99
	Lays potatoes Chips	17.40	30.06	29.36
	Lays Tortilla Chips	18.84	2.85	12.27
	Conn Potatoes Chips	13.06	23.95	17.19
Spaghetti	Mike Sell Potatoes	18.53	16.76	13.75
	Ruffles	17.73	25.02	25.58
	Private corn chips	10.34	1.35	1.890
	Private	4.68	35.07	32.27
	Cormet	5.78	21.13	14.93
Mayonaise	Mueller	4.02	10.33	9.49
	San Grgo	5.51	23.98	27.44
	Barilla	6.52	9.50	15.86
	Private label	6.23	27.45	16.64
	Hellmann	11.47	57.87	70.14
Fresh milk	Kraft	11.32	14.68	13.22
	Private (1 gallon)	1.75	75.86	76.85
	Private (0.5 Gallon)	2.19	17.10	19.63
	Sealest (1 gallon)	2.00	6.31	3.04
Frozen vegetables	Nestle Choc Milk	3.64	0.72	0.48
	Private green beans	6.30	12.02	13.62
	Private Spinach	7.43	17.30	24.68
	Private Broccoli	7.85	37.98	27.29
	Freshlike Broccoli	9.76	20.90	18.52
	GG Poly Broccoli	10.53	6.56	5.26
	BE DLX Green Beans	7.97	5.24	10.62

cents per ounces for both income groups. Like cereal consumption, PL chips represent the best buy too. The LI consumers show a much stronger preference for the PL and lower priced brands, but the HI consumers have much stronger preference for the higher priced brands such as Lays Tortilla Chips. Since PL milk is less expensive than NBs but has a similar quality, both LI and HI shoppers purchased larger proportion of the PL one and half gallon milk.

A similar pattern can be seen for all other product categories. In general, LI consumers have higher preferences for lower-priced brands. Thus, income has impact on both NB (positive) and PL (negative) share. HI consumers increased their NB and paid larger price premium for NBs.

### Estimated demand elasticities

Another important result found in this study is related to the price elasticities of product categories between two income groups. The main focus of this study is even if on PCM, in this section, demand elasticities of all selected food groups demand model will be provided. The results indicate that each model has a considerable explanatory power and most parameters are highly significant and have the expected sign as hypothesized. As expected, the signs of all uncompensated own-price elasticities are negative and those of all expenditure elasticities are positive for all selected product categories.

Comparison of the own-price elasticities between the two income groups shows differences for most of the product categories. For example, the average price elasticity of breakfast cereal brands in LI stores is  $-2.60$ , which is higher than the average elasticity of  $-2.48$  in HI stores. Except for some of the brands of categories, all brand classes show generally higher own-price elasticities for both LI and HI shoppers. One of the main reason of the high elasticities of branded product is that these alternatives are sufficiently similar to be very close to nearly perfect substitutes for one other so that the shoppers are sensitive to price change.

Results for both income groups indicate that own-price elasticities for cereal categories are in general higher, suggesting a lower and more reasonable PCM. Own-price elasticities estimated for cereal vary between  $-1.56$  and  $-4.04$  for LI shoppers and  $-1.32$  and  $-3.77$  for HI shoppers. This suggests that a brand manager maximizing the profits only from his/her own brand would price at a price margin between 25% and 76%. This markup still does not take into account any multi-product firm pricing or potential

price collusion, and therefore seems high. Two brands owned by Kellogg's in this segment have a relatively more elastic demand than the one of the General Mills brand and PL brands. Also price elasticities of PL brands are lower than all NBs as expected.

All brands in the ice-cream product category have negative and significant own-price elasticities that range from  $-2.2$  to  $-4.1$  for HI shoppers and from  $-2.3$  to  $-4.5$  for LI shoppers. Although the unit net profit margin increases with a price increase, high elasticities of ice-cream brands do not necessarily mean that profits will decrease with the increasing price. That increase may balance the decreased units sold with increasing profit. Comparing to other product categories, lower priced brands in this category (PL brands) have the lower own price elasticities. One of the reasons of this lower elasticity may be due to the lower price variability for that brand.

Focusing on the milk demand, we find that the estimated own price demand elasticities ranged from  $-0.76$  for Sealest milk to  $-3.8$  for half-gallon PL milk. All estimated elasticities are highly significant. The price elasticity in LI stores is almost thrice as large as the elasticity of Sealest milk in HI stores. Also in both income groups, price elasticity of PL half-gallon milk is almost thrice as large as the elasticity of PL one-gallon milk. This result indicates that American consumers are almost thrice as price sensitive in their purchasing decisions for PL half-gallon milk than they are for PL one-gallon milk. Thus, while milk products in general may be a good candidate for price promotions, half-gallon milk is the one that has the largest potential for sales responsiveness out of the total milk category. Also, except for the Nestle Chocolate milk, all brand classes show higher price elasticities for LI shoppers. Similar results can be seen for all other product categories.

One of the interesting results from these elasticities is that PL products have generally lower own price elasticities as with compared with NBs. This may be because PL products are generally lower priced items than NBs. The main problem with these estimates is that they are highly driven by the price: The higher price branded product has generally a higher price elasticity than the lower priced branded product alternatives.

All the expenditure elasticities are highly significant and positive. This means that consumers tend to buy more of each brand of product when the expenditure on this product category goes up. As shown in Table 2 and 3, NBs of cereal in HI group have expenditure elasticities which are almost unity, while last two brand of cereal (PL) have values less than unity. This means that NBs have the highest ranking

Table 2. Demand elasticities and price cost margin on two different cases for each product classes in lower-income stores

	Brands	Expenditure elasticity	Own-price elasticity	Price-cost margin	
				$\Theta = -1$	$\Theta = 0$
Breakfast cereal	GM Cheerios	0.796	-2.329	0.319	0.429
	GM Wheaties	0.719	-3.195	0.209	0.313
	Kell Corn Flakes	2.012	-4.045	0.122	0.247
	Kell Rice Krispies	1.145	-2.495	0.239	0.401
	Corn Flakes (private)	0.763	-1.559	0.254	0.641
Ice cream	Wheat Flakes (private)	0.468	-1.952	0.440	0.512
	Private Label 1	0.768	-2.315	0.202	0.432
	Private Label 2 (CC)	1.111	-2.283	0.222	0.438
	Breyers	1.132	-4.538	0.151	0.220
	Eddy's	1.232	-3.559	0.183	0.281
Salad dressing	Haagan Dazs	0.222	-4.342	0.217	0.230
	UDF	0.781	-4.394	0.186	0.228
	Private	1.032	-2.381	0.226	0.420
	Kraft	1.019	-2.534	0.287	0.395
	Kens	0.600	-3.542	0.278	0.282
Cooking oil	Marz	1.169	-2.393	0.237	0.418
	Wishbone	0.933	-2.017	0.298	0.496
	Private Corn oil	0.706	-3.660	0.271	0.273
	Private vegetable	0.909	-1.826	0.357	0.547
	Wesson Canola oil	1.078	-2.230	0.252	0.448
Chips	Mazola corn	1.023	-3.927	0.165	0.255
	Wesson oil	1.269	-4.016	0.143	0.249
	Lays potatoes Chips	1.339	-2.549	0.234	0.392
	Lays Tortilla Chips	0.744	-0.800	0.853	0.912
	Conn Potatoes Chips	0.582	-2.066	0.289	0.484
Spaghetti	Mike Sell Potatoes	0.529	-2.626	0.267	0.381
	Ruffles	1.383	-2.704	0.241	0.370
	Private corn chips	0.174	-1.920	0.335	0.521
	Private	1.165	-1.589	0.492	0.626
	Cormet	1.147	-1.637	0.510	0.611
Mayonnaise	Mueller	0.665	-2.832	0.154	0.353
	San Grgo	1.027	-2.601	0.317	0.384
	Barilla	1.067	-5.031	0.156	0.199
	Private label	0.799	-1.685	0.358	0.593
	Hellmann	1.076	-1.710	0.427	0.585
Fresh milk	Kraft	1.299	-3.670	0.166	0.272
	Private (1 gallon)	0.615	-1.416	0.415	0.706
	Private (0.5 Gallon)	3.017	-3.811	0.232	0.263
	Sealest (1 gallon)	0.199	-2.315	0.316	0.432
Frozen vegetables	Nestle Choc Milk	0.647	-2.011	0.650	0.497
	Private green beans	1.482	-2.606	0.201	0.384
	BE DLX Green Beans	1.594	-3.471	0.177	0.288
	Private Broccoli	0.909	-1.473	0.469	0.679
	Freshlike Broccoli	1.031	-2.836	0.262	0.353
	GG Poly Broccoli	0.480	-3.896	0.252	0.257
	Private Chops Spinach	0.845	-0.918	0.476	0.821

Table 3. Demand elasticities and price cost margin on two different cases for each product classes in higher-income stores

	Brands	Expenditure elasticity	Own-price elasticity	Price-cost margin	
				$\Theta = -1$	$\Theta = 0$
Breakfast cereal	GM Cheerios	0.937	-1.911	0.334	0.523
	GM Wheaties	0.732	-3.767	0.193	0.265
	Kell Corn Flakes	1.707	-2.930	0.174	0.341
	Kell Rice Krispies	0.976	-2.872	0.269	0.348
	Corn Flakes (private)	0.597	-1.325	0.331	0.755
Ice cream	Wheat Flakes (private)	0.616	-2.055	0.239	0.487
	Private Label 1	0.573	-2.168	0.216	0.461
	Private Label 2 (CC)	1.144	-2.685	0.179	0.372
	Breyers	0.877	-3.293	0.200	0.304
	Eddy's	1.612	-2.734	0.194	0.366
Salad dressing	Haagan Dazs	0.292	-3.535	0.250	0.283
	UDF	0.745	-4.091	0.177	0.244
	Private	0.915	-2.318	0.230	0.431
	Kraft	1.064	-1.841	0.376	0.543
	Kens	0.833	-2.877	0.327	0.347
Cooking oil	Marz	1.322	-1.967	0.321	0.508
	Wishbone	0.753	-1.724	0.391	0.579
	Private Corn oil	0.916	-3.614	0.145	0.277
	Private vegetable	0.960	-2.452	0.287	0.408
	Wesson Canola oil	0.933	-2.335	0.235	0.428
Chips	Mazola corn	0.729	-2.224	0.296	0.450
	Wesson oil	1.251	-2.411	0.252	0.415
	Lays potatoes Chips	1.415	-2.189	0.387	0.457
	Lays Tortilla Chips	0.639	-1.027	0.790	0.974
	Conn Potatoes Chips	0.691	-2.350	0.252	0.425
Spaghetti	Mike Sell Potatoes	0.425	-1.376	0.562	0.727
	Ruffles	1.262	-2.713	0.199	0.369
	Private corn chips	0.326	-1.214	0.548	0.824
	Private	1.179	-1.635	0.474	0.612
	Cormet	1.208	-1.888	0.428	0.530
Mayonnaise	Mueller	0.635	-2.996	0.144	0.334
	San Grgo	1.023	-2.399	0.346	0.417
	Barilla	1.040	-3.417	0.235	0.293
	Private label	0.668	-2.166	0.248	0.462
	Hellmann	1.063	-1.593	0.471	0.627
Fresh milk	Kraft	1.332	-3.960	0.152	0.252
	Private (1 gallon)	0.884	-1.09	0.657	0.916
	Private (0.5 Gallon)	1.601	-3.24	0.259	0.309
	Sealest (1 gallon)	0.107	-0.76	0.378	0.810
Frozen vegetables	Nestle Choc Milk	0.333	-2.708	0.350	0.369
	Private green beans	1.152	-2.571	0.254	0.389
	BE DLX Green Beans	1.811	-1.975	0.326	0.506
	Private Broccoli	1.001	-1.654	0.344	0.605
	Freshlike Broccoli	0.888	-2.407	0.324	0.415
	GG Poly Broccoli	0.564	-5.596	0.179	0.179
	Private Chops Spinach	0.733	-0.968	0.537	0.811



in shoppers' choice set of cereal classes. However, in LI areas, Kellogg brands have the highest ranking in shoppers' choice set of cereal brand classes. The expenditure elasticities suggest that higher-income implies a lower level of PL cereal consumptions. The fact that expenditure elasticities in both income groups are less than one implies that PL cereals are necessity and as income increases, a smaller portion of the budget is allocated to them. In the case of ice-cream category, the super premium brand of Haagan Dazs has the lowest expenditure elasticity in both income groups which indicates that this brand has the lowest ranking in the shoppers' choice set of ice cream. Similar results are found for the category of salad dressing and spaghetti for both income groups. However, for other product categories, the results are not consistent between income groups. For example, PL brands of chips and mayonnaise categories have the lowest ranking in shoppers' choice set of product categories.

#### **Estimated PCM for each brand of product categories**

Given the demand elasticities, the PCM for each product classes are computed by using equation 10. This margin is a good indicator whether an industry is price competitive. It measures how much prices in the industry deviate from manufacturing costs. As explained in the methodology section, the PCM is computed by two different ways: the original Bertrand case and the non-collusive case. Because there are so many values over one and also many negative values in the price-matching case, it follows that the price-matching case is not likely an appropriate assumption in these markets as also found by Kinoshita et al. (2001).

In our study, PCMs for cereal brands are found to be below 44% in non-collusive case and below 75% in Bertrand case. But there is only one value that seems high which is PL corn flakes (75%) for HI shoppers. Therefore, results from both cases seem very much realistic. According to the non-collusive case, price cost margin is between 12% and 44% for LI shoppers, but 17% and 33% for HI shoppers. These results are comparable with the previous research. For example, the Supermarket Business reports that the markup for the cereal category was 35.3% in 1997 (Cotterill, Franklin 1998). Lopez et al. (2001) estimated the PCM for cereal to be 18.2%. In another study, Ma (1997) estimated the PCM for three cereal brands by using three different approaches and found the PCM between 0.17 and 0.40. Nevo (1997) estimated the PCM

for cereal items, which is between 35% and 75%, and concluded that the Bertrand equilibrium in prices is consistent with the observed PCM. Moreover, it is well documented that the price of cereal has been increasing faster than other food industries and that the cereal industry is a very concentrated industry (Ma 1997; Gejdenson, Schumer 1995). Similar to the finding of Nevo (1997), if the Nash Bertrand prices are taken as the non-collusive benchmark, then even with the PCM higher than 45%, pricing in the cereal industry is concluded to be approximately non-collusive. As Nevo (1997) indicated that the high PCM are not due to lack of price competition, but are due to consumers' willingness to pay for their favorite brand, and pricing decisions of firms that account substitution between their own brands when setting prices.

PCMs for fresh milk classes are below 66% in non-collusive case and below 92% in Bertrand case. Similar to cereal items, non-collusive case gives a smaller PCM than the Bertrand case. In both cases, PL one-gallon milk gives the highest PCM. Since low demand elasticity will tend to yield a high PCM, this result is reasonable. For example, price elasticity for PL one-gallon milk is  $-1.42$  that gives the highest PCM of 0.74 in non-collusive case. One other reason for this higher PCM is the lower priced of milk. Therefore, lower priced brand has the lowest own-price elasticity but highest PCM in milk industry. This PCM ratio is a little bit higher than the previous study finding (20%) done by Lopez et al (2001). In the case of ice cream, estimated the PCM are between 15% and 25% for the non-collusive case and between 22% and 46% in Bertrand case. Haagan Dazs brand in HI stores has the highest PCM in the non-collusive case, but PL brands in both income stores have the higher PCM in Bertrand case.

Price cost margin for salad dressing classes are between 23% and 39% for non-collusive case and between 28% and 58% in Bertrand case. PL brand in both income locations has the lowest PCM in the non-collusive case. Price cost margin for mayonnaise brands are below 47% in the non-collusive case and below 63% in Bertrand case. Hellmann in both income groups has the highest PCM ratio for both cases.

PCMs for cooking oil classes are between 14% and 35% for the non-collusive case and between 25% and 56% in Bertrand case. With respect to the non-collusive case, PL brand in HI stores, but Mazola and Wesson oil in LI stores have the highest PCM ratios. These PCM ratios are generally smaller than which Lopez et al. (2001) estimated (41.7%).

PCMs for chips brands are between 20% and 85% in the non-collusive case and between 37% and 97%

in Bertrand case. But there is only one value that seems very high which is Lays Tortilla Chips (85% in the non-collusive case). The reason of this higher PCM is due to lower price elasticity of this brand. Therefore, except for Lays Tortilla chips, the results from the non-collusive case seem very realistic.

PCMs for spaghetti brands are between 14% and 51% in the non-collusive case, but between 20% and 63% in the Bertrand case. PL brand in both income groups has the highest PCM ratio for both cases. These results are comparable with the previous research done by Lopez et al. (2001), in which the PCM of macaroni and spaghetti is founded to be 50.3%.

PCMs for frozen vegetables brands are between 18% and 54% in the non-collusive case, but between 18% and 82% in the Bertrand case. PL spinach has a very high PCM in both income groups. As seen for chips category, the reason of high PCM ratio of this brand is because of the lower price elasticity of this brand. Vicker et al. (2000) estimated the PCM to be 83% for the PL frozen vegetable and 79% for NB.

## CONCLUSIONS AND RECOMMENDATIONS

This paper shows that brand-level analysis of store scanner data can be used both in demand studies and industrial organization analysis to provide new insights into the marketing of food products. The purpose of this article is double. First, it extended LA/AIDS model by the Laspeyres Price Index and price normalization, and provided demand elasticities of PLs and NBs of product for both LI and HI groups. A second contribution is that the PCMs are reported within each industry, which can be useful to policy makers concerned with market structure.

Empirical results indicate some systematic patterns and price competition in the US food industries. In general, LI shoppers have a higher preference for lower-priced brands. Therefore, income has impact on both NB (positive) and PL (negative) share. As consumer income increases, they purchase more NB and also pay larger price premium for NBs. Moreover, price paid by customers in LI areas are found to be lower, which suggests that these consumers either have a higher response to advertised prices, or they purchase larger sizes with lower unit prices.

The estimated own-price elasticities in this study indicate that most of the branded products are elastic which is consistent with the microeconomic theory. The average price elasticities are ranged between  $-1.96$  (Snacks) and  $-3.33$  (ice-cream). Expenditure elasticities for product categories are also between 0.79 and 1.12. Moreover, the average price and expen-

diture elasticity varied between income groups. For example, the average aggregated price elasticity of all nine products in LI areas is  $-2.72$ , but this elasticity is found to be  $-2.50$  in higher income areas. Thus, the results clearly show that LI shoppers are more prices sensitive than HIs. Also, American consumers are almost twice as price sensitive in their purchasing decisions for ice cream then they are for chips.

PCMs were computed for two different ways: the original Bertrand case and the non-collusive case. Results from both cases seem very much realistic. The non-collusive case gives smaller PCM than the Bertrand case. There is no value over one in non-collusive case compared to the only two values near one in the Bertrand case which is less than 5% of the total number of items analyzed.

This study indicates that the average PCM for food products is 29.4% and 31.4% for LI and HI areas in non-collusive case, which is lower than in the Bertrand case (43.7% and 48.8%). According to the results from the non-collusive and Bertrand case, ice-cream industry had the lowest PCM (20% and 32.2%), chips (42.7% and 59.8%) and fresh milk (40.7% and 60%) had the highest among all the 9 food industries.

The results of this study are expected to help informing the decision-making of category managers as well as help researchers and other decision-makers who are interested in the profit-maximizing behavior of retailer and manufacturer firms. Moreover, our approach offers several benefits. Since it involves a simple computation when the demand elasticities have been estimated, the method permits calculation of the PCM for a large variety of products.

This study, like any other, suffers from various limitations that are worthy of further attention. Among these, there are the potential impacts of competition across industries and adding wider range of industries to analyze. If the analysis is extended to incorporate other industries will provide further insights for the market structure of firm and price competition between brands. Another limitation of this study is that the data used in this study is obtained from a particular supermarket chain. Future research may examine data from other retailers and look into other aspects of the multiple store brands.

## REFERENCES

- Appelbaum E. (1982): The estimation of the degree of oligopoly power. *Journal of Econometrics*, 19: 287–299.
- Asche F., Wessells C.R. (1997): On price indices in the Almost Ideal Demand System. *American Jour-*

- nal of Agricultural Economics, 79 (November): 1182–1185.
- Bresnahan T.F. (1989): Empirical studies of industries with market power. In: Schmalensee R., Willig R. (eds.): *Handbook of Industrial Organization*. Elsevier Science Publishing.
- Cotterill R.W., Franklin A.W. (1998): An estimation of consumer benefits from the public campaign to lower cereal prices. Food Marketing Policy Issue Paper, No. 18. Food Marketing Policy Center, University of Connecticut.
- Cotterill R.W., Putsis W.P. (2001): Do models of vertical strategic interaction for national and store brands meet the market test? *Journal of Retailing*, 77: 83–109.
- Cotterill R.W., Samson P.O. (2002): Estimating a brand-level demand system for American cheese products to evaluate unilateral and coordinated market power strategies. *American Journal of Agricultural Economics*, 84 (3): 817–823.
- Deaton A., Muellbauer J. (1980): An Almost Ideal Demand System. *American Economic Review*, 70: 312–326.
- Gejdenson S., Schumer C. (1995): Consumers in a box. House of Representatives, U.S. Congress, Washington D.C.
- Green R.D., Alston J.M. (1990): Elasticities in AIDS models. *AJAE*, 72 (2): 442–445.
- Kinoshita J., Suziki N., Kawamura T., Watanabe Y., Kaise H.M. (2001): Estimating own and cross brand price elasticities, and price-cost margin ratios using store-level daily scanner data. *Agribusiness*, 17 (4): 515–525.
- Lerner A.P. (1934): The concept of monopoly and the measurement of the monopoly power. *Review of Economic Studies*, 1: 157–175.
- Lopez R.A., Azzam A.M., Liron-Espana C. (2001): Market power and/or efficiency: An application to U.S. food processing. Food Marketing Policy Center Research Report No. 60, University of Connecticut.
- Ma L.Y. (1997): An econometric analysis of competition in a differentiated product industry: The U.S. ready-to-eat cereal industry. PhD Dissertation, University of Connecticut.
- Moschini G. (1995): Units of measurement and the Stone price index in demand system estimation. *American Journal of Agricultural Economics*, 77 (1): 63–68.
- Nevo A. (1997): Demand for ready-to-eat cereal and its implications for price competition, merger analysis and valuation of new brands. PhD Dissertation, Harvard University.
- Nevo A. (2001): Measuring market power in ready-to-eat cereal industry. *Econometrica*, 69 (2): 307–342.
- Parker P., Kim N. (1997): National brands versus private labels: An empirical study of competition, advertising and collusion. *European Management Journal*, 15 (3): 220–235.
- Perloff J.M. (1991): Econometric analysis of imperfect competition and implications for trade research. Occasional Paper Series, Organization and Performance of World Food Systems: NC-194.
- Vicker S.S., Davies S.P., Fulton J.R., Vantreese V.L. (2000): Estimating market power pricing conduct for private label and national brands in a product differentiated oligopoly: The case of a frozen vegetable market. *Journal of Food Distribution Research*, 31 (2): 26–38.

Arrived on 4<sup>th</sup> July 2005

---

*Contact address:*

Cuma Akbay, Department of Agricultural Economics, University of Sutcu Imam, Kahramanmaras, Turkey  
tel: +90 344 2237 666; fax: +90 344 2230 048, e-mail: cakbay@ksu.edu.tr

---