

# **Decomposing Market Channel Profits: The Case of Ready-to-Eat Cereals in Boston**

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## Abstract:

In this paper we estimate a discrete choice demand model with random coefficients for 37 brands of ready-to-eat cereals (RTECs) at the supermarket chain level in the Boston area. Then assuming a manufacturer Stacklberg model for vertical pricing, we decompose the market channel price-cost margins (PCMs) for individual brands at four supermarket chains. The results shed light on the share of channel PCMs accruing to RTEC manufacturers and retailers. For instance, Stop & Shop, the leading supermarket chain in Boston, gets more than 50% of the channel profits, while RTEC manufacturers get more than 56% of the channel profits when dealing with smaller supermarket chains (Shaw's, DeMoulas and Star Market). The results attest to possible volume discounts and efficiencies as the smaller supermarkets, especially those with urban location, charge higher prices in spite of smaller dollar PCMs, due in part to higher retailing costs. Among the manufacturers, General Mills' brands command the highest PCMs while Post brands command the lowest ones.

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## 1. Introduction

The recent empirical literature on vertical relationships between food manufacturers and retailers has focused on contracts and vertical integration, providing structural models to explain the relationships between manufacturers and retailers (Kadiyali et al., 1999; Villas-Boas and Zhao, 2000; Villas-Boas, 2002; and Manuszak, 2001). In these studies, the quantities sold and the prices at retail and wholesale levels are treated as equilibrium outcomes of a two-stage pricing game that assumes horizontal competition at each stage. This class of structural models allows one to examine the manufacturer-retailer relationship without observing wholesale prices and marginal costs.

The fundamental inquiry of this research is to estimate and decompose the channel profits for the ready-to-eat cereal (RTEC) market in Boston. This will shed light on the power manufacturers and retailers have to set the price of RTECs in the Boston market.

This research contributes to the existing literature in several ways. It is the first study to estimate a discrete choice random coefficient demand system for branded products at the chain as opposed to market level.<sup>1</sup> Moreover, the study decomposes channel profits accruing to manufacturers and retailers respectively not attributing all profits to manufacturers as in Nevo's work (2001). Villas-Boas (2002) has estimated a similar model for yogurt at the store level for a few stores. The advantage of this study is that it pursues on chain wide strategic pricing in a relevant regional market area, Boston Information Resources Incorporated (IRI) market. This study uses four-week data while

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<sup>1</sup> Cotterill and Dhar (2002) is the only prior chain level demand study and it uses a nested logit model.

prior brand demand analysis uses quarterly (Nevo, 2001); Hausman et al., 1994) or weekly (Kadiyali et al., 1999; Cotterill and Haller, 1997) observations.<sup>2</sup> There is no consensus concerning which time unit is desirable. Quarterly may be too aggregate, while weekly may be too disaggregate to measure strategic pricing moves in a static equilibrium model. Since we have quarterly analyses (Ma, 1997; Nevo, 2001) and weekly analyses (Cotterill and Haller, 1997) of RTEC, this study at the four-week level may shed light at the importance of time aggregation in this particular industry. Comparison, however, will be difficult because of the differences in the methods across these studies.

## **2. Methodology**

The methodology used consists of two steps. First, the retail demand for differentiated brands of RTEC is estimated using a random coefficient model. Second, a two-stage pricing model is implemented assuming a Nash-Bertrand competition at each stage. In the vertical market, we assume manufacturer Stacklberg conduct holds; i.e., retailers play Nash-Bertrand when evaluating wholesale prices and maximizing profits, while manufacturers employ the retail reaction functions to their wholesale price change when maximizing profits (Choi, 1991). The demand results are used to compute the total channel price-cost margins and to decompose them into the price-cost margins at the retail and manufacturer stages. As a byproduct, the wholesale to retail price transmission rate is obtained. The model is sufficiently flexible to allow for transmission above or bellow 100%.

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<sup>2</sup> There is no consensus concerning which time unit is desirable. Quarterly may be too aggregate, while weekly may be too disaggregate to measure strategic pricing moves in a static equilibrium model.

## 2.1. Demand Side

Consider the case where consumers choose a brand of a product that maximizes their utility. More specifically, the indirect utility<sup>3</sup> of consumer  $i$  from buying the brand  $j$  is given by

$$U_{ij} = \beta_j + x_j \beta_i - \alpha_i p_j + \zeta_j + \varepsilon_{ij}, \quad i = 1, \dots, n \quad j = 1, \dots, J \quad (1)$$

where  $\beta_j$  represents the store/brand fixed effects,  $x_j$  are the observed product characteristics of brand  $j$ ,  $p_j$  is the price of the brand  $j$ ,  $\zeta_j$  are the unobserved (by the researcher) product characteristics, and  $\varepsilon_{ij}$  represents the distribution of consumer preferences about the unobserved product characteristics, with a density  $f(\varepsilon)$ . The parameters to be estimated are  $\alpha_i$  and  $\beta_i$ . Note that those parameters are allowed to vary across consumers, therefore taking into account the heterogeneity taste of consumer.

These coefficients can be decomposed into a fixed component and a variable component (changing with consumers' observed and unobserved characteristics). This decomposition can be expressed as:

$$\alpha_i = \alpha + \lambda D_i + \gamma_i, \quad (2)$$

$$\beta_i = \beta + \varphi D_i + \rho v_i, \quad (3)$$

where the  $D_i$  represents the consumers' observed characteristics such as demographics variables (e.g., income), and  $v_i$  denotes the unobserved consumers' characteristics.

Substituting (2) and (3) in (1) yields

$$U_{ij} = \beta_j + x_j \beta + \lambda D_i x_j + \gamma_i x_j - \alpha p_j - \lambda D_i p_j - \gamma_i p_j + \zeta_j + \varepsilon_{ij}. \quad (4)$$

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<sup>3</sup> The indirect utility comes from a quasi-linear utility function.

Unobserved consumer characteristics  $v_i$  are assumed to be normally distributed  $N(0, I)$ , where  $I$  is the identity matrix; and the observed consumer characteristics  $D_i$  have an empirical distribution  $h(D)$ , not necessarily a normal distribution.

The indirect utility in (4) can be decomposed into two parts: a mean utility given by  $\delta_j = \beta_j + \beta x_j - \alpha p_j + \zeta_j$  and a deviation from that mean, which is a function of the interaction between the observed and unobserved consumer's characteristics and the price and observed brand characteristics, given by

$$\mu_{ij} = \lambda D_i x_j - \lambda D_i p_j + \gamma_i x_j - \gamma_i p_j + \varepsilon_{ij}. \quad (5)$$

To complete the model, an outside good is included to give the consumer the possibility not to buy any one of the  $J$  brands included in the choice set.<sup>4</sup> The utility of the outside good is normalized to be constant over time and equal zero. Given the observed and unobserved consumer characteristics define the set of choice by

$$S(x_j, p_j, \zeta_j; \theta) = \{(D_i, v_i, \varepsilon_{ij}) : U_{ij} \geq U_{ik} \forall k = 0, 1, \dots, N\}, \quad (6)$$

where  $\theta$  is a vector that includes all the parameters of the model.

The consumer purchases one unit of the brand that yields the highest utility. The global market share of the  $j$ th brand corresponds to the probability the  $j$ th brand is chosen. That is,

$$s_j = \int I\{(D_i, v_i, \varepsilon_{ij}) : U_{ij} \geq U_{ik} \forall k = 0, 1, \dots, N\} dH(D) dG(v) dF(\varepsilon). \quad (7)$$

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<sup>4</sup> The inclusion of the outside good is necessary in order to accomplish with the exhaustiveness of alternatives of the discrete choice model. For a detailed discussion, see Train (2002). For the case at hand, the outside good can include all other brands, or the residual brands not included in the study.

Depending on the assumptions regarding  $D$ ,  $\nu$ , and  $\varepsilon$ , the integral in (7) can have or not a closed formula. In a general setting, the integral in (7) does not have a closed formula and should be solved numerically (BLP, 1995; Nevo, 2000, Villas-Boas, 2002).

The Random coefficients model (RCM) allows for consumer heterogeneity  $\alpha_i$  and  $\beta_i$  as described in (2) and (3). That is, each consumer is different from another consumer in their response to price and brand characteristics. However, the RCM poses two challenges. First, the integral in equation (7) has no closed formula and should be solved numerically.<sup>5</sup> Second, information on the distribution of demographics is needed to compute the individual market shares. Intuitively, the integral in (7) is solved based on the choice of the parameters that minimize the distance between the predicted market shares given by equation (7) and the observed market shares. This paper follows Berry (1994) inversion of the market share function that obtains the mean utility valuation  $\delta$  that equates the predicted market shares with observed market shares.

Given starting values for  $\theta_2$  (parameters that enter non-linearly) in (4) and  $\delta$ , and the draws from the distributions of  $D$  and  $\nu$ , the integral in (7) is estimated numerically.<sup>6</sup> Nevo (2000) proposes to use the smooth estimator that makes use of the extreme value distribution on  $f(\varepsilon)$  to integrate the  $\varepsilon$ s analytically. The predicted market shares are approximated by

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<sup>5</sup> The integral in (7) is solved using the simulation technique proposed by Pakes (1986).

<sup>6</sup> The starting values for the mean utility value  $\delta$  come from the Logit model estimation

$$s_j(p, x, \delta, P_{ns}; \theta_2) = \frac{1}{ns} \sum_{i=1}^{ns} s_{ji} = \frac{1}{ns} \sum_{i=1}^{ns} \frac{\exp(\delta_j + \mu_{ij})}{1 + \sum_{m=1}^J \exp(\delta_m + \mu_{im})}. \quad (8)$$

where  $ns$  is the number of draws from the distributions  $D$  and  $\nu$  given by the distribution  $P_{ns}$ .

The above predicted market shares allow computing the mean utility valuation  $\delta$  that equates the predicted market shares with observed market shares. This is an iterative step and is solved numerically due to the non-linearity of the inversion of the equation  $s_{jt}(\delta_{jt}; \theta_2) = S_{jt}$ .<sup>7</sup> The errors are then computed and interacted with the instruments to form the objective function to be minimized using the General Method of Moments (GMM) estimation technique.

The elasticities of the random coefficients model are given by

$$\eta_j = \frac{\partial s_j}{\partial p_k} \frac{p_k}{s_j} = \begin{cases} \frac{p_j}{s_j} \sum_{i=1}^{ns} \alpha_i s_{ji} (1 - s_{ji}), & \text{if } j = k, \\ -\frac{p_k}{s_j} \sum_{i=1}^{ns} \alpha_i s_{ji} s_{ki}, & \text{otherwise.} \end{cases} \quad (9)$$

The random coefficients model offers several important advantages over the traditional discrete choice models (Logit and Nested Logit models). First, the own price elasticities depend now on the price sensitivity of the individual in the sample and not on the functional form. Instead of being determined by the single parameter  $\alpha$ , the own price elasticities are obtained by averaging the price sensitivity of the individuals in the sample.

A second advantage is that the full model is not constrained by a-priori segmentation of

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<sup>7</sup> Berry, Levinsohn and Pakes (1995) suggest using the following contraction mapping

$$\delta^{t+1} = \delta^t + \ln(S) - \ln(s(p, x, \delta, P_{ns}; \theta_2)), \quad t = 0, \dots, T$$

where  $s(\cdot)$  is the predicted market shares computed by equation (8) and  $T$  is the smallest integer such that

$\|\delta^T - \delta^{T-1}\|$  is smaller than some tolerance level

the market allowing for flexible substitution patterns. Finally, the full model by taking into account the consumer heterogeneity taste, gives another explanation besides the price variation to the variation of market shares across markets.

## 2.2. Supply Side

Consider the case where a manufacturer chooses the wholesale price for each brand it sells. Then, each chain retailer chooses the retail price for each brand to maximize his own profits in a horizontal Nash –Bertrand model of competition. The game is solved using backward induction starting from the retailers and going back to the manufacturers' equilibrium.

The  $r^{th}$  retailer's problem is to maximize profits, given by

$$\pi_r = \sum_{j \in S_r} (p_j - w_j - c_j^r) s_j(p) M, \quad (10)$$

where  $S_r$  is the set of brands sold by the  $r$ th supermarket,  $p_j$  is the retail price for brand  $j$ ,  $w_j$  is the wholesale price the  $r$ th retailer pays for brand  $j$ ,  $c_j^r$  is the retailer's marginal cost for brand  $j$ ,  $s_j(p)$  is the share of brand  $j$ , and  $M$  is a measure of the market size.

The first-order conditions are given by

$$s_j + \sum_{m \in S_r} (p_m - w_m - c_m^r) \frac{\partial s_m}{\partial p_j} = 0. \quad (11)$$

Repeat the procedure for each supermarket, stack the solutions and write them using an ownership matrix to obtain the retailers' price-cost margins.<sup>8</sup>

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<sup>8</sup>  $T_r$ , the matrix of ownership, is introduced to facilitate the matrix notation of equation (12). It is a matrix of 1 and 0. The  $T_r$  elements are 1 when brands  $m$  and  $j$ , in  $\frac{\partial s_m}{\partial p_j}$  in equation (11), are sold by the same supermarket and 0 otherwise.

$$p - w - c^r = -(T_r * \Delta_r)^{-1} s(p), \quad (12)$$

where  $T_r$  is the retailer's ownership matrix with the general element  $T_r(m, j)$  and  $\Delta_r$  is a matrix of first derivatives of all the shares with respect to all retail prices. The matrix  $(T_r * \Delta_r)$  is the element-by-element multiplication of the two matrices.

Now consider the RTEC manufacturer's problem. Each manufacturer sets the wholesale price  $w$  in order to maximize profits, given by

$$\pi_w = \sum_{j \in S_w} (w_j - c_j^w) s_j(p(w)) M, \quad (13)$$

where  $S_w$  represents the set of brands produced by manufacturer  $m$ , and  $c_j^w$  is the manufacturer's marginal cost for brand  $j$ . The first-order conditions are

$$s_j + \sum_{m \in S_w} (w_m - c_m^w) \frac{\partial s_m}{\partial p_j} = 0. \quad (14)$$

Similarly, defining a matrix of manufacturers' ownership  $T_w$  and a matrix of manufacturer's response  $\Delta_w$ , and stacking all the manufacturers' first-order conditions one obtains the manufacturers' PCMs:

$$w - c^w = -(T_w * \Delta_w)^{-1} s(p). \quad (15)$$

The matrix  $\Delta_w$  is more complicated to compute than the matrix  $\Delta_r$  due to the chain rule

effect of wholesale prices on market shares given by  $\frac{\partial s_j(p(w))}{\partial w_j} = \frac{\partial s_j}{\partial p_j} \frac{\partial p_j}{\partial w_j}$ . In matrix

notation the manufacturers' response matrix can be written as  $\Delta_w = \Delta_p' \Delta_r$ , where  $\Delta_p$  is a matrix of derivatives of all the retail prices with respect to all the wholesale prices. The difficulty lies in estimating  $\Delta_p$ . Following Villas-Boas (2000), this matrix can be derived

by totally differentiating for a given equation  $j$  in (11) with respect to all prices and wholesale prices, and solving for the derivatives of all prices with respect to the wholesale prices. That is,

$$\sum_{k=1}^N \left[ \frac{\partial s_j}{\partial p_k} + \sum_{i=1}^N (T_r(i, j) \frac{\partial^2 s_i}{\partial p_j \partial p_k} (p_i - w_i - c_i^r)) + T_r(k, j) \frac{\partial s_k}{\partial p_j} \right] dp_k - T_r(f, j) \frac{\partial s_f}{\partial p_j} dw_f = 0. \quad (16)$$

In matrix notation, (16) becomes

$$Gdp - H_f dw_f = 0. \quad (17)$$

Solving for the derivatives of all prices with respect to wholesale prices yields

$$\Delta_p = G^{-1} H_f. \quad (18)$$

The market channel price-cost margin is the sum of the supermarkets' and the manufacturers' price-cost margins given by equations (12) and (15) respectively.

$$p - c^r - c^w = -(T_r * \Delta_r)^{-1} s(p) - (T_w * \Delta_w)^{-1} s(p). \quad (19)$$

### 3. Data Sources and Management

The data used in the above analysis consists of two kinds of variables: retail sales variables and demographic variables.

The sales data were obtained from the Information Resource, Inc. (IRI) Infoscan database at the Food Policy Marketing Center of University of Connecticut. It covers RTEC sales for 37 brands at the four leading supermarkets in Boston (Stop & Shop, Shaw's, DeMoulas and Star Market) for four-weekly periods between April 1995 and December 1997. One important feature of this period is that it covers significant price drops in the 1990s when the RTEC industry was being questioned on market power (Cotterill, 1999, and Connor, 1999). The sales data collected consists of the following

variables: dollar sales, volume (in pounds) sales, and the percent volume sold with any feature.

From the RTEC sales data, the market shares and the retail prices were computed for each brand and supermarket. Market shares are obtained by converting volume sales into number of servings sold and dividing by the potential market size. This is done by using the serving weight found on the box of cereals. The potential market size is assumed to be one serving per capita and per day as in Nevo (2001). The real retail prices were computed by dividing the dollar sales of each brand by the number of servings sold and then deflated using the urban consumers CPI for Boston (with CPI=100 for 1981).

The analysis is conducted using a set of 37 RTEC brands produced by six manufacturers (Kellogg's, General Mills, Post-Kraft, Quaker, Ralston and Nabisco) sold in four supermarket channels (Stop & Shop, Shaw's, DeMoulas and Star market) in Boston market from April 1995 to December 1997 for 5180 observations.

Primary data on product characteristics were collected by examining the cereal boxes. The variables collected were the sugar content, the fiber content and the total calories. A dummy variable was created to classify the branded cereals into "Kid cereal" or not. It is assumed that those characteristics did not change since between 1995 and 1997. Besides the sales data, the analysis uses the demographic data to take account of the heterogeneity of consumer taste. This study uses two demographic variables: the natural logarithm of age and income. Further it is assumed that those variables are jointly normally distributed with mean given by the Grocery data and variance-covariance matrix given by the CPS data at Boston level.<sup>9</sup>

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<sup>9</sup> Romeo (2005) shows that knowing the joint distribution for demographics at the city level is sufficient to infer the distribution at the county or zip code levels.

The demand model presented above implies endogeneity of RTEC prices, and, hence, can lead to biased parameter estimates<sup>10</sup>. This implies that prices are correlated with product characteristics. This study uses a set of instrumental variables to control for retail price endogeneity in a particular supermarket. The set has three subcomponents. The first one consists of the retail price of the brand in other supermarkets in Boston and the percentage of RTEC sold under any kind of merchandizing (Promotion) in that particular chain. The second contains the brand dummy variables<sup>11</sup>. The third subcomponent is the interaction between the input prices and the supermarket dummy variables. Wages in the Boston area and the price indices of energy, grain and sugar were interacted with supermarket dummy variables.

All the price instruments mentioned above are interacted with the error terms when applying the GMM estimation procedure. The use of GMM technique implies the need for an optimal weighting matrix. This paper follows Hansen (1982) who shows that setting the weighting matrix equal the inverse of an asymptotic covariance matrix is optimal in the sense that it gives parameter estimates with the smallest asymptotic variance.

## **4. Empirical Results**

### **4.1. Demand Estimation Results**

The estimates of the RCM parameters are presented in Table 1. The parameter estimates for the price and promotion are the GMM estimates of equation (4) while the taste parameters  $\beta$  are the minimum distance estimates. The results of the random

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<sup>10</sup> This endogeneity comes from the fact that retail prices depend on observed and unobserved product characteristics. Any variation in those characteristics induces a variation in retail prices.

<sup>11</sup> The use of brand dummies implies that the model does not identify the taste parameters  $\beta$  given by the product characteristics in the indirect utility function in equation (4). To circumvent this shortcoming, the study uses the minimum distance (MD) procedure proposed by Chamberlain (1982).

coefficients model account for the consumer heterogeneity by allowing the coefficients on price, sugar, calories, fiber contents and kid-cereal dummy variable to vary across consumers as a function of the natural logarithm of their age and income, and the unobserved consumer characteristics.

As expected, the price coefficient is negative and highly significant, meaning that the mean valuation utility decreases when price increases. The promotion coefficient is positive and highly significant, implying that the promotion increases the mean valuation utility. The taste parameters obtained by the MD approach are all highly significant. The brand unobserved characteristics (constant) have a negative and significant effect on the indirect utility. For the average consumer, sugars as well as the dummy for kids' cereals have a negative marginal utility. Stanley and Tschirhart (1991) and Nevo (2000) find a positive sugar coefficient. The negative sign of the coefficient of sugar may be explained by the increased worry of consumer on the effect of sugar consumption on weight gain. The calories and fibers have a positive marginal utility. For the calories, the positive sign maybe explained by the fact that consumer perceive the RTEC as a good sources of energy. For the fiber, the positive coefficient shows the nutrition component of the RTEC.

The estimates of standard deviations of the taste parameters are all significant, meaning that the unobserved consumer characteristics play an important role in the deviation from the mean utility. The marginal utility from the price increases with the income and decreases with age. Marginal valuation of sugar increases with age and decreases with income, as does the variable calories, while the variable fiber interacts

negatively with the income and positively with the age. For the Kid dummy has a positive interaction with income and age.

Turning now to the implied elasticities, Table 2 presents the own-price elasticities implied by the RCM. The RCM elasticities are higher than those implied by the Logit Model<sup>12</sup>. The own price elasticities range from -3.2301 Ralston Cookie Crisp in Stop & Shop to -1.1973 for Kellogg's corn Flakes in Stop & Shop.

#### **4.2. Supply Results**

This section presents the results of the estimation of the price-cost margins (i.e., the differences between the price and the marginal cost) for the manufacturers, the retailers and the whole channel, under a double marginalization scenario. Given the demand estimates from the previous section, the price-cost margins were computed. The results are given in Tables 3, 4 and 5 (in \$/lb) for the four leading supermarkets, the manufacturers (at the brand level) and the entire channel respectively. For the retailers, the price-cost margins vary from \$0.6450/lb for Ralston Rice Chex in DeMoulas to \$1.0439/lb for Post Raisin Bran in Stop & Shop. The remaining supermarkets obtain smaller dollar margins. The highest margins are realized by Stop & Shop (the leading supermarket) with an average of \$0.8706/lb.

For the manufacturers, the margins are higher than the retailers' PCMs, except Stop & Shop who splits the channel margins evenly with the manufacturers. The manufacturers' PCMs vary from \$0.1676/lb for Post Grape Nuts in Stop & Shop to \$1.52/lb for Kellogg's Corn Pops in DeMoulas. For the whole channel, the price-cost margins vary from \$1.0685/lb for Kellogg's Corn Frosted Flakes in Stop & Shop to

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<sup>12</sup> Logit estimates are available upon request.

\$2.31/lb for Kellogg's Corn Pops in DeMoulas. However, on average, dollar market channel margins are virtually identical across all four supermarkets (around \$1.74/lb).

Table 6 shows the average RTEC prices charged to consumer at various supermarkets. Stop & Shop, in spite of obtaining the largest dollar margins, charged prices close to the overall average price (\$3.34/lb). On the other hand, Star Market, mostly an urban supermarket with generally small store size, charged the highest prices that were approximately 10% higher than those of other supermarkets (\$3.61/lb). Given Star Market's relatively lower price-cost margins, one concludes that the higher prices are in part due to higher retailing cost.

Table 7 presents the price-cost margins as a percentage of the retail price (i.e., the Lerner index) for the supermarket chains. Interestingly, the results show that the Lerner index is proportional to the size of the supermarket chains.

In sum, Stop & Shop (the leading supermarket) is able to capture a larger dollar margin than other supermarkets while RTEC manufacturers obtain a lower dollar margin at Stop & Shop. Since they charge higher prices, the larger PCMs are may be due to efficiency in handling a larger volume as well as possible volume discounts.

The shares of the price-cost margins accruing supermarkets are given in Table 8. On average, the share of the manufacturers in Stop & Shop, the leading supermarket in Boston, is the lowest among the four supermarkets. In Stop & Shop, the manufacturer's share do not exceed 50% of the whole channel margins, while this share attains more than 58% in Star Market. Stop & Shop supermarkets get more profits from Post, Nabisco and Ralston than from Kellogg and general Mills. In the remaining supermarkets, the retailers' shares do not exceed 44%. This may show the balance of power between the

retailers and the manufacturers. Hence, in Stop & Shop, General Mills' brands get the highest share of the price-cost margins attaining more than 52% of the whole channel profit, while the Post brand did not reach 40% of the channel profit. In the remaining supermarkets, General Mills seem to exercise power over the retailer since more than 60% of the channel profits go to the GM manufacturers.

## **5. Conclusion**

The purpose of this paper was to decompose the channel price-cost margins for ready-to-eat cereals in the Boston area. The study uses highly disaggregated (supermarket chain and brand level ) monthly data from Information Resources Inc (IRI) from 1995 to 1997. The random coefficients model is used to estimate the demand for 37 brands of RTECs in the top four supermarkets in the Boston area. The demand estimates are then used to compute the price-cost margins for retailers and manufacturers under double marginalization scenario. The RCM allows estimating 21,904 own- and cross-price elasticities along with the elasticities of the other variables. The RCM results show the importance of the price and the product characteristics in the consumer choice of RTECs brands.

The results shed light on the share of channel PCMs accruing to RTEC manufacturers and retailers. For instance, Stop & Shop, the leading supermarket chain in Boston, gets more than 50% of the channel profits, while RTEC manufacturers get more than 56% of the channel profits when dealing with smaller supermarket chains (Shaw's, DeMoulas and Star Market). The results attest to possible volume discounts and efficiencies as the smaller supermarkets, especially those with urban location, charge higher prices in spite of smaller dollar PCMs, due in part to higher retailing costs. Among

the manufacturers, General Mills brands command the highest PCMs while Post brands command the lowest ones.

Table 1. RTEC Demand Parameter Estimates and Related Statistics, Boston Market.

	Variable	Estimate	t-Statistic
Means ( $\beta$ 's)	Price	-12.2180***	69.9771
	Promotion	1.0362***	29.0571
	Constant <sup>1</sup>	-8.1029***	11.3300
	Sugar <sup>1</sup>	-0.1186***	9.5312
	Calories <sup>1</sup>	2.9416***	7.3540
	Fiber <sup>1</sup>	0.0927***	3.0123
	Kid Dummy <sup>1</sup>	-0.3009***	50.1451
Standard Deviation	Price	-0.8715***	4.9321
	Constant	0.5726***	9.3257
	Sugar	0.0117*	1.5811
	Calories	0.6619***	3 4.8368
	Fiber	0.3141***	18.6964
	Kid Dummy	-0.7157***	17.4136
Interaction with Age	Price	2.5828***	0.5097
	Constant	-7.9903***	3.1830
	Sugar	0.1818	0.0861
	Calories	3.7094***	12.6342
	Fiber	-0.2290	0.2209
	Kid Dummy	0.5502	2.6799
Interaction with Age	Price	-31.8100***	46.1793
	Constant	6.1302***	29.8597
	Sugar	-0.5275	59.2697
	Calories	-0.0708	0.4658
	Fiber	2.0762**	63.1064
	Kid Dummy	1.8825*	22.1731

Note A "1" indicates that the estimate comes from a minimum distance procedure. One, two and three asterisks indicate significance at 10%, 5% and 1% levels, respectively. The sample consisted of 5,180 observations.

Table 2. Own-Price Elasticity Estimates for RTECs in Boston Supermarkets

RTEC Brand	Stop & Shop	Shaw's	DeMoulas	Star Market	Simple Average
KApple Jacks	-2.3739	-2.2148	-2.1948	-2.0365	-2.205
KComplete Bran	-2.0464	-2.0012	-1.9888	-2.0418	-2.0196
KCorn Flakes	-1.1973	-1.2732	-1.3501	-1.0870	-1.2269
KCorn Pops	-1.8982	-1.9043	-2.0876	-1.8410	-1.9328
Kcrispix	-2.2925	-2.1981	-2.5129	-2.0003	-2.251
Kfroot Loops	-2.2855	-2.4063	-2.1488	-2.7885	-2.4073
Kfrosted Flakes	-1.6779	-1.7551	-1.6465	-1.4205	-1.625
Kfrosted Mini Wheats	-1.7186	-1.6921	-1.5742	-1.4167	-1.6004
Kraisin Bran	-1.4468	-1.5854	-1.4531	-1.3162	-1.4504
Krice Krispies	-2.1174	-2.0748	-2.1382	-2.1717	-2.1255
Kspecial K	-2.3950	-2.4371	-2.6445	-2.0056	-2.3706
GMcheerios	-1.7354	-1.6504	-2.0737	-1.6652	-1.7812
GMCinammon Crunch	-2.3319	-2.1618	-2.4416	-2.2890	-2.3061
GMCoco Puffs	-2.1520	-2.0850	-2.3137	-2.3554	-2.2265
GMGolden Grahams	-2.4183	-2.2308	-2.4339	-2.133	-2.304
GMHoney Nut Cheerios	-2.0481	-2.0128	-1.9883	-1.6510	-1.925
GMKix	-2.4137	-2.3017	-2.8226	-2.1767	-2.4287
GMLucky Charms	-2.2563	-2.1042	-2.4017	-1.8628	-2.1563
GMMulti Gain Cheerios	-2.6348	-2.5806	-2.5016	-2.2399	-2.4892
GMTotal	-2.4816	-2.2369	-2.5859	-2.064	-2.3421
GMTotal Raisin Bran	-1.8795	-1.9669	-1.8949	-1.4876	-1.8072
GMWheaties	-1.6982	-1.6723	-1.8380	-1.5533	-1.6905
GMApple Cinnamon	-2.0642	-2.1263	-2.0928	-2.1800	-2.1158
Pbanana Nut Crunch	-2.0205	-1.7775	-2.1404	-2.6916	-2.1575
Pcocoa Pebbles	-2.3105	-2.0744	-2.2694	-2.9949	-2.4123
Pfruit Pebbles	-2.2228	-1.9779	-2.2172	-2.1996	-2.1544
Pgrape Nuts	-1.3631	-1.3989	-1.4825	-1.2914	-1.384
Phoney Comb	-2.1603	-1.9707	-2.1531	-1.8585	-2.0357
Praisin Bran	-1.4876	-1.4063	-1.4592	-1.288	-1.4103
Qcap N Crunch	-2.0318	-1.9192	-2.0169	-2.3833	-2.0878
Qoat	-1.9242	-1.6939	-1.5993	-1.7101	-1.7319
QToasted	-2.1657	-2.0391	-2.1332	-1.9859	-2.081
N Frosted Wheat Bites	-1.9999	-1.8932	-1.9777	-1.6027	-1.8684
N Spoon Size	-1.8953	-1.7277	-1.8770	-1.4994	-1.7498
R Cookie Crisp	-3.2301	-2.8600	-2.7595	-2.8939	-2.9359
R Corn Chex	-2.4346	-2.1804	-2.5402	-2.1586	-2.3285
R Rice Chex	-2.4301	-2.1902	-2.5586	-2.1502	-2.3323

Table 3: Price-Cost Margins for Supermarkets in Boston (\$/lb)

RTEC Brand	Stop & Shop	Shaw's	DeMoulas	Star Market	Simple Average
KApple Jacks	0.8779	0.7325	0.7221	0.7548	0.7718
KComplete Bran	0.9793	0.7548	0.7509	0.7057	0.7977
KCorn Flakes	0.8320	0.6917	0.6857	0.6880	0.7243
KCorn Pops	0.9347	0.7680	0.7900	0.8138	0.8266
Kcrispix	0.7822	0.6686	0.6595	0.6665	0.6942
Kfroot Loops	0.7836	0.6706	0.6597	0.6753	0.6973
Kfrosted Flakes	0.8195	0.7038	0.6868	0.6980	0.7270
Kfrosted Mini Wheats	0.9418	0.7397	0.7297	0.7432	0.7886
Kraisin Bran	0.9923	0.7595	0.7439	0.7892	0.8212
Krice Krispies	0.7865	0.6803	0.6630	0.6680	0.6994
Kspecial K	0.7925	0.6752	0.6488	0.6733	0.6974
GMcheerios	1.0085	0.7853	0.7400	0.7055	0.8098
GMCinammon Crunch	0.8015	0.6801	0.6499	0.6701	0.7004
GMCoco Puffs	0.8691	0.7344	0.7401	0.7294	0.7682
GMGolden Grahams	0.8237	0.7001	0.6936	0.7112	0.7321
GMHoney Nut Cheerios	0.8286	0.6943	0.6758	0.6886	0.7218
GMKix	0.8061	0.6808	0.6487	0.6736	0.7023
GMLucky Charms	0.8300	0.7042	0.6891	0.7042	0.7319
GMMulti Gain Cheerios	0.8555	0.6963	0.6777	0.6859	0.7288
GMTotal	0.8275	0.6940	0.6620	0.6791	0.7156
GMTotal Raisin Bran	0.8883	0.7373	0.6930	0.7448	0.7658
GMWheaties	0.8745	0.7176	0.7109	0.7002	0.7508
GMApple Cinnamon	0.8182	0.7044	0.6804	0.6979	0.7252
Pbanana Nut Crunch	0.9370	0.7542	0.7069	0.7373	0.7839
Pcocoa Pebbles	0.8561	0.7256	0.6980	0.7278	0.7519
Pfruit Pebbles	0.8775	0.7234	0.7105	0.7344	0.7614
Pgrape Nuts	0.9899	0.7658	0.7486	0.7384	0.8107
Phoney Comb	0.8141	0.6964	0.6722	0.6953	0.7195
Praisin Bran	1.0439	0.7879	0.7750	0.7997	0.8516
Qcap N Crunch	0.8693	0.6997	0.7034	0.6882	0.7401
Qoat	0.8678	0.7292	0.6901	0.7235	0.7527
QToasted	0.8666	0.7330	0.6805	0.7194	0.7499
N Frosted Wheat Bites	0.9418	0.7357	0.7099	0.7234	0.7777
N Spoon Size	0.9163	0.7286	0.7203	0.7344	0.7749
R Cookie Crisp	0.9376	0.7583	0.7341	0.7992	0.8073
R Corn Chex	0.7709	0.6683	0.6455	0.6700	0.6887
R Rice Chex	0.7704	0.6672	0.6450	0.6707	0.6883
Simple Average	0.8706	0.7175	0.6984	0.7143	0.7502

Table 4. Price-Cost Margins for RTEC Manufacturers (\$/lb)

RTEC Brand	Stop & Shop	Shaw's	DeMoulas	Star Market	Simple Average
KApple Jacks	1.2035	1.3387	1.3806	1.3516	1.3186
KComplete Bran	1.0612	1.2768	1.3179	1.3506	1.2516
KCorn Flakes	1.2937	0.6276	0.6100	0.5644	0.7739
KCorn Pops	1.3516	1.4803	1.5200	1.4825	1.4586
Kcrispix	1.1184	1.2131	1.2535	1.2119	1.1992
Kfroot Loops	1.1257	1.2139	1.2681	1.2358	1.2108
Kfrosted Flakes	0.2490	1.2355	0.4044	1.2424	0.7828
Kfrosted Mini Wheats	0.3667	0.5604	0.6676	0.5104	0.5263
Kraisin Bran	0.5563	0.6727	0.7891	0.6485	0.6667
Krice Krispies	1.1259	1.2113	1.2531	1.2185	1.2022
Kspecial K	1.1269	1.2240	1.2453	1.2292	1.2064
GMcheerios	0.6362	1.0045	0.6747	0.5921	0.7269
GMCinammon Crunch	1.0574	1.1826	1.1744	1.1620	1.1441
GMCoco Puffs	1.0469	1.1589	1.1418	1.1118	1.1149
GMGolden Grahams	1.0179	1.1245	1.1281	1.1021	1.0932
GMHoney Nut Cheerios	1.0934	1.2098	1.2232	1.2018	1.1821
GMKix	1.0990	1.2224	1.1906	1.1989	1.1777
GMLucky Charms	1.0588	1.1710	1.1815	1.1580	1.1423
GMMulti Gain Cheerios	1.1471	1.3055	1.3385	1.2595	1.2626
GMTotal	1.0744	1.2360	1.2125	1.1904	1.1783
GMTotal Raisin Bran	1.0397	1.1840	1.2117	1.1822	1.1544
GMWheaties	0.3061	0.5075	0.4356	1.2828	0.6330
GMApple Cinnamon	1.0624	1.1681	1.1636	1.1511	1.1363
Pbanana Nut Crunch	0.8358	1.0412	1.0347	0.9939	0.9764
Pcocoa Pebbles	0.8905	1.0095	1.0016	0.9987	0.9751
Pfruit Pebbles	0.9016	1.0119	1.0162	1.0124	0.9855
Pgrape Nuts	0.1676	0.3754	0.3663	1.0939	0.5008
Phoney Comb	0.8468	0.9476	0.9643	0.9660	0.9312
Praisin Bran	0.2419	0.5644	0.5538	0.3925	0.4382
Qcap N Crunch	0.7632	0.8682	0.9250	0.9372	0.8734
Qoat	0.9837	1.0957	1.0998	1.1138	1.0732
QToasted	0.9728	1.1021	1.1072	1.1092	1.0728
N Frosted Wheat Bites	0.6259	0.8200	0.8483	0.8307	0.7812
N Spoon Size	0.6937	0.8606	0.8992	0.8650	0.8296
R Cookie Crisp	0.7876	0.9507	0.9213	0.9197	0.8948
R Corn Chex	0.7835	0.8791	0.8972	0.8904	0.8626
R Rice Chex	0.7832	0.8794	0.8966	0.8924	0.8629
Simple Average	0.8783	1.0253	1.0086	1.0447	0.9892

Table 5. Price-Cost Margins for the Entire Channel (\$/lb)

RTEC Brand	Stop & Shop	Shaw's	DeMoulas	Star Market	Simple Average
KApple Jacks	2.0813	2.0712	2.1026	2.1063	2.0904
KComplete Bran	2.0406	2.0316	2.0687	2.0562	2.0493
KCorn Flakes	2.1257	1.3192	1.2957	1.2524	1.4982
KCorn Pops	2.2863	2.2484	2.31	2.2964	2.2853
Kcrispix	1.9005	1.8817	1.9129	1.8784	1.8934
Kfroot Loops	1.9093	1.8845	1.9277	1.911	1.9081
Kfrosted Flakes	1.0685	1.9394	1.0912	1.9404	1.5099
Kfrosted Mini Wheats	1.3085	1.3001	1.3973	1.2536	1.3149
Kraisin Bran	1.5487	1.4322	1.5329	1.4378	1.4879
Krice Krispies	1.9123	1.8916	1.9161	1.8864	1.9016
Kspecial K	1.9195	1.8993	1.8941	1.9025	1.9038
GMcheerios	1.6447	1.7898	1.4146	1.2976	1.5367
GMCinammon Crunch	1.8589	1.8627	1.8244	1.832	1.8445
GMCoco Puffs	1.9161	1.8933	1.882	1.8411	1.8831
GMGolden Grahams	1.8415	1.8246	1.8216	1.8132	1.8252
GMHoney Nut Cheerios	1.922	1.9041	1.899	1.8904	1.9039
GMKix	1.9052	1.9031	1.8393	1.8725	1.8801
GMLucky Charms	1.8887	1.8751	1.8706	1.8621	1.8742
GMMulti Gain Cheerios	2.0025	2.0018	2.0161	1.9454	1.9915
GMTotal	1.9019	1.9299	1.8745	1.8695	1.894
GMTotal Raisin Bran	1.928	1.9213	1.9047	1.927	1.9202
GMWheaties	1.1806	1.2251	1.1464	1.9829	1.3838
GMApple Cinnamon	1.8805	1.8725	1.844	1.8489	1.8615
Pbanana Nut Crunch	1.7729	1.7954	1.7416	1.7311	1.7602
Pcocoa Pebbles	1.7465	1.7351	1.6996	1.7265	1.7269
Pfruit Pebbles	1.7791	1.7353	1.7266	1.7468	1.7469
Pgrape Nuts	1.1575	1.1412	1.1149	1.8323	1.3115
Phoney Comb	1.6609	1.644	1.6366	1.6613	1.6507
Praisin Bran	1.2858	1.3523	1.3289	1.1921	1.2898
Qcap N Crunch	1.6324	1.5679	1.6285	1.6254	1.6136
Qoat	1.8515	1.8249	1.7899	1.8373	1.8259
QToasted	1.8395	1.8351	1.7878	1.8286	1.8227
N Frosted Wheat Bites	1.5678	1.5557	1.5582	1.5541	1.5589
N Spoon Size	1.6099	1.5893	1.6195	1.5994	1.6045
R Cookie Crisp	1.7252	1.709	1.6554	1.7189	1.7021
R Corn Chex	1.5545	1.5473	1.5427	1.5604	1.5512
R Rice Chex	1.5535	1.5467	1.5416	1.5631	1.5512
Simple Average	1.7489	1.7428	1.7070	1.7590	1.7394

Table 6. Average Retail Prices (\$/lb) for RTEC in Boston, April 1995 through December 1997.

RTEC Brand	Stop & Shop	Shaw's	DeMoulas	Star Market	Simple Average
KApple Jacks	3.87	3.64	3.53	4.06	3.77
KComplete Bran	3.09	3.01	3.01	3.30	3.10
KCorn Flakes	2.91	2.00	2.12	2.21	2.31
KCorn Pops	3.28	3.20	3.62	3.67	3.44
Kcrispix	3.56	3.41	3.90	4.01	3.72
Kfroot Loops	3.56	3.73	3.33	3.59	3.55
Kfrosted Flakes	2.70	2.78	2.62	2.87	2.74
Kfrosted Mini Wheats	2.68	2.62	2.45	2.86	2.65
Kraisin Bran	2.36	2.52	2.33	2.67	2.47
Krice Krispies	3.31	3.22	3.33	3.43	3.32
Kspecial K	3.76	3.80	4.10	4.03	3.92
GMcheerios	2.93	2.70	3.27	3.35	3.06
GMCinammon Crunch	3.59	3.34	3.74	3.77	3.61
GMCoco Puffs	3.51	3.41	3.74	3.70	3.59
GMGolden Grahams	3.87	3.55	3.87	4.24	3.88
GMHoney Nut Cheerios	3.23	3.15	3.11	3.31	3.20
GMKix	3.73	3.55	4.33	4.33	3.98
GMLucky Charms	3.62	3.35	3.82	3.72	3.63
GMMulti Gain Cheerios	4.02	3.94	3.82	4.45	4.06
GMTotal	3.82	3.44	3.95	4.14	3.84
GMTotal Raisin Bran	3.01	3.13	3.01	3.00	3.04
GMWheaties	2.63	2.57	2.82	3.13	2.79
GMApple Cinnamon	3.27	3.37	3.30	3.59	3.38
Pbanana Nut Crunch	3.14	2.75	3.30	3.40	3.15
Pcocoa Pebbles	3.74	3.31	3.63	4.00	3.67
Pfruit Pebbles	3.62	3.18	3.57	4.00	3.59
Pgrape Nuts	2.15	2.15	2.27	2.61	2.29
Phoney Comb	3.41	3.10	3.38	3.71	3.40
Praisin Bran	2.42	2.23	2.28	2.61	2.38
Qcap N Crunch	3.14	2.95	3.09	3.68	3.21
Qoat	3.19	2.78	2.55	3.47	3.00
QToasted	3.45	3.23	3.38	3.98	3.51
N Frosted Wheat Bites	3.09	2.93	3.05	3.22	3.07
N Spoon Size	2.96	2.68	2.90	3.02	2.89
R Cookie Crisp	5.25	4.64	4.42	5.72	5.01
R Corn Chex	3.81	3.40	3.96	4.29	3.87
R Rice Chex	3.80	3.42	3.97	4.27	3.86
Simple Average	3.34	3.14	3.32	3.61	3.35

Table 7: Price-Cost Margins for Supermarkets in Boston (Percent of Retail Price)

RTEC Brand	Stop & Shop	Shaw's	DeMoulas	Star Market	Simple Average
KApple Jacks	22.68	20.13	20.45	18.60	20.46
KComplete Bran	31.70	25.05	24.93	21.40	25.77
KCorn Flakes	43.55	34.62	32.29	31.11	35.39
KCorn Pops	28.47	24.03	21.81	22.15	24.11
Kcrispix	21.99	19.59	16.92	16.63	18.78
Kfroot Loops	22.02	17.97	19.82	18.79	19.65
Kfrosted Flakes	30.40	25.28	26.22	24.31	26.55
Kfrosted Mini Wheats	35.16	28.23	29.82	25.97	29.80
Kraisin Bran	41.97	30.12	31.91	29.60	33.40
Krice Krispies	23.75	21.11	19.90	19.46	21.06
Kspecial K	21.05	17.79	15.83	16.71	17.85
GMcheerios	34.42	29.12	22.61	21.09	26.81
GMCinammon Crunch	22.30	20.37	17.38	17.77	19.45
GMCoco Puffs	24.75	21.53	19.79	19.71	21.44
GMGolden Grahams	21.30	19.70	17.92	16.76	18.92
GMHoney Nut Cheerios	25.64	22.03	21.70	20.83	22.55
GMKix	21.62	19.17	14.98	15.55	17.83
GMLucky Charms	22.92	20.99	18.04	18.95	20.22
GMMulti Gain Cheerios	21.28	17.69	17.76	15.40	18.04
GMTotal	21.69	20.16	16.74	16.40	18.75
GMTotal Raisin Bran	29.50	23.57	23.00	24.82	25.22
GMWheaties	33.31	27.87	25.18	22.41	27.19
GMApple Cinnamon	24.99	20.90	20.60	19.45	21.48
Pbanana Nut Crunch	29.83	27.45	21.42	21.69	25.10
Pcocoa Pebbles	22.91	21.89	19.24	18.20	20.56
Pfruit Pebbles	24.27	22.76	19.92	18.35	21.33
Pgrape Nuts	46.13	35.65	32.95	28.31	35.76
Phoney Comb	23.89	22.48	19.87	18.77	21.25
Praisin Bran	43.08	35.38	33.93	30.65	35.76
Qcap N Crunch	27.68	23.70	22.78	18.71	23.22
Qoat	27.23	26.25	27.11	20.85	25.36
QToasted	25.11	22.70	20.11	18.06	21.49
N Frosted Wheat Bites	30.52	25.10	23.31	22.47	25.35
N Spoon Size	30.90	27.14	24.81	24.31	26.79
R Cookie Crisp	17.87	16.35	16.63	13.97	16.20
R Corn Chex	20.26	19.65	16.31	15.62	17.96
R Rice Chex	20.29	19.53	16.23	15.70	17.94
Simple Average	27.47	23.60	21.90	20.53	23.38

Note: The price-cost margins correspond to  $(p-MC)/p$ .

Table 8. Supermarkets Shares of the Channel Profit

	<i>Stop &amp; Shop</i>	<i>Shaw's</i>	<i>DeMoulas</i>	<i>Star Market</i>	<i>Mean</i>
Kellogg	49.78	40.72	41.73	41.12	43.34
General Mills	47.81	39.39	39.77	38.61	41.40
Post	61.15	48.87	48.22	46.00	51.06
Quaker	49.08	41.51	39.94	40.35	42.72
Nabisco	58.49	46.57	45.02	46.23	49.08
Ralston	51.18	43.57	42.67	44.11	45.38
Mean	52.92	43.44	42.89	42.74	45.50

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