Vertical Relationships in the Ready-to-Eat Breakfast Cereal Market: A Brand-Supermarket Level Analysis.

By

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Abstract:
The purpose of this paper is to examine the vertical relationship between the manufacturers of ready-to-eat cereals (RTEC) and the retailers in the Boston area. The study uses highly disaggregated (supermarket and brand level) monthly data from Information Resources Inc (IRI) from 1995 to 1997.The Logit model is used to estimate the demand for 37 brands of RTEC in the top four supermarkets in the Boston area. The demand estimates are then used to compute the price-cost margins (PCM) for retailers and manufacturers under different vertical scenarios, including vertical Nash double marginalization, non-linear pricing, vertical integration, and collusion. The results of the study shed light on the power each agent (manufacturers and retailers) has to set the price of RTECs in the Boston market, and assess inter- and intra-brand substitution among brands of different manufacturers.

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1. Introduction

The vertical relationships, including vertical integration and vertical constraints, between manufacturers and the wholesale and retail firms that distribute their products are basically the business arrangements between buyers and sellers (Azzam and Pagoulatos, 1997). Traditionally, vertical relationships have been interpreted either as an instrument of market power or as a device for correcting failure in the market for distribution services and improving efficiency. Recently, retailers have become more and more powerful in negotiating with manufacturers (Villas-Boas, 2002), but it is not evident whether the manufacturers or the retailers are the chain captains.

The theoretical and institutional aspects of the vertical relationship between manufacturers and retailers have been much studied in the literature from (McGuire and Staelin, 1983; Mathewson and Winter, 1984; Rey and Tirole, 1986; Gal-Or, 1991; Besanko and Perry, 1993; Waterson, 1993; Klein and Murphy 1997; for a survey see Azzam and Pagoulatos, 1999). The theoretical literature on vertical constraints (resale price maintenance and exclusive territories) imposed by upstream firms on downstream firms has focused on the existence of non-linear pricing as a device to internalize the vertical pricing externality between manufacturers and retailers, and to avoid the double marginalization problem (Mathewson and Winter, 1984; Rey and Tirole, 1986; Gilligan, 1986; Besanko and Perry, 1993). This literature suggests that for a manufacturing

monopoly competition, regulators should not be concerned about vertical restraints as long as inter-brand competition is not restricted by the contract.

The empirical literature on vertical relationships between manufacturers and retailers has focused on contracts and vertical integration. Here the emphasis is on providing a structural model that explains the relationship between manufacturers and retailers and testing these models using observed data. Some recent and noteworthy studies in this area are those by Kadiyali et al. (1999), Villas-Boas and Zhao (2000), Villas-Boas (2002), and Manuszak (2001). In these studies, the quantities and prices are treated as equilibrium outcomes of some prespecified pricing strategy, generally a Bertrand-Nash game. These studies use structural models where the demand and supply relations are estimated using a structural framework.

One important aspect of structured models is that they allow one to study the manufacturer-retailer relationship without observing wholesale prices and costs at upstream and downstream levels, which are usually not available as data. The structural models also allow estimating the mark-ups of manufacturers and retailers.

The ready-to-eat cereal (RTEC) industry along with the supermarket channels in Boston provides an interesting and useful case study to analyze the vertical relationship between manufacturers and the retailers. The RTEC industry is characterized by its high concentration level, high degree of product differentiation, high price-cost margins and large advertising-to-sales ratios (Schmalensee, 1978; Scherer, 1979; Nevo, 2001).

The fundamental inquiry of this research is to examine the vertical relationship between manufacturers and retailers in the RTEC industry in Boston in order to shed light on the power each agent has to set the price of RTECs in the Boston market. More

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precisely, the question to be answered is: What kind of vertical relationship exists between the manufacturers and the retailers? Does this relationship support the high price-cost margins in the RTEC industry? To this end the study uses a discrete choice model for demand to help estimate the markups at the manufacturer and retailer levels, and assess the inter- and intra-brand substitution among different manufacturers.

This research will contribute to the existing literature in several ways. First, the data are highly disaggregated (at the brand and store level) and the variables are monthly rather than quarterly at the city level used by Nevo (2001). This gives more insight into the behavior of manufacturers and retailers. Second, the study will add new empirical evidence on the estimation of the vertical relationship between downstream and upstream firms. This study differs from Villas-Boas (2002) by looking at retailer strategic behavior, not at the individual store behavior. Lastly, the study will extend the literature on both the vertical relationship between manufacturers and retailers and the use of discrete choice to model consumer demand.

2. The RTEC Industry

The RTEC industry is highly concentrated, with the top four companies accounting for 84 percent of all RTE cereals. Four companies (Kellogg, General Mills, Post and Quaker) make practically all of the branded RTE cereal in the United States. According to Connor (1999), there are 6 to 13 domestic manufacturers of any given variety of cereal. Production of RTE cereal at the plant level has also become increasingly concentrated over time (Connor, 1999). In the first decade of the 20th century, over 100 plants manufactured both hot and cold cereals. During the following 30 years, the number of plants fell dramatically. By 1940, only 30 to 35 plants produced

nearly all RTE cereals. The most recent census information indicates that in 1997 36 plants produced all RTE cereals. The dominant cereal manufacturers lower their per unit production costs by operating large plants that each supply 40 to 60 million pounds of cereal annually. In addition, the large cereal manufacturers enjoy economies of advertising.

Because of the high rate of concentration, the major RTEC manufacturers de-emphasize price competition. In addition to pricing strategies, the major manufacturers use a variety of nonprice strategies. Advertising is used to differentiate similar cereals and to create consumer loyalty for particular brands. Connor (1999) shows that the major branded cereal manufacturers spend 10 to 15 percent of the value of their sales on mass media advertising. Besides advertising, manufacturers use sales promotions such as couponing. For RTEC, couponing is the predominant strategy. Companies' couponing averages 17 to 20 percent of sales. Nevo and Wolfram (2002) assess the relationship between coupons and shelf prices in light of the widely expressed view that coupons are the primary tool for price discrimination. They did not find a relationship between the coupons and shelf prices.

Top manufacturers of branded RTEC's produce several brands that cover every possible segment in the market. This strategy, known as product proliferation, is another means of competition. Product proliferation also minimizes market penetration by small firms and private-labels.

Concentration in the RTEC industry was fostered by a wave of mergers in the 1990s. In 1992, General Mills, the second largest U.S. producer of RTEC tried to acquire the Nabisco cereal line, but later called off the deal for antitrust reasons. The Nabisco

cereal line was acquired in 1993 by Kraft, the owner of Post (third largest RTEC producer) in spite of a challenge by the state of New York; and by the end of 1996 General Mills's proposal to purchase Ralston Purina's branded cereal line was approved.

The RTEC industry has also been characterized by high price-cost margins. According to Nevo (2001), the industry markups are consistent with a Nash-Bertrand pricing game. The author concludes that the high PCMs are not due to lack of price competition, but rather to consumer willingness to pay for their favorite brand and pricing decisions by firms that take into account limited substitution among their own brands. Thus market power, if any, in this industry is due to the firm's ability to maintain a portfolio of differentiated products and influence perceived product quality through advertising.

3. The Model

Following Villas-Boas (2002), this paper examines the vertical relationship between the RTEC manufacturers and the supermarkets in Boston at the supermarket chain level. Three categories of scenarios are examined, assuming a vertical Nash behavior: (1) double marginalization pricing; (2) non-linear pricing behavior; and (3) collusive pricing behavior. This task depends on the estimated demand functions of RTEC brands in the market under study, estimated using a discrete choice method.

3.1. Demand Side

Consider a consumer choosing N brands sold by J retailers during each shopping trip at time t. The indirect utility of consumer i from buying the brand j during the travel trip t is given by

$$U_{ijt} = \beta_j + x_{jt}\beta_i - \alpha_i p_{jt} + \zeta_{jt} + \varepsilon_{ijt}, \tag{1}$$

where β_j represents the store fixed effects, x_{jt} are the observed product characteristics,

p_{jt} is the price of brand j, ζ_{jt} are the unobserved (by the econometrician) product

characteristics, and ε_{ijt} represents the distribution of consumer preferences about the

unobserved product characteristics with a distribution density $f(\varepsilon)$. The parameters to

be estimated are α_i and β_i. Note that those parameters are allowed to vary across

consumers, therefore allowing random coefficients for consumers' preferences. These

random coefficients can be decomposed into a fixed component not varying across

consumers, and a varying component changing according to observed and unobserved

consumer characteristics. That is,

$$\alpha_i = \alpha + \lambda D_i + \gamma\nu_i, \tag{2}$$

$$\beta_i = \beta + \lambda D_i + \gamma\nu_i, \tag{3}$$

where the D_i represents observed consumers characteristics (such as demographics,

income) and ν_i represents unobserved consumers characteristics. Substituting equations

(2) and (3) into (1) yields

$$U_{ijt} = \beta_j + x_{jt}\beta + \lambda D_i x_{jt} + \gamma\nu_i x_{jt} - \alpha p_{jt} - \lambda D_i p_{jt} - \gamma\nu_i p_{jt} + \zeta_{jt} + \varepsilon_{ijt}. \tag{4}$$

Assume that the unobserved consumer characteristics ν_i are normally distributed $N(0, I)$,

and the observed consumer characteristics D_i have an empirical distribution $h(D)$ from

the demographic data.

The indirect utility given in equation (4) consists of two parts: a mean utility

given by $\delta_{jt} = \beta_j + \beta x_{jt} - \alpha p_{jt} + \zeta_{jt}$ and a deviation from that mean, which is a function

of the interaction between the observed and unobserved consumer characteristics and the price and observed brand characteristics, given by

$$\mu_{ijt} = \lambda D_i x_{jt} - \lambda D_i p_{jt} + \gamma v_i x_{jt} - \gamma v_i p_{jt} + \varepsilon_{ijt}.$$ (5)

To complete the model, an outside good (all residual brands) is included to give the consumer the possibility not to buy any one of the brands. The utility of the outside good is normalized to be constant over time and equal to zero.

Assume also that the consumer purchases the brand that gives the highest utility. Given the observed and unobserved consumer characteristics we define the set of choice by

$$S_{jt}(x_{jt}, p_{jt}, \zeta_{jt}; \theta) = \{(D_i, v_i, \varepsilon_{ijt}) : U_{ijt} \geq U_{ikt} \forall k = 0,1,...N\},$$ (6)

where θ is a vector that includes all the parameters of the model.

The market share of the *jth* brand corresponds to the probability the *jth* is chosen, that is:

$$s_{jt} = \int I\{(D_i, v_i, \varepsilon_{ijt}) : U_{ijt} \geq U_{ikt} \forall k = 0,1,...N\} dH(D) dG(v) dF(\varepsilon).$$ (7)

Depending on the assumptions regarding D, v, and ε, the integral in (7) can have a closed formula or not. In general, setting the integral in (7) does not have a closed formula and should be solved numerically. This paper assumes that consumer characteristics enter the model through the separable additive random shock ε. Equation (4) becomes

$$U_{ijt} = \beta_j + x_{jt}\beta_{jt} - \alpha p_{jt} + \varepsilon_{ijt},$$ (8)

which corresponds to the logit model. In this situation the integral in equation (7) has a closed form and can be solved analytically. The brand market shares are given by the following equation:

$$s_{jt} = \frac{\exp(x_{jt}\beta - \alpha p_{jt})}{1 + \sum_{k=1}^{J} \exp(x_{kt} - \alpha p_{kt})}.$$

(9)

The market shares defined by equation (9) give the following price elasticities:

$$\eta_{jkt} = \frac{\partial s_{jt}}{\partial p_{kt}} \frac{p_{kt}}{s_{jt}} = \alpha p_{jt}(1 - s_{jt}), \text{ for } j = k \text{ ; and}$$

(10)

$$\eta_{jkt} = \frac{\partial s_{jt}}{\partial p_{kt}} \frac{p_{kt}}{s_{jt}} = \alpha p_{jt} s_{kt}, \text{ otherwise.}$$

3.2. Supply Side

In this section, the scenarios considered are described, and the corresponding models are solved to obtain the retailers' and the manufacturers' price cost margins. All models assume vertical Nash pricing. In addition, pricing is assumed to be a two-stage game. First, the manufacturers choose the wholesale prices to their retailers. Then, the retailers choose the retail prices to maximize their own profits, given the wholesale prices and their incurred costs. The game is solved using backward induction starting from the retailers and going back to the manufacturers' equilibrium.

3.2.1. Double Marginalization Scenario

Beginning with the retail problem, consider that there are N_r Bertrand-Nash retailers in the retail market, and N_w Bertrand-Nash manufacturers competing in the wholesale market. The *rth* retailer's problem is to maximize profit, given by

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$$\pi_{rt} = \sum_{j \in S_{rt}} (p_{jt} - w_{jt} - c^r_{jt}) s_{jt}(p), \tag{11}$$

where S_{rt} is the set of brands sold by the *rth* retailer at time t, w_{jt} is the wholesale price the *rth* retailer pays for brand j, c^r_{jt} is the retailer's marginal cost for brand j, $s_{jt}(p)$ is the share of brand j, and M is a measure of the market size. This measure is assumed to be proportional to the population of the market under study. The first order conditions are given by

$$s_{jt} + \sum_{m \in S_{rt}} (p_{mt} - w_{mt} - c^r_{mt}) \frac{\partial s_{mt}}{\partial p_{jt}} = 0. \tag{12}$$

Repeating the same procedure for each retailer and each brand and stacking all the first order conditions together, we get the following implied price cost margin as a function of the demand side:

$$p_t - w_t - c^r_t = -(T_r * \Delta_{rt})^{-1} s_t(p), \tag{13}$$

where T_r is the retailer's ownership matrix with the general element $T_r(i, j)$ equal to one when the brands i and j are sold by the same retailer and zero otherwise; and Δ_{rt} is a matrix of first derivatives of all the shares with respect to all retail prices. The matrix $(T_r * \Delta_{rt})$ is the element by element multiplication of the two matrices.

Turning now to the upstream level, each manufacturer sets the wholesale price w in order to maximize profit, given by

$$\pi_{wt} = \sum_{j \in S_{wt}} (w_{jt} - c^w_{jt}) s_{jt}(p(w)), \tag{14}$$

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where S_{wt} represents the set of brands produced by manufacturer m, and c_{jt}^w is the marginal cost of the manufacturer that produces brand j. The first order conditions are given by

$$s_{jt} + \sum_{m \in S_{wt}} (w_{mt} - c_{mt}^w) \frac{\partial s_{mt}}{\partial p_{jt}} = 0 . \tag{15}$$

Similarly, defining a matrix of manufacturers' ownership T_w and a matrix of manufacturer's response Δ_{wt}, and stacking all the manufacturers' first order conditions we get

$$w_t - c_t^w = -(T_w * \Delta_{wt})^{-1} s_t(p) . \tag{16}$$

Here again the matrix $(T_w * \Delta_{wt})$ is the element by element multiplication of the matrices T_w and Δ_{wt}. However, the matrix Δ_{wt} is more complicated to compute than the matrix Δ_{rt}. If fact, due to the composed effect of the wholesale prices on the market shares, the elements of this matrix are given by $\frac{\partial s_{jt}(p(w))}{\partial w_{jt}} = \frac{\partial s_{jt}}{\partial p_{jt}} \frac{\partial p_{jt}}{\partial w_{jt}}$.

In matrix notation the manufacturers' response matrix can be written as $\Delta_{wt} = \Delta_{pt}' \Delta_{rt}$, where Δ_{pt} is a matrix of derivatives of all the retail prices with respect to all the wholesale prices. 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.

Totally differentiating (11) with respect to all the retail prices and wholesale prices gives

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

(17)

In matrix notation, (17) becomes

$$Gdp - H_f dw_f = 0.$$

(18)

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

$$\frac{dp}{dw_f} = G^{-1}H_f.$$

(19)

Therefore

$$\Delta_p = G^{-1}H_f.$$

(20)

Finally, the implied price-cost margins for the retailers and the manufacturers is obtained by summing up the implied price-cost margin for the retailer and the price-cost margin for the manufacturer of equations (12) and (15)

$$p_t - c_t^r - c_t^w = -(T_r * \Delta_{rt})^{-1} s_t(p) - (T_w * \Delta_{wt})^{-1} s_t(p).$$

(21)

3.2.2. Non-Linear Pricing Scenario

The Non-linear pricing occurs when the manufacturer sets the price equal to marginal cost and lets the retailer be the residual claimant. The retailers pay the manufacturer part or the full surplus in the form of a fixed fee, depending on the power they have. In a one manufacturer-one retailer case, this pricing model (known as a two-part tariff) is optimal under a demand certainty assumption (Tirole, 1988, page 176) when the retailers follow manufacturers in setting prices. Rey and Tirole (1986) and Tirole

(1988, page 177) have shown that the two-part tariff is still optimal in the simple double

marginalization setting under demand uncertainty and asymmetric information.

In the case of multiple manufacturers and multiple retailers, the non-linear pricing

model can be analyzed under two different sub-cases. In the first sub-case, one can

assume that the manufacturers' margins are zero. Given that the wholesale prices are

equal to marginal costs, the retailers have the ultimate decision in setting prices. In the

second sub-case, the retailers' margins are assumed to be zero, in which case the

manufacturers have the pricing decision and set the final consumer prices. In either case,

one agent is exercising market power by setting the price well above marginal costs, and

the channel's profits will be higher than in the case of double marginalization.

Case 1: Manufacturers margins are zero

In this case the manufacturers' implied price-cost margins are zero and the

wholesale prices are equal to marginal costs. The implied price-cost margins for the

retailers are given by replacing the wholesale prices by the marginal costs ($w_t = c_t^w$).

Hence equation (12) becomes

$$p_t - c_t^r - c_t^w = -(T_r * \Delta_{rt})^{-1} s_t(p).$$ (22)

This scenario gives the retailers the entire margin of the industry and implies a more

vertically integrated structure at the retail level.

Case 2: Retailers margins are zero

In this case the retailers' implied price-cost margins are set to zero, and the final

price the consumers pay is the sum of the wholesale price and the retailers' marginal

costs, i.e., $p_{jt} = w_{jt} + c_{jt}^r$. The manufacturers get all the channel's profits. Their implied

price-cost margins are given by

$$w_t - c_t^r - c_t^w = -(T_w * \Delta_{rt})^{-1} s_t(p).$$ (23)

3.2.3. Collusive Model: Manufacturer Level

This scenario presents the case where manufacturers collude and set the wholesale prices to maximize their joint profits. This setting implies a manufacturers' ownership matrix T_w equivalent to a matrix full of ones, as if all the brands are controlled by a single firm. If we let this matrix be T_1, the manufacturers' price-cost margins are given by

$$w_t - c_t^w = -(T_1 * \Delta_{wt})^{-1} s_t(p) .$$ (24)

The implied price-cost margins of the retailers are similar to the ones in the first scenario (equation 12):

$$p_t - w_t - c_t^r = -(T_r * \Delta_{rt})^{-1} s_t(p).$$ (25)

The industry's implied price-cost margins are obtained by adding up equation (19) and equation (25):

$$p_t - c_t^r - c_t^w = -(T_r * \Delta_{rt})^{-1} s_t(p) - (T_1 - \Delta_{wt})^{-1} s_t(p)$$ (26)

3.2.4. Collusive Model: Retail level

This scenario is similar to the previous one with the difference that the collusion is now at the retail level. This implies that T_r (retailers' ownership matrix) is full of ones. The retail price-cost margins are given by

$$p_t - w_t - c_t^r = -(T_1 * \Delta_{rt})^{-1} s_t(p).$$ (27)

and the manufacturers' price-cost margins are

$$w_t - c_t^w = -(T_w * \Delta_{wt})^{-1} s_t(p) \,. \tag{28}$$

Adding up (27) and (28) gives the industry implied price-cost margins

$$p_t - c_t^r - c_t^w = -(T_1 * \Delta_{rt})^{-1} s_t(p) - (T_w - \Delta_{wt})^{-1} s_t(p) \,. \tag{29}$$

3.2.5. Monopolist Model

In this scenario, the industry is horizontally and vertically coordinated, i.e., $T_r = T_w = T_1$. In this case the implied price-cost margin of the industry is given by

$$p_t - c_t^r - c_t^w = -(T_1 * \Delta_{rt}) s_t(p) \,. \tag{30}$$

The scenarios presented above are tested in order to determine whether contracting in the Boston RTEC market follows the double marginalization pricing model or whether more efficient relationships are observed. The estimated price-cost margins will help to determine whether vertical integration, collusion or double marginalization prevails in the relationship between manufacturers of the RTEC and the retailers in Boston. Combined with the own- and cross-price elasticities from the demand side, the estimation of the price-cost margins will allow assessment of the nature of competition. Further, the substitution pattern will shed light on the competition prevailing among the brands included in the study.

3.3. Instruments

The model presented above implies the need to use instrumental variables to account for the endogeneity of the prices. The issue of using instruments in this kind of setting has been largely discussed in the literature of the discrete choice model (for example BLP, 1995; Nevo, 2000). The instrument used has to be uncorrelated with the error term and highly correlated with the endogenous variable under consideration.

BLP(1995) note that if the producers know the values of the unobserved (to the econometrician) characteristics, then the prices are likely to be correlated with them. For the automobile industry they suggest using the cost and demand characteristics for all products in a given year. Nevo (2000) uses two alternative sets of instrumental variables: the prices of the brand in other cities and a set of instruments that attempt to proxy for regional marginal costs (material, labor, energy, transportation). Villas-Boas (2002) uses the interactions between the input prices and the brand dummy variables. This study considers two sets of instrumental variables: the prices of the brand in other markets (supermarkets) and the product characteristics of the brands. The use of the other prices as instruments comes from the fact that for a given brand, the manufacturer is unique and the wholesale prices charged for different retailers would be comparable. As argued by BLP (1995), the product characteristics are correlated with their prices.

4. Data Sources and Management

The study is conducted using a scanner data set from Information Resources Inc (IRI) that covers purchases of RTEC in four supermarkets in Boston (Stop & Shop, Shaw's, Demoulas and Star Market) by unit sales, volume sales, dollar sales, percentage of RTE cereals sold under any type of merchandising, and the weighted average of any price reduction. The data are for four-week periods from February 1995 to December 1997. Prices are computed using volume sales and dollar sales. Market shares are computed using volume sales (converted to servings, one serving equal to 30 gr) and the market size. The market size corresponds to the potential market obtained by multiplying the total population in the Boston market by the per capita monthly consumption of RTE.

5. Results

5.1. Logit Demand

Table 1 presents the results of the regression of $\ln(s_{jt}) - \ln(s_{0t})$ on prices, promotion and product characteristics. The characteristics included are the content of calories, sugar, proteins, vitamins, minerals, sodium, potassium, fiber and total fat. The regression also includes dummy variables for corn, oat, rice and fruits and a dummy variable for children's cereals.

Table 1 Logit Results.

Variables	OLS Estimates	IV Estimates
Price	-9.9046*** (0.2795)	-11.9629*** (3.0531)
Promotion	0.0078*** (0.0004)	0.0070** (0.0025)
Calories	-0.0179*** (0.0008)	-0.0163*** (0.0054)
Total Fat	0.0298* (0.0185)	0.0583 (0.1267)
Sugar	-0.0207*** (0.0034)	-0.0149 (0.0235)
Proteins	0.1316*** (0.0136)	0.1371* (0.0903)
Fiber	-0.0291** (0.0146)	-0.0562 (0.1018)
Minerals	0.0009 (0.0017)	-0.0019 (0.0119)
Vitamins	-0.0165*** (0.0013)	-0.0114 (0.0103)
Sodium	-0.0030*** (0.0003)	-0.0021 (0.0019)
Potassium	0.0037*** (0.0003)	0.0030 (0.0021)
Corn Dummy	0.0243 (0.0361)	0.0468 (0.2397)
Oat Dummy	0.2365*** (0.0347)	0.1589 (0.2466)
Rice Dummy	0.0644 (0.0530)	0.0351 (0.3517)
Fruit Dummy	0.1301***(0.0250)	0.0926 (0.1712)
Kid Dummy	-0.3680*** (0.0306)	-0.2773 (0.2287)

Figures in parentheses are the standard deviations of the estimates.
(***) Significant at 0.1% level.
(**) Significant at 5% level.
(*) Significant at 10% level.

The second column of Table 1 presents the results of the ordinary least squares (OLS) regression, while column 3 presents the instrumental variables (IV) results of a two-stage least squares regression. For each brand, the IVs are obtained by stacking together the product characteristics and the price of the same brand in the other stores. The OLS and IV results show that most of the variables are of the expected sign with few exceptions. Hence, the parameter estimates of the price, calories, sugar and sodium are negative as one would expect. On other hand, the parameter estimates of proteins, minerals and potassium are positive as expected. However, one does not expect total fat to have a positive effect on the share of the brand, nor the fiber and vitamins contents to have a negative effect. The negative sign of fat content may be explained by the fact that RTECs are not a major source of fat and consumers do not have this concern when they chose their brand.

Table 2 gives the own-price elasticities estimated from the Logit model as given in equation (10). As expected, all the own-price elasticities are negative with a magnitude greater than one in absolute value. This implies that at the supermarket level the demand for differentiated brands is elastic. The elasticities range from -3.2556 to -1.7889 in the Stop & Shop supermarket channels, for Shaw's, from -3.4691 to -2.1770, while for Demoulas and Star Market the elasticites range from -3.4393 to -1.9683 and from -3.4156 to -2.2650 respectively. These elasticities are comparable to those found by Nevo (2001) taking into account consumer heterogeneity. From the results it appears that the same brand has different elasticity values in different supermarket channels. Furthermore, for almost all brands included in the study, the brands' demand is less elastic in the Stop & Shop supermarket channel than in other channels.

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At the manufacturer level the elasticities range from -3.2198 for General Mills Cheerios to -2.3636 for Quaker Oat. On average, the own-price elasticities are higher (in absolute value) for General Mills brands than for Kellogg, Post, Quaker and Nabisco brands.

To analyze the substitution pattern between different brands, Table 3 gives the cross-price elasticities for some selected brands of Kellogg and General Mills in the Stop & Shop supermarket channel.

Table 2 Own-Price Elasticities by Brand and Market Channel

	Stop & shop	Shaws	Demoulas	Star Market	Manufacturer
GM Cheerios	-2.8288	-3.2219	-3.4373	-3.3911	-3.2198
GM CinnamonTSTCrunch	-2.6433	-3.2598	-3.4393	-3.2408	-3.1458
GM CocoaPuffs	-2.6301	-3.2375	-2.6674	-3.3354	-2.9676
GM GoldenGrahams	-2.5747	-3.22	-2.4447	-3.4156	-2.9138
GM HoneyNutCheerios	-2.1433	-3.2302	-3.3597	-2.5593	-2.8231
GM Kix	-2.6587	-3.2334	-3.3586	-3.3595	-3.1526
GM LuckyCharms	-2.5449	-3.2157	-3.0487	-3.3053	-3.0287
GM MultiGrainCheerios	-2.6045	-3.1783	-3.0424	-3.2759	-3.0253
GM Total	-2.4665	-2.1823	-2.4375	-3.2917	-2.5945
GM TotalRaisinBran	-2.1638	-3.2082	-2.9995	-2.5683	-2.7350
GM Wheaties	-1.7889	-3.0579	-3.0329	-3.059	-2.7347
GM AppleCinnamonCheers	-2.0625	-3.0742	-2.9756	-3.3345	-2.8617
K AppleJacks	-2.3848	-3.0823	-2.7519	-2.7525	-2.7429
K CompleteBranFlakes	-2.5469	-2.6375	-2.2352	-3.2215	-2.6603
K CornFlakes	-1.8332	-2.9903	-2.5755	-2.9821	-2.5953
K CornPops	-2.3094	-2.9122	-2.6035	-3.1738	-2.7497
K Crispix	-2.4271	-2.2038	-2.6106	-2.8279	-2.5174
K FrootLoops	-2.0428	-2.8221	-2.5868	-2.8608	-2.5781
K FrostedFlakes	-2.0809	-2.7905	-2.7079	-2.9187	-2.6245
K FrostedMiniWheats	-2.0747	-2.177	-2.7078	-3.0023	-2.4905
K RaisinBran	-2.2567	-2.5723	-2.6528	-2.679	-2.5402
K RiceKrispies	-2.25	-2.4863	-2.6617	-2.8295	-2.5569
K SpecialK	-2.1384	-2.715	-2.6258	-2.7031	-2.5456
P BananaNutCrunch	-2.2757	-2.4598	-2.4678	-2.668	-2.4678
P CocoaPebbles	-1.9473	-2.6492	-2.4345	-2.8006	-2.4579
P FruitPebbles	-2.2658	-2.6249	-2.3862	-2.7162	-2.4983
P GrapeNuts	-2.2602	-2.6467	-2.3484	-2.8862	-2.5354
P HoneyComb	-2.1867	-2.5998	-2.2358	-2.9675	-2.4975
P RaisinBran	-2.164	-2.6581	-2.2092	-3.1005	-2.5330
Q Life	-2.2005	-2.6573	-2.0236	-2.7298	-2.4028
Q Oat	-2.1417	-2.5711	-1.9683	-2.7734	-2.3636
Q Toasted	-2.0853	-2.2152	-3.3101	-2.724	-2.5837

N FrostedWheatBites	-1.9361	-2.6009	-3.1923	-2.6987	-2.6070
N SpoonSize	-1.8806	-3.4691	-3.3072	-2.265	-2.7305
R CookieCrisp	-1.9843	-3.4647	-3.2158	-2.7783	-2.8608
R CornChex	-3.2556	-3.4512	-3.194	-2.7735	-3.1686
R RiceChex	-3.227	-3.4339	-3.2095	-2.8035	-3.1685

Table 3 Own- and Cross-Price Elasticities for Selected Brands in Stop & Shoe Supermarket Channel.

	GM Cheerios	GM Golden Graham	GM Kix	GM Total	K Corn Flakes	K Frosted Flakes	K rice Krispies
GM Cheerios	-2.8288	0.0103	0.0179	0.0193	0.0146	0.0180	0.0223
GM Golden Graham	0.0299	-2.5747	0.0236	0.0255	0.0192	0.0237	0.0294
GM Kix	0.0289	0.0132	-2.6587	0.0245	0.0185	0.0229	0.0283
GM Total	0.0295	0.0135	0.0233	-2.4665	0.0190	0.0234	0.0290
K Corn Flakes	0.0148	0.0067	0.0117	0.0126	-1.8332	0.0117	0.0145
K Frosted Flakes	0.0209	0.0095	0.0165	0.0177	0.0134	-2.0809	0.0205
K Rice Krispies	0.0256	0.0117	0.0202	0.0218	0.0165	0.0203	-2.2500

Note that all the cross-price elasticities are positive, meaning that the brands are substitutes of each other. However, these elasticities do not give a clear substitution pattern between brands due to the restrictive and unrealistic substitution pattern implied by the Logit model.

5.2. Price-Cost Margins

Given the demand parameters estimated, we can use scenarios previously described to compute PCM for different brands and market channels. Summary statistics for the PCM estimates, given a Logit demand model, are provided in table 4. For the double marginalization model the retail margins are higher than the wholesale or manufacturer margins. Manufacturer margins average 53% when the manufacturer

decides the prices (zero retail margins) much greater than in the double marginalization model. When manufacturers are colluding, the retail margins are same as in the double marginalization scenario, while manufacturer margins are higher, on average, than in the double marginalization scenario but lower than the case when the manufacturer gets the industry margins (zero retail margins). Finally, the monopolist scenario gives, on average, higher margins than when the retailer or the manufacturer has the price decision (Scenario 2 cases 1 and 2).

Table 4 Summary statistics of Retail and Wholesale Margins for Different Scenarios

Scenario	Mean	Std	Min	Max
Scenario 1: Double Marginalization-Wholesale (%)	19.07	15.39	0.50	64.68
Scenario 1: Double Marginalization- Retail (%)	53.03	10.47	30.32	88.67
Scenario 2: Case 1 Retailer Decision	53.03	10.47	30.32	88.67
Scenario 2: Case 2 Manufacturer Decision	52.98	12.45	23.99	96.35
Scenario 3: Manufacturer Collusion- Wholesale (%)	41.69	10.54	18.80	77.44
Scenario 3: Manufacturer Collusion- Retail (%)	53.03	10.47	30.32	88.67
Scenario 4: Retail Collusion- Wholesale (%)	21.07	13.12	7.35	59.3
Scenario 4: Retail Collusion- Retail (%)	63.25	12.31	33.07	92.38
Scenario 5: Monopolist (%)	63.25	12.31	33.07	92.38

7. Conclusion

The purpose of this paper is to examine the vertical relationship between manufacturers and retailers in the RTEC industry in Boston. The alternative models presented give different results regarding the margins of the retailers and manufacturers.

The paper follows the approach that consists of determining the PCMs of the agents (retailers and manufacturers) without observing the wholesale prices. This approach relies heavily on the choice of the demand estimation method. This paper uses the Logit model to estimate the parameters of the demand for RTECs in the Boston market. Given demand estimates, the PCMs implied by different vertical contracting between retailers and manufacturers are estimated. The results show that the double marginalization scenario does not give the highest margins to manufacturers and retailers. In the double marginalization setting, retailers' margins are greater than manufacturers' margins. This may suggest that retailers are the chain captains. When manufacturers collude, *citerus paribus* their margin increases and the industry margin increases making the consumer take the burden of the collusion. When the retailers collude, *citerus paribus* their margin increases compared to double marginalization and here again the consumer is paying the cost of retailers' collusion. However, a testing procedure to determine whether vertical relationships follow the double marginalization pricing model or more efficient pricing solutions is needed. This is the object of further work along with the use of a full random coefficient approach which takes into account consumer heterogeneity. In fact, the Logit model imposes restrictions on the substitution patterns and produces estimates that are not adequate to measure market power.

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