The Role of Retail Services in Food Market Equilibrium

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Context

The increasing importance of services in industrialized economies is reflected in the relative importance of service in product offerings at the retail level. Yet, typical economic studies account only for physical product attributes in models of product differentiation even when conducted with retail data. In U.S. food retailing, the issue is very important as raw farm products account for only 19% of every dollar the consumer pays for food, most of the remaining going to services that do not transform the product but that add consumer utility and cost. In this paper, we examine this issue using the case of breakfast cereals in Boston in the context of upscale retail services provided by supermarkets.

Focusing on ready-to-eat cereals (RTECs) allows us to look more closely at the role of services in product market equilibrium. First, supermarket retail services go beyond the obvious single product exchange function as consumers value services and suppliers incur a cost in providing them. Given that retail services affect the primitives of the market, i.e., demand and costs, they also affect retail prices. Third, regardless of inter-supermarket variation in costs and prices, the issue of who's got the power in the RTEC vertical market channel has been a hotly debated issue. The usual suspect has been the RTEC manufacturing industry, although previous studies have not modeled the retailing stage of the marketing channel to determine their relative contribution to channel price-cost margins and the role of retail services. The conventional wisdom is that the RTEC manufacturing industry mutes price competition and engages in non-price competition (Schmalensee, 1978; Scherer, 1982).
This paper contributes to the literature in two important ways. First, it extends the Berry, Levinsohn and Pakes (BLP, 1995) model of market equilibrium to ready-to-eat cereals (RTECs) in Boston by including consumer taste for supermarket retail services. Second, it tests and compares alternative pricing games between manufactures and supermarkets in order to assess their relative market power.

Supermarket Services

Supermarkets are the last players in the distribution of RTECs to consumers. Like other retailers, they rely on the concept of joint supply which gives them the possibility of carrying different manufacturing products and providing other services in a single location, hence reducing transaction costs (Blumenthal and Cohen, 1998). Indeed, this is a trend of one-stop shopping of evolving retail formats such as the supermarket superstore, defined by the Progressive Grocer as any full-line, self-service grocery store with a sales volume of $8 million or more annually, with at least 30,000 square feet, offering an expanded selection of non-food items and specialty departments. However, due to a declining trend in the share of food-at-home expenditure and the emergence of other retail formats (e.g., Wal-Mart Supercenters), U.S. supermarket sales growth has been slow since the late 1990s.

In Boston, the supermarket industry is dominated by four supermarket chains: Stop & Shop, Shaw's, DeMoulas and Star Market, who jointly control more than 71% of total food retail sales in Boston. Stop & Shop chain is the dominant chain in the Boston area. Founded in 1914, it is now owned by Dutch retail giant Royal Ahold. It employs more than 58,000 workers and is the largest food retailer in New England. Shaw's Supermarkets is the second largest chain in terms of sales, operating approximately 200 stores and it is now owned by Albertson's. De Moulas is the only privately owned retail chain in Boston, operating about 60 stores. Star Market has a significance presence in the older, more densely populated urban areas, operating smaller stores than their suburban counterparts.

In Boston, supermarket chains offer convenience to their customers through offering services beyond simply retailing food, such as in-store banking and pharmacy, bakery, a seafood department, restaurants and snack bars, salad bars, and non-food items. Stop & Shop offered more non-food services such as in-store banks and pharmacies in 1997 than other supermarket chains. In contrast, Shaw's offered more food services such as bakery, salad and seafood departments. A similar pattern, with less intensity, was followed by Star Market while DeMoulas offered the most limited scope of services.

Supermarkets charge significantly different prices for the same RTEC products. Although price differences may reflect differences in retail costs (as urban stores cost more to operate), it is hypothesized that the scope of services play a significant role in explaining those price differences. Like the RTEC manufacturers, Boston supermarkets have also been accused of exercising oligopoly power in certain food items such as milk (Chidmi, Lopez and Cotterill, 2006) and being the channel captains through the control of shelf space and using shelf space allowances to carry manufacturers products.

The Model

In the BLP model (summarized here for expository purposes), the indirect utility of consumer *i* from buying one unit of brand *j* (U_{ij}) is given by

(1) $$U_{ij} = \alpha_i p_j + \beta_i x_j + \varepsilon_{ij}\ , \qquad i = 1,...n;\ j = 1,..., J$$

where x_j is a vector of the observed product characteristics of brand *j* (including the joint supermarket services), p_j is the price of brand j, α_i and β_i are taste parameters unique to each consumer, and ε_{ij} represents the distribution of consumer preferences around the unobserved product characteristics with a probability density function $f(\varepsilon)$.

Following BLP, let $\alpha_i = \alpha + \lambda D_i + \gamma v_i$ and $\beta_i = \beta + \varphi D_i + \rho v_i$, where D_i denotes observed consumer characteristics (e.g.., demographics) with a probability density function $h(D)$; v_i denotes the unobserved consumer characteristics with a probability density function $g(v)$, assumed to be normally distributed $N(0,1)$; and $\theta_1(\alpha, \beta)$ and $\theta_2 = (\lambda, \varphi, \gamma, \rho)$ denote fixed parameters. Substituting yields:

(2) $$U_{ij} = \underbrace{\alpha p_j + \beta x_j}_{\delta_j} + \underbrace{\phi D_i x_j + \rho v_i x_j + \lambda D_i p_j + \gamma v_i p_j + \varepsilon_{ij}}_{\mu_{ij}}.$$

The mean utility term δ_j is common to all consumers, and the deviation from that mean, μ_{ij}, accounts for interactions between consumer and product (including service) characteristics.

Let $k = 0$ denote an outside option if the consumer decides not to buy any of the J brands (i.e., buys breakfast alternatives). As each consumer purchases a unit of the brand that yields the highest utility or the outside good, aggregating over consumers, the market share of the j^{th} brand corresponds to the probability that the j^{th} brand is chosen. That is,

(3) $$s_j(p, x, \theta_2) = \int I\{(D_i, v_i, \varepsilon_{ij}) : U_{ij} \geq U_{ik} \forall k = 0,.., J\} dH(D) dG(v) dF(\varepsilon),$$

where *H(D)*, *G(v)* and *F()* are cumulative density functions for the indicated variables, assumed to be independent from each other. Using (3), the price elasticities of the market shares for individual brands are:

(4) $$\eta_{jk} = \frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j} = \begin{cases} \frac{p_j}{s_j}\int \alpha_i s_{ij}(1 - s_{ij}) dH(D) dG(\nu), & for\ j = k, \\ -\frac{p_k}{s_j}\int \alpha_i s_{ij} s_{ik} dH(D) dG(\nu), & otherwise. \end{cases}$$

To the extent that the market shares and tastes for price in the population depend on the scope of services, then price elasticities will depend on the scope of services as well. A brand here is defined as product brand-supermarket combinations.

Following Villas-Boas (2005), we specify and compare three different vertical scenarios to assess the bargaining power of RTEC manufacturers vs. supermarkets: (1) the double marginalization scenario; (2) non-linear pricing with dominant retailers; and (3) non-linear pricing with dominant manufacturers.

Scenario 1: Double Marginalization

Double marginalization occurs when the manufacturer and the retailer add a margin to their marginal costs, making the consumers face two margins. 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

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

where S_r is the set of brands sold by the rth retailer, w_j is the wholesale price the rth retailer pays for brand j, c_{jt}^r is the retailer's marginal cost for brand $s_j(p)$ is the share of brand j, and M is market size. The first order conditions lead to the following retailer's price cost margin

(6) $$p_t - w_t - c_t^r = -\Delta_r^{-1} s_t(p) ,$$

where Δ_r is a matrix whose elements are the first derivatives of market shares with respect to all retail prices if those brands are sold by the same retailer and are zero otherwise.Turning now to the upstream level, each manufacturer sets the wholesale price w in order to maximize profit, given by

(7) $$\pi_w = \sum_{j \in Sw} (w_j - c_j^w) s_j(p(w)) ,$$

where S_w represents the set of brands produced by manufacturer m, and c_j^w is the marginal cost of the manufacturer. The first order conditions lead to the following manufacturers' price cost margins:

(8) $$w_t - c_t^w = -\Delta_w^{-1} s(p) .$$

The channel or total price-cost margin is then:

(9) $$p \; - c^r - c^w = (\Delta_r^{-1} + \Delta_w^{-1}) s(p) .$$

Scenario 2: Non-Linear Pricing with Powerful Retailers

Non-linear pricing behavior occurs when either the manufacturer or the retailer sets the price equal to marginal cost and lets the other be the residual claimant. 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) when the retailers follow manufacturers in setting prices. In the case of multiple manufacturers and retailers, the non-linear pricing model can be analyzed under the framework proposed by Rey and Vergé (2004) where the manufacturer proposes a two-part tariff contract that consists of a wholesale price w_j, a franchise fee F, and the retail price p_j.

In the case of powerful retailers with competitive manufacturers (zero margins), the manufacturer offers the retailer a two-part tariff contract and a resale price maintenance clause. In this case the manufacturers' implied price-cost margins are zero and the wholesale prices are equal to the manufacturer's 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 (9) becomes

(12) $$p - c^r - c^w = -\Delta_r^{-1} s\ (p).$$

This scenario gives the retailers the entire margin of the industry and implies a more vertically integrated structure at the retail level. However, the manufacturer recovers the margins through franchise fees. F.

Scenario 3: Non-Linear Pricing with Powerful Manufacturers

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., $p_j = w_j + c_j^r$. The manufacturers get all the channel's profits given by equation (12).

Data and Estimation

The BLP model is applied to 37 brands of RTECs over 35 four-weekly periods between April 1995 and December 1997 at five supermarket chains in Boston. Thus, in total 6,475 observations were assembled (37 brands x 5 supermarkets x 35 time periods). The data consist of product characteristics (including sales data, brand attributes, and retail services) and consumer characteristics at the Boston level (including observable demographic and unobservable characteristics). Retail services are defined via principal components of retail configuration variables such as square footage and the presence of pharmacies and restaurants to create a service quality index.

Each time period is treated as a separate market. That is, each time period contains separate market shares for brand-supermarket combinations and 100 observations on consumer characteristics (number of kids and household income) drawn randomly from the Consumer Population survey. The data are then stacked for estimation and the Nevo (2000) algorithm for the BLP procedure is modified for parameter estimation. The quality service index is included in the mean valuation utility as well as in interaction with consumer characteristics. The procedure is repeated for three vertical scenarios (following Villas-Boas, 2005) and the results are compared.

Empirical Results

Table 1 presents the parameter estimates of the random coefficients model with and without supermarket service quality index as a characteristic of the brand. The quality service index is included in the mean valuation utility as well as in the deviation from the mean utility where it is interacted with the observed and unobserved consumer characteristics. The parameter estimates of the variables price, promotion, calories, fiber, sugar content, and the kid dummy in the mean valuation utility preserve the same sign when service quality is included but their level of significance improves largely. The service quality parameter estimate is positive and significant in the mean valuation utility, while it interacts negatively with the number of kids in the household and the income. It seems that service quality index is driven more by the distribution of the unobserved consumer characteristics.

Table 1. Demand Parameter Estimates with Service Quality

Variable	Notation	Parameter	With Services Estimate	Std. Error	Without Services Estimate	Std. Error
Mean Utility Valuation	δ_j					
Price	P_j	α	-16.5410	0.0185	-19.2100	2.2059
Calories	X_{1j}	β_1	-4.6392	0.0070	-4.0378	0.3602
Fiber	X_{2j}	β_2	-0.0954	0.0006	-0.1298	0.0627
Sugar	X_{3j}	β_3	0.2728	0.0017	-0.2439	0.1591
Kid Dummy	X_{4j}	β_4	0.0030	0.0011	0.0697	0.0942
Promotion	X_{5j}	β_5	1.3645	0.0023	0.8516	0.1189
Service Quality	Q	ϕ	0.3001	0.0098		
Interactions	μ_{1j}					
# of Kids	D_{1i}	λ_{11}	1.7839	0.0490	0.0761	1.1142
# of Kids x Price	$D_{1i}P_j$	λ_{12}	-0.3764	0.1269	-0.3159	9.4316
# of Kids x Calories	$D_{1i}X_{1j}$	ϕ_{11}	-2.1213	0.0214	-1.3135	1.1613
# of Kids x Fiber	$D_{1i}X_{2j}$	ϕ_{12}	-0.2796	0.0035	-0.4293	0.2462
# of Kids x Sugar	$D_{1i}X_{3j}$	ϕ_{13}	-0.7519	0.0132	-0.9102	0.06709
# of Kids x kid Dummy	$D_{1i}X_{ij}$	ϕ_{14}	-0.3416	0.0087	0.2443	0.4242
+ of Kids x Service Brands	$D_{1t}Q$	τ_1	-0.1455	0.0840		
Income	D_{2i}	λ_{21}	1.0256	0.0307	0.1491	0.9652
Income x Price	$D_{2i}P_j$	λ_{22}	0.1437	0.0664	-0.1603	4.8647
Income x Calories	$D_{2i}X_{1j}$	ϕ_{21}	-1.2707	0.0083	-0.0643	0.6361
Income x Fiber	$D_{2i}X_{2j}$	ϕ_{22}	-0.0711	0.0012	0.0068	0.1140
Income x Sugar	$D_{2i}X_{3j}$	ϕ_{23}	-0.3866	0.0043	-0.3483	0.2906
Income x Kid Dummy	$D_{2i}X_{4j}$	ϕ_{24}	-0.1220	0.0032	0.0869	0.2492
Income x Service Quality	$D_{2i}Q$	τ_2	-1.0443	0.0482		
Unobserved	v_i	γ_1	0.0342	0.0072	-0.1429	0.4393
Unobs. x Price	v_iP_j	γ_2	-1.5457	0.0481	-1.6609	2.9547
Unobs. x Calories	v_iX_{1j}	ρ_1	-2.489	0.0052	-2.3954	0.1758

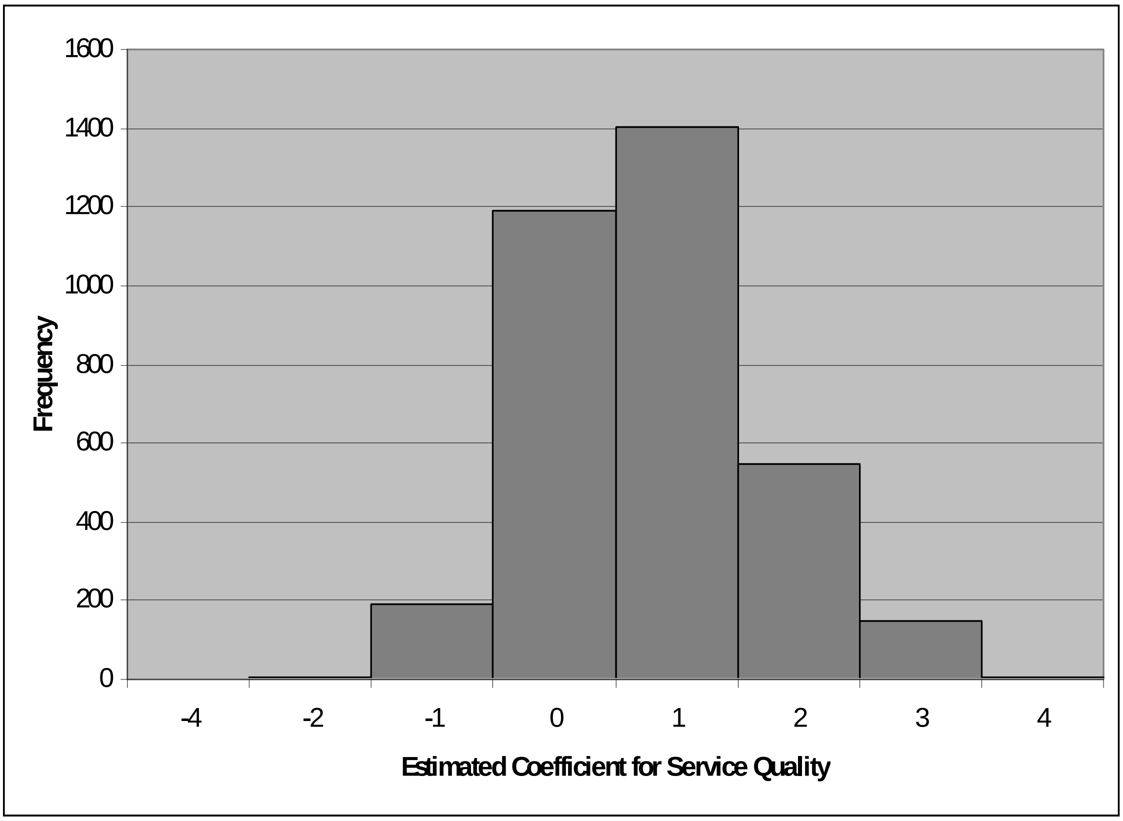

Figure 1. Distribution of the Parameter Estimate for the Service Quality of Supermarkets

Figure 1 shows the distribution of the service quality parameter estimate across all individuals in the sample. As it can be seen, most consumers value positively the service quality offered by the supermarket they shop in. In fact the results in Table 2 show how the magnitude of the price sensibility dropped when the service quality index variable was included. This suggests that consumers are willing to pay higher prices provided that the quality of the services offered by the store is higher. This implies lower price elasticities of demand compared to the ones obtained when service quality is ignored. Table 4 clearly shows that introducing the service quality in expression of the indirect utility lowers the magnitude of the own price elasticities. These elasticities range from -6.2790 for Ralston Cookie Crisp in Star Market to -2.0737 for Kellogg's Corn Flakes in Stop & Shop, with a mean of -3.6496 and standard deviation of 0.6851.

On the supply side, markups increase significantly with retail services, although manufacturers hold the market channel power. Except for the scenario where the retail margins are zero, the other two scenarios (double marginalization and zero-manufacturer margins) lead to some negative estimated marginal costs. In addition, the Rivers and Vuong (2002) test resulted also selected the zero-retail margin scenario as the best to fit the data. Marginal costs at the brand-supermarket level did not appear to be related to the level of service per se but rather to the size (market share) of the supermarket chain and their location (urban/suburban).

Table 2. Own-Price Elasticity Estimates for RTEC Brands at Boston Supermarkets

	Stop & Shop	Shaw's	Demoulas	Star Market	Average	Aver.w/o services
Kellogg						
Apple Jacks	-4.2446	-3.9902	-3.8620	-4.4532	-4.1375	-4.7066
Complete Bran	-3.3585	-3.2769	-3.2725	-3.5874	-3.3738	-3.8894
Corn Flakes	-2.0737	-2.1817	-2.3084	-2.4095	-2.2433	-2.5964
Corn Pops	-3.5965	-3.5025	-3.9597	-4.0301	-3.7722	-4.2996
Krispix	-3.8890	-3.7302	-4.2534	-4.3813	-4.0635	-4.6530
Froot Loops	-3.8843	-4.0788	-3.6270	-3.9271	-3.8793	-4.4471
Frosted Flakes	-2.9261	-3.0357	-2.8469	-3.1307	-2.9849	-3.4378
Frosted Mini Wheats	-2.8932	-2.8450	-2.6451	-3.1063	-2.8724	-3.3151
Raisin Bran	-2.5225	-2.7452	-2.5194	-2.8903	-2.6694	-3.0721
Rice Krispies	-3.6031	-3.5147	-3.6255	-3.7452	-3.6221	-4.1796
Special K	-4.0913	-4.1368	-4.4629	-4.3952	-4.2716	-4.8849
General Mills						
Cheerios	-3.1561	-2.9167	-3.5380	-3.6192	-3.3075	-3.8192
Cinnamon Crunch	-3.9186	-3.6391	-4.0721	-4.1156	-3.9364	-4.5243
Cocoa Puffs	-3.8498	-3.7377	-4.0907	-4.0547	-3.9332	-4.4882
Golden Grahams	-4.2307	-3.8853	-4.2261	-4.6455	-4.2469	-4.8439
Honey Nut Cheerios	-3.5078	-3.4315	-3.3830	-3.5969	-3.4798	-4.0005
Kix	-4.0609	-3.8700	-4.7146	-4.7242	-4.3424	-4.9818
Lucky Charms	-3.9544	-3.6656	-4.1691	-4.0648	-3.9635	-4.5288
Multi Grain Cheerios	-4.3760	-4.2856	-4.1513	-4.8487	-4.4154	-5.0585
Total	-4.1512	-3.7477	-4.3043	-4.5107	-4.1785	-4.7851
Total Raisin Bran	-3.3007	-3.4450	-3.3084	-3.3003	-3.3386	-3.8092

Wheaties	-2.8578	-2.8041	-3.0739	-3.4049	-3.0352	-3.5022
Apple Cinnamon Cheers	-3.5824	-3.6897	-3.6097	-3.9297	-3.7029	-4.2374
Post						
Banana Nut Crunch	-3.4197	-2.9959	-3.6177	-3.7281	-3.4404	-3.9276
Cocoa Pebbles	-4.0941	-3.6279	-3.9662	-4.3830	-4.0178	-4.5895
Fruit Pebbles	-3.9557	-3.4736	-3.8960	-4.3850	-3.9276	-4.4877
Grape Nuts	-2.3271	-2.3348	-2.4682	-2.4297	-2.3900	--2.7772
Honey Comb	-3.7250	-3.3859	-3.6935	-4.0524	-3.7142	-4.2573
Raisin Bran	-2.6078	-2.4251	-2.4865	-2.8315	-2.5877	-2.9797
Quaker						
Can N Crunch	-3.4224	-3.2215	-3.3656	-4.0158	-3.5063	-4.0448
Oat Life	-3.5554	-3.2201	-2.7887	-3.8824	-3.3617	-3.8434
Toasted	-3.7921	-3.5519	-3.7090	-4.3841	-3.8593	-4.3989
Nabisco						
Frosted Wheat Bites	-3.3766	-3.2005	-3.3262	-3.5268	-3.3575	-3.8582
Spoon Size	-3.2239	-2.9348	-3.1752	-3.2997	-3.1584	-3.6273
Ralston						
Cookie Crips	-5.7585	-5.0837	-4.8305	-6.2790	-5.4879	-6.1988
Corn Chex	-4.1664	-3.7225	-4.3234	-4.6962	-4.2271	-4.8450
Rice Chex	-4.1567	-3.7370	-4.3423	-4.6788	-4.2287	-4.8470
Average	-3.6111	-3.4343	-3.6220	-3.9309	-3.6496	-4.1823
Aver. w/o Service	-4.1353	-3.9423	-4.1579	-4.4935		-4.1823

Summary and Conclusions

Empirical results confirm that services play a strong role in market equilibrium. On the demand side, higher-income consumers with less or no kids are willing to pay more for RTECs with added services. Estimated parameters indicate although consumers are price sensitive with respect to their chosen cereals and that they exhibit strong brand and supermarket loyalty, their price sensitivity decreases with added services. Furthermore, the service index coefficient is positive and significant in the mean valuation utility, while the interactive effect is negative in most cases with the number of kids and income. The distribution of the taste parameters for service show that most consumers value positively the service quality offered by supermarkets they shop in. In fact, the magnitude of the price sensitivity dropped when the service quality index was included in the model. This suggests that the role of price diminishes and that consumers are willing to pay higher prices when the store services are higher. All the market share elasticities with respect to service are positive, meaning that higher services, ceteris paribus, lead to larger market shares.

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