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Abstract

This article investigates the competition effects of supermarket food and non-food services using fluid milk as a case study. A simultaneous equation model for services and price competition is estimated with scanner data from 16 supermarket chains operating in six U.S. cities. Empirical results show that a greater scope of services results in higher retail cost, greater supermarket chain-level demand but lower price elasticity, and enhanced market power, all leading to higher milk prices and quantity of milk sold. However, unlike previous research, we conclude that increases in cost rather than market power explain most of the ensuing price increases.

Key words: retailing, service, pricing, milk, market power, competition.

JEL: L81, D40, L66

Competition Effects of Supermarket Services

Supermarket chains are significantly increasing their scope of services well beyond traditional food distribution: food services that capitalize on the growth of food away from home (Park, 1998) as well as non-food services that combine one-stop shopping convenience and time-saving features (Kinsey and Senauer, 1996).[1] The latter is also a strategic response to increasing competition from mass merchandisers and big box retailers that are branching out into groceries. Supermarket service levels can affect demand, costs, market power and therefore prices. However, to date there is no study that ties together all these elements.[2]

On the demand side, services are likely to directly expand demand for all items sold, by attracting more consumers and behaving as strict complements with physical products sold (Betancourt and Gautschi, 1990, 1993). The existing literature has not taken into consideration the strategic interactions between retailing firms in their service-setting behavior (Betancourt and Gautschi, 1993) and has neglected the fact that an increase in services is also likely to affect consumers' price responsiveness. Food retailers investing in services are more likely to differentiate themselves from the competition, empowering them to segment the market and capture consumers with lower price sensitivities.

On the cost side, the process of enhancing store quality through services generates an increase in costs. The linkage between retailing quality and fixed costs has been strongly established by Ellickson (2006) based on the endogenous cost model (Shaked and Sutton, 1987). Ellickson found that the increase in quality for the supermarket industry comes primarily from an increase in fixed costs, which establishes this industry as a natural oligopoly with a two-tiered structure: high quality supermarkets and a fringe of lower quality grocery stores. In terms of variable costs, it is customary in the business marketing literature to assume that an increase in services increases marginal cost (e.g., Lal and Rao, 1997).

Given the impacts of services on demand and cost, the impact of retail services on food prices is expected to be positive, although some studies find weak evidence. Richards and Hamilton (2006), for example, used a nested constant elasticity of substitution model to find that supermarkets compete in product variety, while the depth of product offering has an unclear impact on prices. Cotterill (1999), using a traditional structure-performance model relating industrial concentration to store quality, found that some in-store services are positively related to food prices while concentration is not related to the level of supermarket services.[3] Bonanno and Lopez (2004) found that in-store services are positively associated with the price of fluid milk across three U.S. cities. Besides models of price discrimination in non-food case studies (Shepard, 1991; Barron, Taylor, and Umbeck, 2001), the impact of services on pricing power has not been addressed in the empirical literature other than by relating profit margins to the level of services (Betancourt and Gautschi, 1993; Messinger and Narasimhan, 1997).

The purpose of this article is to estimate the impact of the scope of supermarket services on cost, demand, and prices as well as of the nature of service competition among supermarkets, using fluid milk as a case study. Milk, being a relatively homogeneous good, allows identifying cost and price differences primarily due to differentials in store services and pricing conduct. A two-stage conceptual model for supermarket services competition and monopolistic milk pricing is developed and estimated with scanner data for fluid milk sales from 16 supermarket chains located in six U.S. cities. Empirical results corroborate strong effects of in-store food services (bakery, seafood and prepared food departments) as well as non-food services (pharmacies and full service banking) on milk retailing cost, supermarket-level demand for milk as well as price responsiveness, market power and milk prices paid by consumers.

The Conceptual Model

Consider the marketing decisions of supermarkets as consisting of two stages: prices are set in the short run while services are set in the long run (Bentacourt and Gautshi, 1993; Ellickson, 2006). To make the problem tractable, the demand is assumed to be separable for all products except for services offered. In this setting, the major goal of increasing services is to attract consumers (and increase loyalty of existing ones) to the store, resulting in a positive spillover effect for all products. Thus, let the demand for milk faced by the *i*-th supermarket chain be given by:

$$q_i\left(p_i, s_i, s_j, Z_i\right), \tag{1}$$

where q_i is the quantity of milk sold by supermarket chain *i*, p_i is its retail price, s_i and s_j are respectively the services offered by supermarket chain *i* and the other supermarket chains in the market (indexed by *j*), and Z_i is a vector of other demand shifters.

Assuming non-jointness of production and following the technology specification of Röller and Sickles (2000), each supermarket faces the same long-run cost structure $\left(C_i^{LR}\right)$ for milk retailing specified by:

$$C_i^{LR}\left(q_i, s_i \mid \omega, w\right) = C_i\left(q_i \mid s_i, w\right) - h_i\left(s_i \mid \omega\right), \tag{2}$$

which is decomposed into a short-run component given by $C(\cdot)$, and a long-run component indicated by $h_i(\cdot)$. The vectors w and ω are short- and long-run input prices, respectively. Equation (2) implies that services are taken as given in the short run but are variable in the long run.

In this model, food retailers maximize profits by competing in service in the first stage (long-run) and setting prices in the second stage (short-run). In modeling the second stage, supermarkets are assumed to act as local monopolies (Slade 1995; Besanko, Gupta and Jain, 1998), based on the fact that consumers value the overall convenience and attributes of a store more than the price charged for a single product or category.[4]

In the short run, supermarkets choose milk prices monopolistically, taking the level of services as given, so that:

$$p_i = -\frac{1}{\eta_i} + mc_i, \tag{3}$$

where $\eta_i \left(= \partial \ln q_i / \partial p_i\right)$ is the semi-elasticity of demand and $mc_i \left(= \partial C(\cdot) / \partial q_i\right)$ is the short-run marginal cost of selling milk. Differentiating (3) w.r.t. services, one obtains

$$\frac{\partial p_i}{\partial s_i} = \frac{\partial \eta_i / \partial s_i}{\eta_i^2} + \frac{\partial mc_i}{\partial s_i}. \tag{4}$$

The first term on the right-hand side, the market power effect, is expected to be positive ($\partial\eta/\partial s > 0$) since services are expected to increase store loyalty and to attract higher income customers, decreasing price responsiveness to milk prices. The second term, the shift in short-run marginal cost due to a change in services, is left unsigned: although marginal cost is likely to increase with services, the possibilities of economies of scope (Panzar and Willig, 1981) may also take place. The sign of (4) is, however, expected to be positive.

In the long-run, supermarkets engage in competition in services to attract more customers and to capitalize on the eventual gain in pricing power over all product categories. Assuming that the portion of the long-run profits coming from a category is constant, maximizing total supermarket profits is equivalent to maximizing[5]

$$\max_{s_i} \pi_{il} = q_{il} p_{il} - C_{il}\left(q_{il} \mid s_i, w\right) - h_{il}\left(s_i \mid \omega\right). \tag{5}$$

The first-order condition for setting the services level is:

$$(p_i - mc_i)\left[\frac{\partial q_i}{\partial p_i}\frac{\partial p_i}{\partial s_i}\right] + \frac{\partial p_i}{\partial s_i} q_i + (p_i - mc_i)\left[\frac{\partial q_i}{\partial s_i} + \sum_{j \neq i}\frac{\partial q_i}{\partial s_j}\frac{\partial s_j}{\partial s_i}\right] - \frac{\partial C_i}{\partial s_i} - \frac{\partial h_i}{\partial s_i} = 0, \tag{6}$$

where the term $\partial q_i/\partial s_i$ is the direct effect of a variation in own services on demand (expected to be positive) while $\partial q_i/\partial s_j$ is the effect of the variation of other supermarkets' services (expected to be negative). Other terms are as defined before. Combining (3) and (6), the level of services offered by the *i*-th retailer solves:

$$-\frac{1}{\eta_i}\left[\frac{\partial q_i}{\partial s_i} + \sum_{j \neq i}\frac{\partial q_i}{\partial s_j}\frac{\partial s_j}{\partial s_i}\right] = \frac{\partial C_i}{\partial s_i} + \frac{\partial h_i}{\partial s_i}. \tag{7}$$

That is, supermarkets offer services up to the point where the marginal revenue from services is equal to the marginal cost of providing them, taking also into account the reaction of competitors.

To illustrate the impact of services, consider the case where a supermarket increases its services from s_1 to s_2, resulting in an increase of both milk demand and marginal cost. In Figure 1, the corresponding demands for milk are depicted by D_1 and D_2 and the corresponding marginal cost curves by mc_1 and mc_2. The short-run equilibrium price and quantity are (p_1,q_1) and (p_2,q_2), respectively. Although the equilibrium price increases with services, the impact on quantity sold depends on the relative shifts of demand and marginal cost. When demand shifts dominate (top panel), the equilibrium quantity increases); when marginal cost increases dominate, quantity decreases, as is the case of high-end supermarkets that maintain high prices and services.

Empirical Model

The empirical model draws from the works of Azzam (1997) and Lopez, Azzam and Liron-España (2002) on the effect of industrial concentration on price and cost, extended to include supermarket services and long-run decision making. The demand for milk in equation (1) is assumed to take a semi-logarithmic form:

$$\ln q_i = \tau_0 + \left(\eta + \sum_k \eta_k s_{ik} \right) \left(p_i / d \right) + \sum_k \delta_{ik} s_{ik} + \sum_k \sum_j \delta_{jk} s_{jk} + \sum_l \tau_l z_l + \mu_{iq}, \qquad (9)$$

where p_i is the price of milk; d is a price deflator; $\eta + \sum_k \eta_k s_{ik}$ represents the semi-elasticity of demand, with services acting as shifters; s_{ik} is the k-th type of service offered by supermarket i; $\sum_k \delta_{ik} s_{ik}$ and $\sum_k \sum_j \delta_{jk} s_{jk}$ capture the shifting effect that supermarket services, both own (i) and other (j) have on milk demand; the zs are demand shifters, wile ηs, τs and δs are parameters to be estimated and μ_{iq} is an error term. The parameters $\delta_{ik} = \frac{\partial q_i}{\partial s_{ik}} \frac{1}{q_i}$ and $\delta_{jk} = \frac{\partial q_i}{\partial s_{jk}} \frac{1}{q_i}$ are expected to be positive and negative, respectively as an increase in own services increases demand but an increase in services by other supermarkets should decrease it.

The functional form for the cost function for the short-run component follows Hamilton and Richards (2006), who assume it to be a Generalized Leontief with constant marginal cost, and for the long-run component it follows Röller and Sickles (2000), who assume it to be linear in services. The short-run component has services entering the const function linearly and with interactions to capture synergies that may result in economies of scope:

$$C_i^{LR}\left(q_i, s_i \mid w, \omega\right) = q_i \left(\frac{1}{2} \sum_{g,h} \alpha_{gh} w_g^{1/2} w_h^{1/2} + \sum_k \beta_k s_{ik} + \sum_{k,l} \beta_{kl} s_{ik} s_{il} \right) + \sum_k \lambda_k \omega_k s_{ik} \quad (10)$$

where the ws and ωs are, respectively, short-run and long-run input prices, the αs, βs and λs are parameters to be estimated, and the other notation is as defined above.

The first-order condition for short-run profit maximization is therefore:

$$p_i = -\frac{1}{\eta + \sum_k \eta_k s_{ik}} + \frac{1}{2} \sum_{g,h} \alpha_{gh} w_g^{1/2} w_h^{1/2} + \sum_k \beta_k s_{ik} + \sum_{k,l} \beta_{kl} s_{ik} s_{il} + \mu_{ip}, \quad (12)$$

in which μ_{ip} is an error term. The impact of supermarket services on milk prices is:

$$\frac{\partial p_i}{\partial s_{ik}} = \frac{\eta_k}{\left(\eta + \sum_k \eta_k s_{ik}\right)^2} + \beta_k + \sum_l \beta_{lk} s_{il} , \tag{13}$$

where η_k and $\beta_k + \sum_l \beta_{lk} s_{il}$ denote, respectively, the change in the semi-elasticity of demand and the change in marginal cost due to a change in the level of the *k*-th service. Next, multiplying and dividing the right-hand side of (7) by q_i,[6] using equations (10) and (12) and solving for the level of services yields:

$$s_{ik} = -\frac{1}{\eta_k} \frac{\delta_{ik} + \sum_j \delta_{jk}\theta_{jk}}{\beta_k + \sum_l \beta_{lk} s_{il} + \frac{\lambda_k \omega_k}{q_i}} - \frac{\eta + \sum_{h \neq k} \eta_h s_{ih}}{\eta_k} + \mu_{ik} , \tag{14}$$

where $\theta_{jk} = \frac{\partial s_{jk}}{\partial s_{ik}}$ represents the service reaction of retailer *j* to the variation in the *k*-th service offer by retailer *i*, capturing the extent of the competition in the *k*-th service, and μ_{ik} is an error term. Given the endogeneity of q_i and the cross-parameter restrictions that allow the identification of the reaction parameter θ_{jk}, equations (9), (12) and (14) are estimated simultaneously.

Data and Estimation

The empirical model is estimated using a custom supermarket database provided by the Food Marketing Policy Center at the University of Connecticut. The database, consisting of scanner data supplied by Information Resources, Incorporated (IRI), includes 58 four-weekly observations on milk sales (quantity and value of sales) for the period March 1996 - July 2000 by 16 supermarket chains located in six city areas:

Boston, Chicago, Miami, Northern New England (hereafter NNE), New York City and Seattle, generating a total of 928 observations. The milk price is obtained by dividing dollar sales by quantity of milk sold. The milk data are matched with store service measures and demographics. Supermarket chains' services include the presence of bakery departments, seafood departments, prepared foods (eateries and salad bars), pharmacies and full service banks. Services are aggregated to the supermarket chain level and expressed in percentage of stores in a chain offering each service. In order to keep the analysis tractable[7], services are divided into two groups: food and non-food and their levels are measured by applying principal component analysis (as in Cotterill, 1999).[8] The resulting components are scaled from zero to 100 to obtain indexes. Table 1 presents the average percentages of stores offering a given service for each chain in the sample along with the computed service indexes.

Besides own services and service of other chains,[9] other demand shifters included city-level income and average household size (from Market Scope) and supermarket specific percentages of households of Hispanic origin (from the supermarket database). Price and income are deflated by the Consumer Price Index. City-specific unobservables are controlled for by including city fix effects, while seasonal variations in milk demand are captured through quarter dummies.

For the short-run cost function, input prices include the price of raw milk, supermarket wages and the price of electricity. The raw milk price used is the maximum of the Federal Milk Marketing Order price or the market price applicable to each city area. Wages are measured as earnings per worker in the SIC 541 industry (Grocery

Stores), obtained from the Quarterly Census of Employment and Wages of the U.S. Bureau of Labor Statistics. Electricity prices for commercial use are retrieved from the U.S. Department of Energy website. The services indexes are used as short-run cost shifters, as described in the previous section.

For the long-run cost component, input prices include pharmacy wages and housing prices, the latter used as proxy for the rental price of retailing space. Pharmacy wages are measured as state-level per capita earnings in the Drug Stores and Proprietary Stores (SIC 591) industry, (obtained also from the BLS Quarterly Census of Employment and Wages) and are used as proxy for the cost of operating non-food services.[10] City-specific housing prices, obtained from the National City Inc. websites captures the cost connected with a reduction in selling-area due to an increase in the space allocated to services.

Four equations are estimated simultaneously: equations (12) and (13) and two equations for food and non-food services, as in (14). Endogenous variables are price, quantity, and the food and non-food indexes. The estimation was performed using a heteroscedastic robust Non-Linear Three-Stage Least Squares.[11] The econometric results are presented below: the estimated parameters are used to estimate the impact of services on cost, price and quantity sold at the sample averages and to simulate the impact of services on the whole 0-100 range of the indexes.

Empirical results

The estimated parameters of the system of equations are reported in table 2. In general, the signs of the estimated coefficients match a priori expectations.

Demand effects

For the demand equation, the empirical results confirm that an increase in supermarket services lowers consumers' response to changes in milk prices. Furthermore, the effect of food services on the semi-elasticity of demand for milk is six times greater than that of non-food services (the estimated coefficients are, respectively, 0.00192 and 0.00032). Likewise, services have a strong role as demand intercept shifters with food services playing a stronger role than non-food services offered by a given supermarket chain. The effects of non-food services are as expected, with the own-chain services attracting more consumers (increasing a chain's demand for milk) and other competing chains' services luring consumers away (i.e. decreasing demand). The estimated coefficient for the effect of other supermarket chains' food services on the demand for milk is, however, contrary to the expectations, as it is positive and significant. Other estimated demand coefficients are of the expected signs, except for household size, which is negative but not significant at the 5% level of significance.

The estimated parameters are used to calculate the price elasticities of milk demand for all combinations of food and non-food services indexes in the sample. The simulation results are presented in Figure 2, while some relevant combinations are reported in the upper part of Table 3. The estimated price elasticity of milk demand for a hypothetical chain offering no services is -1.69 while a chain offering the best combination of both types of services faces a more inelastic demand of milk by 30%, or -1.301; at the sample averages, the estimated price elasticity is -1.4616. [12]

Cost effects

The results in Table 2 show that food services have a positive effect on the short-run marginal cost, while non-food services as well as the interaction of food and non-food indexes have a negative effect. The latter indicates economies of scope associated with non-food services. These results may be explained considering that food services, needing more floor space than non-food services are likely to compete in the use of common inputs with retailing milk. Non-food services, on the other hand, are instead provided while creating economies of scope in the short-run. This implies that supermarkets with a more complex retail format that include non-food services will experience economies of scope in selling milk and possibly other food products, granting them a cost advantage over the competition.

The long-run cost parameters for input prices are both positive and significant, indicating that offering additional services creates additional costs to be borne by the supermarket chains. Both estimated parameters are positive and significant. All other coefficients are significant and consistent with a well-behaved cost function.

Services also have a strong impact on marginal costs, accounting for up to 34% of the estimated short-run marginal cost of milk retailing, or 0.5973 \$/gallon (see lower part of Table 3 and the simulated values in Figure 3). At the sample averages, the marginal cost is estimated at 1.9594 \$/gallon, for the maximum level of service reaching 2.1452 \$/gallon. These estimates of marginal cost are within the range of those of previous studies, for example, Chidmi, Lopez and Cotterill (2005), who estimated the average cost of selling milk in Boston to be 2.2096 \$/gallon. It should be noted that the long-run component of cost adds significantly to the total cost of selling milk. Even though the additional long-run cost component does not impact the marginal cost in the short-run, adding the long-run cost of services increases it by 0.68 \$/gallon. Also, as depicted in the plot of the simulated values in Figure 3, as a supermarket specializes in food services, the marginal cost of selling milk increases dramatically: for a hypothetical chain specializing in food services, the marginal cost may reach up to 2.5 \$/gallon.

The last two estimates in Table 2 are for the services reactions. The coefficients for both food and non-food services are positive as expected and significant, indicating that supermarket chains react to others by increasing their services. The estimated parameters are equal to 0.501 for food and 0.282 for non-food services. The reaction coefficient for food being larger than non-food services points toward greater competition in food services that non-food services, consistent with the convergence of food services across chains that one can observable at the national level (Statistical Abstract of the United States, 2006).

Price effects

The estimated marginal impact of retail services on milk prices (at the sample averages) are reported in the first part of Table 4. Services impact milk prices positively, corroborating Cotterill's (1999) general findings for the impact of breadth of product line on food prices. The increase in marginal cost is the major determinant of price increases:

only one third of the marginal price increase of 0.9 ¢/gallon comes from an increase in pricing power due to differentiation.

Also, food services account for 85.6% of the total market power effect of 0.315 ¢/gallon. If on the one hand non-food services have a limited impact on supermarkets' pure pricing power, on the other hand they mitigate the marginal cost of selling milk. Two explanations can be provided in support of this result: 1) non-food services do not need much selling area and are not directly managed by the supermarkets, having therefore less impact on costs; 2) the introduction of non-food services may take place after economies of scope become evident, which may lead to the observed negative effect on cost.

Quantity effects

As shown in Table 5, services have a positive impact on the quantity of milk sold, indicating that consumers are attracted away from supermarkets offering few services to those with better services. The estimates reported in Table 5 show that (at the sample averages) the marginal effect of food services on milk quantity sold is tenfold that of non-food services and that their combined average impact is of approximately 4.8%. The simulated values reported in Figure 4 also show that the positive impact of services on milk sales becomes somewhat smaller as services increase.

Concluding remarks

This article has analyzed the impact of supermarkets' service competition on milk demand, prices, cost and quantity sold. The empirical results support the already existing evidence that retail prices increase with the level of services and that the increase in price comes primarily from an increase in marginal cost associated with food services, with market power playing a relatively small role in the overall effect. Also, as a result of the process of differentiation through an increase in their scope of services, supermarkets are able to attract less price sensitive consumers. This results in higher food and non-food services translating into higher prices, attracting increasingly less price sensitive consumers into the stores: as services increase prices, supermarkets increasing their services do become less attractive to consumers, but the number of high price sensitive consumers moving away from high-service, high-prices stores is smaller than those who show increased store loyalty, resulting in overall gains from the long-run investment in services. In sum, services play a crucial, multilayered role in supermarkets' performance and competitiveness.

Endnotes

1. Betancourt and Gautschi (1988, p. 135) state that "a retail establishment provides goods or services for purchase but at the same time it provides other outputs, namely *distribution services*, that are not explicitly sold". Here we are mainly concerned with services for purchase and product/service assortment.

2. Supermarkets still predominate in food retailing, accounting for approximately $337 billion or 73% of U.S. food sales in 2000 (Kaufman, 2002). Even though supermarkets' sales in 2000 were more than 14 times greater than they were in 1958 (in real terms), their share of grocery sales has declined after having reached a plateau in the 1980s and 1990s.

3. Defined by Cotterill (1999) as "breadth of supermarket's product line" (delicatessen, bakery, restaurant, service seafood, and pharmacy) and "promotions" (contest, continuity programs, trading stamps).

4. According to Bliss (1988), the main determinants of the decision for a consumer to shop in a given store are the price of all the products she intends to purchase and the transportation cost required of going to a given store. Bliss' theoretical analysis of food retail pricing points out that "a store enjoys a limited but significant natural monopoly of the demand of the shopper who has incurred the cost of coming to the store. That is, the shopper will not go to another shop to buy her milk because it is a little cheaper there" (Bliss, 1988, p. 378). Therefore, once the consumer has chosen the store, the price of milk in the store will determine only how much milk to buy.

5. Considering l product categories in a supermarket, total profit is given by $\pi_i = \left[\sum_l p_{il} q_{il} + C_{il} \left(q_{il} \mid s_i, w \right) \right] - H_i \left(s_i \mid \omega \right)$, where $H_i \left(s_i \mid \omega \right)$ is the total long run cost of services. Maximization of this profit equation leads to the same service level as maximizing (4) for milk if the profit proportionality factor is denoted by λ_{il} $(\sum_l \lambda_{il} = 1)$ and $\lambda_{il} H_i \left(s_i \mid \omega \right) = h_{il} \left(s_i \mid \omega \right)$.

6. Substituting the parameters of (10) and (12) in (7), one obtains an empirical counterpart of (7): $-q_i \left(\delta_{ik} + \sum_j \delta_{jk} \theta_{jk} \right) \Big/ \left(\eta + \sum_k \eta_k s_{ik} \right) = q_i \left(\beta_k + \sum_l \beta_{lk} s_{il} \right) + \lambda_k \omega_k$, which, rearranged, gives the k equations defined in (14).

7. The number of equations to be estimated in the model is $2k$+2, where k is the number of services. Reducing the number of services to 2 lowers the number of services coefficients to be estimated considerably, from 35 to 9.

8. Principal component analysis was initially performed on the five services indicators. The first two components explained 69.32% of the common variance of the indicators. After the components' rotation using the Varimax Method, the first component was highly correlated with food services (bakery, seafood departments and prepared food) and the second with non-food services (pharmacy and full service banking). Thus, food and non-food services were separately subjected to principal component analysis and their first components retained, which are given by:

Food Component = 0.813**Bakery*+0.812* *Seafood* +0.730**Prepared,*

Non-food Component = 0.883**Pharmacy*+0.872**Bank,* from which the 0-100 services indexes are obtained.

9. Two of the cities in the sample (Boston and New York City) have four supermarket chains, the other four cities (Chicago, NNE, Miami, Seattle; see Table 1) have only two chains. Services of "other" chains were measured by averaging the services indexes of the other three chains for Boston and New York City, and by the "other" chain for the other cities.

10. The non-food services-specific input considered is the specialized labor needed to operate pharmacies; contracts with this specialized labor force (pharmacists) can be the major source of costs for this service. In-store banks are not directly operated by the supermarket chains as are pharmacies.

11. In addition to the exogenous variables in the system, additional instruments used in the estimation include six different income categories and average store size, following the variables used in Smith's (2004) model of consumers' supermarket choice.

12. Other studies have found inelastic demand for milk at the supermarket level: see, for example, Cotterill and Dhar (2003) and Kinoshita, J. N. Suzuki, T. Kawamura, Y. Watanabe, and H. M Kaiser (2001).

Table 1. Description of Supermarket Services in the Data Sample

City	Supermarket Chain	Services (% of stores offering each service)					Indexes(a)	
		Bakery	Prepared Food	Seafood	Bank	Pharmacy	Food	Non-food
Boston	*DeMoulas*	54.40	5.51	82.89	4.60	1.71	28.17	4.16
	Shaw's	92.41	6.44	100.00	39.06	5.54	83.37	29.94
	Star Market	97.80	17.95	97.06	36.54	37.01	83.92	44.82
	Stop & Shop	86.07	4.34	94.66	57.77	56.68	72.63	69.67
New York	*A&P*	73.68	5.32	70.02	15.08	25.58	43.07	23.17
	Grand Union	68.13	6.24	73.81	6.53	35.42	53.31	22.18
	Pathmark	80.75	8.99	89.45	60.51	97.44	52.43	91.97
	Waldbaum's	67.65	5.13	45.89	44.83	33.05	12.41	49.11
Chicago	*Dominick's*	83.63	33.89	98.56	66.53	74.83	86.32	85.53
	Jewel-Osco	87.32	3.96	93.31	56.23	85.01	57.17	83.39
Northern New England	*Shaw's*	96.92	4.07	99.65	58.37	7.03	88.71	44.22
	Shop'n Save	87.65	1.08	91.21	50.58	74.32	69.44	73.46
Miami	*Publix*	90.93	14.01	93.68	25.31	28.55	62.99	31.81
	Winn–Dixie	76.01	19.40	88.17	21.86	33.29	51.85	32.05
Seattle	*Albertson's*	98.82	2.38	84.57	33.09	50.83	64.80	49.48
	Safeway	83.77	24.62	67.88	56.28	60.74	52.69	71.15

Source: authors' elaboration on IRI Market Scope Data: March 1996 – July 2000 averages.
(a): Food and non-food service indexes are obtained through principal component analysis as described in the text.

Table 2. Econometric Results

	Variables	Estimates	St. errors	T-ratio (under *Ho: β*=0)
Demand				
	Constant	16.9020	0.2257	74.8932
	Price	-0.9748	0.0678	-14.3742
	Price*food service	0.0019	0.0003	7.5478
	Price*non-food service	0.0003	0.0001	4.5406
	Income	0.0001	0.0001	1.3305
	%Hispanic	-0.6539	0.0572	-11.4330
	Household size	-0.0042	0.0038	-1.0971
	Food service	0.0025	0.0006	4.1929
	Non-food service	0.0014	0.0010	1.4136
	Food service others	0.0090	0.0004	21.2303
	Non-food service others	-0.0145	0.0015	-9.9366
	City Dummies	Yes		
	Quarter Dummies	Yes		
Short-run marginal cost				
	Price raw milk	0.2551	0.0310	8.2315
	Wages	- 0.3140	0.0083	-37.7288
	Electricity	- 0.8115	0.0181	-44.7811
	$(\text{Wages*electricity})^{1/2}$	1.1270	0.0250	45.0000
	Food service	0.0095	0.0004	22.0691
	Non-food service	- 0.0027	0.0002	-14.6581
	Food*non-food services	0.0000	0.0000	-11.0194
Long-run marginal cost				
	Housing price	410.4291	57.0250	7.1974
	Pharmacy wages	395.7300	97.9150	4.0415
Service reactions				
	Food service	0.50103	0.1063	4.7156
	Non-food service	0.28185	0.0949	2.9705

Wald Test for the overall significance of the model

Test Value=83.317.810   0.1% critical value of $\chi^2_{(30)} = 59.70$

Table 3. Estimated Effect of Services on Price Elasticity and Short-run Marginal Cost

	Estimate	St. Error	T-ratio (under *Ho:* β=0)
Price Elasticity of Milk Demand			
Sample Averages	-1.4616	0.0935	-15.6400
Maximum Level of Service	-1.3014	0.0801	-16.2478
Minimum Level of Service	-1.6901	0.1176	-14.3742
Marginal Cost			
Sample Averages	1.9594	0.0751	26.0815
Maximum Level of Service	2.1452	0.0810	26.4877
Minimum Level of Service	1.5479	0.0682	22.7093

Table 4. Estimated Effect of Services on Milk Prices (¢/gallon)

	Estimate	St. Error	Wald-stat
Market Power			
Food	0.2701	0.0278	94.1225
Non-food	0.0454	0.0084	28.9563
Food + non-food	0.3155	0.0357	78.1119
Cost Effect			
Food	0.9113	0.0437	434.755
Non-food	- 0.3230	0.0176	337.232
Food + non-food	0.5883	0.0337	304.665
Total Price Effect			
Food	1.1814	0.0306	1489.05
Non-food	- 0.2776	0.0241	132.662
Food + non-food	0.9038	0.0314	825.898

Note, for the Wald test the 0.1% critical value of $\chi^2_{(1)} = 10.83$.

Table 5. Estimated Effect of Services on Quantity of Milk Sold (%)

	Estimate	St. Error	Wald-stat
Food	4.3481	0.8444	26.5151
Non-food	0.4757	0.1394	11.6471
Food + non-food	4.8238	0.9747	24.4925

Note, for the Wald test the 0.1% critical value of $\chi^2_{(1)} = 10.83$.

Figure 1. Equilibria under alternative levels of services

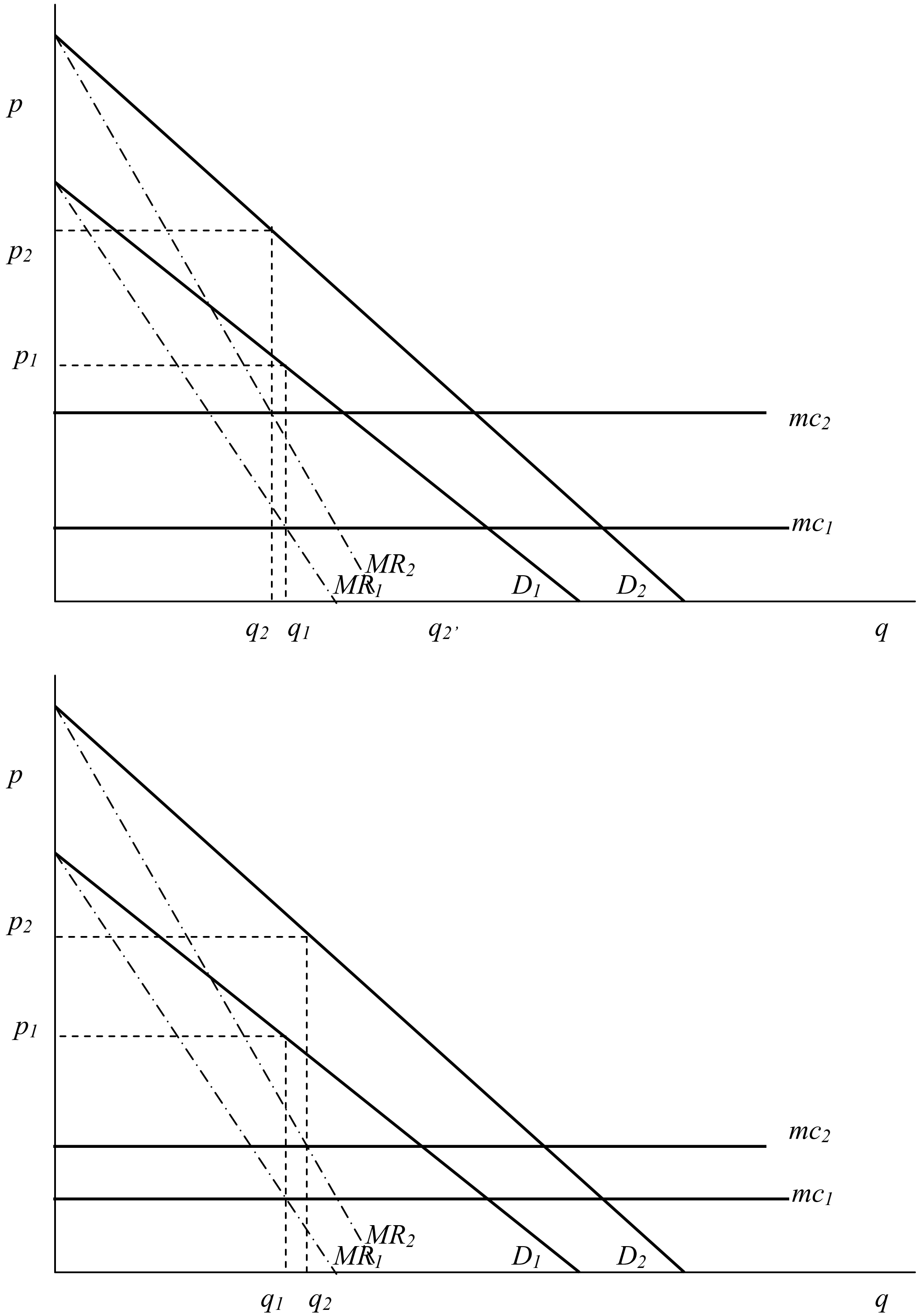


Figure 2. Price elasticity of milk demand as function of services

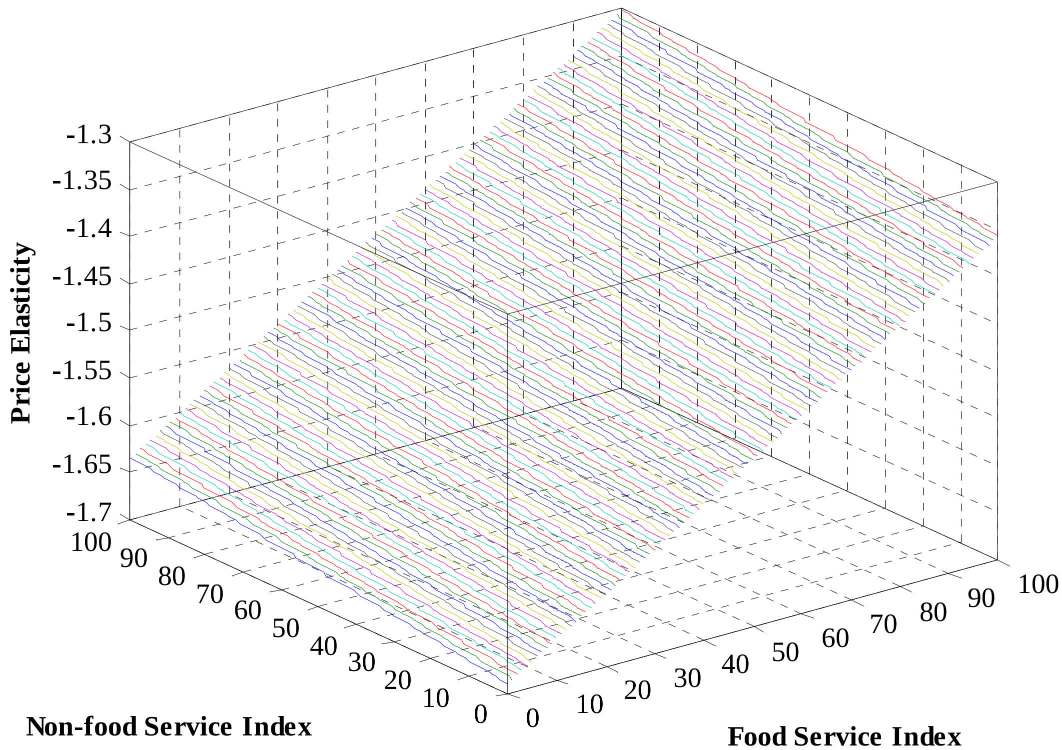


Figure 3. Marginal cost of selling milk as function of services

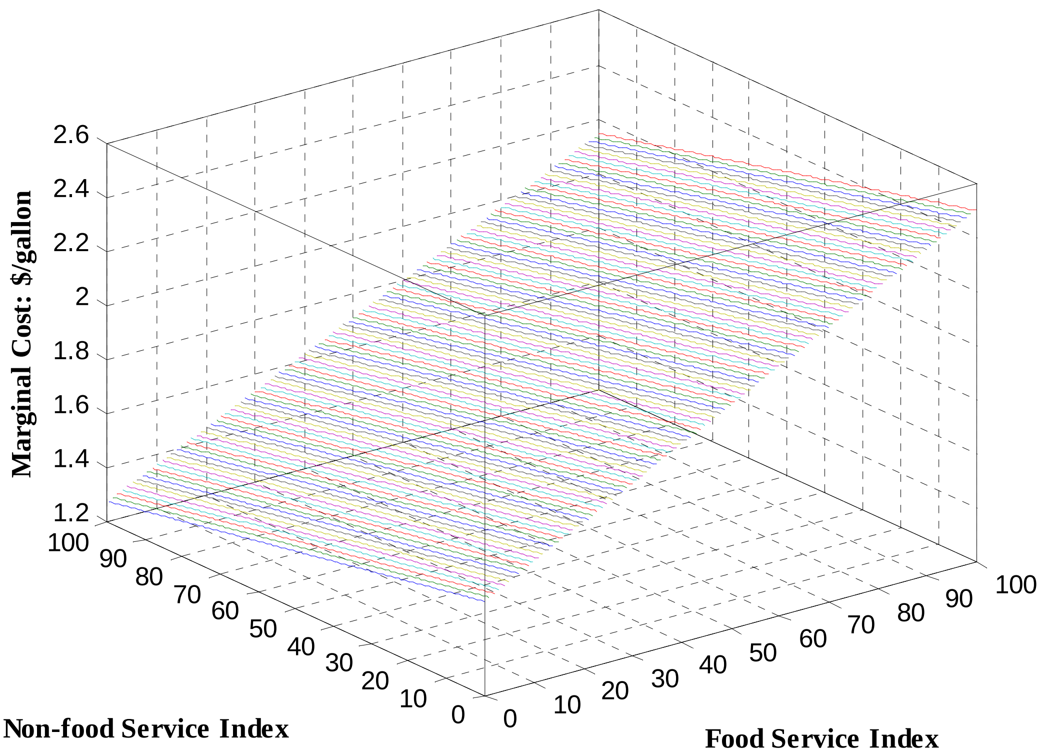
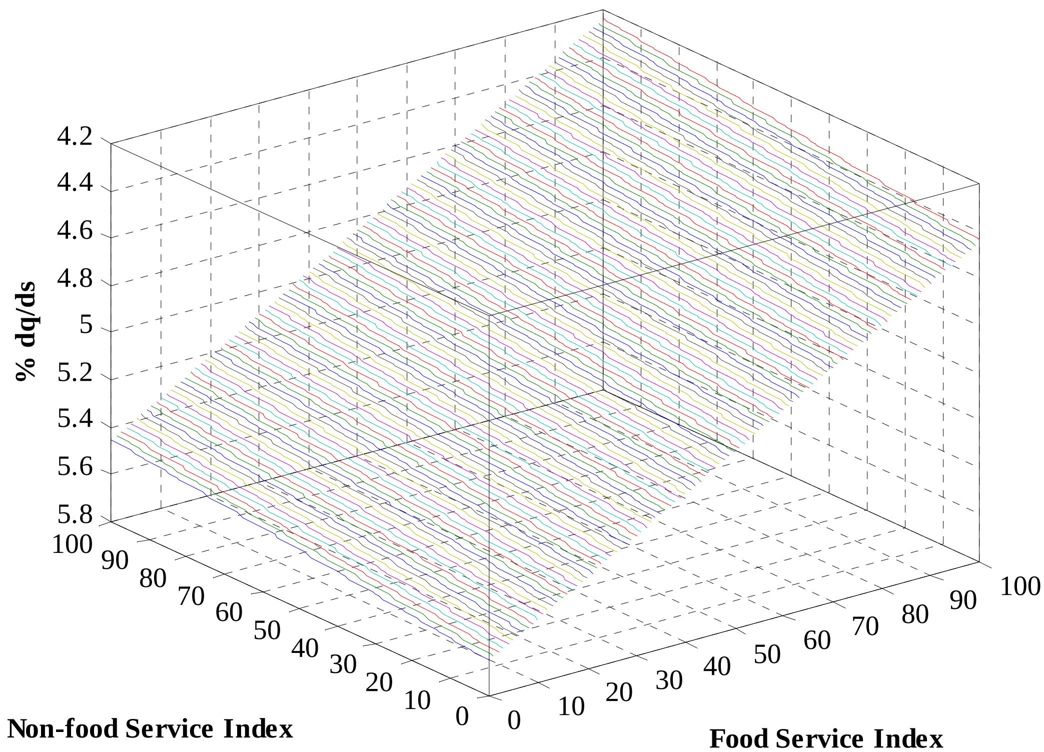


Figure 4. Percent variation of quantity of milk sold as function of services



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