Competition Effects of Supermarket Services

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Abstract

This paper investigates the effect of in-store services on retail food prices, supermarket competition, and demand using fluid milk as a case study. It is shown that higher-service supermarkets charge higher milk prices essentially because of an increase in market power due to differentiation of service offering. Results show that different types of services impact milk prices differently, that upscale food-retailers face stronger competition in newer services, and that service competition results in a trade-off for the consumer between the attractiveness of the enhanced retail configuration and the increase in prices.

Key words: retailing, pricing, milk, supermarkets

JEL: L81, D40, L66

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Introduction

Food-retailing is an ever-expanding industry[1], characterized by an increase in distributional services offered to consumers. Food retailers have increased and modified the depth and latitude of their in-store services and product offering, combining one-stop shopping convenience and time-saving features (Kinsey and Senauer, 1996). This phenomenon has created a new type of competition – competition in service – which has become central to their performances. Despite the importance of this new competitive environment, the impact of services on the overall performances and competitiveness in food-retailing is little understood. Food-retailing services can affect costs, consumer response, market power and therefore, prices. So far there is no study to tie together all the implications of an increase in service competition.

On the cost-side, the process of creating store quality through service will generate an increase in fixed and/or variable cost. Different types of association between quality and cost can result in profoundly different market structures (Sutton, 1991) depending on the characteristics of the industry[2]. Ellickson (2006) showed that an endogenous cost model (henceforth ECM, inspired by Shaked and Sutton, 1987), characterizes well the characteristics of food-retailing: the prediction of the ECM is that in some industries, natural oligopolies arise

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[1] The level of sales in food stores has more than doubled, going from $220.2 billion in 1980 to approximately $484 billion in 2000 (Kaufman 2002). Supermarkets, with their sales of $337.1 billion in 2000, account for the largest slice (73.5%) of grocery stores food sales. Even though supermarkets' sales in 2000 were more than 14 times larger than in 1958 (in real terms) its share on the total grocery sales is declining after having reached a plateau oscillating around 76-78% in the 1980's and 1990's. The fact that the minimum level of annual sales required for a store to be classified as a supermarket has largely increased (reaching $2 million or more in 1980 dollars in 2000) has caused the relative importance of this format to be declining slightly.

[2] Different industries may as present different quality-improving technologies: Barry and Waldfogel (2003) find that the newspaper's quality increase with an increase in the fixed cost, or rather that it follows Sutton (1991) endogenous cost model, while restaurants quality improves through an increase in variable cost, showing the level of varieties increasing largely with market size.

because firms in the market invest in product-quality improvements, and this adds to the frontier of fixed cost, shifting it forward. According to Ellickson's findings, food-retailing can be characterized as a natural oligopoly with a two-tiered structure: high quality supermarkets and a fringe of low quality grocery stores, establishing that the increase in quality for the retailing industry comes primarily from an increase in fixed cost.

Studies relating food prices with retailing services are scant, while other aspects of the source of pricing power in food-retailing have been investigated widely (for example structure[3]). Richards and Hamilton (2006) showed that the competition in product variety (i.e. in the *"depth"* of product line) has an unclear impact on prices but that, on average, retailers appear to cooperate in both pricing and product-line decisions. Investigating the impact of market concentration on store-quality, Cotterill (1999) found that market concentration is not influential in determining the level of service provided, while some in-store services[4] were positively related with food prices. Another study (Bonanno and Lopez; 2004) found in-store services (deli, bakery, pharmacies and full service banking) affecting positively the price of fluid milk across three U.S. city areas[5]. Outside the world of food-retailing there is evidence that other retailers, such as gas stations, price discriminate through store/product quality and assortment (i.e. retail configuration: Shepard, 1991; Barron, Taylor, and Umbeck, 2001). The impact of service competition has been

[3] See for example Marion, Mueller, Cotterill, Geithman and Schmelzer (1979), who using 32 Standard Metropolitan Statistical Areas (SMSAs) data on sales, profit, prices from large food retail chains for a large basket of food products, estimating a positive impact of several alternative measures of market concentration on a food price index. Improving upon this study, Cotterill (1986) used a sample of Vermont supermarkets to find again retail food prices affected positively by concentration (measured in different forms) and stores size. Weiss (1989) offers a broad review of studies of the relationship between concentration and prices in retailing and other industries.

[4] Defined by Cotterill as "Breadth of supermarket's product line" (BROAD – delicatessen, bakeries, restaurant, service seafood and pharmacies) and "promotions" (PROMO – contests, continuity programs, trading stamps)

[5] The fact that food prices are positively related to store quality may also raise concerns in term of food policy. There is evidence that low-income households shopping preferably in low-service supermarkets sacrifice service and convenience adopting economizing strategies (Leitbag and Kaufman, 2003). Also stores redeeming a large amount of food stamps have been found to offer fewer convenience services to consumers (King, Leitbag and Behl, 2004).

also analyzed in the business/marketing literature, by examining retailers' margins (Betancourt and Gautschi, 1993), profit margins and consolidations (Messinger and Narasimhan, 1997).

An other issue with the empirical literature investigating the role of retailing-service is that some of the categories of distributional services[6], are hard to measure or to appreciate empirically. Betancourt and Gautschi (1993), for example, inferred store-ambience with the gross value of assets which could instead capture size, and measured distribution services with payroll per establishment, measure that may not be the most appropriate because more efficient retailers may also face lower payroll cost still providing the same distributional services than ones facing high payroll costs. In other cases, in order to avoid the complication arising by the non-measurability of some services, researchers have avoid the complexity of the whole service offer using rough measures as proxies for it: Ellickson for example validates his theoretical ECM model using average establishment size as a proxy of quality in the food-retailing industry.

This paper examines several aspects of the impact of in-store services on supermarket competition. Through a two-stage structural model this analysis accounts explicitly for both short-run pricing decisions and long-run competition in service, assessing the impact of a variation in store quality on both price and quantity sold, using fluid milk, a relatively homogenous product sold in practically all supermarkets, as a case study. The total impact of in-store services on prices is decomposed in a pure market power component and a cost component. Another novel feature of this paper is that measures supermarkets' service through indexes measuring the richness of in-store observable services characteristics (presence of bakery, seafood, prepared food departments, pharmacies and full service banks).

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[6] As reported by Betancourt and Gautschi, (1988, pg 135), "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 on the market." According to these authors the typologies of service that retailers provide can be categorized in five categories: Ambience, Product assortment (breadth – different product lines; depth – different varieties in a product line); Accessibility of location, Insurance of delivery; Information.

The results of this paper show that upscale food-retailers gain significant market power acquired through service. The overall impact of retail services on milk prices is positive, with marginal economies of scope mitigating the price increasing effect. The increase in services seems to be related with an increase in fixed cost more than in variable costs, consistently with Ellickson's (2006) result and with Sutton's ECM.

Conceptual Model

The model developed here aims to investigate the ability of upscale supermarket chains to attract consumers with lower price responsiveness through an increase of in-store services gaining in market power. The model aims also to account specifically for the competition in store quality (i.e. in-store services) and its impact on cost, and final demand. The modelling strategy follows the oligopsony and oligopoly models developed respectively by Azzam (1997) and Lopez, Azzam and Lirón-España (2002) who decompose the price increasing effect of market concentration into market power and cost effects. In order to make the analysis tractable only one commodity, fluid milk, is used. Since milk is carried by all grocery stores and it is arguably a homogenous product, price differences across retailers may reflect market power and the difference in operative cost related the level of retail services offered. In the following analysis food-retailers maximize profits following a two-stage decision process:[7] they compete in service in the first stage (long-run) and set prices in the second stage (short-run). In modeling the second stage, supermarkets are assumed to be local monopolies; this assumption in not new in the literature (Slade 1995; Besanko, Gupta and Jain, 1998) and it is based on the fact that consumers' value more the overall convenience and attributes of a store than the price charged for a single

[7] The two stage decision process seems plausible and it has already been used to solve similar type of problems: see Bentacourt and Gautshi (1993) and Röller and Sickles (2000), and second and third stage in Ellickson (2006).

product or category[8]. Even thought pricing decision takes place in the second stage only, it is important to explicitly model the first stage to avoid biases in the measure of market power (Röller and Sickles; 2000). In cases in which service decreases marginal costs, the measure of market power could be biased upwards, while a potential downward bias exists when in increase in service increases marginal cost.

Before illustrating the model, some additional assumptions are at this point necessary. First, to simplify the analysis, additional revenue generated directly from service is assumed negligible: this assumption implies that the major goal in increasing the level of service is to drive consumers in the stores. Second, each supermarket chain is assumed to face separable demand function for the products sold. Let the demand for milk at the supermarket chain *i* be:

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

where q_i is the quantity of milk sold by the supermarket chain *i*, p_i is its retail price, s_i and s_g are respectively the service offers by supermarket chain *i* and the other supermarket chains in the market and Z_i is a vector of demand shifters.

Assuming also for simplicity nonjointness of production as in Richards and Hamilton (2006) and following Röller and Sickles (2000), each supermarket faces the same long-run cost structure $\left(C_i^{LR}\right)$ specified by:

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

[8] Bliss (1988), in its theoretical analysis of food retail pricing pinpointed, 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. The shopper will not go to another shop to buy her milk because it is a little cheaper there. [Bliss, 1998, pg. 378]". According to Bliss' view, the main determinants of the decision for a consumer to shop in a given store are the price of all the products that she intends to purchase and the transportation cost required to go to a given store. Therefore, once the consumer has chosen the store in which to shop given the level of service that the store offers, only the price of milk in the store will determine whether she will buy milk there or not.

where C^{LR} denotes the long-run cost function which is decomposed into a short-run component given by $C(\cdot)$ and an additional long-run component indicated with $h(\cdot)$. The vectors *w* and *ω* are short- and long-run input prices, respectively.

Note that in the short-run the level of service is given. Supermarkets choose milk prices in the short-run given the pre-existing level of service. Acting as a local monopoly, the supermarket *i* will charge a price charged for milk that follows the usual monopoly solution:

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

where $\eta_i \left(= \partial \ln q_i / \partial p_i\right)$ is the semi-elasticity of demand, and $mc_i \left(= \partial C(\cdot) / \partial q_i\right)$ represents the short-run marginal cost of selling milk. Differentiating (3) with respect to service one obtains the following comparative static expression

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

The first term in (4) represents the shift in short-run marginal cost due to a change in service and it is left unsigned. Some analyses of service-competition in the retailing industry assume that an increase in service increases marginal cost (e.g. Lal and Rao; 1997). However, the existence of economies of scope is also possible: food-retailers are multi-product firms who use some of their inputs across the different products and services, condition that is the basic determinants of economies of scope (Panzar and Willig, 1981). The presence of economies of scope may also reinforce the Shaked and Sutton effect, similarly to what Barry and Waldfogel (2003) pointed out for the economies of scale in the newspaper market. The second term on the right-hand side represents the power gained by an increase in service (market power effect) and is expected to be positive ($\partial \eta / \partial s > 0$) since store-quality increases store loyalty, and/or attracts higher income customers, resulting in a net decrease in the average price responsiveness of consumers (positive shift in the semi-elasticity of demand) .[9] Although the sign of the variation of marginal cost through price cannot be defined a priori, overall, a positive sign for (4) is expected.[10]

In the long-run, supermarkets engage in competition in service to attract more customers and to capitalize from the eventual gain in pricing power: retailer *i* chooses services in order to maximize the long run profits:

$$\max_{s_i} \pi_i = q_i p_i + C\left(q_i \mid s_i, w\right) + h\left(s_i \mid \omega\right). \tag{5}$$

The first-order-condition for (5) is

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

where the term $\partial q_i / \partial s_i$ is the direct effect of a variation in service on demand, and $\sum_{g \neq i}\frac{\partial q_i}{\partial s_g}\frac{\partial s_g}{\partial s_i}$ represents the indirect effect of competition in services on the quantity of milk sold, defining how the changes in services by other supermarkets will impact the demand faced by all the chain *i*. Each of the terms $\partial s_g / \partial s_i$ represents the reaction of the *g*-th supermarket to a variation in service of the *i*-th chain. Combining (6) and (2), the optimal amount of services offered by retailer *i,* will solve:

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

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[9] It is postulated here that service impacts the elasticity of demand: this comes loosely from Pagoulatos and Sorensen (1986) findings that firms' competitive behaviors can be determinants of industry-level price elasticities.

[10] This implies that either $\partial mc / \partial s \geq 0$ or that otherwise $\left|\frac{\partial \eta / \partial s}{(\eta)^2}\right| > \left|\frac{\partial mc}{\partial s}\right|$.

Consider now the total variation in quantity for a variation in service:

$$\frac{dq_i}{ds_i} = \frac{\partial q_i}{\partial s_i} + \sum_{g \neq i} \frac{\partial q_i}{\partial s_g} \frac{\partial s_g}{\partial s_i} + \frac{\partial q_i}{\partial p_i} \frac{\partial p_i}{\partial s_i} \tag{8}$$

where the first and the second component include the direct and indirect quantity effect, holding price constant, while the third component accounts for the variation in quantity for a variation in the equilibrium price: $\frac{\partial q_i}{\partial p_i} \frac{\partial p_i}{\partial s_i}$. Signing equation (8) is not possible because of the conflicting signs of its components: as long as upscale food-retailers are likely to attract more costumers when services increase, the first term assumes a positive sing; given that demand is affected negatively (when it is affected at all) by an increase in service by competing supermarkets, and that the service reactions are positive, the second term has non-positive sign; the last component is negative ($\partial p_i / \partial s_i$ is expected to be positive, $\partial q_i / \partial p_i$ negative).

However, using the long-run equilibrium condition in (7) it is possible to determine that, for constant prices, the equilibrium quantity of milk sold increases with services. This behavior can be observed only under two conditions: 1) the long-run cost component is quasi-concave in service $(h` > 0; h`` \leq 0)$; 2) the variation in long-run cost dominates the variation in short-run cost (consistently with Sutton ECM) [11]. This conditions being satisfied one has:

$$\left.\frac{\partial q_i}{\partial s_i}\right|_{p_i = const} = \frac{\partial q_i}{\partial s_i} + \sum_{o \neq i} \frac{\partial q_i}{\partial s_o} \frac{\partial s_o}{\partial s_i} = -\eta_i \left[\frac{\partial C_i}{\partial s_i} + \frac{\partial h_i}{\partial s_i} \right] > 0 \tag{9}$$ [12]

[11] Ellickson (2006) shows that in food-retailing the increase in quality follows the ECM, or that quality is created through an increase primarily in fixed costs.

[12] Differentiating (8) with respect to service one obtains $\frac{\partial \left[\frac{\partial q_i}{\partial s_i} + \sum_{j \neq i} \frac{\partial q_i}{\partial s_j} \frac{\partial s_j}{\partial s_i} \right]}{\partial s_i} = -\eta_i \left[\frac{\partial^2 C_i}{\partial s_i^2} + \frac{\partial^2 h_i}{\partial s_i^2} \right] - \frac{\partial \eta_i}{\partial s_i} \left[\frac{\partial C_i}{\partial s_i} + \frac{\partial h_i}{\partial s_i} \right]$ whose L.H.S. results to be negative under the assumptions made in the text.

Figure 1 offers a graphical representation of the equilibrium conditions. In this representation, the demand for milk $D(p,s)$ is assumed to be linear and the marginal cost $mc(s)$ is assumed to be constant. The curves $q(s|p)$ represent service/quantity combinations for a given level of price and will be referred to as iso-prices. In the initial situation the service offer is s_1, the demand for milk $D(p,s_1)$ and the marginal cost $mc(s_1)$. The optimal short-run profit maximizing price and quantity pair are indicated with q_1 and $p(s_1)$ respectively, which identify the point $q(p(s_1),s_1)$ in the upper quadrant. In the lower quadrant, the quantity q_1 identifies the point A on the iso-price $q(s|\ p(s_1))$. Consider now an increase in service from s_1 to s_2. By increasing service the retailer will face a larger demand represented by $D(p,s_2)$[13], passing through the point indicated with $q(p(s_1),s_2)$. If price stayed at the initial optimal level $p(s_1)$, the quantity demanded would be $q`(s_2)$. However, in this representation, an increase in service will shift the marginal cost upward to $mc(s_2)$, with $q(p(s_1),s_2)$ no longer representing an optimal combination of quantity and price. Under the new service offer, it is optimal for the supermarket to charge a higher price $p(s_2)$ for a corresponding quantity demanded of q_2. The curve representing the substitution between quantity and service at a constant price $p(s_2)$ is the iso-price $q(s|\ p(s_2))$, lying below $q(s|\ p(s_1))$. For an equilibrium quantity of q_2 one can identify point B on the iso-price $q(s|\ p(s_2))$, defining the final outcome of the interaction of short-run and long-run decisions. A and B both lie on the curve representing the relationship linking equilibrium quantity with service including direct, indirect, and price effects. In figure 1 the curve $q(s,\ p)$ is upward sloping, however, alternative scenarios total quantity decreases in service are also possible.

[13] In Figure 1,the demand experiences both a shift outward and a shift in its slope. This need not be the case, given that a reduction in its slope is the only necessary condition for this analysis to hold. The increased size in the demand is considered in order to make the graphical analysis simpler, but the conclusions will hold true otherwise.

Empirical Model

It is assumed that, for the empirical counterpart of the conceptual above, the short-run component of the cost function is represented by a modified version of a Generalized Leontief cost function (with constant marginal cost) in which services act as technological shifters[14], while, following Röller and Sickles (2000), the long-run component of the cost function is linear in service. For supermarket chain *i*:

$$C_i^{LR}\left(q_i, s_i \mid \underline{w}, \underline{\omega}\right) = q_i\left(\frac{1}{2}\sum_{l,j}\alpha_{lj} w_l^{1/2} w_j^{1/2} + \sum_{l,k}\beta_{lk} w_l s_{ik} + \sum_{l,h\neq k}\beta_{khl} w_l s_{ik} s_{ih}\right) + \sum_k \lambda_k \omega_k s_{ik} + \sum_{h\neq k}\lambda_{kh}\omega_{kh} s_{ik} s_{ih} \quad (10)$$

where q_i is the quantity of milk sold, s_{ik} represents supermarket *i* *k*–th service, w_s and ω_s are respectively short-run and long-run input prices, the α_s, β_s and λ_s are parameters. This empirical const function accounts explicitly the impact of services on both short-run and long-run costs, differing from previous study addressing similar problems (for example the model developed by Richards and Hamilton investigating product variety competition assumes that product variety is a linear shifter in the marginal cost of selling fresh fruits and that there is no long-run decision involved in offering more product variety).

The short-run marginal cost for retailer *i* is:

$$mc_i = \frac{1}{2}\sum_{l,j}\alpha_{lj} w_l^{1/2} w_j^{1/2} + \sum_{l,k}\beta_{lk} w_l s_{ik} + \sum_{l,h\neq k}\beta_{khl} w_l s_{ik} s_{ih} \quad (11)$$

The demand for milk for supermarket *i* is assumed to take a semi-logarithmic form:

$$\ln q_i = \tau_0 + \left(\eta_i + \sum_k \eta_{ik} s_{ik} + \sum_{h\neq k}\eta_{kh} s_{ik} s_{ih}\right)\left(p_i/d\right) + \sum_l \tau_l z_l + \sum_k \delta_{ik} s_{ik} + \sum_{k,g}\delta_{gk} s_{gk} + \mu_i \quad (12)$$

[14] Each service enters the short-run cost function as simple shifter and interacted with the other services one by one. These interactions aim to capture the eventual presence of economies of scope

where p_i is the price of milk sold by retailer *i*, $\eta_i + \sum_k \eta_{ik} s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih}$ represents the semi-elasticity of demand where services act as shifters, $\sum_k \delta_{ik} s_{ik}$ and $\sum_{k,g} \delta_{gk} s_{gk}$ account for the shift in milk for the *i*-th chain due to a change in its own *k*-th service and in other food retailers (*g*) *k*-th service respectively, d is a price deflator, the z_s are demand shifters, while η_s, τ_s and δ_s are parameters to be estimated, and μ is an error term. The parameter $\delta_{ik} = \frac{\partial q_i}{\partial s_{ik}} \frac{1}{q_i}$ represents the direct semi-elasticity of milk demand for a variation in the *k*-th service and it is expected to be non-negative, while $\delta_{gk} = \frac{\partial q_i}{\partial s_{gk}} \frac{1}{q_i}$ represents the cross-chain semi-elasticity of demand to the *k*-th service and it is expected to be non-positive.

The first-order condition of profit maximization subject to (11) and (12) yields:

$$p_i = -\frac{1}{\eta_i + \sum_k \eta_{ik} s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih}} + \frac{1}{2} \sum_{l,j} \alpha_{lj} w_l^{1/2} w_j^{1/2} + \sum_{l,k} \beta_{lk} w_l s_{ik} + \sum_{l,h \neq k} \beta_{khl} w_l s_{ik} s_{ih} + \varepsilon_i \,. \quad (13)$$

in which ε_i is an error term.

k additional equations (one for each service) are needed to complete the model. Multiplying and dividing the right hand side of (7)[15] by q_i, using equations (10) and (12) and rearranging yields:

[15] Substituting the parameters of (10) and (12) in (7), one obtains an empirical counterpart of (7):

$$-\frac{q_i \left(\delta_{ik} + \sum_o \delta_{ok} \theta_{ok} \right)}{\eta_i + \sum_k \eta_{ik} s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih}} = q_i \left(\sum_l \beta_{lk} w_l + \sum_{h \neq k} \beta_{khl} w_l s_{ih} \right) + \lambda_k \omega_k + \sum_h \lambda_{khl} \omega_k \omega_h s_{ih}$$

Which, rearranged, gives the k equations defined in (14)

$$s_{ik} = -\frac{1}{\eta_k + \sum_h \eta_{kh} s_{ih}} \left[\frac{\delta_{ik} + \sum_g \delta_{gk} \theta_{gk}}{\sum_l \beta_{lk} w_l + \sum_{h \neq k} \beta_{khl} w_l s_{ih} + \frac{\lambda_k \omega_k + \sum_h \lambda_{khl} \omega_{kh} s_{ih}}{q_i}} + \sum_{h \neq k} \eta_{fh} s_{ih} + \sum_{\substack{h \neq k \\ h \neq f \\ k \neq f}} \eta_{fh} s_{ih} s_{if} \right] + e_{ik} \tag{14}$$

where $\theta_{gk} = \frac{\partial s_{gk}}{\partial s_{ik}}$ represents the service reaction and it captures the extent of the competition in service and the e_{ik} are error terms (the subscript k indicating each error term for each of the k equations). An estimable expression of the variation of milk prices with service, is obtained differentiating equation (13) with respect to the k-th service:

$$\frac{\partial p_i}{\partial s_{ik}} = \frac{\eta_{ik} + \sum_h \eta_{kh} s_{ih}}{\left[\eta_i + \sum_k \eta_{ik} s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih} \right]^2} + \sum_l \beta_{lk} w_l + \sum_{h \neq k} \beta_{khl} w_l s_{ih} \ . \tag{15}$$

The first term on the RHS of (15) represents the market power effect while the second term represents the cost effect due to a variation in the service offer. The variation of quantity with service can be obtained using equations (8), (9) and the empirical primitives, obtaining both an estimable expression of the total variation on milk demand with service and for the same variation holding prices constant:

$$\begin{aligned} \frac{dq_i}{ds_i} = &-\left(\eta + \sum_k \eta_k s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih} \right) \left(\sum_l \beta_{lk} w_l + \sum_{h \neq k} \beta_{khl} w_l s_{ih} + \frac{\lambda_k \omega_k + \sum_h \lambda_{khl} \omega_{kh} s_{ih}}{q_i} \right) + \\ &+ q_i \left(\eta_i + \sum_k \eta_{ik} s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih} \right) \left(\frac{\eta_{ik} + \sum_h \eta_{kh} s_{ih}}{\left(\eta_i + \sum_k \eta_{ik} s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih} \right)^2} + \sum_l \beta_{lk} w_l + \sum_{h \neq k} \beta_{khl} w_l s_{ih} \right) \end{aligned} \tag{18}$$

$$\left.\frac{\partial q_i}{\partial s_i}\right|_{p_i} = -\left(\eta + \sum_k \eta_k s_{ik} + \sum_{h \neq k} \eta_{kh} s_{ik} s_{ih}\right)\left(\sum_l \beta_{lk} w_l + \sum_{h \neq k} \beta_{khl} w_l s_{ih} + \frac{\lambda_k \omega_k + \sum_h \lambda_{khl} \omega_{kh} s_{ih}}{q_i}\right). \qquad (17)$$

Data and Estimation

The empirical model is estimated using primarily two custom databases provided by the Food Marketing Policy Center (FMPC) at the University of Connecticut. The scanner-data milk database (Progressive grocer – Market Scope) includes 58 four-weekly observations at the retail level containing information regarding milk sales (quantity, value of sales, average volume sold) for a period going from March 1996 to July 2000. 16 supermarket chains, operating in six IRI City Areas (Boston, Chicago, Miami, Northern New England- NNE, New York City and Seattle), are included in the sample for a total of 928 observations. Milk price used is the average dollar/gallon value of milk sold in each supermarket chain. The second source is a retail-specific database (Spectra) providing store characteristics as well as demographic characteristics of the population served by each store that was included in the milk data. The original database provides quarterly information on five different in-store physical services: bakery department, full service bank, pharmacy, fresh fish department and prepared food (combination of restaurants and salad bars)[16]. The extent of the service offer is measured by the percentage of supermarkets in each chain offering each service. In order to keep the analysis tractable,[17] the number of services is reduced through principal component factor analysis (as in Cotterill, 1999) and the method of the Scree test (Cattell, 1966) used to retain the appropriate number of components.

[16] These characteristics correspond to those identified by Cotterill (1999) as "Breadth of supermarket product line".
[17] The number of equation to be estimated in the model is $2k+2$, where k is the number of services offered. In each of the equations the number of coefficients to be estimated, increases largely with the number of services included in the analysis: for the 5 services originally measured in the database, 60 "service coefficients" should be estimated. Reducing the number of service to 2, the number of estimated service coefficient will be 16.

Two components, which combined explain 69.32% of the common variance are retained.[18] The first component is highly correlated with food services (bakery, seafood departments and prepared food), while the second is instead correlated with non-food services (pharmacy and full service banking). From the scores of the two components, two city-specific (0-100) indexes are computed, ranking the supermarket-chains in each city in terms of their service offering. For the purpose of estimation of equation(s) (14), the structure of the data results in an "unbalanced" panel because the milk database contains information on four supermarket chains for two cities (Boston and New York City) and only on two chains for the remaining six cities (Chicago, NNE, Miami, Seattle, see table 1). The service offer by the other supermarkets is the value of the service indexes for the competing supermarket in each of the cities with two chains. (*i.e.* in Seattle, Albertson's service indexes will represent other supermarket chains-service offer for Safeway, and vice versa). For those cities with data for four supermarket chains, an indicator of the overall extent of service offered by the other chains operating in the city is obtained by averaging the service indexes of the other chains (*i.e.* for Demoulas in Boston, the service offer of the competing chains, will be obtaining by the simple average of the service indexes for Shaws, Starmarket and Stop N' Shop).

On the cost side, following Chidmi, Lopez and Cotterill (2005), two retailing inputs (electricity and labor) and two milk processor inputs (raw milk price and cost of packaging) are used to specify the short-run cost function.[19] Retailing input prices are collected from publicly available sources: annual state-level electricity prices for commercial use are retrieved from the U.S. Department of Energy, Energy Information Administration. The cost of labor is proxied by

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[18] After rotation with the Varimax method, the two retained components explain 44.55% and 24.77% of the total variance, respectively. See Appendix 1 for a full picture of the factor analysis results.

[19] As assumed by these authors, price of raw milk is connected to the wholesale price of milk through a fixed and a proportional part, correcting for the cost of packaging.

annual state-level earnings per worker in the SIC 541 (Grocery Stores) industry (thousand of dollars) obtained from the Bureau of Labor Statistics (BLS), Quarterly Census of Employment and Wages (QCEW) from their website. Polynomial interpolation is used to obtain four-weekly observations. The raw milk price (dollar/gallon) used is the Federal Milk Marketing Order price prevailing in the city area where a supermarket chain operates, also provided by the FMPC. The proxy used for the cost of processor's packaging is the national Produce Price Index (PPI) for packaging industry, divided by the average volume per units of milk sold in each retail chain, obtained from the milk data. On the demand side, the general Consumer Price Index (CPI) is used as price deflator. Percentage of Hispanic households, average household size and total population served by each chain (quarterly, obtained from the supermarket-database) are used as demand shifters. Annual per capita income, obtained from Market Scope, is also used after four-weekly observations are obtained through polynomial interpolation.

For the long-run cost, input prices for service-specific inputs and a common input are needed. Annual state-level per capita earnings in the SIC 591, "Drug Stores and Proprietary Stores" industry (in $ thousand) is used as proxy for the cost of operating Non-food services[20], and are obtained from the QCEW of the BLS. Given that the major specific input for the development of food services is the square footage to be allocated to specialized food departments, the average volume of weekly sales per square foot (in thousand dollars over thousand of square feet, from the Spectra database), is used as proxy of the opportunity cost of "giving-up" selling area. This is further deflated by the Produce Price Index (PPI) for packaging industry, to capture the additional packaging cost that food-retailers face when offering food-services (monthly observations are obtained via polynomial interpolation). Capital is considered

[20] The Non-food service specific input considered is the specialized labor needed to operate pharmacies; contracts with specialized labor force (pharmacists) can be the major source of costs for this service, given that in-store banks are not directly operated by the supermarket-chains.

as common input for both food and non-food services; the monthly national interest rate (Moody's seasoned Aaa investment type) is used as proxy for its cost.

Table 1 presents the average percentage of stores offering a given service for the each supermarket chain in the sample, along with both the service indexes. It emerges from this table that the presence of non-food services is much more limited than food services for all the supermarket chains included in the analysis. It emerges also that the presence of more traditional food departments, such as bakery and fresh fish departments, varies less than the presence of newer food services (restaurant-salad bars) and of non-food services, in particular pharmacies. It appears from the data that the supermarket chains used in the analysis are, at least in some extent converging in term of the food-services provided to consumers, with the exceptions of restaurants and salad bars (in average only 8% of Demoulas stores in Boston offer salad bars, versus more that 96 % of the stores belonging to Jewels in Chicago). At the opposite side the data show that there is much more dispersion in the level of in-store non-food services provided to consumers. These facts lead to expect a larger extent in the competition in newer, less traditional non-food services that in food services, and that the to types of services may have radically different effect in attracting consumers and therefore in influencing the pricing power of food retailers.

Before proceeding to the estimation, some more considerations on the estimable forms are due. Given that the number of services used is reduced to two, the last term on the RHS of equation (14), $\sum_{h \neq k; h \neq f; k \neq f} \eta_{fh} s_{ih} s_{if}$, will disappear. Four equations will be estimated simultaneously: equations (12) and (13), and two equations for food and non-food services as in (14). The estimation is done using a heteroschedastic robust NL3SLS estimator. The system presents four variables that are clearly endogenous: price, quantity and the two service indexes.

Additional instruments are needed to control for the possible endogeneity of other two variables in the system: for average volume per unit, the instruments used are interactions of the farm price with supermarket chain specific dummies and CPI for food, while for sales per square footage the instruments are the percentages of the population served belonging to a given income group. The validity of these instruments has been tested running regressions of each of the endogenous variables on the complete set of instruments. The high *R*-squared for these regressions and the highly joint-significance of both the overall regressions coefficients and of the coefficients of the additional instruments, calculated with *F*-tests suggest that the instruments used are appropriate (see Table A-3 in the appendix for the detailed statistics).

Results and Discussion

The main econometric results are presented in Table 2. The key coefficients appear all to be significant at either the 1 or 5% level. The estimated baseline semi-elasticity is negative and significant while its shifters are positive as expected with non-food service having a greater impact than food service (0.0511 vs. 0.0313) on the price responsiveness of consumers. This indicates that non-food service yields a higher power in attracting less price responsive consumers than food service. This result is most likely due to the fact that non-food services are newer and not offered at the same extent as food services (as it can be seen from table 1). The estimated semi-elasticities of demand to service show the expected signs and are significant at the 1% level. Both the own- and cross-chain service elasticities show that the demand for milk is more responsive to a change in non-food services than to one in food service. The estimated non-food service own- and cross-chain semi-elasticities appear to be much larger than for food service. The own chain semi-elasticity of demand for non-food service is 20 times larger thatn for food services, while for the cross-chain elasticity a marginal increase in other chains' food service index generates a decrease of 1.23% in demand for milk, and a decrease of 19.53% for a marginal increase in non-food service index. Even though these estimates are large, one should remember that the total impact of service on demand will be weighted by the estimated service reactions. The values of the estimated service reaction coefficients show that competition in food service is weaker than in non-food service. The estimated reaction is not statistically different from one in the case of non-food service, while it is estimated to be 0.44 for food service. These results are both consistent with the features of the data, which show higher variability in terms of non-food versus food services: given that the number of stores offering non-food services is relatively lower than the number of stores offering food-services, it is reasonable to expect supermarkets competing more in the first type of service than the second.

On the cost side, the estimated parameters for the variable input factors show that food service is positively related with labor utilization, but negatively related with electricity. Non-food service appears to shift the marginal cost downward the marginal cost for both retailing inputs considered, indicating economies of scope. The interaction of the two service indexes with the input prices show that a more complex service offer (measured by the estimated coefficient for the interaction of food and non-food services) suggests instead that an increase in complexity may be associated with a better utilization only of labor. Considering the long-run components of the cost function related with service, one can observe that both the services are positively related with an increase in the long-run cost, even though some economies of scope seem to arise when their interaction is considered.

The other estimated parameters behave mostly as expected: on the cost side, both the variables capturing processors' costs appear positively related with retailing costs and are significant. The interaction term of the retailing variable input prices is also positive and significant. On the demand side, the percentage of households being Hispanic, affects negatively the demand for milk. Two of the estimated parameters present perverse sign: total population served appears to be related negatively with the demand for milk, while household size seems not to show any effect on it.

The total impact of service on the semi-elasticity of demand is evaluated at the sample averages of the two service indexes and its values are reported in Table 3. At the sample averages, the semi-elasticity of demand appears to be reduced by 58% going from an initial -5.85 to -2.49. It should be noted that baseline value of -5.85 also represents the semi-elasticity of demand for milk for a retail chain with the worst service offer in each city (i.e. for a hypothetic chain with values of both the service indexes equal to 0). As expected from the estimated parameters, non-food service is a more powerful semi-elasticity shifter than food service. Considering a hypothetical supermarket with the best offer of both food and non-food services (i.e. for a chain showing values of 100 for both indexes), the semi-elasticity will reduce to -0.714 (one eighth of the initial value). The estimated marginal cost, calculated at the sample averages of the input prices for a hypothetical supermarket offering the worst combination of service amounts to $1.9 /gallon. At the averages of the service indexes, food service increases the retailer’s marginal cost by $0.05, non-food service generates instead economies of scope of $-0.33/gallon and the interaction of both services results in an increase in the marginal cost of 1.6 cents/gallon. The net result is for services to act as short-run cost reducers, with the marginal cost of selling milk resulting in $ 1.649/gallon at the sample averages. The supermarket chain offering the best combination of both services will experience a relevant reduction in marginal cost (1/3 of the baseline estimate), for an estimated value of $1.3/gallon.

The estimated market power and cost effects associated with a marginal increase in service are calculated according to equation (15) at the sample averages and are reported in table 4. The results point out that milk prices tend to increase with services and that market power is the main source of price increases. In the case of food service, the increase in marginal cost accounts for less than a third of the total marginal price increase, while for non-food services, strong economies of scope counterbalance (and overpower) the otherwise large market power effect. The total effect of a variation in both indexes results in market power of 0.8 cents/gallon: the estimated marginal market power effect for food (non-food) service index is 0.28 (0.52) cents a gallon. Even though these figures appear small, it should be considered that a marginal increase in half a cent in market power can results in a 50 cents/gallon price differential (coming from market power only) between the worst and the best supermarket in a given area. The marginal cost effect is positive (0.11 cents/gallon) for food service, and negative (-0.68 cents/gallon) for non-food service, for an overall price decreasing effect of -0.57 cents/gallon. The resultant total price effects consists on a 0.39 cents/gallon price increase for food service and a net price decreasing effect for non-food service (-0.16 cents/gallon), for a total increase in price of 0.22 cents/gallon.

The values of the estimated marginal impact of service on the demand for milk are reported in Table 5. The total effect of an increase in both service indexes results in an increase in demand equal to 21.431%, this being balanced by the estimated effect of the competition in service (obtained multiplying the estimated reaction coefficients times the cross-chain- service elasticities), equal to -21.436%. The net responsiveness to service (excluding the indirect effect though prices) is positive for food service (0.000231) and negative for Non-food service (-0.005255). The average slope of the iso-price curves, calculated as in (16) is positive as predicted in the theoretical model for both food and non-food service, with the latter being much steeper than the former. The total (marginal) variation in demand due to service is negative and large for food services (-11,169) and positive for non-food services (4,933.9). These result in an overall negative effect on demand for milk equal to -6,757.2 gallons of milk sold for an increase in 1% of both indexes. This final result points out that supermarkets increasing their service offer tend to benefit from an expansion of the final demand for the goods sold, but also that eventually the increase in price may cause a shrunk in the quantity demanded, resulting in smaller sales. Consumers with higher willingness to pay may be attracted, but overall the extent of the price increase and the price sensitivity will dictate the variation in the final demand with a variation in service. In fact, the above estimates report that non-food service, showing an overall negative price effect, will increase the demand for milk, while food service, which is the major source of the price increase, will impact the demand for milk negatively.

The estimates discussed so far are computed at the sample averages of the service indexes, failing to give a complete picture of the impact of services on pricing and competition among upscale food-retailers. In this section, the behavior of supermarket chains presenting all the possible combinations of the service indexes is simulated, using the estimated coefficients discussed above and the sample averages of milk prices, cost of labor and electricity prices.

From the simulated values of the own-price elasticity, non-food service appears to be a much more powerful elasticity shifter than food services as shown in Figure 2, as expected from the estimated coefficients. The effect of food services on the price elasticity for milk is small for consumers shopping at supermarkets ranking high in non-food services. Figure 3 shows the impact of service on the marginal retailing cost of selling milk. Also in this case, the simulated values corroborate the picture given by the estimated values in table 3. The marginal cost always decreases with non-food service, while an increase in food service index is related with a slight increase in marginal cost. Overall, the impact of an increase in both services results in strong economies of scope and end up lowering the cost of selling milk by approximately 0.68 cents a gallon for the stores with the highest index values.

The incremental effects of an increase in store-quality on milk prices is shown in Figure 4, 5, and 6. The simulated market power effects (Figure 4) shows Non-food service having (at the margin) a larger positive market power effect than food services. Supermarkets specializing in food services can increase their market power also improving their non-food service portfolio. Conversely, a chain ranking high in non-food services could gain up to 9.25 cents/gallon of milk sold if increasing the same service, while investing in food service may even cause a slight decrease in market power. The simulated marginal effect of in-store service on cost (Figure 5) shows synergies that develop in effective economies of scope. Differently from the market power effect, the cost reduction appears to be approximately of equal intensity for both services. The largest marginal decrease in marginal cost is 0.64 cents for those supermarkets chains showing the best quality in each city. Given that an increase in quality marginally decreases the cost of selling milk and that the long-run cost increases with service, it can be concluded that the Shaked and Sutton ECM model is representative to describe food-retailing, confirming Ellickson's (2006) findings. Combining both marginal market power and cost effects, the total impact of in-store service on milk pricing is positive for medium high values of services and it is much more relevant for non-food services than for food services. From the simulated values, it appears that low-service supermarkets decrease their prices when starting to offer more service, probably to attract more consumers and to benefit, in the future by the eventual increase in prices. The maximum marginal increase in price due to an increase of 1 unit of both quality

Indexes results to be 8.3 cents/gallon of milk sold for a supermarket chain already specializing in non-food service. The simulated values of the total effect of service on milk prices are plotted in Figure 7, which show that increasing the service offer allows charging higher prices for medium-high level of service. By increasing the service offer food retailers can charge higher prices for milk up to a maximum price differential between the worst and the best supermarket chain in a given area of $ 0.82/gallon.

The last simulations performed illustrate the relationships between the service offer and the quantity of milk demanded. Figure 8 portrays the slope of the iso-prices curve for each combination of service, showing that they are positive and decreasing with service for all the combinations of the service indexes, consistently with the prediction of the theoretical model developed above. Figure 9 is a plot of the simulated values of the variation of milk sold in the market due to service. The simulated values indicate that demand increases with service for low values of the service indexes, decreasing instead when the service offer is larger. The initial increase is equal to 27,985 gallons for the supermarket with the worst service. The variation in quantity with service becomes more negative with an increase in non-food service at a faster rate than for a variation in food service; indeed, for high values of the non-food index, an increase in food service pushes the value of dq/ds towards less negative values. For non-food service at its maximum and food service at its minimum, an increase in food service may cause a loss in demand equal to -77,600 gallons.

The overall picture that emerges is that low-service supermarkets can initially increase both their final demand and the prices charged. By further increasing their service offer they will retain consumers with higher store loyalty (willing to pay higher prices), but they will lose a portion of the total demand for milk.

Concluding remarks and further research

Intuitively, food-retailers attract consumers with higher willingness to pay by offering improved services; it follows also from intuition and every-day experience that stores offering more services also charge higher prices. This analysis undertaken in this paper has aimed to answer some empirical questions on: 1) the source of the price increase; 2) the extent of service competition on food retailing and 3) the impact of services on total quantity sold using fluid milk sold across retailers in 6 U.S. city areas. The results show that the source of price increase comes largely from an increase in market power. Specifically, the presence of food services (bakery, seafood and prepared food) raise prices because of an increase in both market power and short-run costs, while an increase in non-food services enhances market power but also creates (in the short-run) economies of scope which mitigate the final price increasing effect. This paper provides empirical support of the fact that quality in the retailing industry is increased primarily with an increase in fixed costs (according to the Sutton's ECM as in Ellickson, 2006), using an appropriate measure of in-store service quality. The results also show that service competition in non-food service is much more marked that for food service, and that, if no adjustments in price are in place, the increase in service will result in an increase in the equilibrium quantity of milk demanded. Accounting for the variation in prices, an increase in service stimulates demand only for stores with a low initial service offer. High service supermarkets appear willing to sacrifice potential demand to attract more loyal, less price sensitive, consumers in their stores.

The present analysis could be expanded in multiple directions. A general way to expand this study could be to consider the impact of non-traditional store formats, such as supercenters, in the evolution of the competition in service and on their pricing power. The current analysis has in fact proved that food-retailers can exert market power through store differentiation even for an undifferentiated product such as fluid milk. This fact clearly may raise some concern because low-income individuals need to spend additional efforts to find basic products at low prices as the service level increases. In light of this consideration, it appears relevant to include in further analysis the competitive pressure coming from supermarkets adopting Every Day Low Pricing (EDLP) on the power of Hi-Lo retailers and on their service strategy, especially in light of the increase service offer by EDLP stores. Other directions of further developments could consider releasing the assumption of local monopoly in pricing, or extending the analysis to a multi-product case, introducing perhaps differentiated products to measure how much power can be exerted from products that are per se perceived differently by consumers.

Table 1: Description of the supermarket service data

City	Food retail chain	Services provided						Service Indexes	
		Bakery	Restaurant	Salad Bar	Seafood	Bank	Pharmacy	Food	Non-food
Boston	*Demoulas*	54.4043	5.5137	8.6434	82.8994	4.6094	1.7187	27.4874	6.6105
	Shaws	92.4058	6.4419	83.0986	100.0000	39.0645	5.5401	91.5887	30.0155
	Starmarket	97.8027	17.9537	72.7680	97.0656	36.5475	37.0178	87.3014	54.5019
	Stop N' Shop	86.0696	4.3462	74.2261	94.6656	57.7773	56.6836	71.2275	91.4626
Ney York	*A&P*	73.6784	5.3238	55.4359	70.0298	15.0832	25.5868	65.7158	11.0803
	Grand Union	68.1278	6.2415	89.9176	73.8105	6.5380	35.4214	80.8528	5.4855
	Pathmark	80.7545	8.9949	21.4263	89.4553	60.5108	97.4416	61.8634	91.4164
	Waldbaum	67.6480	5.1372	16.7229	45.8908	44.8384	33.0552	16.6613	44.7831
Chicago	*Dominick's*	83.6372	33.8961	85.0162	98.5638	66.5303	74.8391	81.6992	35.8125
	Jewels	87.3208	3.9618	21.3056	93.3142	56.2352	85.0181	35.0280	66.1259
Northern New England	*Shaws*	96.9230	4.0747	96.5932	99.6595	58.3781	7.0390	96.1553	14.4496
	Shop N' Save	87.6495	1.0820	71.0654	91.2132	50.5871	74.3295	47.0754	82.0641
Miami	*Publix*	90.9327	14.0142	25.8457	93.6866	25.3127	28.5525	83.1594	56.5762
	Winn Dixie	76.0072	19.4020	22.6436	88.1722	21.8694	33.2926	67.2871	55.5869
Seattle	*Albertson*	98.8210	2.3810	47.2457	84.5785	33.0985	50.8310	49.0368	25.7221
	Safeway	83.7751	24.6245	56.0871	67.8887	56.2820	60.7449	22.0917	84.9197

Table 2: Estimated parameters of equations (12), (13) and (14)

Estimated parameters	Baseline		Food		Non-food		Food*Non-food	
Semi-elasticity	-5.858	***	0.031364	**	0.051125	***	-0.0003105	***
	(0.43686)		(0.00247)		(0.0040164)		(0.0000246)	
Own chain elasticity			0.56407	**	20.867	***		
			(0.22962)		(0.22343)			
Cross-chain elasticity			-1.2714	***	-19.535	***		
			(0.32267)		(0.43749)			
Service reactions			0.44349	**	1.0685	***		
			(0.025056)		0.025056			
Short-run cost								
Labor	-0.11511	***	0.0002	***	-0.0002063	***	-1.31E-06	***
	(0.00905)		(0.000043)		(0.0000379)		(2.87E-07)	
Electricity	-0.30908	***	-0.000262	***	-0.0004351	***	3.02E-06	***
	(0.022058)		(0.000057)		(4.226E-05)		(6.58E-07)	
Long-run cost components			5.0051	***	0.88103	***	-1.9189	***
			(1.0944)		(0.06334)		(0.41781)	
Other coefficients								
Constant (marginal cost)	1.0272	***						
	(0.09351)							
Price of raw milk	0.17698	***						
	(0.03564)							
Packaging cost	0.58904	***						
	(0.0191)							
*Labor*Electricity*	0.40307	***						
	(0.02796)							
Constant (demand equation)	111.46							
	(175.03)							
Per Capita Income	-0.034736	***						
	(0.004918)							
Population	-0.0018775	***						
	(0.0000349)							
Household size	-81.06							
	(70.058)							
Percentage Hispanics	2.9769	**						
	(1.3077)							

Asymptotic standard errors are reported in parentheses.
*** =1% significance level; ** = 5% significance level; * = 10 % significance level

Table 3: Estimated semi-elasticities and marginal cost with respect to service

Measures	Baseline		Food		Non-food		Food*Non-food		Total Impact		Final Values		Limit values	
Semi-elasticity	-5.858	***	1.8944	**	2.3256	***	-0.85307	***	3.36693	***	-2.49107	***	-0.71398	***
	(0.43686)		(0.1492)		(0.1827)		(0.067632)		(0.26401)		(0.36897)		(0.0393)	
Marginal Cost	1.9098	***	0.051495	***	-0.32908	***	0.016752	***	-0.26083	***	1.649	***	1.3085	***
	(0.02592)		(0.01121)		(0.02247)		(0.003663)		(0.030527)		(0.04386)		(0.0732)	

Standard errors are reported in parentheses.
*** =1% significance level; ** = 5% significance level; * = 10 % significance level

Table 4: Estimated market power, cost and total effects of services

	Food		Non-food		Total	
Market power	0.0027782	***	0.005217	***	0.007995	***
	(0.0001758)		(0.000325)		(0.000499)	
Cost effect	0.0011299	***	-0.00687	***	-0.00574	***
	(0.000246)		(0.000525)		(0.00067)	
Total effect	0.0039081	***	-0.00165	***	0.002259	***
	(0.0002118)		(0.000255)		(0.000299)	

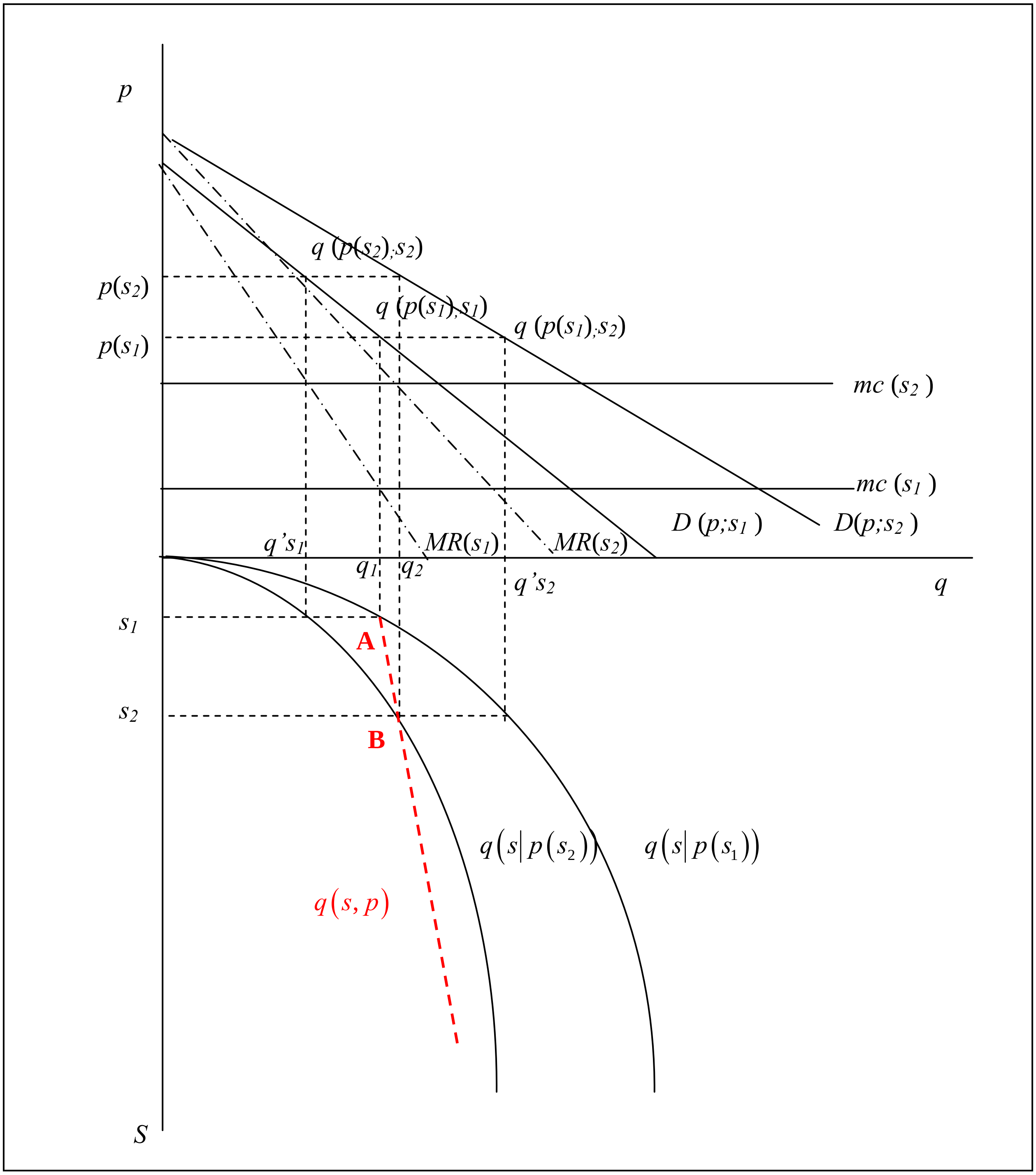
Asymptotic standard errors are reported in parentheses. *** =1% significance level; ** = 5% significance level; * = 10 % significance level

Table 5: Estimated responsiveness of milk demand to services

	Food		Non-food		Total	
Direct service-elasticity of demand	0.56407	**	20.867	***	21.431	***
	(0.2296)		(0.22343)		(0.25857)	
Impact of service competition on log(q)	-0.56384	**	-20.873	***	-21.436	***
	(0.2297)		(0.22336)		(0.25854)	
Partial responsiveness to service	0.000231	***	-0.005255	***	-0.00502	***
	(0.000061)		(0.00041)		(0.00042)	
Average slope of Iso-prices	0.0016672	***	0.018926	***	0.020593	***
	(0.000436)		(0.000868)		(0.00098)	
Total variation in milk sold due to service	-11691.1	***	4933.9	***	-6757.2	***
	(935.18)		(648.41)		(1138.8)	

Asymptotic standard errors are reported in parentheses. *** =1% significance level; ** = 5% significance level; * = 10 % significance level

Figure1: Interaction of the Short-run and long-run decision defining the quantity/service relationship



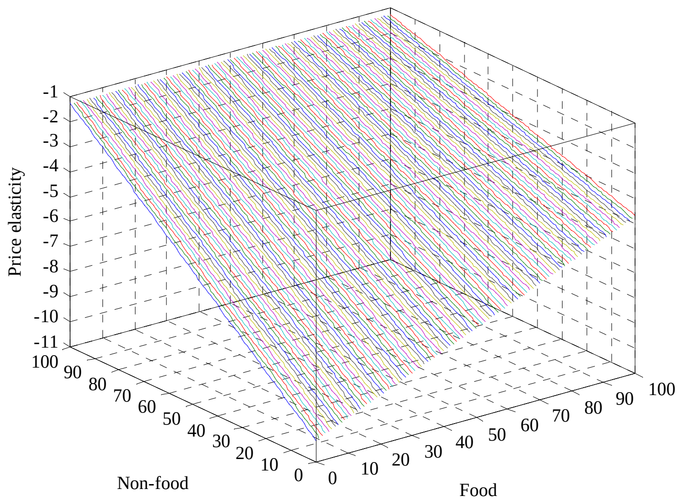


Figure 2: Price elasticiy of demand for milk as function of services

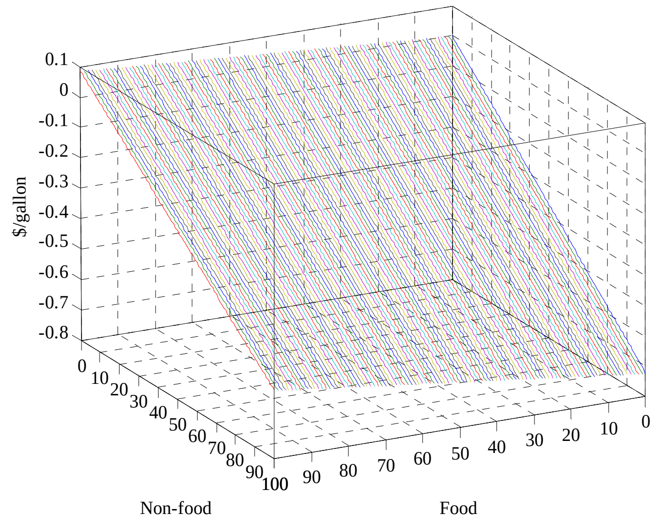


Figure 3: Variation in marginal cost depending on service levels

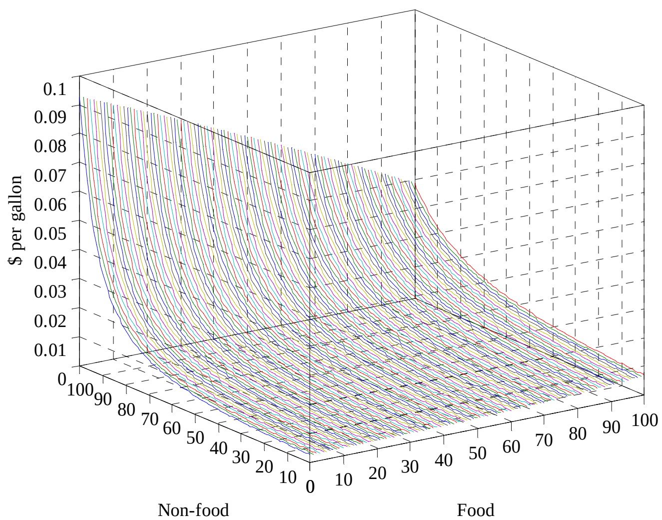


Figure 4: Market power effect of services

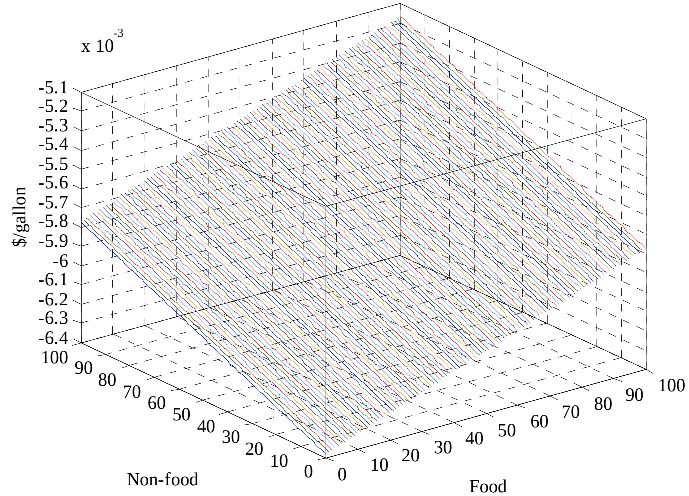


Figure 5: Cost effect of services

Figure 6: Total price effect of services

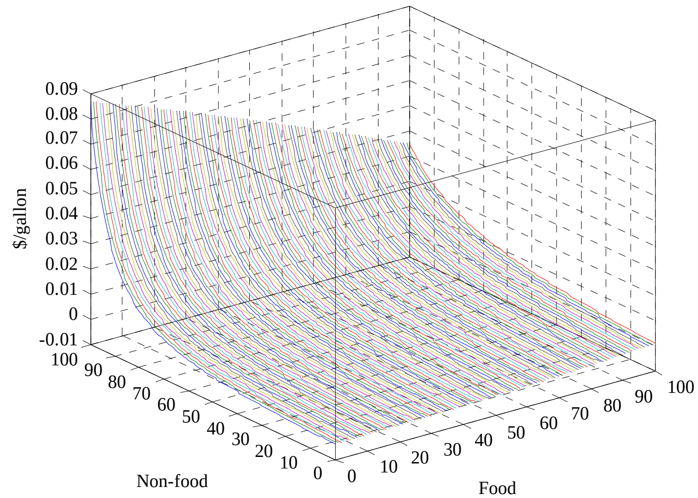


Figure 7: Total impact of services on milk prices

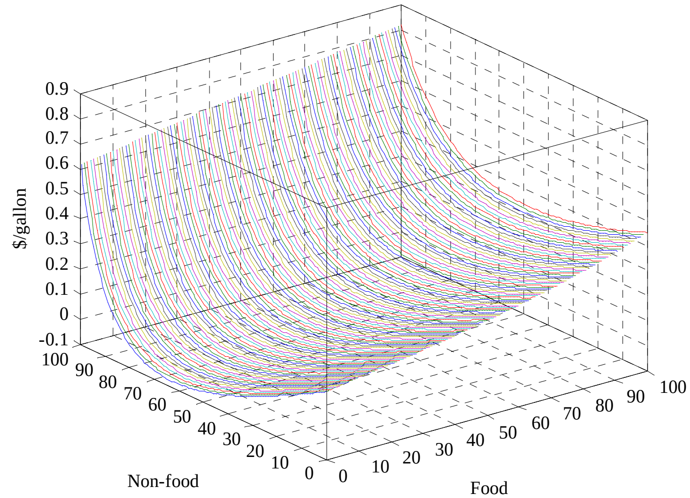


Figure 8: Slope of the Iso-price curves

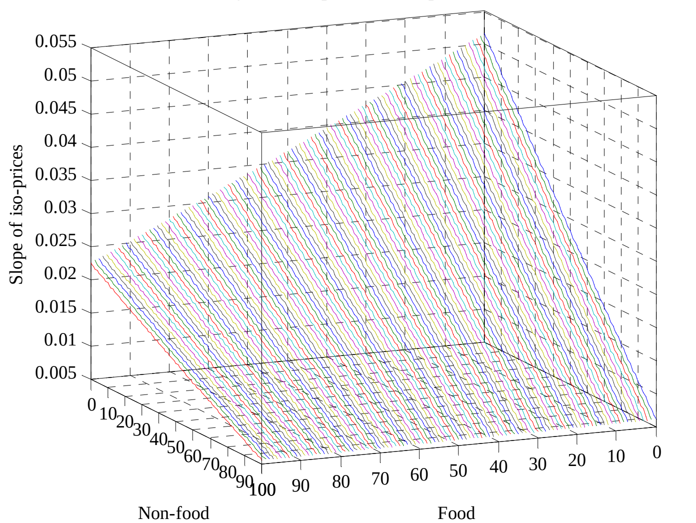
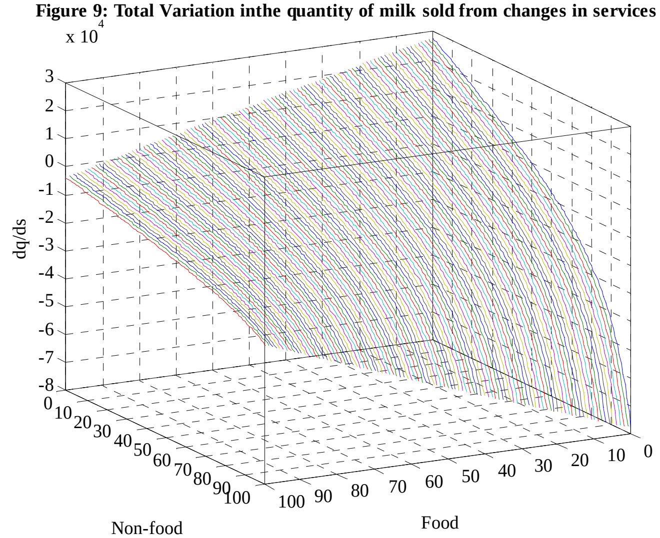


Figure 9: Total Variation inthe quantity of milk sold from changes in services



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Appendix: Results of the Principal component analysis

Table A-1: Results of the principal component analysis: total Variance Explained

Component	Initial Eigenvalues		
	Eigenvalues	% of Variance	% Cumulative Variance
1	2.2274	44.5474	44.5474
2	1.2383	24.7659	69.3134
3	0.6661	13.3216	82.6350
4	0.4844	9.6877	92.3227
5	0.3839	7.6773	100.0000

Extraction Method: Principal Component Analysis.

Table A-2: Correlation of the retained components with the original variables

	After rotation	
	1	2
BAKERY	0.7499	0.2815
BANK	0.2637	0.8228
PHAR	-0.0186	0.9119
SEAF	0.7960	0.1079
PREP	0.7744	-0.0265

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 3 iterations.

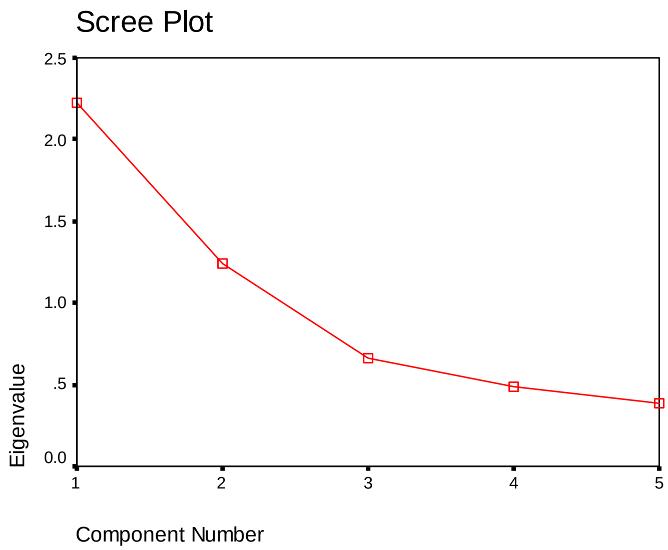

Table A-2 Results of F-tests for the validity of the additional instruments

Dependent Variable	R-squared	F-tests d.f.	F-Statistic	P-values	% instruments significance > 10%
Price	0.9048	44; 883	190.75810	0.0000	64.7059
(additional instruments)		17; 883	13.360135	0.0000	
Log (quantity)	0.9861	44; 883	1420.0847	0.0000	47.0588
(additional instruments)		17; 883	5.8426926	0.0000	
Food	0.8726	44; 883	137.46185	0.0000	41.1764
(additional instruments)		17; 883	18.329431	0.0000	
Non-food	0.9122	44; 883	208.41076	0.0000	58.8223
(additional instruments)		17; 883	31.409265	0.0000	
Average volume	0.8362	44; 883	102.42880	0.0000	41.1764
(additional instruments)		17; 883	10.231954	0.0000	
Sales/square feet	0.9479	44; 883	364.76256	0.0000	52.9412
(additional instruments)		17; 883	8.8673726	0.0000	