Food Marketing Policy Center

Private Labels, Retail Configuration, and Fluid Milk Prices

by Alessandro Bonanno and Rigoberto A. Lopez

Food Marketing Policy Center
Research Report No. 82
July 2004

Research Report Series

http://www.fmpc.uconn.edu

University of Connecticut
Department of Agricultural and Resource Economics

Private Labels, Retail Configuration, and Fluid Milk Prices

by Alessandro Bonanno and Rigoberto A. Lopez

Food Marketing Policy Center
Research Report No. 82
July 2004

Department of Agricultural and Resource Economics
University of Connecticut

Contents

List of Tables

Affiliation

The authors are doctoral student and professor, Department of Agricultural and Resource Economics, the University of Connecticut, respectively. Contact address: R. Lopez, Dept. of Agricultural and Resource Economics, University of Connecticut, Storrs, CT 06269-4021, telephone: (860) 486-1921, rlopez@canr.uconn.edu. Partial funding obtained from USDA–CSREES Special Grant No. 2003-34178–13469 is gratefully acknowledged.

Preface

This paper investigates the impacts of store brands (i.e., private labels) and retail characteristics (scanners, deli, bakery, and pharmacy departments, ATMs, restaurant and store size) on fluid milk prices using 1,740 supermarket-level observations from four cities. Non-parametric results reveal that although private label milk initially exerts a pro-competitive effect on milk prices, eventually the effect is to raise the prices of both manufacturers' brands and private labels. Econometric results further reveal that price differentials are larger for reduced-fat milk than for whole milk and that the more enhanced the retail configuration is, the higher milk prices are. Overall, the results attest to some degree of price discrimination by retailers through controlling the brand of milk sold and providing one-stop shopping convenience.

1. Introduction

Two of the most significant changes in food retailing in the last two decades are the expansion of private labels (whereby retail stores rather than manufacturers own a brand) and of the number of retail services provided to consumers through new retail formats (Kinsey and Senauer, 1996; Kaufman, 2002).[1] These changes have the potential to critically impact the prices paid by consumers by altering multidimensional competition across retailers, between retailers and manufacturers, and between retailers and other types of businesses (e.g., restaurants, pharmacies, and bakeries).[2]

The impact on consumers of private label (PL) food expansion is unclear. The conventional wisdom is that PLs, by virtue of generally being cheaper than manufacturer branded (MB) products, decrease MB prices (e.g., Putsis, 1997; Narashiman and Wilcox, 1998). Recent studies, however, have found that an expansion of PL products is correlated with higher MB prices and leads to reductions in price promotion (e.g., Ward, Shimshack, Perloff and Harris, 2002), especially when retailers have a cost disadvantage (Bontems, Monier-Dilhan, and Réquillart, 1999). Much of the emphasis of previous studies has focused on the impact of PL expansion on MB prices relative to PL prices without examining PL prices themselves.

The impact on consumers of the emerging food retail configuration (i.e., inclusion of services such as deli, bakery, and pharmacy departments, restaurants, use of scanners and banking facilities) is even less clear than that of PL expansion. An increase in the number of services increases consumer time saving and better satisfies the demand for one-stop shopping. At the same time, such an increase in the scope of retail services enhances firms' capabilities in achieving economies of scale and scope, higher profit margins and further consolidation (Messinger and Narasimhan, 1997). However, empirical studies making the connection between food price levels and retail configuration has not yet been made, particularly regarding milk.[3]

The fluid milk retail market in the United States provides an interesting case study to examine the role of PLs and a store's retail configuration. First, price differentials between PLs and MBs are substantial although milk quality differentials are not.[4] Second, PL market shares and retail configurations vary widely across supermarkets, allowing examination of a full range of situations. Third, since consumers typically purchase milk as part of a larger supermarket purchasing experience, price differentials might in part be accounted for by retail configuration. Fourth, retailers appear to have wide latitude in pricing milk.[5]

The thrust of this paper is to assess the impact of PL expansion and retail configuration on fluid milk prices to better understand the relationship between the level of success of PLs in a given market and the characteristics of the

---

[1] Milk is by far the largest private label category ($6.6 billion in sales), reaching $4.4 billion for low fat/skim milk and $2.2 billion for whole milk in 2002 (Pierce, 2002). In fact, about one of every five items sold in U.S. supermarkets, drug chains, and mass merchandisers are private labels, reaching approximately $52 billion in sales, accounting for 16.3% of sales including food products (PLMA, 2003). This percentage is, however, much larger in some European countries such as France (21.7% of sales), Germany (25.7%) and Great Britain (37.4%).

[2] Most studies show that market power shifts in favor of retailers over manufacturers where PL products are introduced into a market (Cotterill and Putsis, 2001; Mills, 1995, 1999; Narashiman and Wilcox, 1998). A few studies that attribute greater market power to manufacturers include Bontems, Monier-Dilhan and Réquillart (1999). Note also that there is a broader (outside PLs) and growing literature addressing bargaining power between manufacturers and retailers (Katz, 1989; Vickers and Waterson, 1991; Berto Villas-Boas, 2002).

[3] There are a few studies, however, concerning different prices charged by gas stations depending upon their retail characteristics (Shepard, 1991; Barron, Taylor and Umbeck, 2000).

[4] Quality comparable to MBs is one of the key characteristics for PLs to be successful (Barsky, Bergen, Dutta, and Levy, 2001; Hoch and Banjeri, 1993), especially in relation to price (Galizzi, Venturini and Boccaletti, 1997; Sinha and Batra, 1999). Of course, there are situations where there may be important quality differences, as when MBs supply, for example, organic and BsT-free milk and PLs do not. Given the small market shares of those types of milk, the present analysis assumes that important quality differences do not exist.

[5] Except for a few studies (Chidmi, Lopez, and Cotterill, 2003; Dhar, 2001; General Accounting Office, 2001), retail-level studies of milk competition are scant, although they point out that retailers exert significant oligopoly power in fluid milk markets. In addition, as pointed out in footnote 2, retailers seem to be the channel captains in terms of pricing power over manufacturers. More general studies of supermarket competition focus on the link between grocery prices and market concentration (Binkley and Connor, 1996; Cotterill, 1986).

retailers who sell them. The analysis uses parametric and non-parametric methods with 1,740 IRI scanner observations on reduced-fat and whole milk sales at supermarkets in Boston, Chicago, Hartford and New York.[6] Empirical results show that although the initial impact of PLs is to exert a pro-competitive effect on milk prices, eventually the effect is to raise the prices of both MB and PL milk. Higher milk prices are also correlated with a greater scope of retail services, with the exception of the use of scanners and the presence of restaurants.

2. Conceptual framework

The conceptual model draws from the work of Jaskold-Gabsewich and Thisse (1979) as modified by Shepard (1991). The model is based on the following assumptions. First, consumers are willing to pay for brand loyalty for the MB product.[7] Second, the consumer does not incur a cost in shifting to another brand. Third, it is assumed that consumers have identical preferences and that higher-income individuals exhibit a lower marginal utility of income, which would separate them on the basis of their willingness to pay for branded products.

The consumer choice problem consists of two stages. In the first stage, consumers choose the level of retail services (i.e., a supermarket chain) in order to buy a bundle of goods and/or services, and in the second stage the consumer chooses the type of milk to buy. In this model we take the first stage as given in order to focus on the milk brand choice. However, the level of services spills over into the utility of buying milk. Obviously, the first stage involves more than just the level of services such as proximity, income, and alternative outlets.

Define the consumer type t as a monotonic function of income uniformly distributed on [0,1], with higher values of t for a higher income level. Let s represent the level of services offered by supermarket chains. Let $U_t(s)$ represent the level of utility of a typical consumer from buying milk, where $\partial U_t/\partial s>0$. Assuming that the consumer buys not more than one unit of milk at a time, preferences can be specified as follows:

$$U_t(s)=\begin{cases} V(g;s)(t-P_g), \\ V(o;s)t, \end{cases} \tag{1}$$

where g represents a good type (either MB or PL) and P_g its price. If a consumer chooses to purchase the MB, the utility level reached will be $V(mb;s)(t-P_{mb})$, while $V(pl;s)(t-P_{pl})$ is the utility from purchasing the PL and $V(o;s)$ the utility level when no milk is purchased.

It is assumed that the purchase of MBs instead of PLs allows reaching a higher level of utility, despite the hypothesized absence of a physical quality gap. This holds when brand loyalty, apart from decreasing substitutability risk, generates a better image for MBs, allowing them to better satisfy consumer needs, or in other words

$$V(mb;s) > V(pl;s) > V(o;s) > 0. \tag{2}$$

The demand functions for MB and PL products when only one brand is sold by a retailer are given by:

$$D(P_g,s) = 1 - \frac{V(g;s)P_g}{V(g;s)-V(o;s)}. \tag{3}$$

However, the most common case is that both MBs and PLs are sold by retailers. In this case, the demand functions are given by:

[6] For the purpose of this paper, reduced-fat milk includes 1%, 2% and skim milk.

[7] Under this assumption, brand loyalty is not exclusively or necessarily connected with a difference in physical quality but rather with product image, availability in supermarkets, and advertising (Du Wors and Haines, 1990; Popowshi-Leszczcy and Gönül, 1996).

$$D_{mb}(P_{mb}, P_{pl}, s) = 1 - \frac{V(mb;s)P_{MB}}{V(mb;s) - V(pl;s)} + \frac{V(pl;s)P_{PL}}{V(mb;s) - V(pl;s)}, \quad (4)$$

$$D_{pl}(P_{mb}, P_{pl}, s) = 1 - \frac{V(mb;s)P_{PL}}{V(mb;s) - V(pl;s)} + \frac{V(pl;s)[V(mb;s) - V(o;s)]P_{PL}}{[V(mb;s) - V(pl;s)][V(pl;s) - V(o;s)]}. \quad (5)$$

The retailer model also has a simple two-stage set up. In the first stage, firms make retail configuration decisions (*s*) in the long run. In the second stage, firms make short-run decisions on how to price PL and MB milk (P_{pl} and P_{mb}). As retail costs are in part endogenized in the first stage, retail configuration affects marginal costs in the second stage. Hence, retail configuration and consumer behavior are taken as given in the second stage and the level of services offered is assumed to be the one sought by the relevant segment of consumers. The profit maximization problem in the second stage becomes:

$$\max_{Pmb,Ppl} \prod = (P_{mb} - m - w(s))\, D_{mb}(P_{mb}, P_{pl}, s) + (P_{pl} - w(s)) D_{pl}(P_{pl}, P_{mb}, s), \quad (6)$$

where *m* is the incremental manufacturer margin (relative to PL milk) per unit of MB milk sold and *w* is the marginal retailing cost for milk.

The maximization of equation (6) with respect to P_{pl} and P_{mb} yields the following first order conditions:

$$P_{pl} = \frac{AB}{C} + \frac{2w(s)V(mb;s)V(pl;s)}{C} + \frac{mV(mb;s)B}{C}, \quad (7)$$

$$P_{mb} = \frac{2V(pl;s)[V(mb;s) - V(o;s)]}{C} + \frac{w(s)A}{C} + \frac{mV(pl;s)[2V(mb;s) + B]}{C}, \quad (8)$$

where $A = V(mb;s)+V(pl;s)$, $B = V(pl;s)–V(o;s)$, $C = 3V(mb;s)V(pl; s)+ V(mb;s) V(o;s) +V(pl;s)^2 - V(pl;s)V(o;s)$.

We now wish to examine how milk prices charged by retailers respond across brands and to changes in retail configuration. Of particular interest is to conceptually assess the price differential between PL and MB, given by $\Delta P = P_{mb} - P_{pl} > 0$. From (7) and (8), this differential is a function of the incremental manufacturer margin *m* for MBs, the retailer marginal cost *w*, and consumer preferences. For reasonable values of those parameters and non-negative equilibrium quantities, ΔP is positive.[8]

Within the framework presented above, the level of services can affect PL and MB milk prices through consumer preferences as well as through changes in marginal retailing cost. Within this model it is not possible to indicate unequivocally whether an increase in *s* increases or decreases price. It is possible, however, to point out that when

[8] Using (7) and (8), a positive value for ΔP implies that

$$w < \frac{V(pl;s) + (1+m)V(o;s)}{V(pl;s)} + m\frac{A}{V(mb;s) - V(pl;s)},$$

That is, the price differential is more likely to be positive and of a greater magnitude the larger the manufacturer's allowance for MB products, the smaller the marginal retail cost, and the more consumers value services even if they do not purchase milk on a given trip.

strong efficiency gains occur (technological or otherwise) as retail configuration becomes more complex or when consumers are indifferent to retail configuration, prices charged by supermarkets are more likely to decrease. Otherwise, an increase in retail configuration is likely to increase fluid milk prices, *ceteris paribus*.[9]

3. Empirical Model

From the preceding analysis it is reasonable to assume that the price charged for milk by a retailer will depend upon the brand (PL or MB), the retailer's strategic variables (including the level of penetration of PL milk, as represented by the in-store PL market share), and retail configuration.

The equation which summarizes the empirical determinants of the price charged for unit of milk is given by

$$P_{ijk} = \alpha_0 + \alpha M_{ijk} + \beta Z_j + MB_k(\gamma_0 + \gamma M_{ijk} + \delta Z_j) + \lambda RC_{ij} + \varepsilon_{ijk}, \quad (9)$$

where P_{kij} is the price charged in the i^{th} retail chain in the j^{th} city for milk brand k. MB_k is a MB dummy variable equal to one for MB milk (zero otherwise), M_{ijk} is a vector of retailer strategic characteristics, Z_j is a vector of city-specific effects, RC_{ij} is a vector of retailer configuration characteristics, and ε_{ijk} is an error term.

Note that the price of PL milk in a given market and city is $\alpha \; + \alpha M_{ijk} + \beta Z_j$ while the price of MB milk is $(\alpha_0 + \gamma_0) + (\alpha + \gamma) M_{ijk} + (\beta + \delta) Z_j + \lambda RC_{ij}$. Thus, the empirical measure for the price differential is $\Delta P = P_{mb} - P_{pl}$ is $(\gamma_0 + \gamma M_{ijk} + \delta Z_j)$, hypothesized to be positive. The impact of retail configuration on milk prices is given simply by the vector λ, to which no *a priori* sign expectation is assigned.

Retailers' strategic characteristics include the PL market share, average volume per unit sold, and volume sold under merchandising. PL in-store share is one of the variables of primary interest since it reflects the intensity of PL presence in a given supermarket. To address the problem caused by potential endogeneity of PL share, an instrumental variable for PL in-store share is used.[10]

If there is a positive relationship between retail milk prices and PL share, then the effect of PL on prices can be thought of as being pro-competitive in the sense that it benefits consumers. If the presence of PL increases milk prices, then PL can exhibit uncompetitive behavior. However, it is conceivable that both types of behavior may be present over different ranges of PL expansion. City-specific dummies are included to capture unobserved local effects on retail prices. The price of raw milk is included as cost control.

Retail configuration was defined as consisting of grocery market share, square footage (size), and presence of scanners, deli, bakery, and pharmacy departments and restaurant and bank services. Grocery market share in a given

---

[9] The impact of retail configuration on retail prices hinges on the signs of the derivatives $\partial P_{MB}/\partial s$ and $\partial P_{PL}/\partial s$. For simplicity, consider the case when only one brand (PL or MB) is sold. Solve for profit maximization to obtain an expression for milk prices charged by retailers and then take a partial derivative with respect to s to obtain

$$\frac{\partial P_g}{\partial s} = \frac{1}{2}\left(v_g \frac{V(o;s)}{V(g;s)^2} - \frac{v_o}{V(g;s)} + \frac{\partial w}{\partial s} \right),$$

where g represents either MB or PL, $v_o = \partial V(o;s)/\partial s > 0$ (positive marginal utility even if no milk is purchased) and $v_g = \partial V(mb;s)/\partial s = \partial V(pl;s)/\partial s$ (the marginal utility from a variation in service offered is independent of the type of milk). If $\partial w/\partial s = 0,$ then prices increase if $v_g / v_o > V(g;s)/V(o;s)$. If $\partial w / s > 0,$ then prices are even more likely to increase and if $\partial w / \partial s < 0$ (efficiency/economics of scope case), then prices are more likely to decrease with increase retail services.

[10] The instrument is obtained from the predicted value of regressing PL share on truly exogenous variables such as per capita income, average family size, percentage of population under 18 years, average age, and percentage of the population being hispanic in each city market.

city and square footage capture the traditional effects of market structure, concentration and economies of size. The last five characteristics, on the other hand, include the effects of economies of scope afforded by retail configuration.

The data for retail milk prices and marketing variables at the supermarket level came from the Food Marketing Policy Center of the University of Connecticut, Information Resources Incorporated (IRI) Infoscan database. The raw milk price used is the Federal Milk Marketing Order price prevailing in the city area where a supermarket in the sample was operating and was also provided by the Food Marketing Policy Center. Retail configuration came from two sources. Grocery market shares were extrapolated from annual data from Market Scope. The other retailer characteristics came from a supermarket-specific (custom) CD-Rom by Trade Dimensions (1998). Sample statistics for the retail configuration data used are reported in Table 1.

It is assumed that consumers do not switch between reduced-fat and whole milk due to personal tastes and according to a worldwide trend regarding health and nutrition (Connor, 1994). Accordingly, separate equations are specified for reduced-fat and whole milk.

The data set assembled includes 58 observations (in four-week intervals) at the retailer level including the March 1996 to July 2000 period for the cities of Boston, Chicago, Hartford and New York. Since PL and MB milk are considered separate data points and the sample involved 15 distinct supermarket chains, the complete database to operationalize equation (9) contains 1,740 observations at the supermarket chain level. As (9) is to be estimated for both reduced-fat and whole milk, the parameters of both equations are estimated together using the Seemingly Unrelated Regressions (SUR) technique and SHAZAM 9.0 software. Both nonparametric and parametric results are presented in the following section.

4. Empirical Results

4.1 Nonparametric Results

Nonparametric analysis was used to assess the impact of PL expansion on milk price levels, regressing PL and MB milk prices (reduced-fat and whole) on PL in-store shares.[11] The results are presented in Figures 1 and 2 along with the corresponding weighted average retail and raw milk prices.

The nonparametric results suggest the following:

(1) PL milk prices are always below MB prices, indicating $\Delta P > 0$; (2) an expansion of PL milk has, over certain ranges, a price increasing effect for both PL and MB milk; (3) the average retail price for milk tends to decrease as consumers switch from the higher-priced MB milk to PL milk; (4) pricing in the reduced-fat milk segment seems to follow a pattern somewhat similar to that for the whole milk segment, although the price differentials of the reduced-fat milk segment are approximately twice as large as those for the whole milk segment (average 0.76 v. 0.38 for whole milk); (5) the relationship between MB and PL milk retail prices and the raw milk price is weak; and (6) the relationship between retail milk prices and PL share is nonlinear and complex and can be used in specifying the econometric model.[12]

The last point suggests furthermore that the relationship between milk prices and PL share can be presumed to be polynomial. Likelihood ratio tests were conducted to test for alternative polynomial degrees for PLs in order to choose the best functional form. A cubic specification for PL milk and a fourth degree polynomial specification for MB milk were supported by these tests for both reduced-fat and whole milk. Higher degree polynomials did not significantly add explanatory power, while lower degree ones involved a significant loss of information.

The nonparametric results also suggest that for PL reduced-fat milk, an expansion of PL share initially has a price decreasing effect on PL milk, then moderate price increases and declines and eventually a price-increasing effect as PL becomes predominant. For MB milk, the impact is quite different. Although there is some price moderating effect when PL and MB have about the same in-store share, ultimately the effect is to dramatically raise

[11] Estimation techniques used in nonparametric analysis are based on the search for the best way to construct local averaging (Yatchew, 1998). Another advantage of the nonparametric technique is that there is no need to decide a priori on one particular functional form or what relationship holds between the variables.

[12] As reported for example in Chavas and Cox, (1995, 1997) and Castagnini (1999), the nonparametric analysis may be used to detect from the data itself the best parametric functional form to be used, becoming an interesting and useful tool as a complement to the classic models.

the MB price. The latter suggests a price discriminating effect. One possibility is that retailers segment the market while capitalizing on brand equity of MB milk. Another is that when PL becomes dominant, the only MB left on the shelves often is specialty milk, which is usually sold at much higher prices. These may include organic, hormone-free, and other "healthy" milks such as non-fat "Simply Smart" milk sold under the Hood MB in the Boston and Hartford areas (for approximately $5.50-6/gallon).

4.2 Econometric Results

The econometric results are presented in Table 2. These results conform to a priori expectations in terms of price differentials and retail configuration.

The results for the relationship between PL share and reduced-fat milk prices (based on $\partial P_{ijk} / \partial PLS$) suggest the following. For PL milk, there is an initial price decreasing effect (between 0 and 65% PL share), followed by a price increasing effect in the mid-range of PL share (up to 84%), and then eventually a price decreasing effect (up to 100%). For MB milk, the impact on price is more complex and quite different. Although there is some moderating effect when MB and PL have similar in-store shares (between 45 and 67% PL share), ultimately the effect is to raise the MB price. The latter suggests that there is an element of price discrimination and reinforces the nonparametric findings. The latter result is also consistent with previous work that generally finds a positive correlation between PL market shares and MB prices (e.g., Ward et al., 2002; Putsis and Cotterill, 1999).

The econometric results also indicate that as the average volume per unit increases, the price of milk and the price differentials decrease. Merchandising has the expected price decreasing effect, which is one of the merchandising goals. In terms of city-specific effects, Boston, New York and Chicago exhibit higher fixed effects than Hartford, although price differentials in Boston and New York tend to be lower than those in Hartford. In addition, the price of raw milk was found to significantly affect milk retail prices as well as the PL and MB price differentials.

As for the impact of retail configuration on reduced-fat milk prices, the overall effect of enhanced retail configuration is to increase milk prices, with the exception of the use of scanners and presence of restaurants. It is conceivable that the efficiency effects of using scanners (via saving labor cost and check-out time) outweigh any market power effects, thus decreasing milk prices. It is also conceivable that larger supermarkets tend to use scanners. However, the effect of supermarket size on milk prices was not statistically significant. It is not known why the presence of restaurants (defined in a broad sense as any eatery facility) lowers the price of milk. One possibility is some degree of cannibalization or competition between supermarkets and restaurants (Binkley and Connor, 1996).

Note that grocery market share in a given city did not significantly affect reduced-fat milk prices. This suggests that the traditional market structure variable did not play a role in terms of increasing market power. Also note that milk prices were not affected by the size of the supermarket, suggesting that economies of scope, as represented by other retail configuration features, is more important than economies of scale, as represented by supermarket size.

Most of the estimated coefficients for whole milk are similar in sign, but not in magnitude, to those estimated for reduced-fat milk. Even though we assumed that consumers do not shift preferences between whole and reduced-fat milk, it seems instead that retailers follow a similar pricing strategy for both products and that retail configuration variables affect the prices of both in a similar manner. Overall, one important difference is that price differentials and price levels for reduced-fat milk are larger than those for whole milk. This may be due to consumers' willingness to pay for healthier products containing a lower fat content, especially among high income households (Kim and Cotterill, 2003).

5. Concluding Remarks

This paper focused on two contemporary issues affecting the performance of food retailing: the expansion of private labels and of food retailer services. Specifically, it assessed the impact of private labels and retail configuration on fluid milk prices using IRI data from four cities. An econometric model, based on Shepard's (1991) model, was estimated for reduced-fat and whole milk using 1,740 supermarket-level observations.

The impact of private label expansion was analyzed via nonparametric and parametric methods with in-store PL shares ranging from nearly zero to 100%. The empirical results pointed out that although the price of private label milk is below that of manufacturer brand milk, an expansion of PL milk generally increases the prices of both. However, both pro-competitive and counter-competitive effects on fluid milk prices were evident over a wide range of PL presence.

The impact of retail configuration (scanners; deli, pharmacy, and bakery departments; restaurant and bank services; size and grocery market share) on fluid milk prices was generally positive as high service supermarkets charged higher prices for the same milk. With the exception of scanners and restaurant services, additional retail configuration features increased prices. Furthermore, the scope of services was more significant in determining fluid milk prices than supermarket size or grocery market share.

References

Barron, J. H., B. A. Taylor, and J. R. Umbeck. "A Theory of Quality-Related Differences in Retail Margins: Why There Is a 'Premium' on Premium Gasoline." *Economic Inquiry* 38 (2000): 550-569.

Barsky, R., M. Bergen, S. Dutta, and D. Levy. "What Can the Price Gap Between Branded and Private Label Products Tell Us About Markups?" Working Paper 8426, National Bureau of Economic Research, Cambridge, MA, 2001.

Berto Villas-Boas, S. *Vertical Relationships Between Manufacturers and Retailers.* Ph.D. Dissertation, University of California at Berkeley, 2002.

Binkley, J. K. and J. K. Connor. "Market Competition and Metropolitan-Area Grocery Prices." Regional Research Project NE-165, Working Paper No. 44, 1996.

Bontems, P., S. Monier-Dilhan, V. and Réquillart. "Strategic Effects on Private Labels." *European Review of Agricultural Economics* 26(1999):147-165.

Castagnini, R. "Specification of Demand System: Using Nonparametric and Parametric Techniques." Selected Paper by the Annual Meeting of the American Agricultural Economics Association, Nashville, Tennessee, August 8-11, 1999.

Chavas, J. P. and T. L. Cox. "On Nonparametric Supply Response Analysis." *American Journal of Agricultural Economics* 77(1995): 80-92.

______ "On Nonparametric Demand Analysis." *European Economic Review* 41(1997): 75-79.

Chidmi, B., R.W. Lopez, and R.W. Cotterill. "Retail Oligopoly Power and Fluid Milk Prices in Boston." Selected Paper, American Agricultural Economics Association Annual Meetings, Montreal, Canada, July 27-30, 2003.

Connor J. M. "North America as Precursor of Changes in Western European Food-Purchasing Patterns." *European Review of Agricultural Economics* 21(1994): 155-73.

Cotterill, R.W. "Market Power in the Retail Food Industry: Evidence from Vermont." *Review of Economics and Statistics* 68 (1986):379-386.

Cotterill, R. W. and W. P. Putsis, Jr. "Do Models of Vertical Strategy Interaction for National and Store Brands Meet the Market Test?" *Journal of Retailing* 77(2001): 83-109.

Dhar, Tirtha P. "Two-State Oligopoly Pricing with Differentiated Product: The Boston Fluid Milk Market." University of Connecticut, Storrs, Ph.D. Dissertation, 2001.

Du Wors, R. E. Jr, and G. E. Haines, Jr. "An Investigation Into the Order of the Brand Choice Process." *Journal of Marketing Research* 27(1990):485–493.

Galizzi, G., L. Venturini, and S. Boccaletti. "Vertical Relationships and Dual Branding Strategies in the Italian Food Industry." *Agribusiness* 13(1997):185–195.

Hoch, S. J. and B. Banjeri. "When Do Private Label Succeed?" *Management Review* 34 (1993): 56-67.

Jaskold-Gabsewich, J. and J. F. Thisse. "Price Competition, Quality and Income Disparities," *Journal of Economic Theory* 20(1979): 340–59.

Kaufman, P. R. "Food Retailing" In *The U.S. Food Marketing Sytem,* 2002, J.M. Harris, P.R. Kaufman, S.W. Martinez, and C. Price, contributors, Economic Research Service/USDA, Agricultural Economic Report No. 811, June 2002.

Katz, M.L. "Vertical Contractual Relations." In *Handbook of Industrial Organization*, Volume I, R. Schmalansee and R.D. Willig, eds. Amsterdam: North Holland, 1989, pp. 655-721.

Kim, D. and R.W. Cotterill. "Estimation of the Effects of New Brands on Incumbents' Profits and Consumer Welfare." Working Paper, Department of Agricultural and Resource Economics, University of Connecticut, April 2003.

Kinsey, J. and B. Senauer. "Consumer Trends and Changing Food Retailing Formats." *American Journal of Agricultural Economics* 78(1996):1187–1191.

Messinger, P. R. and C. Narasimhan. "A Model of Retail Formats Based on Consumers' Economizing on Shopping Time." *Marketing Science* 16(1997):1- 23.

Mills, D. E. "Why Retailers Sell Private Label." *European Review of Agricultural Economics* 26(1995): 125-145.

______"Private Label and Manufacturer Counterstrategies." *Journal of Economic Management and Strategy* 4(1999): 509-528.
Narashiman, C. and T. R. Wilcox. "Private Label and Channel Relationship." *Journal of Business* 71(1998): 573-600.
Pierce, J. J. "Low-Fat and Premium Drive PL Dairy Sales." *Private Label Magazine*, July-August, 2002. Accessed online on June 6, 2003 from:
www.privatelabelmag.com/pdf/july_august_2002/low_fat.cfm
Popowshi Leszczcy, P.T.L. and F.F. Gönül. "Multiple Ways of Measuring Brand Loyalty." *The Canadian Journal of Economics* 29(1996): S494 – S497.
Private Label Manufacturer Association. Homepage. Accessed online on June 6, 2003 from: www.plma.com/storebrands/sbt.html
Putsis, W. P., Jr. "An Empirical Study of the Effect of Brand Proliferation and Private Label-National Brand Pricing Behavior." *Review of Industrial Organization* 12(1997):355-371.
Putsis, Jr., W. P. and R. W. Cotterill. "Share, Price and Category Expenditure – Geographic Market Effect and Private Labels." *Managerial and Decision Economics* 20(1999): 175-187.
Shepard, A. "Price Discrimination and Retail Configuration." *Journal of Political Economy* 99(1991): 30– 53.
Sinha, I., Rajeev and R. Batra. "The Effect of Consumer Price Consciousness on Private Label Purchases." *International Journal of Research in Marketing* 16(1999): 237–251.
Trade Dimensions. *Information Resources, Inc. (IRI) Infoscan Data on Milk Markets*. Custom CD, Wilton, Connecticut, 1998-2000.
______. *Food Retailer Characteristics.* Custom CD, Wilton, Connecticut, 1998.
_______. *Market Scope.* Wilton, Connecticut, 1998-2000.
U.S. General Accounting Office. *Dairy Industry: Information on Milk Prices and Changing Market Structure.* Report GAO-01-561. Washington, D.C., June 2001.
Vickers, J., and M. Waterson. "Vertical Relationship: An Introduction." *Journal of Industrial Economics* 39(1991): 445-450.
Ward, M. B., J. P. Shimshack, J. M. Perloff, and M. Harris. "Effects of the Private-Label Invasion in Food Industries." *American Journal of Agricultural Economics* 84(2002): 961 – 973.
Yatchew, A. "Nonparametric Regression Techniques in Economics." *Journal of Economics Literature* 36(1998): 669–721.

Figure 1. Nonparametric Results for Low-Fat Milk

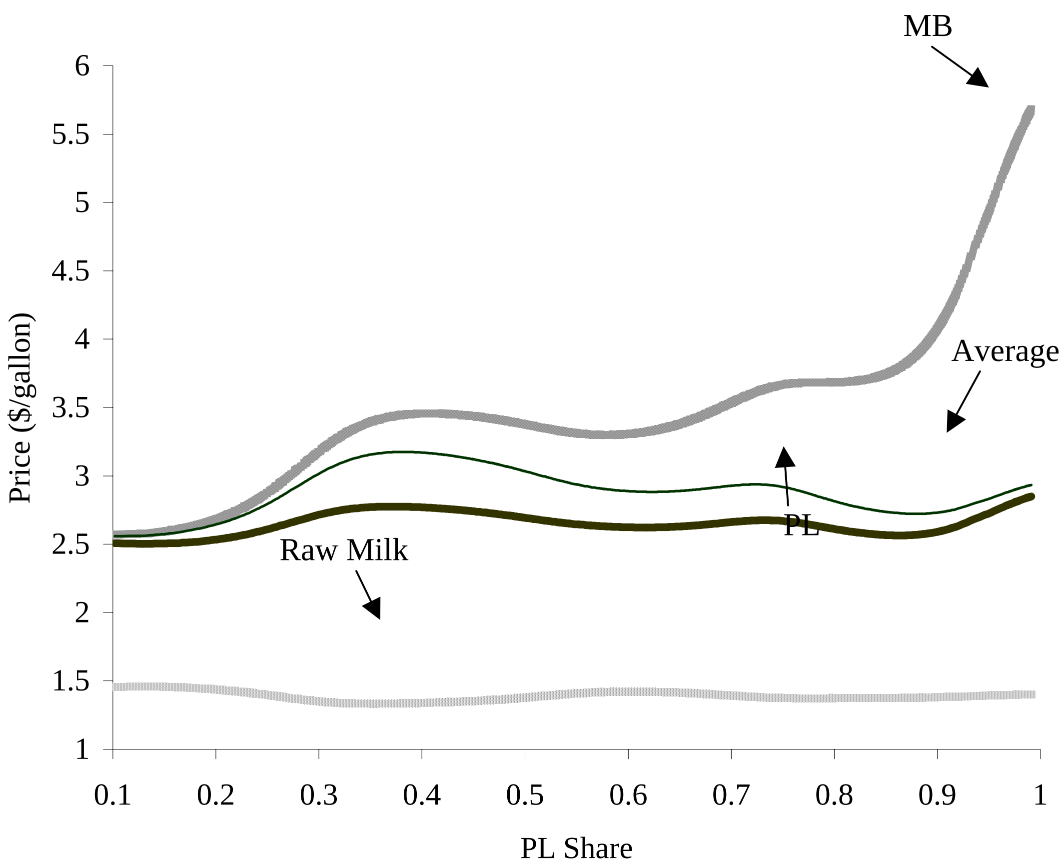

Figure 2. Nonparametric Results for Whole Milk

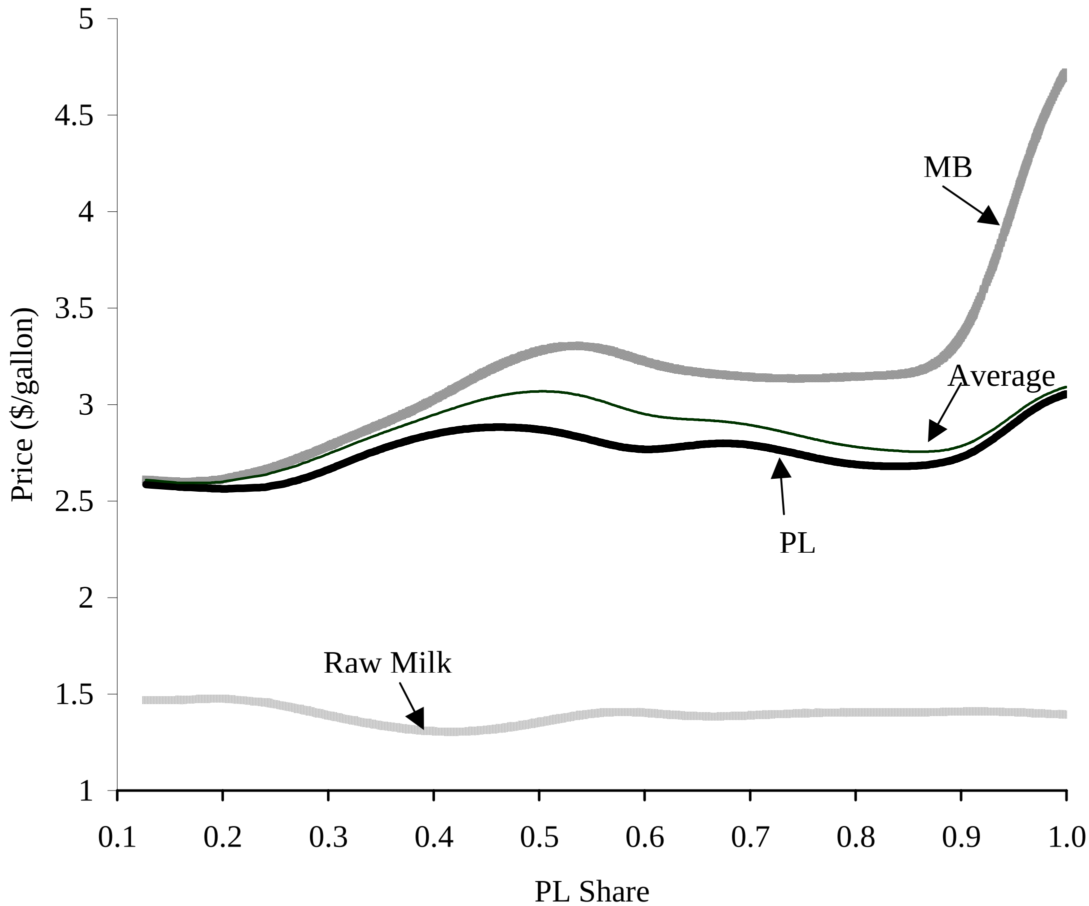

Table 1. Average Food Retailer Chain Characteristics

	PL Share Red.-fat	PL Share Whole	Grocery Market Share	Square Footage (1000)	Scanner	Deli	Bakery	Pharmacy	Restaurant	Bank
Boston:								Percentages		
Demoulas	0.8618	0.8575	12.5245	40.5862	96.5517	96.5517	51.7241	0.0000	3.4483	89.6552
Shaws	0.6413	0.7488	16.7500	40.8980	93.8776	97.9592	97.9592	32.6531	16.3265	75.5102
Starmarket	0.4337	0.5655	13.5768	38.1778	95.5556	95.5556	95.5556	37.7778	35.5556	86.6667
Stop & Shop	0.6327	0.7368	26.5683	83.4355	91.9355	91.9355	74.1935	48.3871	12.9032	72.5806
Others	0.2232	0.2996	30.5804	20.9853	83.8235	94.1176	83.8235	2.9412	7.3529	67.6471
Average Boston	*0.5585*	*0.6416*	*0.6942*	*44.8165*	*92.3488*	*95.2239*	*80.6512*	*24.3518*	*15.1173*	*78.4119*
Chicago:										
Dominick's	0.9777	0.9761	25.6770	44.5664	92.0354	91.1504	91.1504	79.6460	29.2035	91.1504
Jewels	0.5837	0.5300	35.6308	45.4720	98.7578	97.5155	97.5155	86.3354	4.3478	57.7640
Others	0.8196	0.7665	38.6923	16.7322	76.9874	85.7741	65.2720	5.0209	12.1339	43.5146
Average Chicago	*0.7937*	*0.7575*	*0.6131*	*35.5902*	*89.2602*	*91.4800*	*84.6460*	*57.0008*	*15.2284*	*64.1430*
Hartford:										
Stop & Shop	0.6949	0.8096	37.9961	48.7457	94.9152	96.6101	86.4406	74.5762	15.2542	88.1355
Others	*0.5692*	*0.6582*	62.0039	26.9603	74.2574	93.5644	81.6832	22.7723	13.3663	54.4554
Average Hartford	0.6321	0.7339	N.A.	37.8530	84.5864	95.0872	84.0619	48.6742	14,3102	71.2955
New York City:										
A&P	0.7559	0.8545	6.3367	25.7179	66.6667	84.6154	74.3590	23.0769	2.5641	33.3333
Grand Union	0.3654	0.4719	8.2310	21.4194	64.5161	96.7742	58.0645	12.9032	3.2258	29.0323
Pathmark	0.8562	0.6669	14.5085	41.9130	100.0000	86.9565	82.6087	89.1304	10.8696	50.0000
Waldbaum	0.5518	0.5934	6.5507	31.7500	97.2222	100.0000	63,8889	27.7778	0.0000	58.3333
Others	0.4557	0.4141	64.3730	22.3273	74.4604	75.1799	55.7554	11.5108	6.8345	40.6475
Average NYC	*0.5970*	*0.6002*	*0.3563*	*28.6255*	*80.5731*	*88.7052*	*66.9353*	*32.8798*	*4.6988*	*42.2693*

Table 2. Econometric Results for Supermarket Fluid Milk Prices

	Reduced-fat Milk			Whole Milk		
Variable	Private Label	MB Incremental Effect	Manuf. Brand	Private Label	MB Incremental Effect	Manuf. Brand
Marketing Variables						
Constant	23.412** (10.549)	-123.15*** (33.711)	-99.742*** (35.436)	-124.45*** (25.709)	366.04*** (80.919)	241.59*** (82.93)
PL Share (PLS)	-134.26*** (44.826)	775.81*** (208.24)	641.55*** (218.04)	524.36*** (113.29)	-2114.3*** (478.99)	-1589.9*** (492.92)
PLS^2	183.12*** (67.910)	-1759.1*** (485.11)	-1586.0*** (503.90)	-784.62*** (168.99)	4594.8*** (1079.8)	3810.1*** (1111.6)
PLS^3	-81.857** (33.370)	1772.0*** (503.36)	1690.1*** (514.35)	387.22*** (83.638)	-4426.2*** (1097.7)	-4309*** (1118.5)
PLS^4		-658.39*** (195.35)			1595.1*** (423.32)	
Average vol. per unit	-0.13642 (0.10867)	-1.7450*** (0.17104)	-1.8814*** (0.13713)	-0.84894*** (0.19294)	-1.5461*** (0.21477)	-2.3950*** (0.12225)
Merchandising	-0.002247*** (0.0002681)	-0.000885*** (0.00035616)	-0.003132*** (0.00027649)	-0.002201*** (0.00023034)	0.0006753** (0.00032272)	-0.0015258*** (0.0022484)
City Specific Effects						
Boston	8.3129*** (0.52332)	-1.1325*** (0.14429)	7.1804*** (0.49503)	9.5850*** (0.72070)	-0.94969*** (0.12921)	8.6353*** (0.66784)
New York	9.4599*** (0.50082)	-0.85407*** (0.13366)	8.6058*** (0.47874)	9.7034*** (0.71245)	1.0191*** (0.181)	8.6843*** (0.67425)
Chicago	5.5008*** (0.3456)	0.23593 (0.22395)	5.7362** (0.26963)	5.5082*** (0.34429)	0.085362 (0.10009)	5.5936*** (0.34306)
Raw Milk Price	0.12142*** (0.039568)	-0.041144 (0.055292)	0.080278* (0.38873E-01)	0.17108*** (0.037343)	-0.022491 (0.052434)	0.14859*** 0.14859
Retail configuration						
Grocery Mk. Share	-0.00016759 (0.0001768)	-	-0.00016759 (0.0001768)	-0.00015773 (0.00016911)	-	-0.00015773 (0.00016911)
Size	-0.000039257 (0.00002736)	-	-0.000039257 (0.000027364)	-0.00002711 (0.000026023)	-	-0.00002711 (0.000026023)
Scanner	-0.12636*** (0,0070012)	-	-0.12636*** (0,0070012)	-0.12485*** (0.0083797)	-	-0.12485*** (0.0083797)
Deli Department	0.027841*** (0.004314)	-	0.027841*** (0.004314)	0.027555*** (0.0042942)	-	0.027555*** (0.0042942)
Bakery Department	0.021042*** (0.004314)	-	0.021042*** (0.004314)	0.016283*** (0.0036829)	-	0.016283*** (0.0036829)
Pharmacy	0.027152*** (0.0031094)	-	0.027152*** (0.0031094)	0.029351*** (0.32378)	-	0.029351*** (0.32378)
Restaurant	-0.048728*** (0.0045872)	-	-0.048728*** (0.0045872)	-0.050528*** (0.47334)	-	-0.050528*** (0.47334)
Bank	0.099833*** (0.0045603)	-	0.099833*** (0.0045603)	0.092447*** (0.0056012)	-	0.092447*** (0.0056012)

Notes: One, two and three asterisks indicate 10, 5 and 1% level of significance. Note that the retail configuration estimates are repeated in the PL and MB columns.

FOOD MARKETING POLICY CENTER
RESEARCH REPORT SERIES

This series includes final reports for contract research conducted by Policy Center Staff. The series also contains research direction and policy analysis papers. Some of these reports have been commissioned by the Center and are authored by especially qualified individuals from other institutions. (A list of previous reports in the series is given on the inside back cover.) Other publications distributed by the Policy Center are the Working Paper Series, Journal Reprint Series for Regional Research Project NE-165: *Private Strategies, Public Policies, and Food System Performance*, and the Food Marketing Issue Paper Series. Food Marketing Policy Center staff contribute to these series. Individuals may receive a list of publications in these series and paper copies of older Research Reports are available for $20.00 each, $5.00 for students. Call or mail your request at the number or address below. Please make all checks payable to the University of Connecticut. Research Reports can be downloaded free of charge from our website given below.

Food Marketing Policy Center
1376 Storrs Road, Unit 4021
University of Connecticut
Storrs, CT 06269-4021

Tel: (860) 486-1927
FAX: (860) 486-2461
email: *fmpc@uconn.edu*
http://www.fmpc.uconn.edu