Understanding Dynamic Retail Competition Through the Analysis of Strategic Price Response Using Time Series Techniques♣

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Abstract: This paper analyzes strategic retail pricing behavior in fluid milk in Boston and New York market using reduced form time series analysis. Pricing in Boston market is found to be more strategic than in the New York market. Plausible reasons can be due to retail pricing laws, ownership structures of retail chains, and brand loyalty. This paper also looks at the impact of North East Dairy Compact on retail pricing in Boston. Strategic pricing behavior in the Boston market changed dramatically and became less competitive after the Compact.

Key Words: Fluid Milk, Retail Competition, North East Dairy Compact, Oligopoly, Focal point pricing.

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"Retail prices are frequently regarded as exceptions both to the law of costs and generally to every rational process of price formation, which is all the more remarkable since these prices are the only ones which are of direct interest to the consumer and which are directly influenced by consumption."- (Knut Wicksell)

ˉ A quote from Tucker, K. A., and Yamey, B. S., (1973), 'Economics of Retailing' (Penguin Modern Economics Readings).

Introduction

During the recent decade supermarket concentration has gone up dramatically. Some of the largest supermarket mergers in history have been announced in the past few years. In 1992, the top five supermarket chains had 19% of the market; in 1999 that share has almost doubled to 33%. In fact the food-retailing sector faced the largest number of antitrust reviews by the Federal Trade Commission (FTC) next only to the pharmaceutical industry in recent years (Balto, 1999). Thus a better understanding of retail competition is important for economic policies, especially for analyzing issues related to merger and antitrust enforcements. But recent theoretical and empirical economics have little to say about retailing. The theories of production and pricing have mainly concentrated on manufacturing firms and they do not readily translate to the case of retailing. Empirically there are few papers that really looked at the nature of retail competition. Exceptions include Holdren (1960), Marion et al. (1979), Cotterill (1986), Baumol et al. (1964) and Slade (1995).

In this paper, we first explain some of the basic structures of retail competition and then empirically analyze oligopolistic retail competition using recently developed econometric technique of the panel vector auto regression (P-VAR). Rather than analyzing pricing strategies for a basket of supermarket groceries we look at the strategic pricing behavior within a significant product category (i.e. fluid milk) among the top four (in terms of market share) retail chains in two major retail grocery markets (Boston and New York). The reason for choosing fluid milk as the category is because milk is known as the 'loss-leader' or significant category for building 'store traffic' in the marketing literature and in retail trade journals. Pricing in this type of product category is designed to lure the purchasers into stores and 'should reflect careful deliberation and consideration of any retailers competitive position' (Baumol et al., 1964). As a result, study of the fluid milk category addresses strategic competition among chains more directly than a study of less visible categories. More narrowly construed, this is a study of retail competition in a significant product category such as fluid milk.

In the case of Boston market, the period of study also includes the Northeast Dairy Compact. In July of 1997, the North East Dairy Compact Commission established an over-order price premium for dairy farmers. Such premium led to a virtual price floor for the price of raw milk in the New England region. A study by Cotterill et al. (2000) strongly suggest there was significant shift in the nature of retail competition between the pre- and post-Compact period. We explore this issue of structural change by studying the pricing structure during pre- and post-Compact period for the Boston market.

We use the Information Resources Incorporated (IRI)-Infoscan database available at the Food Marketing Policy Center-University of Connecticut, on retail fluid milk and milk substitute category.[1][i] This database is four dimensional, containing price and promotional information over: city (Boston and New York), time (by months), retail chains (top four retail chains within the market) and brands (by skim/Low fat and whole milk). Our database for Boston market contains data for the period of March 1996 to July 2001. For the New York market the data are from March 1996 to July 1998. So, our results on New York market and Pre-compact Boston are comparable given the same time frame.

In terms of empirical implementation, this paper is similar to Bauamol et al. (1964) and Cotterill et al. (1999). Compared to the earlier studies, our statistical approach is much more evolved in terms of applying advances in dynamic time series analysis to take advantage of the panel nature of our database.

Theories and empirics of Retail Competition

In this section, we review theories of retail competition and expand the reasons for choosing fluid-milk pricing as the category to understand the dynamics of retail competition.

One of Wicksell's key concepts for retailing was *'joint supply'*. It is the *'jointness'* of sales that provide the distinctive feature of a retail store, not *'jointness'* of production. His concept of *'jointness'* in recent years has evolved into the theory of the cluster-market. In a cluster-market a set of services and products are put together in a single location and aggregated to reduce transaction costs (Blumenthal and Cohen, 1998). Blumenthal and Cohen (1998) explain that a cluster market is viable if: (1) the distribution channel is characterized by repeat purchases; (2) the average value of any individual component of the cluster is low relative to the cost of de-clustering; and (3) the goods do not require significant search cost. Supermarkets operate as a cluster-market and similar to cluster-markets in hospital services, banks, and general department store retailing.

One of the implications of clustering is that consumers in a cluster-market shop for a bundle of goods. And within this bundle, products can be divided into two groups: necessities purchased on every shopping trip and impulse and infrequent purchase items. And it is easier for consumers to do comparison-shopping on those products that are bought on every shopping trip. The product of our study: Fluid milk is one such product. Also from the supply side perspective, given the sheer number of products on a supermarket grocery store shelves (a typical chain supermarket carries over 30,000 items), it may not be possible for a retail store manager to consider the pricing behavior of her competitors for each and every product. So, if there exists strategic price competition between retailers, it occurs on a limited set of products.

In terms of the nature of competition, Baumol et al. (1964) did attempt to empirically test for a few types of conjectured oligopolistic interdependence. They use the following types of oligopolistic interdependence to develop testable hypotheses: *reacting oligopoly* (the prototypes of this analysis are the Cournot-Bertrand-Edgeworth models), *imitating or differentiating oligopoly* (this is a special case of the first), *gaming oligopoly* (most recent developments of oligopolistic theory are in this area) and *pseudo-independent oligopoly* (the basic assumption is that many retailers ignore their competitors when making routine decisions on their weekly and monthly pricing even though retailers might not be unaware of their competitors' existence). In the empirical section of the paper, they use price data from weekend newspaper inserts from

Philadelphia for four retail chains in 1961-62. This study found mixed bag of results in terms of price competition between different supermarkets.

In one of the more recent studies of price conduct of grocery chains, Cotterill et al. (1999) use a large scale scanner database and demonstrate that supermarket do, in some situations, compete on prices in Connecticut. Competitive pricing occurs as strategic response to entry. In an earlier study of Vermont's retail food industry, Cotterill (1986) demonstrated that prices are significantly higher in more concentrated markets implying exertion of oligopolistic market power.

On the other hand, there are quite a few recent studies in the economics and marketing science literature that treat retailers as 'localized monopolies' (i.e. the fourth type of game as suggested by Baumol et al.). Slade (1995), in her study of supermarket competition interviewed grocery chain managers, who reported that the vast majority of households (over 90%) do not engage in comparison shopping by visiting several stores to seek out the best deal on a particular product. Empirically within a category her study demonstrates that sales within one chain are unaffected by prices at other chains, suggesting pricing *independence* across rival chains. This is also consistent with the work of Walters and Mackenzie (1988), who use data across all grocery items sold by two retailers in a local market. Both the Slade, and Walter and Mackenzie studies are based on small geographic areas involving less than four chain stores.

In this paper, we first test whether grocery supermarkets do react to each other's prices using the concept of Granger causality. The basic hypothesis is that supermarket competition in prices is of the two types: 'reacting oligopoly' or otherwise 'pseudo-independent oligopoly'. Secondly, if they do react we then ask is the reaction instantaneous (within a month), or is it dynamic (lagged by months)? Once we find the pattern of strategic interactions between retailers, we then use information from other sources to identify the causes and reasons for observed response patterns. Given the signs and directions of causality, we construct the Table 1 on nature of retail competition. All the inferences are based on the implicit assumption that the underlying cost structures for the products in analysis are not significantly different from each other.

In the first case ([1] in Table 1) of symmetrically positive causality in oligopolistic market implies either collusive pricing (either tacit and explicit) or otherwise independent pricing by each retailer based on underlying cost structure. In both cases any oligpolistic player in the market will be able raise it's profit level from the situation where it competes aggressively (negative price response). On the other hand, symmetric negative causality (i.e. bi-directional) clearly suggests competitive oligopolistic pricing ([2] in Table 1). If negative response is unidirectional ([3] in Table 1) then that may suggest weaker form of oligpolistic competition.[2][ii] Such pricing for a large or a maverick firm can be for the purpose of gaining market share, and for a weaker firm it can be for the purpose of maintaining market share from the onslaught of large and powerful firms. In the case of unidirectional positive causality ([4] in Table 1) there can be non-cooperative leader-follower relationship between a dominant firm and a smaller follower (fringe firm) otherwise a tacit understanding between two firms to develop such leader-follower relationship. And lastly symmetric causality with opposite signs ([5] in Table 1) makes it difficult to ascertain the nature of the competition. In such a case we will have to depend on other market related information.

<u>*Database:*</u>

In the empirical estimation, from the IRI-Infoscan database we use the following variables for brands of milk sold through different retail chains: dollar sales, volume sales, percentage volume under any merchandising and weighted average of percentage price reductions (of any types of price reduction). These variables are assumed to explain strategic dynamics on the demand side.

For the Boston market we have data from the top four grocery supermarket chains: Stop & Shop, Shaw's, Star Market and DeMoulas. And for New York we have data from: A&P, Grand Union, Path Mark and Waldbaum's.

Within each retail chain to generate the panel data for estimation, we use only the top six fluid milk brands (three each from skim/low fat and whole milk category) to obtain clearer picture on strategic price changes for a fixed set of brands rather than price changes due to variation in brands sold over time. These top three brands for any single chain controls almost 90% of fluid milk disappearance. The remaining brands each have insignificant market share, in most cases less than 0.5% market share. Detailed description of these top brands is presented in the next section.

To instrument for the supply side we use Federal Milk Marketing Order (FMMO) milk price series for New York and Boston. This price reflects the raw fluid milk paid by processors to farmers.

Structure of the Boston and New York Retail Market:

We chose Boston and New York for our study because both cities are close enough to have similar milk economies. They have similar sources of milk, processing technologies, climate, per capita income, supermarket concentration and household size. In terms of marketing area, Boston and New York are two of the largest retailing markets in the US. In terms of grocery store sales, New York is ranked 2nd and Boston 6th. And in terms of percentage of supermarket sales of all food sales both cities are close to around 80%.

In terms of ownership structure, two of the biggest chains in the Boston market and two in New York (both A&P and Waldbaum's) are owned by a European retail giant. In the Boston market, Stop &Shop is owned by the Dutch retail giant Royal Ahold and Shaw's by the British retail giant Sainsbury. In the New York market both A&P and Waldbaum's are owned by the German retail giant Tengelmann. All of these corporate European retail giants have a stated policy of aggressive market expansion in the US and due to their size they have the resources to compete vigorously in any market. Also, two of the retailers in the New York market (Pathmark and Grand Union) and one in Boston (Star Market) were highly leveraged during the period of our study. DeMoulas in Boston is the only privately held retail chain and due to ownership disputes is financially a much weaker player.

In the New York market, although A&P and Waldbaum's are owned by the same corporate entity, separate management runs them. Tengelmann-the German owner of the two chains does not have any immediate plan to integrate them. On the other hand, in the Boston market Star Market has been acquired by Sainsbury (parent of Shaw's) in 1998, and currently is in the process of integrating the operations of the two retailers. In the long run, Sainsbury plans to re-banner all the Star Market stores under Shaw's. Recently (November 2000) in the New York market, Grand Union went into its third bankruptcy in as many years, and Pathmark is in the process of recovery after massive debt restructuring.

So, in terms of financial resources, Stop & Shop and Shaw's (in the post-Compact period it is thee merged Shaw's and Star Market) are the most powerful players in the Boston market. In the New York market the powerful players are A&P and Waldbaum's.

In terms of pricing mechanism in the Boston market, during the period of our study, Shaw's offered 'Every Day Low Price' (EDLP) and the rest of the retailers used a 'High-Low Price' (Hi-Lo) pricing strategy.[3][iii] Interestingly, very recently after the period of our study, Shaw's has moved out of the EDLP scheme to Hi-Lo pricing.

Table 2 and 3 presents the market share (of total supermarket sales) for the top four retail chains in Boston and New York. In terms of market share, for the period of our study Stop & Shop is the biggest gainer in the Boston market. The other retailers marginally lost market share. In the New York market, except for A&P, every one lost market share, especially Pathmark and Grand Union (loss of 1.7% and 0.8% respectively).

Table 2 shows the market share (in terms of total volume sales) in the Boston market for the period of our study. Market leader Stop & Shop gained and had upward trend for the full period of our study. Shaw's and Star Market's market share declined for the last few months of the period of our study. Similarly, Table 3 shows the market shares of retailers of the New York market. In New York, Pathmark gained market share. A&P's share remained at a steady level for most of the period though their share started to pick-up from January 1998. Grand Union and Waldbaum's share fell very steadily throughout the period of our study.

Table 4 presents shares for the fluid milk brands used in this study. In terms of brand composition New York and Boston market are quite different. Unlike in the New

York market, Boston shows a consistent pattern of brand shares. The top three brands are the same (Private label, Garelick and Hood) in each retail chain. In both the Skim/Low fat and Whole milk subcategories private label is the brand share leader. Garelick and Hood are the 2nd and 3rd ranked brands for Stop & Shop, Shaw's and Star Market. In the case of skim/low fat milk sold at DeMoulas, the ranking of Garelick and Hood flips.

On the other hand, in the New York market the top three brands are not the same in each retail chain. For example, Sealtest-whole milk, the number three brands in A&P, is not even carried by the market share leader Pathmark. Even private label, which is overwhelmingly the number one brand in Boston market, is the number-two brand in New York Grand Union. Some specialty brands also show up on the New York top three lists. Morning Star (Lactaid milk), a milk brand that caters mainly to the people with lactose intolerance is the number-three brand for Pathmark, Grand Union and Waldbaum's. This may be due to the fact that New York has significant minority population and lactose intolerance is much more prevalent especially among ethnic Hispanics and blacks. Given the fact that the brand share matrix is much more heterogeneous in New York market than in the Boston market, we define the New York market as a market with 'weak brand presence' whereas Boston has 'strong brand presence'.

Table 5 presents statistics on brand price. The average price of fluid milk is lower in Boston than in New York, even for the private label brands, which dominate market share in each retail chain except in Grand Union. In our database higher priced milk has a higher standard deviation. This may be due to the fact that higher priced brands have more price-reducing merchandising than other brands. In our empirical analysis we do control for the effect of merchandising on price.

In terms of retail pricing of fluid milk, New York also has a unique price gauging law. The law states that the retail price cannot be greater than 200% of the farm level milk at least for one of the brand in store shelf. For example, if the farm level milk price is $1.00 then the retail price for at least a single brand in a store has to be less than $2.00. The price gauging law provides a convenient price point for the retailers lowest price brands.

The Model

Our New York and Boston market have 32 and 58 observations respectively. We take advantage of the richness in information content of the four dimensional database by developing data panel by stores brands, following the frame work similar to the one developed by Holtz-Eakin et al. (1989). Due to highly disaggregate nature of the data the present model will be able capture the brand level variations within each market. In the following section we describe the Panel VAR of the model:

Let,

[1] $$P_t^{k1} = \left[p_{1t}^{k1},\ldots\ldots,p_{Nt}^{k1}\right]', P_t^{k2} = \left[p_{1t}^{k2},\ldots\ldots,p_{Nt}^{k2}\right]', P_t^{k3} = \left[p_{1t}^{k3},\ldots\ldots,p_{Nt}^{k3}\right]' \text{ and}$$

$$P_t^{k4} = \left[p_{1t}^{k4},\ldots\ldots,p_{Nt}^{k4}\right]'$$

where, $p_{1t}^{k1},\ldots,p_{Nt}^{k1}$ represent the prices of brands *1* to *N* in retailer *k1*. Brand prices are similarly stacked for retailer *k2*, *k3*, and *k4*. To capture brand specific unobservable (to econometrician) strategic non-price effects we define a vector of two-dimensional Store-Brand binary as $\partial^{k1} = \left[\delta_1^{k1},...,\delta_N^{k1}\right]$. As a result, each of the six brands sold through a retail chain will have a unique binary variable. Examples of these unobservable effects can be a form of strategic premium that a retailer can generate over it's competitors due to location advantages or superior store level amenities. Binaries for other retailers are constructed in the similar manner. Given the above panel structure, we can define our P-VAR equations in vector form:

[2] $$P_t^{k1} = \sum_{l=1}^{m} P_{t-l}^{k1} + \sum_{l=0}^{m} P_{t-l}^{k2} + \sum_{l=0}^{m} P_{t-l}^{k3} + \sum_{l=0}^{m} P_{t-l}^{k4} + \partial^{k1} + u_t^{k1}$$

$l = 0\ to\ m$ represent the lag structure.

u_t^{k1} represent the error structure for the price equation.

and $t = 1,..., 32$ represents the time period of the study

We assume the lagged price to be pre-determined and therefore exogenous to the system. Similar to Eakin et al. we also assume that the error structure satisfies the following condition:

[3] $$E\left[P_s^{k1}u_t^{k1}\right] = E\left[P_s^{k2}u_t^{k1}\right] = E\left[\delta^{k1}u_t\right] = 0, \text{ for } s < t.$$

In our specification of the P-VAR there is a potential problem of simultaneity bias because of the presence of the current price of other retailers in the equation. Retail price movement at any point of time can be due to three reasons: demand induced price movement (for example: demand surge due to change in consumer preference may lead to increase in price), price movement due to a cost shock (for example: farm level milk price may go up due to bad weather), price movement for strategic reasons (for example: a competing firm may decrease price to poach market share from other firms).

In this model current retail prices are endogenous. We instrument the current retail price with the supply side and strategic decision variables of the retailers. The implicit assumption is that the supply price of farm milk and demand side promotional variables are exogenously determined but highly correlated with current retail prices of the rest of the players in the market. As a result instrumented retail price is purged of any demand induced price movement that can generate potential endogeneity problem in regression analysis. This approach to instrumenting retail price is similar to Nevo (1997), and Hausman et al. (1994). So, our estimated system of equation can be written as:

$$[4] \quad P_t^{k1} = \sum_{l=1}^{m} \beta_l^{k1} P_{t-l}^{k1} + \alpha^{k2} \hat{P}_t^{k2} + \sum_{l=1}^{m} \beta_l^{k2} P_{t-l}^{k2} + \alpha^{k3} \hat{P}_t^{k3} + \sum_{l=1}^{m} \beta_l^{k3} P_{t-l}^{k3} + \alpha^{k4} \hat{P}_t^{k4} + \sum_{l=1}^{m} \beta_l^{k4} P_{t-l}^{k4} + \partial^{k1} + u_t^{k1}$$

where, $\hat{P}_t^{k2}$, $\hat{P}_t^{k3}$, $\hat{P}_t^{k4}$ are the vector of instrumented retail current price of retailer 2, 3 and 4. α's and β's are the parameters to be estimated.

Our preliminary OLS regression analysis suggests that the relationship between farm level milk price and retail price is not linear. So, to capture the non-linear effect, we also use the squared farm level milk price. Following suggestion of Berry (1994), we use price reduction and merchandising variables of each of the retailers as instruments for each current period retail-price series. We lag the price reduction and merchandising data by two periods to control for any strategic residual effect. For example, successful merchandising in the previous period may generate lasting good will to influence the consumer in the current period. We also use Federal Milk Marketing Order Class-I price series as the farm level milk price to control for any supply side price variations. The marketing order authority sets this FMMO price so it can be safely assumed to be exogenous to any retail price setting behavior. Farm level milk is also the largest cost component of packaged fluid milk, accounting for 50-60% of the total cost. Our instruments for current price can be written as:

[5] $$\hat{P}_t^{ki} = f\left(FMMO_P, FMMO_p^2, PRM_t^{ki}, PRM_{t-1}^{ki}, PRM_{t-2}^{ki}\right)$$

where, $FMMO_P$ = Announced Class-I Federal Milk Marketing Order price

PRM_{t-j}^{ki} = Vector of price reduction and merchandising variables.

Empirical Analysis

Regression results are presented in Table 6 (Boston) and Table 7 (New York). The results suggest that there are strategic interactions between retailers in terms of significant price coefficients in the response equation of each retailer. To determine the optimum lag structure we use the Akaike Information Criterion (AIC) on separate regressions for each retailer. After minimizing for the lowest AIC, we found that the optimum lag is one period for competitors lagged prices and two period lags for own prices. This also holds for all the retailers. Thus we found a fairly short strategic response period in both the markets. This result is not surprising, given the fact that in the retail milk market one does not have a long time for inventory adjustments, for a product as perishable as milk. Frigon et al. (1999) also found maximum a two period lag structure for the aggregate New York retail market. In our regression model for both the markets the current period price coefficient is larger than the lagged price coefficients implying dissipating lag effects.

For the simplicity of exposition we generate causality relationships of pricing between different retailers. Diagram 1 and 2 show the pattern of causality in pricing between retail chains in the Boston market for the pre- and post-Compact period respectively. Diagram 3, shows causality relationships for the New York market. All three diagrams are based on at least 10% significance level of t-statistic of the estimated parameters of regression analysis. In general the response pattern in both the market varies a lot between retailers. Only strategic oligopolistic pricing between retailers can generate such a rich response pattern. Also in the Boston market the pre- and post-Compact pricing behavior is very different suggesting structural shift in retail competition.

Pre-Compact Period in Boston:

During this period, there was significant farm and retail price volatility in the Boston market. Our analysis suggests, there was symmetrically positive current-period causality between Stop & Shop and Star Market. As the third largest player with the largest LBO debt Star Market played safe during this period and followed pricing of the top player Stop & Shop. Stop & Shop responded aggressively to the maverick Shaw's with negative price response. On the other hand, Shaw's response to Stop & Shop's price change is negative but insignificant. Shaw's only significant price response was against Star Market and it was positive during this period. DeMoulas as the lowest price player in the market also responded aggressively against the price change by Shaw's. And followed the price lead of the market leader Stop & Shop and the third largest player Star Market.

Post-Compact Period of the Boston Market:

During this period, the strategic oligopolistic game changed dramatically. The top three players became accommodative to each other's price change with positive price response. The merged firms, Shaw's and Star Market, showed classic post merger behavior. They have bi-directional positive causality in the current period. As merged players it is important for them to have very similar pricing strategy so that they do not lose market share to each other and can focus on competing with other retailers. Of the merged entity, Star Market had stronger price relationships with Stop & Shop with positive bi-directional price responses lagged by one period. Star Market also affected Stop & Shop's price in the current period and Shaw's price with a one period lag. Shaw's as the second largest player in the market followed Stop & Shop's price with a positive one period lag. DeMoulas as the smallest player acted to aggressively to stay in the market. It reacted with negative price response to any price change by other three players with no lags, though it had positive one period lag response to any price change by merged Shaw's and Star Market. The post-Compact period pricing suggests softening of the pricing regime between the top three players Stop & Shop, Shaw's and Star Market and the weaker player DeMoulas becoming aggressive to maintain market share. The Pre-Compact aggressive pricing policy by Stop & Shop helped to discipline Shaw's, the then newly acquired chain by Sainbury of UK.

New York Market:

New York shows an extremely different picture of retail price interaction. Compared to Diagram 1 and 2, Diagram 3 does clearly suggest much less price interaction than in the Boston market. Although A&P and Waldbaum's are owned by the same German parent company, but they have no price response relationship. This may be due to the independent nature of their management. Waldbaum's acted more like a localized monopoly during the period of our study. A&P priced aggressively in response to pricing of the weakest player in the market (i.e. Grand Union). On the other hand, Grand Union followed A&P's price lead with a lag and followed current period price lead of Waldbaum's. Debt restructured Pathmark responded aggressively with negative price response with no lag to price change by A&P. Though such aggressive price response did not help Pathmark to gain market share from A&P.

Concluding Remarks

Our analysis of the Boston market shows significant change in strategic response pattern between retailers in both the pre- and post-Compact period. Post-Compact period is also the period when Shaw's and Star Market merged. The pre-Compact period was more competitive for the top two players (Stop & Shop and Shaw's). Such strategic change in pricing behavior between Stop & Shop and Shaw's is also borne out by a study of the Connecticut retail market by Cotterill et al. (1999). The post-Compact period suggest a price enhancing relationship between Stop & Shop, and merged Shaw's and Star Market. It is possible that retailers (i.e. Stop & Shop, and merged Shaw's and Star Market) used the dairy compact as focal point (Schelling, 1964) to tacitly collude on prices. The other explanation can be due to the aggressive price disciplining behavior by Stop & Shop during the pre-Compact period leading to Shaw's accepting Stop & Shop's market leadership during the post-Compact period. Such shift in market structure is also borne out in the recent discussions of trade journals and newspaper article.[4][iv]

In New York market, on the other hand, the retail competition is quite different with much less strategic interactions between retailers. Here the financially the strongest player A&P influences pricing of the weakest player (i.e. Grand Union). The largest retailer Pathmark reacts aggressively to the price change by A&P. Soft competitive pricing in New York can also be due to focal point pricing. In the New York market there is frequent complain against retailers that they tend to use price their milk near the maximum permissible limit of price gauging law.

The other explanations for the differences in strategic response can also come from the differences due to within store top brand configurations in the two markets. The Boston market, with strong private label and regional brands, shows much more strategic interaction between retailers than the New York retail market. Significant strategic interaction in Boston market with its strong brand presence implies that retailers can use milk-pricing strategy to lure customers. Stronger brand loyalty leads consumers to switch stores rather than switch between brands within a store. On the other hand in the 'weak brand' market (New York) consumers tend to switch more between brands within a store.

Overall, our results suggest that we have a much stronger 'reacting' oligopolistic market structure in the Boston market. The only 'pseudo-independent' oligopolistic behavior was shown by Walbaum's of New York. Our results also suggest strategic roles of events (such as compact announcements) or government regulations (such as price gauging law) in shaping retail competition. Future research should explore such issues further.

Reference:

1. Balto, David A., "Supermarket Merger Enforcement". Antitrust Report, Federal Trade Commission: August 1999.

2. Baumol, William J., Richard E. Quandt, Harold T. Shapiro, "Oligopoly Theory and Retail Food Pricing", *Journal of Business*, Vol. 37 (4), October 1964, 346-363.

3. Berry, Steven T.; "Estimating Discrete Choice Models of Product Differentiation" *Rand Journal of Economics*; 25(2), Summer 1994, pages 242-262.

4. Blumenthal, William., and David A. Cohen., "Channels of Distribution as Merger "Markets": Interpreting Staples and cardinal, Antitrust Report, Federal Trade Commission, Nov 1998 at 2.

5. Chamberlin, E.H., "The theory of Monopolistic Competition". Cambridge, Mass., Harvard University Press: 1933.

6. Comanor, W., "Comments on Quantitative Studies of Industrial Organization", in M. Intrilligator. Editor, Frontiers in Quantitative Economics. North Holland, Amsterdam: 1971.

7. Cotterill Ronald W., Tirtha P. Dhar and Andrew W. Franklin., "Post Merger Price Conduct: A Case Study of Pricing in Connecticut Markets After the 1996 Royal Ahold-Stop & Shop Merger", Food Marketing Policy Center Research Report No.47. October 1999.

8. Cotterill, Ronald W., "Market Power in the Retail Food Industry: Evidence from Vermont," *Review of Economics and Statistics*, Vol. 68, August 1986, 376-386.

9. Geir., Grisprud, and Kjell Gronhaug., "Structure and Strategy in Grocery Retailing: A Sociometric Approach". *Journal of Industrial Economics*, Volume 33, Issue 3 (Mar., 1985), 339 – 347.

10. Holdren, B.R., "The Structure of Retail Market and the Behavior of Retail" Units, Prentice-Hall, Englewood Cliffs, N.J. 1960.

11. Holtz-Eakin, Douglas, Whitney Newey and harvey S. Rosen, "Estimating Vector Auto Regression with Panel Data", *Econometrica*, Vol. 56 (6), November 1988. 1371-1395.

12. Kadiyali, V., Vilcassim, N.J., and Chintagunta, P., "Empirical Analysis of Competitive Product Line Pricing Decisions: Lead, Follow, or Move Together." *Journal of Business*. 69(4), Pp: 459-87, 1996.

13. Paul, Joskow, “Firm Decision-Making Processes and Oligopoly Theory”, *American Economic Review* LXV (May 1975). Pp. 295 – 300.

14. Slade, Margaret E., “Product Rivalry with Multiple Strategic Weapons: An Analysis of Price and Advertising Competition,” *Journal of Economics and Management Strategy*, Vol. 4 (3), Fall 1995, 445-476.

15. Chevalier, Judith A. “Capital Structure and Product-Market Competition: Empirical Evidence from the Supermarket Industry.” American Economic Review, June 1995a, 85(3), pp. 415-35.

16. Walters, Rockney G. and Mackenzie, Scott B. “A Structural Equations Analysis of the Impact of Price Promotions on Store Performance.” *Journal of Marketing Research*, February 1988, XXV, pp. 51-63.

17. Nevo, A. “Demand for Ready to Eat Cereal and its Implications for Price Competition, Merger Analysis and Valuation of New Brands.” Ph.D. Dissertation. Department of Economics, Harvard University. May 1997.

18. Frigon, Mathieu, Maurice Doyon, and Robert Romain. 1999. Asymmetry in Farm-RetailPrice Transmission in the Northeast Fluid Milk Market. Groupe de rechercheen economie et politique agricoles (GREPA) Laval University. Food Marketing Policy Center-University of Connecticut Research Report Series No. 45.

19. Hausman, Jerry; Leonard, Gregory and Zona, Douglas J. “Competitive Analysis with Differentiated Products.” *Annales D’Economie et de Statistique*, 1994, 34, pp. 159-180.

Table 1: Relationship between Causality and Competition

	Signs of Causality	**State of the Market**
[1]	Symmetrically Positive	Perfectly Competitive Market / Collusion [Strong]
[2]	Symmetrically Negative	Non-Collusive Oligopoly [Competitive Pricing]
[4]	Negative but Unidirectional	Competitive Oligopoly-Weak [Example: Poaching for Market Share, strategy for not losing market share]
[3]	Positive but Unidirectional	Leader-Follower / Collusion [Weak]
[5]	Opposite Sign	Unknown

Table 2: Market Share of Boston Retail Chains

Retailer	Market Share [of Supermarket Sales]				
	1996	1997	1998	1999	2000
Stop & Shop	18.20	26.20	26.20	28.30	28.00
Shaw's	16.90	16.90	16.80	16.20	16.70
Star Market	14.30	13.50	16.50	16.00	12.70
DeMoulas	12.90	13.10	12.50	12.10	12.30

Table 3: Market Share of New York Retail Chains

Retailer	Market Share [Of Supermarket Sales]		
	1996	1997	1998
Pathmark	16.20	14.50	14.50
A&P	10.00	10.30	11.20
Grand Union	6.90	6.30	6.30
Waldbaum's	7.60	6.90	6.80

* Supermarket Sales Data obtained from 1999 Market Scope published by Trade Dimensions, CT: USA.

Table 4: Brand Share Matrix by Total Dollar Sales

Boston Market					
Brand Name	**Stop & Shop**	**Shaw's**	**Star Market**	**DeMoulas**	**Total Share**
Private Label – S/L Milk	**58.3 (1)**	**26.4 (3)**	**38.1 (1)**	**81.6 (1)**	**51.9**
Garelick Farms – S/L Milk	**20.1 (2)**	**9.3 (2)**	**33.0 (2)**	**5.62 (3)**	**27.5**
Hood – S/L Milk	**15.3 (3)**	**59.6 (1)**	**20.8 (3)**	**8.2 (2)**	**13.7**
Private Label – Whole Milk	**71.4 (1)**	**72.5 (1)**	**52.2 (1)**	**83.7 (1)**	**63.2**
Garelick Farms– Whole Milk	**14.9 (2)**	**18.2 (2)**	**26.3 (2)**	**8.2 (2)**	**22.4**
Hood – Whole Milk	**12.6 (3)**	**8.43 (3)**	**18.6 (3)**	**7.3 (3)**	**11.6**

New York Market					
	Pathmark	**A&P**	**Grand Union**	**Waldbams**	**Total Share**
Private Label – S/L Milk	**81.74 (1)**	**72.65 (1)**	**30.36 (2)**	**59.89 (1)**	**50.88**
Farmland – S/L Milk	**8.05 (2)**	**7.37 (2)**	**56.70 (1)**	**31.23 (2)**	**16.56**
Tuscan dairy – S/L Milk	6.60	**5.63 (3)**	-	0.06	**10.06**
Morning Star – S/L Milk (Lactaid Milk)	**3.40 (3)**	4.49	**3.77 (3)**	**4.60 (3)**	**3.97**
Private Label – Whole Milk	**66.38 (1)**	**85.73 (1)**	**44.49 (2)**	**67.13 (1)**	**47.83**
Farmland – Whole Milk	**18.18 (2)**	0.89	**49.46 (1)**	**32.48 (2)**	**14.19**
Tuscan Dairy – Whole Milk	1.9	**6.61 (2)**	-	0.02	**19.04**
Sealtest – Whole Milk	-	**1.84 (3)**	**3.65 (3)**	-	**1.38**
New Square – Whole Milk	**10.84 (3)**	-	0.03	0.04	**1.11**
Horizons Organic – Whole Milk	2.25	1.32	1.57	**0.3 (3)**	**0.056**

- Share is estimated as within the product category: Skim/Low Fat, Whole Milk
- Numbers in the parenthesis is the rank of the brand
- Time Period: Boston Market: February 1996 to July 2000; New York Market: February 1996 to July 1998.

Table 5: Average Price of Milk by Brands and Reatilers

Boston Market				
Brand Name	**Stop & Shop**	**Shaw's**	**Star Market**	**DeMoulas**
Private Label – S/L Milk	3.07 (0.271)	2.9675 (0.30039)	3.0583 (0.23097	2.8747 (0.27656)
Garelick Farms – S/L Milk	3.06 (0.17029)	3.0246 (0.25103)	3.1689 (0.16265)	3.0174 (0.19937)
Hood – S/L Milk	2.6319 (0.15138)	2.5718 (0.19415)	2.6582 (0.16572)	2.3398 (0.15845)
Private Label – Whole Milk	2.7676 (0.13600)	2.7240 (0.16941)	2.7387 (0.14596)	2.5596 (0.11050)
Garelick Farms– Whole Milk	3.0706 (0.22838)	3.0666 (0.25738	3.1583 (0.21771)	2.8871 (0.21550)
Hood – Whole Milk	3.0352 (0.13952)	3.0237 (0.21040)	3.2548 (0.11700)	2.9970 (0.12358)
New York Market				
	Pathmark	**A&P**	**Grand Union**	**Waldbaum's**
Private Label – S/L Milk	2.7963 (0.069884)	2.9068 (0.039184)	2.7972 (0.071458)	2.7871 (0.13027)
Farmland – S/L Milk	3.5893 (0.32889)	4.0649 (0.37558)	3.0490 (0.084840)	3.3681 (0.14501)
Tuscan dairy – S/L Milk	-	2.9304 (0.081008)	-	-
Morning Star – S/L Milk	6.5045 (0.11570)	-	6.3447 (0.14288)	6.2559 (0.14713)
Private Label – Whole Milk	3.0431 (0.10226)	2.8862 (0.047604)	2.8598 (0.071286)	2.7851 (0.13495)
Farmland – Whole Milk	3.1957 (0.22132)	-	2.9076 (0.086847)	2.8522 (0.14886)
Tuscan Dairy – Whole Milk	-	2.8475 (0.083626)	-	-
Sealtest – Whole Milk	-	3.3886 (0.20676)	3.5168 (0.72063)	-
New Square – Whole Milk	3.0165 (0.029939)	-	-	-
Horizons Organic – Whole Milk	-	-	-	5.6511 (0.40502)

- Share is estimated as within the product category: Skim/Low Fat, Whole Milk
- Numbers in the parenthesis is the rank of the brand
- Time Period: Boston Market: February 1996 to July 2000; New York Market: February 1996 to July 1998.

Table 6: Regression Results-Boston

Variable				
	Pre Compact		Post-Compact	
	Estimate	P-Value	Estimate	P-Value
Stop & Shop				
Binary: Stop & Shop G S/L	**1.6340**	**0.0180**	**0.3937**	**0.0000**
Binary: Stop & Shop H S/L	**1.7150**	**0.0250**	**0.3749**	**0.0010**
Binary: Stop & Shop P S/L	**1.5184**	**0.0110**	**0.3436**	**0.0010**
Binary: Stop & Shop G W	**1.6954**	**0.0190**	**0.3688**	**0.0010**
Binary: Stop & Shop H W	**1.7726**	**0.0210**	**0.3522**	**0.0030**
Binary: Stop & Shop P W	**1.6103**	**0.0110**	**0.3756**	**0.0000**
Lag_O Price: Shaw's	**-0.3465**	**0.0190**	-0.0612	0.2110
Lag_O Price: Star Market	**0.3533**	**0.0170**	**0.1778**	**0.0020**
Lag_0 Price: DeMoulas	-0.0688	0.6330	**-0.2286**	**0.0000**
Lag_1 Price: Stop & Shop	**0.2155**	**0.0500**	**0.8409**	**0.0000**
Lag_2 Price: Stop & Shop	-0.0328	0.7530	**-0.0630**	**0.2160**
Lag_1 Price: Shaw's	0.0970	0.4510	0.0340	0.4640
Lag_1 Price: Star Market	0.1477	0.4930	**0.1691**	**0.0110**
Lag_1 Price: DeMoulas	-0.0200	0.8890	-0.0124	0.7990
Shaw's				
Binary: Shaw's G S/L	**1.0084**	**0.0670**	0.2500	0.2030
Binary: Shaw's H S/L	**1.1671**	**0.0610**	0.2362	0.2450
Binary: Shaw's P S/L	**0.8877**	**0.0610**	**0.3096**	**0.0940**
Binary: Shaw's G W	**1.0586**	**0.0670**	**0.2808**	**0.1600**
Binary: Shaw's H W	**1.0539**	**0.0840**	**0.2308**	**0.2650**
Binary: Shaw's P W	**0.9249**	**0.0650**	**0.3142**	**0.0940**
Lag_O Price: Stop & Shop	-0.0958	0.3570	-0.1656	0.1540
Lag_O Price: Star Market	**0.2627**	**0.0810**	**0.2667**	**0.0240**
Lag_0 Price: DeMoulas	-0.1722	0.1160	**-0.3508**	**0.0000**
Lag_1 Price: Shaw's	**0.6441**	**0.0000**	**0.4634**	**0.0000**
Lag_2 Price: Shaw's	0.0893	0.4890	**-0.1008**	**0.0690**
Lag_1 Price: Stop & Shop	-0.0545	0.5330	**0.2977**	**0.0040**
Lag_1 Price: Star Market	-0.0617	0.7340	**0.2086**	**0.0470**
Lag_1 Price: DeMoulas	-0.0070	0.9510	**0.2656**	**0.0010**
Star Market				
Binary: Star Market G S/L	**1.3434**	**0.0000**	0.2264	0.1280
Binary: Star Market H S/L	**1.4824**	**0.0000**	**0.2801**	**0.0690**
Binary: Star Market P S/L	**1.1803**	**0.0000**	0.1689	0.2290
Binary: Star Market G W	**1.4399**	**0.0000**	**0.2614**	**0.0850**
Binary: Star Market H W	**1.5809**	**0.0000**	**0.3301**	**0.0360**
Binary: Star Merket P W	**1.2225**	**0.0000**	**0.1659**	0.2430
Lag_O Price: Stop & Shop	-0.0269	0.5220	0.0934	0.1830

Lag_O Price: Shaw's	-0.0464	0.4430	**0.2351**	**0.0000**
Variable	**Pre Compact**		**Post Compact**	
	Estimate	**P-Value**	**Estimate**	**P-Value**
Lag_1 Price: Star Market	**0.3845**	**0.0010**	**0.4811**	**0.0000**
Lag_2 Price: Star Market	-0.0657	0.5400	**0.0746**	0.1960
Lag_1 Price: Stop & Shop	**0.0853**	**0.0860**	**0.3327**	**0.0000**
Lag_1 Price: Shaw's	0.0333	0.5590	0.0035	0.9480
Lag_1 Price: DeMoulas	0.1072	0.1190	**- 0.0087**	0.8750
DeMoulas				
Binary: DeMoulas G S/L	**- 0.3103**	**0.3610**	**0.1303**	0.3570
Binary: DeMoulas H S/L	**- 0.3615**	**0.3370**	**0.1564**	0.2840
Binary: DeMoulas P S/L	**- 0.2929**	**0.3160**	**0.0781**	0.5540
Binary: DeMoulas G W	**- 0.3483**	**0.3240**	0.1185	**0.4080**
Binary: DeMoulas H W	**- 0.3627**	**0.3340**	0.1381	**0.3530**
Binary: DeMoulas P W	**- 0.3000**	**0.3310**	**0.1158**	**0.3910**
Lag_O Price: Stop & Shop	**0.0799**	**0.2110**	0.0110	0.8840
Lag_O Price: Shaw's	**- 0.1216**	**0.0560**	- 0.0057	0.9180
Lag_0 Price: Star Market	0.0739	0.4290	- 0.0474	0.5170
Lag_1 Price: DeMoulas	**0.7907**	**0.0000**	**0.7249**	**0.0000**
Lag_2 Price: DeMoulas	0.1276	0.2910	- 0.0374	0.4640
Lag_1 Price: Stop & Shop	- 0.0640	0.2220	0.1107	0.1310
Lag_1 Price: Shaw's	0.0380	0.5310	0.0230	0.6660
Lag_1 Price: Star market	**0.1961**	**0.0670**	**0.1628**	**0.0330**

* P-Value: Significance Level of the Estimated t-statistic
* Highlighted Numbers are significant at least at 10% Level

Lag_0: Current Period
Lag_1: 1 Period Lag
lag_2: 2 Period Lag

Table 7: Regression Results-New York

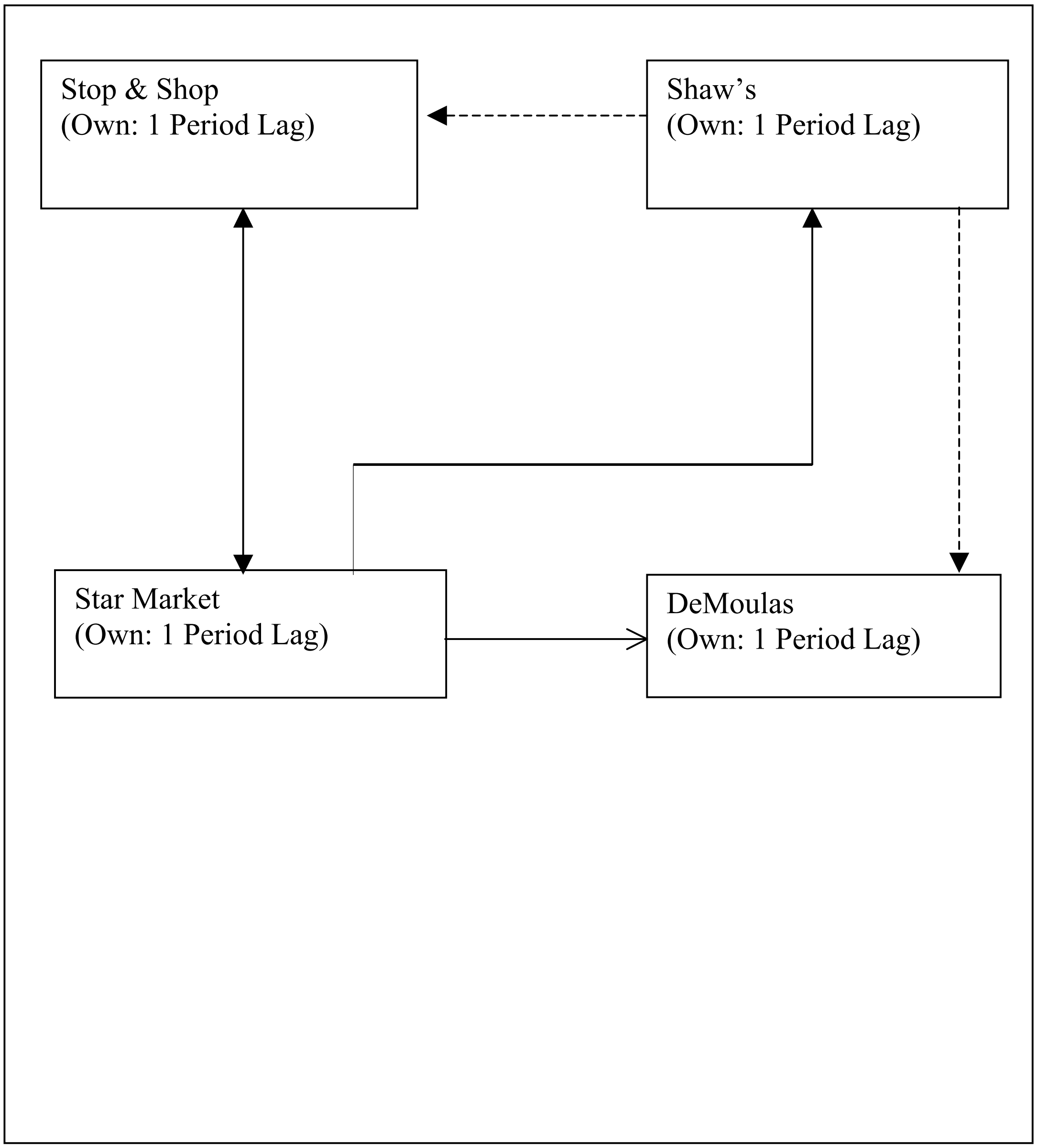
Variable	Estimate	P-Value
A&P		
Binary: A&P Private Label S/L	0.1184	0.8010
Binary: A&P Farmland S/L	- 0.1629	0.7670
Binary: A&P Tuscan Dairy S/L	1.2547	0.3030
Binary: A&P Priavet Label W	0.0507	0.9190
Binary: A&P Tuscan Dairy W	0.0848	0.8710
Binary: A&P Sealtest W	- 0.0302	0.9540
Lag_0 Price: Grand Union	- 0.0021	0.9390
Lag_0 Price: Pathmark	- 0.0007	0.9900
Lag_0: Waldbaum's	0.0690	0.1510
Lag_1: A&P	**1.2902**	**0.0000**
Lag_2: A&P	- 0.0318	0.6000
Lag_1: Grand Union	**-0.3083**	**0.0290**
Lag_1: Pathmark	- 0.0588	0.6800
Lag_1: Waldbaum's	0.0038	0.9080
Grand Union		
Binary: Grand Union Private Label S/L	0.5755	0.3010
Binary: Grand Union Farm Land S/L	- 0.0608	0.9250
Binary: Grand Union Morning Star S/L	**3.1843**	**0.0260**
Binary: Grand Union Private Label W	0.4785	0.4150
Binary: Grand Union Farm Land W	0.5631	0.3600
Binary: Grand Union Sealtest W	0.4358	0.4820
Lag_0 Price: A&P	- 0.0352	0.2150
Lag_0 Price: Pathmark	- 0.0259	0.6570
Lag_0 Price: Waldbaum's	**0.0966**	**0.0840**
Lag_1 Price: A&P	**0.5821**	**0.0010**
Lag_1 Price: Grand Union	**0.4184**	**0.0140**
Lag_2 Price: Grand Union	- 0.0308	0.6100
Lag_1 Price: Pathmark	- 0.1863	0.2620
Lag_1 Price: Waldbaum's	- 0.0018	0.9610
Pathmark		
Binary: Pathmark Private Label S/L	**1.0223**	**0.0000**
Binary: Pathmark Farm Land S/L	**1.2992**	**0.0000**
Binary: Pathmark Morning Star S/L	**2.2384**	**0.0000**
Binary: Pathmark Private Label W	**1.1019**	**0.0000**
Binary: Pathmark Farm Land W	**1.1833**	**0.0000**

Table 2.6 (Continued)

Variable		Estimate		P-Value
Lag_0 Price: A&P		**-0.0491**		**0.0170**
Lag_0 Price: Grand Union		0.0129		0.3440
Lag_0 Price: Waldbaum's		-0.0220		0.1510
Lag_1 Price: A&P		0.0274		0.5150
Lag_1 Price: Grand Union		-0.0246		0.5260
Lag_1 Price: Pathmark		**0.7000**		**0.0000**
Lag_2 Price: Pathmark		-0.0059		0.9300
Lag_1 Price: Waldbaum's		0.0037		0.6860
Waldbaum's				
Binary: Walbaum's Private Label S/L		0.9239		0.1180
Binary: Walbaum's Farm Land S/L		**1.2620**		**0.0550**
Binary: Walbaum's Morning Star S/L		1.4595		0.3080
Binary: Walbaum's Private Label W		0.9177		0.1320
Binary: Walbaum's Farm Land W		0.9316		0.1450
Binary: Walbaum's Horizon Organic W		**2.0973**		**0.0010**
Lag_0 Price: A&P		-0.1084		0.1620
Lag_0 Price: Grand Union		-0.0476		0.5830
Lag_0 Price: Pathmark		0.0592		0.5510
Lag_0 Price: A&P		-0.0852		0.5870
Lag_0 Price: Grand Union		0.1571		0.2970
Lag_1 Price: Pathmark		0.1050		0.5140
Lag_1 Price: Waldbaum's		**0.5397**		**0.0000**
Lag_2 Price: Waldbaum's		0.0416		0.4720

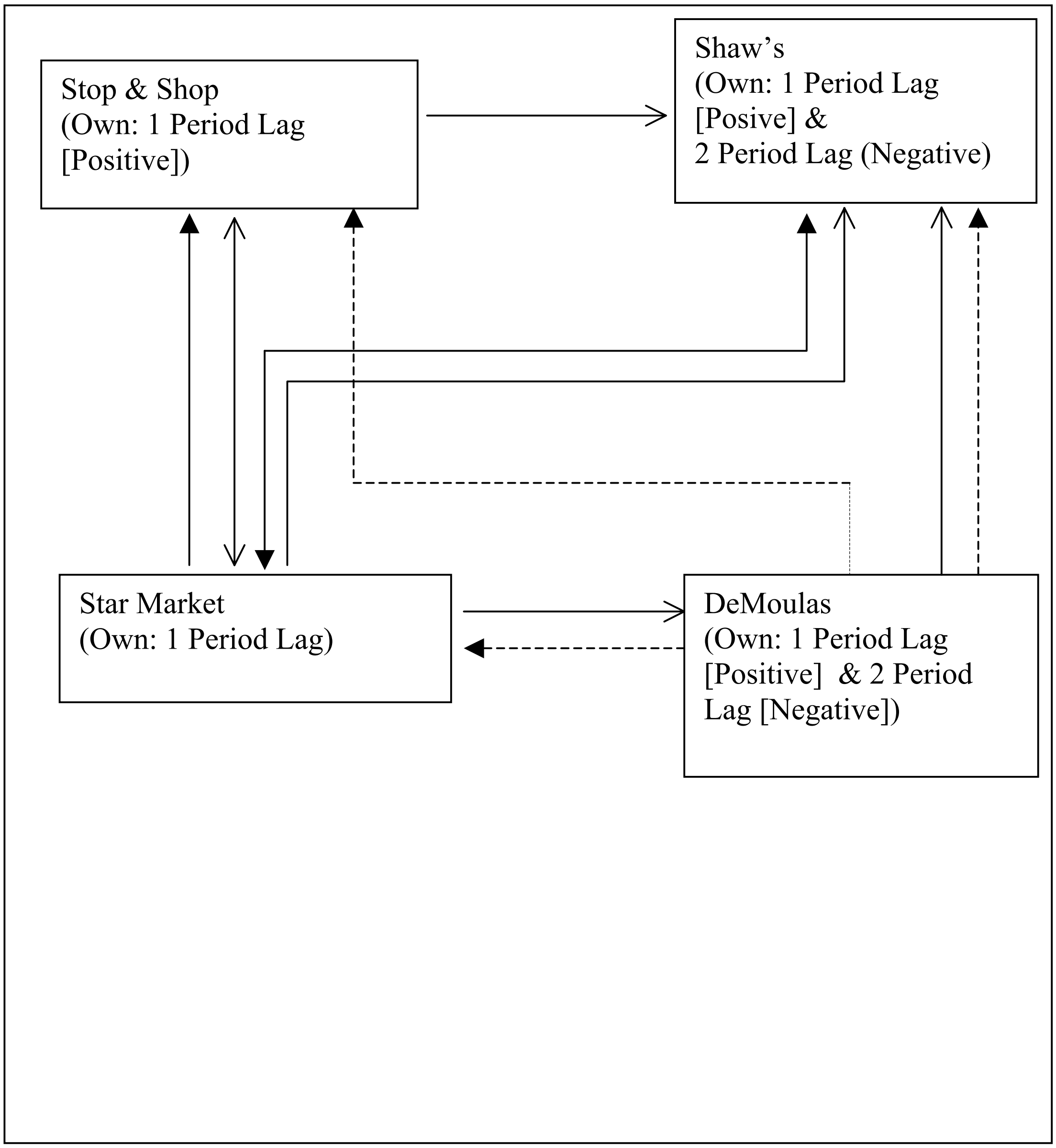
* P-Value: Significance Level of the Estimated t-statistic
* Highlighted Numbers are significant atleast at 10% Level
Lag_0: Current Period
Lag_1: 1 Period Lag
lag_2: 2 Period Lag

Diagram 1: Flow of Causality for the Boston Market (Pre-Compact)



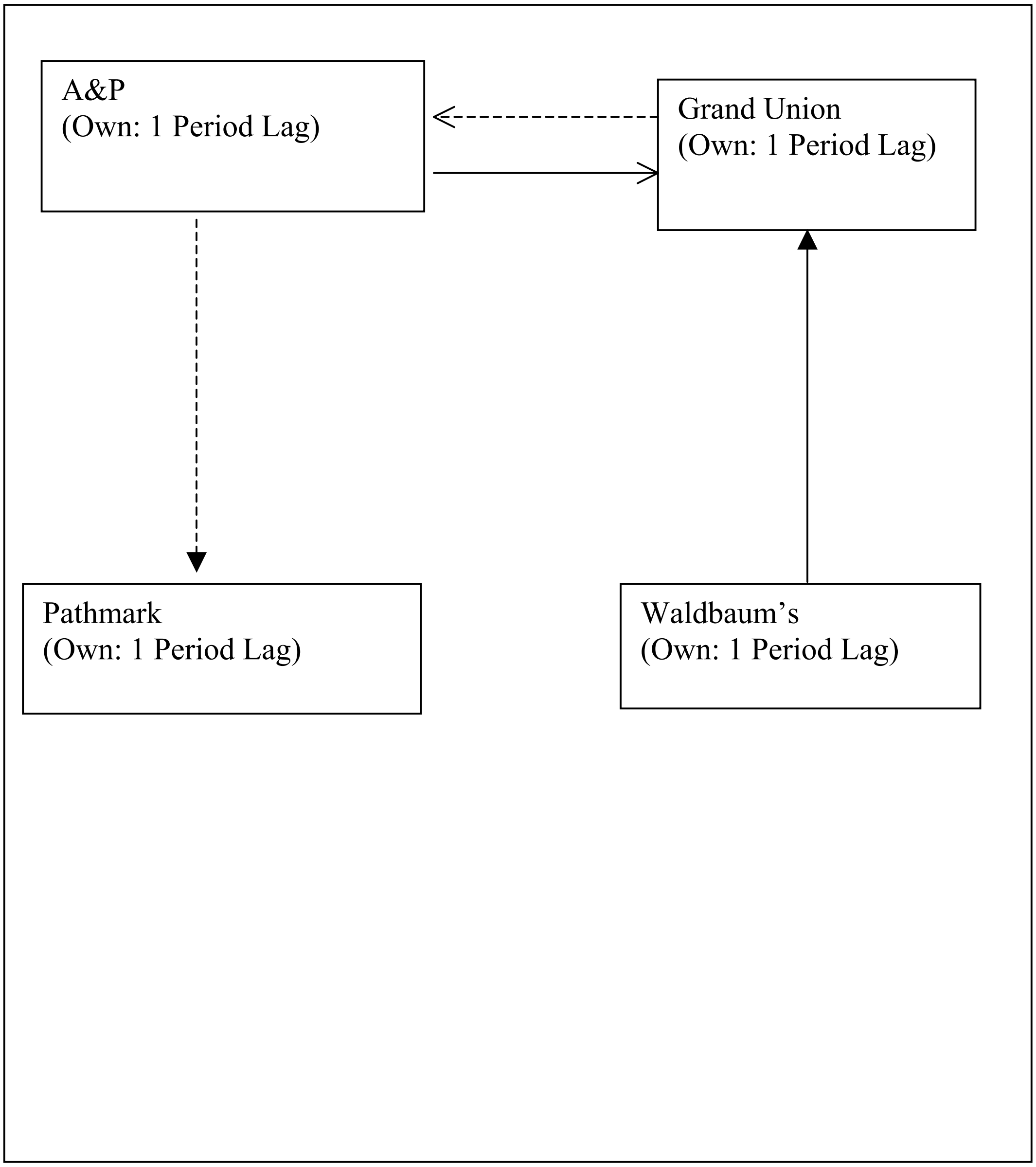
- ◀—▶ : Symmetric Causality in the Current Period
- ⟷ : Symmetric Causality with 1 Period Lag
- —▶ : Unidirectional Causality in the Current Period
- ⟶ : Unidirectional Causality with 1 Period Lag
- Uninterrupted Lines Represent Positive Causality and Dotted Lines Represent Negative Causality

Diagram 2: Flow of Causality for the Boston Market (Post-Compact)



- ◄—► : Symmetric Causality in the Current Period
- <—> : Symmetric Causality with 1 Period Lag
- —► : Unidirectional Causality in the Current Period
- —> : Unidirectional Causality with 1 Period Lag
- Uninterrupted Lines Represent Positive Causality and Dotted Lines Represent Negative Causality

Diagram 3: Flow of Causality for the New York (Full Period: 32 Observations)



- ◀—▶ : Symmetric Causality in the Current Period
- ⟵⟶ : Symmetric Causality with 1 Period Lag
- —▶ : Unidirectional Causality in the Current Period
- ⟶ : Unidirectional Causality with 1 Period Lag
- Uninterrupted Lines Represent Positive Causality and Dotted Lines Represent Negative Causality.

[1] A Chicago based marketing information and consulting firm. They collect data from sample supermarkets with annual sales of more than $2 million dollars located in various size metropolitan areas. Such supermarkets account 82% of grocery sales in the US. In most cities the sample stores covers 20% of the relevant population. Due to the importance of the sample to its customers, IRI makes an effort to make the sample representative.

[2] We use the term competitive oligopoly to explain the nature of competition. In a competitive oligpolistic market firms compete vigorously (tough market). In a non-competitive oligopoly players play by the rule live and let live (soft market).

[3] Under the EDLP scheme profit is maximized by maximizing volume sales with very thin profit margin and very few weekly specials. The 'Hi-Lo' strategy lures consumers with loyalty programs and generous weekly specials on more products, keeping hefty margins on rest of the products. Under EDLP, pricing becomes the main weapon to compete against other retailers and under Hi-Lo scheme merchandising and loyalty becomes the tools of competition.

[4] In a recent article in The Boston Globe (10th Oct. 2000) described the New England retail market as, "With the New England supermarket industry reduced to just two players, it was inevitable that the survivors, Shaw's Supermarkets and Stop & Shop, would take aim at each other. But instead of a price war over bananas or milk, the first battle in the competition for the hearts and minds of shoppers revolves around the fuzzy issue of consumer loyalty."