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MARKET COMPETITION AND METROPOLITAN-AREA GROCERY PRICES

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Abstract: This paper examines the relationship of 1987 retail grocery prices to supermarket sales concentration across 95 U.S. metropolitan areas. The regression model incorporates a large number of population, retail-cost, and retail competition factors and separate prices by type of grocery item. We find that the concentration-price relationship is sensitive to item type: positive for packaged, branded, dry groceries and unrelated for produce, meat, and dairy product prices. As for market rivalry, we find that small grocery stores provide no grocery price competition for supermarkets. However, branded grocery prices are driven down by fast-food places and by rapid price churning, whereas for unbranded foods the presence of warehouse stores places downward pressure on supermarket prices while fast-food presence does not. For the branded-groceries component, we also find prices higher in large, fast-growing, low-income, Eastern cities. We also find that cities where rents, wages, and electricity costs are high tend to have high dry grocery prices. However, for the unbranded-products component retail costs are unrelated to prices, and cities in the South have the highest prices.

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Market Competition and Metropolitan-Area Grocery Prices

The Supermarket Revolution — the replacement of small grocery stores by large, multidepartment grocery stores — came to an end in the 1970s (Marion, *et al*. 1986: Table 5-1). Since then the industry has witnessed a proliferation of retail food outlets. The 1987 annual report of *Progressive Grocer* declared that "the supermarket industry is moving faster to accommodate changes in consumer shopping and eating patterns." The traditional supermarket design is being supplemented by warehouse stores, supercenters, and combination stores, often incorporating food courts. Such retail formats imply a recognition that conventional supermarkets face a more diverse set of market rivals. With a changing market environment and accompanying changes in cost structures, supermarket pricing practices may be changing as well. The purpose of this study is to examine supermarket pricing with special attention to this new competitive environment.

The question of pricing practices in the retail grocery industry has long been of interest in both the business management and economics literatures. Business-management studies tend to focus on the store or product-category level and emphasize the roles of competitive rivalry and customer demographics while paying less attention to inter-store or inter-market cost differences. Economists' models are usually derived from industrial-organization theories that emphasize measures of market structure or the degree of competitive rivalry in the market, taking pains to account for variation in costs. Recent theoretical models of retail pricing in both literatures assume that sellers exploit differences in demand characteristics in setting store-wide or category prices. However, data limitations have prevented the introduction of many such factors in empirical work.

This study draws on both literatures to develop and test a model of retail grocery pricing. The data set is novel, consisting of a large sample of metropolitan areas with widely varying characteristics. While a market-level analysis is limiting in some respects (store-specific factors cannot be studied), it is dictated by our decision to focus on the changing market environment of U.S. supermarkets.

There are two contributions of this study that we view as of special importance. The first is the attention we pay to potentially different pricing rules across different store departments. Our reading of the current economics and management literature is that stores price discriminate by setting the gross margins of individual products in accordance with market conditions. Our results support this hypothesis: we find that factors affecting dry grocery product prices are significantly different from those determining the prices of fresh and chilled foods.

Second, one of the most significant changes in food retailing is the increasing importance of restaurants in total food expenditures, a trend that has "increasingly disturbed" industry leaders, according to the *Progressive Grocer* report. Indeed, its survey found that two-thirds of store managers rated the competitive threat from fast food outlets as at least moderate. It is certainly reasonable to expect that the low-priced segment of the restaurant industry, since ultimately it serves much the same purpose as do grocery retailers, provides potential competition. Our model allows for food service competition, and we indeed find that metropolitan-area grocery prices are affected by competition from the fast-food segment of the restaurant industry.

Literature Review

Business-management studies of retail grocery pricing have tended to focus on determining and evaluating rules for price-setting used in the industry. The managerial problem facing grocery retailers is to set an optimal mix of product prices. Although there are broad differences for chains relative to independents, price-setting is primarily determined by demand facing the selling unit. For chains, everyday selling prices are often determined for an entire division (e.g., a metropolitan area), with each store placed into one of three to five price zones. Price zones essentially rank local trading areas according to the intensity of price competition and possibly local demographic characteristics affecting demand. Promotional prices are fixed uniformly across the chain within a city. For independents, the store owner-manager sets both everyday and promotional prices according to the degree of local price rivalry and customer characteristics.[1]

The business-management tradition places little emphasis on costs, for unit costs of goods sold and unit operating costs are considered to be essentially independent of volume, at least for the short-run pricing decisions that are of most interest to business-management analysts. The retail pricing problem is then formally the same as setting product-category gross margins (Cassady, Leed and German). The gross margin can be viewed as the price of retailing services, with operating costs that vary across product categories as the only relevant costs.[2]

Thus, category management pricing models place almost exclusive emphasis on the elasticity of demand by customers and on competitive conditions (Blattberg and Neslin, Kim *et al.*). The price elasticity of demand incorporates complex information about consumer buying habits in the trading area. Various writers have hypothesized that retail demand elasticity may be related to age, education, income, frequency of product purchase, car ownership, and time of week. Many of these factors reflect household price searching effort.[3] Empirical studies in the business-management literature have found retail price responsiveness to be related to demographic factors, but the results are sometimes inconsistent.[4]

As noted previously, chain grocery companies recognize the importance of local competition on prices or gross margins by placing their stores in one of several price zones within a city market (Leed and German).[5] The most intense price competition for a given grocery store comes from stores offering the same array of goods in the same trading area (in cities, areas of one or two miles radius; in rural areas, larger areas) (Cassady). Less intense price rivalry is generated by neighborhood groceries, convenience stores, specialty food shops, or grocery stores in adjacent trading areas. Significant but weak price competition may arise from gasoline stations, drug stores, discount department stores, and food service retailers. Non-grocery retailers became of increasing importance in the 1980's. Despite recognizing the importance of market competition, few management studies explicitly incorporate competitive intensity in empirical models of price responsiveness. Hoch, *et al.* is an exception: they developed four competitive variables to explain store-level price elasticities of 18 branded grocery products. The size of warehouse stores in the trading area increased the elasticity of demand, while the distance from such stores (including those outside the immediate trading area) negatively affected responsiveness of demand. Unexpectedly, the store's own market share had no significant effect on elasticity.

In the second of the two broad analytical frameworks, that of IO economics, the focus has been on the market-performance implications of retail pricing conduct. An early issue was whether the retailing industry was imperfectly competitive. Most early writers agreed with Smith, who judged retailing to be monopolistically competitive due to consumer search costs and spatial differentiation, a model more formally analyzed by Salop and Stiglitz and Benson and Faminow. Many other economists believed grocery retailing to be essentially oligopolistic in its pricing behavior (Baumol *et al.*, Holdren, and Marion *et al.* (1979)). However, a few IO economists have asserted that most retailing, including large-scale grocery retailing, is workably competitive (Adelman, Stigler).

Increasingly, theoretical treatments of optimal retail pricing or margin behavior follow the third-degree, price discrimination model. Such models assume that firms with identical costs enjoy some localized monopoly power because of enterprise reputation or spatial differentiation, that consumer search costs are significant, and that sellers use posted pricing systems (Katz, Holmes, Bliss).[6] These assumptions would seem to describe the "one-stop shopping" behavior of many supermarket shoppers (Guiletti). Except for the early model developed by Holton (1957), the price discrimination models demonstrate that retail prices or margins are positively related to the own-price inelasticity of product demand. These results hold even if entry is free (Borenstein 1985).

Discriminatory pricing models are more likely to apply when there are multiple goods, because different goods generally have different demand elasticities. For example, Lal and Matutes develop a duopoly model with two goods and two consumer types, that is particularly useful here for two reasons. One is that it is axiomatic within the food industry that there are a number of well-defined consumer types, with different demand characteristics. Coupled with this is our interest in non-traditional sources of supermarket competition, which may be specific to consumer types and/or sets of supermarket commodities. Unfortunately, models incorporating such features tend not to yield tight analytical solutions, even when restrictive assumptions, (e.g., identical costs) are invoked. As a consequence, authors usually resort to specific cases. With these models *a priori* expectations concerning empirical outcomes become much more difficult, exemplified by Lal and Matutes summary statement that "multi-market rivalry substantially alters the nature of competition" (p. 532).

There are four published cross-sectional empirical studies of supermarket price indexes in the IO tradition. All measure competitive rivalry with a metropolitan-area sales concentration index, and three of the four also include company market share. The first study was prepared for the Joint Economic Committee of the U.S. Congress in 1978 and subsequently published in book form (Marion *et al.* 1979). The JEC study used extensive price-checks data generated by three grocery retailers operating in 36 cities. A market-basket price index of 94 branded food items (meat and produce were excluded) was developed. Both four-firm concentration (C4) and firm market share were found to be positively related to the index. Cotterill (1986) verified these results, also using subpoenaed price data, for a sample of 35 stores in 18 mostly small, isolated Vermont towns and cities. Cotterill and Harper (1995) further verified the concentration-price relationship for a sample of 34 local markets in and around Arkansas. A fourth study, drawing on highly aggregated retail food price indexes published for only 18 large U.S. metropolitan areas by the Bureau of Labor Statistics also found that concentration was positively related to food prices (Lamm 1981). Cotterill and Harper also found that the presence of warehouse-type stores significantly reduced grocery prices.[7]

Unlike the business-management studies, economic models of retail prices include few variables meant to capture differences in retail demand conditions. Cross-city studies by Cotterill and Harper and Lamm found average incomes significantly related to higher grocery prices; Cotterill found no significant relationship. On the other hand, economic studies nearly always include some local cost variables, which is certainly appropriate in a multi-city analysis of long-run prices. Labor costs, the largest cost of store operation, were included in the studies by Marion *et al.(1979)*, Lamm, and Cotterill and Harper, but this factor is usually not significant. Other supply-side variables include unionization, economies of scale, or cost of goods sold.[8] Regional or state dummy variables can also capture variation in prices due to either retailing costs or demand characteristics.

Food Prices Model

The model employed in this analysis was of the general form:

P = f(C,D,S),

where P is a measure of retail food price in a given market, C is a vector of variables measuring the competitive climate of the market, D is a vector of demand or demographic factors expected to influence market price, and S a vector of supply-side or cost factors for sellers. The functional form is a simple linear equation. Within C we include a standard measure of concentration, but non-traditional factors, such as the measure of restaurant activity just noted above, are incorporated as well. Our primary concern is the effect of the competitive climate on pricing, but the demand and supply variables are themselves of interest and they may yield insights into the pricing behavior of retail grocery firms. The cost variables are important because our sample is geographically extensive and costs can vary widely over large areas. The majority of the variables are measured at the SMA level, but a few refer to somewhat larger grocery marketing regions.

Dependent Variable and Sample

Supermarket price indexes were taken from a quarterly commercial publication sold by ACCRA, the research arm of the U.S. Chamber of Commerce. ACCRA's major activity is collecting, tabulating, checking, organizing and publishing the *Inter-City Cost of Living Index*. In their words, "This survey . . . published quarterly since 1968, is the only generally available source of data on living cost differentials among U.S. urban areas" (p. 1.1).[9] The primary purpose is to provide information on a market basket of goods and services typical of the purchases by mid-management executive households, with an eye toward assisting firms in relocating employees to another city. One previously published empirical analysis has employed intercity ACCRA grocery price data (Chevalier).

ACCRA reports prices on 59 individual items, 27 of which are grocery items. Enumerators are personnel from local Chambers of Commerce, for which participation is strictly voluntary. Thus, cities reported in one quarter may be absent in the following quarter. ACCRA provides very strict guidance concerning the items and methods of data collection. For example, one of the grocery items is "corn flakes," described as "18 oz. Kellogg's or Post Toasties." Enumerators are instructed to obtain prices from at least five supermarkets; doing so on Thursday, Friday, or Saturday; using the lowest price at each store, exclusive of coupons. These are then averaged to obtain the price reported for the item for the city.[10]

Because the concentration data are based on 1987 census data, we centered attention on that year and used ACCRA price data from the Spring quarter for the three year period 1986-88. There were 153 cities reporting in all three quarters. The final sample was composed of the 95 cities for which we had measures for all other variables. The three price measures we used were ACCRA's overall grocery price index and two we created from the prices of the individual items.

Independent Variables

Reasons for inclusion of most of the independent variables are fairly obvious, and there are generally strong *a priori* notions concerning the directions of their effects. In this section we define the variables and discuss hypothesized effects.[11]

Market Competition

C4 is supermarket sales concentration (Franklin and Cotterill). Most imperfect market models predict that greater concentration leads to greater price, which suggests a positive relation (Cotterill, Weiss). While this is the prevailing view, Salop and Stiglitz have posited a reverse effect. They argue that consumer costs of price search are lower when there are fewer firms, so high concentration may encourage retail sellers to price closer to perfectly competitive levels. Thus, Cotterill concludes that the nature of the price-concentration relation is an "empirical question" (p. 380).

*C4*SIZE*. The largest cities consist of many trading areas, some so distant from one another that distinct geographic markets emerge. If leading retailers tend to congregate in only certain trading areas (the suburbs, say) and independents are found disproportionately in the inner city, then reported C4 is systematically lower when city size is large, and the sign of C4*SIZE is likely to be positive. However, if search costs are higher in large cities, then the Salop-Stiglitz hypothesis, if correct, would contribute to a negative effect for C4*SIZE.

SUPER is the ratio of supermarket sales to total SMA grocery sales. If convenience-type and other small stores represent viable competition for supermarkets, then it is possible that as supermarkets' share of the market increases, so do prices. We doubt if such an effect is strong in retail markets with effective inter-supermarket competition unless supermarket prices were particularly elevated (Marion *et al*. 1986). Furthermore, because operating costs for supermarkets are lower than small stores costs, when SUPER is high, heightened price competition should drive down prices.

WHS measures the extent of warehouse-store presence in a market area. Since warehouse stores typically stock fewer items than do standard supermarkets, while also providing fewer services, they have lower operating costs and hence lower prices. Thus, WHS should carry a negative sign, both directly because of the effect of warehouse stores in lowering average SMA prices and indirectly because of competitive responses by conventional supermarkets.[12]

FAST is the average per person expenditures on low-cost restaurants in the SMA. If supermarkets consider fast food outlets as a source of direct competition, they may respond with lower prices when fast food presence is strong. Although supermarkets during our sample period were clearly concerned with fast food competition, a strong price effect seems unlikely to us. Further, markets with high supermarket prices increase incentive to consume food-away-from-home (reverse causality), which would generate a positive relation between fast food sales and supermarket prices.

CHURN represents the number of grocery items with large (± 10 percent from the mean) quarterly price changes. We interpret high pricing turbulence as evidence that supermarkets were adjusting to a new environment. We expect this to increase price reactions in the market, at least in the short run. Since greater competitive activity will lower overall prices, we expected the effect of CHURN to be negative.

CHAIN. The argument can be made that increasing the presence of chain operators in retail food markets reduces competition by reducing the number of stores operated by nonchain grocery firms. It is widely believed that chains are in a better position to wield power than are independents. For example, chains can employ zone pricing, while most independents cannot. On the other hand, economies of scale in chains' management and distribution will tend to lower costs and, *ceteris paribus*, prices. In short, the direction of effect of this variable is essentially an empirical question. Our expectation is that the factors generating downward price pressures will predominate, especially given our belief that the period under analysis was not a particularly stable one for the supermarket industry.

Retail Cost Factors

WAGE. Wages are the primary component of operating costs, which eventually will be passed on as higher prices.

EMPL/STR. Our data indicate differences in average employees per supermarket ranging from 31 to 60. It is unlikely that such large differences are due to wages or store size, variables which are included in the model. This variable may reflect differences in union strength across areas, the availability of minimum-wage labor, different store practices (such as twenty-four-hour operation), or differences in capital costs per employee. In any case, the differences are likely to affect costs and hence price. The direction of any such effect is purely an empirical question.

SQFT measures the average size of supermarkets in the metro area. If there are significant economies of scale in grocery retailing, then larger stores can charge lower prices. On the other hand, larger stores stock more kinds of items and often provide more services, which can increase unit costs. Also, larger stores presumably reduce the total number of stores, which along with the increased opportunities for differentiating themselves from competitors, can facilitate non-competitive pricing. For these reasons, the sign on this variable is indeterminate *a priori*.

RENT. In place of unavailable commercial rents, we use ACCRA data on the cost of rental housing in the metro area. Assuming commercial and housing rents are somewhat correlated, we expect rental costs to be positively related to grocery prices.

ELEC. Electricity costs are a fairly minor portion of retail operating costs, but they may affect the prices of refrigerated foods. We measured electricity costs by calculating average monthly costs of electricity for commercial accounts using at least 6,000 kwh. For several cities with missing information, comparable cities in the region provided these data. We expect high energy prices to result in high grocery prices.

Demand and Population Factors

SIZE of market is measured by metro-area grocery sales (SIC 541). The Salop-Stiglitz hypothesis may be expected to be evident in large markets where consumer search costs are especially high. On the other hand, large markets may permit scale economies in distribution and retail advertising, which would lower costs and, under competitive conditions, prices. Of course, huge urban agglomerations could exceed the size at which selling costs are minimized, which calls for a curvilinear specification.[12] Thus, the effect of this variable is best viewed as an empirical question.

DENSITY, population per square mile, is introduced to capture differences in urban congestion. Density will make intracity delivery costs higher because of street congestion, the use of smaller trucks, and more frequent deliveries. Density will also impose search costs on consumers. On the other hand, more dispersed urban settlement patterns will lower sales per square foot of store space because larger, more spacious store designs are utilized in cities that have experienced most of their growth since the 1950s; moreover, more widely dispersed store sites will increase delivery costs as a percent of sales. Therefore, *a priori* notions concerning urban density lead to competing hypotheses about the expected sign of DENSITY.

GRO. Rapid population growth, if unanticipated, can strain capacity and result in higher prices. But a growing market may also stimulate entry of new stores and possibly new firms, which we would expect to lead to lower prices. Which (if either) prevails is an empirical question.

INCOME. Average market-level income can positively affect prices because "upscale" stores with more services are likely to be present. Also, income elasticities for food will tend to be lower (since food represents a smaller portion of consumption), thus facilitating the exercise of market power (Cotterill 1986).

REGION. A set of dummy variables was included to allow for differences in average price levels over broad geographic areas. Our regions are based on areas known to be significantly different in food consumption (Larson and Binkley): (1) the East: all northeastern states plus Delaware and Maryland; (2) the Midwest: bordered by (and including) Ohio, West Virginia, Kentucky, Missouri, and the states from Oklahoma to North Dakota; (3) the South: Louisiana, Arkansas and everything east of the Mississippi not in the Midwest or East; and (4) the West: everything else.

Results

Price Components

If supermarkets place similar price markups on all items, then cities with high prices for one item would tend to have high prices for all items. Prices would be highly positively correlated. This is not what we found. The 26 ACCRA grocery items generate 378 unique price correlations. We ranked these, and, given the well articulated national market for food, the results are somewhat surprising. In Table 1 we present the ten largest and ten smallest. The largest is an unexpectedly low .65; the smallest is -.38! In all, only 50% were significantly (.05) positive. This result demonstrates that firms indeed do not set prices in a uniform manner and that a single-price measure has limitations.[13]

Lacking any strong basis for forming combinations of the item prices, we let the data itself do this through the use of principal components analysis. Principal components is a multivariate statistical technique whose purpose is to capture the majority of variation in p variables with $q < p$ variables, the principal components. The principal components are ordered orthogonal linear combinations of the original p variables. The first is the linear combination capturing the maximum variation in the original variables, the second captures the maximum of the remaining variation, and so forth. Because of the orthogonality, variation arising from different sources within the original data would tend to be associated with different principal components. This makes the technique useful for present purposes. If there are groups of items with pricing patterns similar within groups but different across groups, members of different groups may be associated with different principal components. These associations are measured by "loadings" of the original variables on the components.

Principal components were constructed for the 26 prices. The first principal component (hereafter P1) accounted for 27% percent of the price variation. A proportion this small confirms that the overall correlation among the prices is not particularly high. The cumulative total variation captured by the first two components is 38%, and the first three account for 47%. From there it increases in small, slowly decreasing increments, further evidence of low price correlations.

As expected, the principal components are related to commodity groups which share identifiable characteristics (Table 2). The first component tends to have relatively large positive correlations with prepackaged, branded, dry grocery products; the second (P2) primarily with fresh meat, produce, and milk. The pattern for the second is especially strong: its correlation with many of the branded goods is often zero or negative. This price partitioning is striking, providing evidence that factors governing supermarket pricing differ across items. We thus used the first two principal components, P1 and P2, to construct two additional price indices. This was done by multiplying each city's vector of item prices by the corresponding vector of coefficients ("scores") associated with the principal components.

Grocery Price Regressions

In Table 3 appear the price index regression estimates. The explanatory power (as measured by R^2) is reasonable, particularly given the utilization of data on a wide spectrum of city types.

We begin with the group of variables measuring the competitive climate. The concentration variable has the expected positive effect, but unless one takes a one-tailed view, it cannot be adjudged a significant effect. Furthermore, the sign on the concentration-market size interaction term is negative and almost significant. We take this as weak evidence that larger cities with many trading areas may frustrate consumer price-searching. Because we normalized the interaction variable on the average market size in the sample, the net effect of concentration at that value is the sum of the two coefficients. This is seen to be very nearly zero. Indeed, for neither the smallest nor the largest market in the sample was this net effect found to be significantly different from zero at $\alpha = .1$ using a t-test. Similarly, a joint F-test of these two variables was not significant at standard levels.

We obtained strong results for several of the remaining market competition variables. Only SUPER has no perceptible effect, which supports the view of many experts that supermarkets and convenience stores are members of noncompeting strategic groups (Marion *et al.* 1986:300-306). WHS (warehouse store penetration into the region) has the expected negative sign, with a robust level of statistical significance. It certainly supports a view that warehouse stores were a positive competitive force in the industry in the late ‘80's. The coefficient of CHAIN is negative, also with a rather emphatic level of significance. We interpret this as a reflection of cost efficiencies in purchasing and warehousing, which are the primary economic benefits of the chain form of retail organization. We also expected a negative coefficient on CHURN, our measure of price turbulence, regarding it as a reflection of competitive pressures. The results support this view. The coefficient is strongly negative, and is the statistically most important of the rivalry variables. The last of the market-competition variables is FAST, metro area per capita fast food sales. This estimated coefficient is also negative, with a level of significance approaching conventional levels. This invites an inference that supermarkets in fact were beginning to respond to perceived competition from the fast food industry in the late 80's. However, the component price results discussed in the next section suggest that such an interpretation may be facile.

The results for the five variables which are classified as grocery-industry cost measures are in line with prior expectations. In two cases we had no firm priors: store size, with a positive coefficient, and employees per store, whose coefficient is negative, are each significant at least .05. A direct interpretation generates the inference that there are no economies of store scale, but there are economies from labor specialization.[14] Two of the coefficients on direct measures of cost, WAGE and RENT, have the expected positive sign. The first is highly significant, and the second achieves 5% if an (appropriate) one-tailed test is employed. A third direct measure, ELEC, is indistinguishable from zero.

Seven variables in the model relate to the population or demographic characteristics of the metropolitan areas or the regions in which they are located. Three of these variables, city size, density, and growth, may also affect pricing because they affect intercity costs of grocery retailing. Because these variables may affect either the demand for food or costs of grocery retailing services, we group these variables into a factor we call "city characteristics." We find that densely populated cities have (insignificantly) lower retail grocery prices, but cities with large supermarket sales have significantly higher prices (Table 3). Fast-growing cities have slightly higher prices, but the relationship is of only borderline significance. Thus, these single-variable results suggest that large, fast-growing, spread-out cities may have the highest U.S. grocery prices. Perhaps the most relevant test of city characteristics is a joint F-test of significance of the three variables. We conducted this test, and could not reject the null ("no city effect") even at $\alpha = .10$. In short, city characteristics *per se* evidently have little influence on retail food pricing.

The coefficients on the three regional dummies indicate that, corrected for effects due to variables in the model, prices are highest in the East Coast and lowest in the West, and broadly similar across the Midwest and South. A joint F-test of the three dummies was significant at .01. The result for INCOME—a negative, quite significant coefficient—is puzzling. As discussed above, our prior was a positive effect, if any, a prior based on price discrimination arguments. All we can confidently conclude is that there is certainly no evidence of a market power effect operating through income elasticity differences.

Component Regression Results

We now consider the two price component regressions. We will denote the first as the P1 or "dry grocery" component and the second as the P2 or "fresh" component (Table 4). It is evident that results for P1 are largely similar to those for the general price index, while those for P2 are quite different from both. The similarity between P1 and the price index is because most of the ACCRA items are in the dry grocery category. But by design, P2 is dominated by commodities with very different pricing patterns.

Comparing the P1 and P2 equations, the variable with the most similar effect is CHURN, whose coefficient in both cases is negative and reasonably significant. Price turbulence may be generated by endogenous competitive factors (e.g., an inability to maintain an oligopolistic consensus in some cities) or by exogenous price transmissions. The fact that the coefficient on CHURN is more important in the P2 equation may be attributed to the behavior of wholesale prices of fresh commodities (the main P2 constituents) which change much more frequently than wholesale prices of dry grocery items.[15]

Among results for the other variables in the "market competition" group, there are several that warrant discussion. The market power measure C4 is of much stronger effect in P1 than it is in the original price equation and certainly than for P2. The interaction of C4 with SIZE is also stronger. Signs are reversed in the P2 equation but significance levels are the smallest of the three models. What is important is the clear suggestion that the items subject to higher prices due to market concentration tend to be "grocery" items, which are also most likely to be branded, nationally-advertised goods themselves manufactured in concentrated markets. Previous studies of the impact of market power on retail food prices have focused on this type of commodity.

The coefficient on WHS is negative in both models; however, it is estimated to be of greater importance for P2. Because warehouse stores emphasize packaged items in the grocery category (P1 goods), and at best stock only a limited selection of fresh items, this result might appear paradoxical. It implies that supermarkets respond to warehouse store competition by lowering prices more for the goods that warehouse stores do not stock.

However, this paradox assumes a market with one commodity and identical buyers and sellers. A more appropriate interpretation is based on discriminatory pricing, a point that we illustrate with a stylized case. Consider a supermarket with some degree of market power selling two goods, a necessity P1 and a convenience good P2, to two groups of consumers, "rich" and "poor." The poor consumers purchase only P1 and have an elastic demand. The rich purchase both, and are not price sensitive. Under these conditions, the optimal (from the perspective of the supermarket) P1 price would exploit the different demands the store faces and price discriminate by charging a lower price to the poor. But this is not possible because the two markets cannot be segmented (except imperfectly, e.g. with coupons). Hence, it will charge the same P1 price to all consumers, a price between those two that would obtain under price discrimination.

Now suppose a new store enters the market. If the entrant is identical to the incumbent, prices for both goods would be expected to fall (at least in the absence of collusion). However, suppose the new store is a warehouse store, selling only P1. With lower costs, it will set a P1 price below that of the incumbent, and all the poor consumers (who consume no P2) will migrate to the new store.

In this case, even the direction of the P1 price response by the existing supermarket is unpredictable. Attempting to regain poor customers by matching the entrant's price is not a viable long run response since it implies pricing below cost, and any price above this will not entice any poor consumers back. Hence, the optimal price for P1 is determined purely by the elasticity of P1 demand by the rich. Although this elasticity may be higher than before (given the warehouse penetration), it may still be optimal for the existing supermarket to *increase* the price of P1, given the inconvenience that the rich perceive in shopping at two stores. In effect, the warehouse store has segmented the market such that supermarket pricing depends solely on the demand exercised by rich customers. As a consequence, the magnitude and direction of the supermarket's P1 response depends upon three factors (pre-entry level of P1, the warehouse price, and the elasticity of demand by the rich), each of which is case-specific.[16]

In short, competitive price responses in multiproduct markets with non-identical firms serving non-identical consumers are difficult to predict: they depend upon the market parameters. Such markets allow discriminatory pricing, and it is no accident that models of such markets, even when highly simplified, yield few unambiguous implications. Thus, the results with respect to WHS, viewed in this light, are not necessarily surprising.

The comparative results for FAST, metropolitan area fast food sales, are somewhat problematic. In the P1 model, as in the original model, the coefficient is negative, but now it is highly significant. In sharp contrast, for P2 it is positive, and nearly significant at .05. Yet it is fresh items (e.g., meat) that are more directly competitive with food away from home. While it is conceivable that discriminatory pricing along the lines of that just discussed is involved in this result, we believe it most unlikely that it has a major role. Indeed, it seems unlikely that the strong results for either P1 or P2 are measures of supermarket reaction to fast food competition. A much more reasonable interpretation of the P2 result is reverse causality: high supermarket prices for meat and other fresh items are an incentive for consumers to switch to fast food. But this is not consistent with the negative P1 response, which cannot be dismissed as a spurious effect, given the strong statistical measures. Thus, we conclude that there is undeniable evidence of price competition between the grocery and restaurant segments: uncovering its specific nature will require a more targeted model.

To summarize, the effects of market competition on price component P1 (dry and frozen grocery products) are similar to those for the grocery price index. Indeed, the effects of market concentration and fast-food places are even more pronounced than the effects on all grocery prices. However, for fresh and chilled foods, market competition as a whole has no significant impact on prices; indeed, for four of the six variables more competition is actually associated with rising prices.

For the five variables in the cost group—wages, employees per store, store size, rent, and electricity—the P1 results are indistinguishable from those for overall price. However, just as we have seen for the market competition variables, those for P2 are quite different: the variables generally have little effect, and then in the opposite direction. The coefficient on ELEC is positive and significant at .10. This is reasonable, since electricity is a relatively important input for fresh, temperature-controlled commodities. However, such commodities also require more handling, so the same argument suggests that wages should be an important positive factor in their prices, more important than in the case of P1. But it is none of these. Overall, the results suggest that costs play at most a limited role in price-setting for P2 commodities, despite their high service requirements. A joint F-test of significance of the five cost variables yielded an F-statistic of 2.11, which is significant only at .10. The same test for P1 yielded a value of 6.05. This apparent paradox is evidently an accurate characterization: "We have to wonder how much longer grocers can opt for price-cutting programs while simultaneously adding cost-increasing services" note the editors of <u>Progressive Grocer</u> (1987).

The coefficient on CHAIN is negative in both models but in neither case as significant as in the original price equation. Thus, the final conclusion with respect to this variable can only be that, *if anything,* markets with a high percentage of chain stores will tend to have lower prices. Finally, the component models suggest that, beneath the original result that the South and Midwest have similar levels of supermarket prices, lies a more disaggregate one: dry grocery items are cheaper in the South but fresh items dearer.

As a final statistical exercise, we performed a formal test of the hypothesis that supermarket pricing is uniform across goods (though it hardly seems necessary).[17] The results are not surprising. An F-test of over-all coefficient equality was rejected at a level of significance far exceeding .01. In the case of individual coefficients, equality was rejected at least .01 for fast food, store size, and South; at least .05 for warehouse store presence; and at least .10 for income, density, wage, concentration and its interaction, and electricity cost. The equations clearly differ.

Concluding Remarks

The purpose of this study was to examine grocery pricing in the changing market environment in which modern supermarkets were operating in the 1980s. To accomplish this we estimated pricing models using a sample of city data from a wide range of metropolitan areas, with a corresponding variety of market characteristics. We included several variables not previously considered in pricing studies, variables meant to measure aspects of what we view as the “new” competitive environment facing the supermarket industry.

In addition to the analysis of a single measure of metropolitan-area supermarket price, principal-components analysis revealed the presence of two quite different groups of prices: (i) a set of packaged, branded grocery products in the "dry grocery" and "health and beauty aids" departments and (ii) a group of essentially nonbranded, refrigerated products consisting primarily of fresh red meats, milk, and produce departments. Using our model explaining variation in an overall price index, we obtained results similar to those of previous studies for factors previously considered. Results for the dry grocery component mirrored the general grocery price index model, but results for the nonbranded/refrigerated group were quite different, suggesting little if any effects of cost factors and presenting some unexpected rivalry effects. Overall, the evidence is very strong that supermarket pricing varies markedly over different kinds of goods. We suggest that the large differences observed reflect in part discriminatory pricing. Such pricing is especially likely in markets with non-identical competitors perhaps serving specialized segments, such as that of the working hypothesis of this study.

Overall, the results depict a changing market, with the degree of rivalry among super-markets no longer the only important competitive force shaping supermarket pricing decisions. Our evidence is that serious competition has arisen not only from new formats of grocery retailing—warehouse stores, for example—but also from the restaurant industry. In a world in which large changes in the retail landscape are bringing about corresponding changes in con-sumer shopping behavior, and in a world in which food eaten outside the home now accounts for almost one half of consumer food expenditures, this should not be a surprising outcome.

Table 1. Ten Highest and Ten Lowest Price Correlations.

Items	Correlations
Highest	
Canned tuna - margarine	.652
Sugar - Crisco	.638
Canned tuna -Crisco	.635
Laundry detergent - baby food	.621
Crisco - baby food	.587
Canned tuna - laundry detergent	.587
Coffee - laundry detergent	.563
Parmesan cheese - tissue	.561
Canned tuna - baby food	.557
Canned peas - tissue	.548
Lowest	
Potatoes - laundry detergent	-.376
T-bone steak - laundry detergent	-.357
T-bone steak - coffee	-.344
Milk - laundry detergent	-.301
Hamburger - coffee	-.281
Potatoes - coffee	-.277
Milk - canned tomatoes	-.265
Whole chicken - milk	-.259
Lettuce - laundry detergent	-.243
Whole chicken - lettuce	-.241

Note: The total number of correlations is 378.

Table 2. Correlations between First Two Principal Components and Prices.

Price	Correlation	
	P1	P2
T-bone steak, USDA Choice	-.043	.403
Hamburger, lowest price	.074	.393
Bacon, 12 oz., rashers*	.145	.134
Frying chicken, whole, lowest price	.233	-.027
Canned tuna, 6½ oz., in oil*	.297	.018
Milk, ½ gallon, whole	-.062	.335
Eggs, dozen, grade A, large	.220	.049
Margarine, 1 lb., stick*	.293	.019
Parmesan, grated, 8 oz. canister*	.255	.013
Potatoes, 10 lb. sack, white or red, lowest price	-.087	.385
Bananas	.092	.264
Lettuce, iceberg, 1¼ lb. size	-.063	.336
Bread, white sliced, lowest price	.169	-.005
Coffee, 13 oz. can, vacuum*	.193	-.207
Sugar, 5 lb., cane or beet, lowest price	.249	.201
Corn Flakes, 18 oz.*	.113	-.069
Canned peas, 17 oz. can*	.253	-.034
Canned tomatoes, 14½ oz. can*	.178	-.058
Canned peaches, 29 oz. can, whole or slices*	.097	-.010
Tissue, 175-count box*	.258	0.16
Laundry detergent, 42 oz.*	.258	-.234
Shortening, 3 lb. can, all-vegetable oil*	.270	.155
Frozen orange juice, 12 oz. can*	.250	.172
Frozen corn, 10 oz. package, whole kernel, lowest price	.107	.080
Baby food, 4½ oz. jar, strained vegetable, lowest price	.272	-.034
Cola, 2 liter, excluding deposit*	.083	-.095

*One or more major brands specified. Items without asterisk may include unbranded or private label products.

Table 3. Regression Results Explaining Grocery Prices Across 95 Metropolitan Areas.

Variable	Coefficient	t-value[1]
Intercept	87.662	8.46[a]
Market Competition Factors:		
C4	0.047	1.35[c]
C4*SIZE	-0.041	-1.62
SUPER	-6.582	-0.76
WHS	-22.390	-3.35[a]
FAST	-16.484	-1.59
CHURN	-0.250	-3.42[a]
CHAIN	-0.127	-2.71[a]
Retail Cost Factors:		
WAGE	2.032	2.90[a]
EMPL/STR	-0.244	-2.12[b]
SQFT	0.001	3.39[a]
RENT	0.055	1.61[c]
ELEC	-0.001	-0.31
Population Factors:		
SIZE	0.004	1.86[c]
DENSITY	-0.461	-1.40
GRO	0.057	1.20
INCOME	-0.640	-2.13[b]
EAST	6.938	3.62[a]
SOUTH	0.424	0.33
WEST	-2.183	-1.21
R^2	0.62	
$\bar{R}^2$	0.51	
F	6.16[a]	

[1]a, b, and c represent significance from zero at the 1, 5, and 10 percent levels. The following variables are tested using a one-tail test: WAGE, RENT, ELEC, C4, SUPER, WHS, and CHURN.

Table 4. Regression Results Explaining Grocery Price Components Across 95 Cities.

Variable	Dry Groceries (P1)		Fresh & Chilled (P2)	
	Coefficient	t-value[1]	Coefficient	t-value[1]
Intercept	79.623	5.23[a]	112.373	5.52[a]
Market Competition Factors:				
C4	0.100	1.93[b]	-0.063	-0.91
C4*SIZE	-0.062	-1.68[b]	0.060	1.21
SUPER	-15.348	-1.21	4.944	0.29
WHS	-10.929	-1.15	-47.287	-3.61[a]
FAST	-37.080	-2.44[b]	38.388	1.89[c]
CHURN	-0.168	-1.56[c]	-0.354	-2.46[a]
CHAIN	-0.092	-1.34	-0.029	-0.32
Retail Cost Factors:				
WAGE	2.782	2.70[a]	-0.327	-0.24
EMPL/STR	-0.326	-1.93[c]	0.020	0.09
SQFT	0.002	3.68[a]	-0.001	-1.57
RENT	0.080	1.61[c]	-0.020	-0.30
ELEC	-0.006	-0.91	0.015	1.70[b]
Population Factors:				
SIZE	0.006	1.86[c]	-0.005	-1.09
DENSITY	-0.776	-1.60	0.741	1.14
GRO	0.129	1.83[c]	-0.022	-0.24
INCOME	-1.001	-2.27[b]	0.449	0.76
EAST	9.319	3.31[a]	1.998	0.53
SOUTH	-4.122	-2.18[b]	12.934	5.11[a]
WEST	-2.478	-0.94	-4.369	-1.24
R^2	0.63		0.75	
$\bar{R}^2$	0.53		0.69	
F	6.58[a]		11.84[a]	

[1]a, b, and c represent significance from zero at the 1,5, and 10 percent levels.

Endnotes

1. According to Leed and German, only about four percent of the stock-keeping units of a grocery store are ever placed on temporary promotional prices.

2. Gross margins vary from 5 to 50 percent across grocery categories, yet most early writers on grocery pricing policies are highly skeptical that operating costs have any effect on gross margins (Cassady, Holdran). Leed and German presented data showing that operating costs in the meat and produce departments (9 to 12 percent of sales) were much higher than any other department, but still downplayed their importance. More recent studies in the business-management literature likewise omit operating costs from most models of price or margin determination.

3. A more general model that explains the influence of demographic variables on the elasticity of demand is Becker's household production theory: benefits are lower prices but costs include price search, transportation, home inventory management, and the opportunity cost of shopping time.

4. Nine panel-data studies reviewed by Hoch *et al.* found price responsiveness positively associated with age, education level, household size, wealth, car ownership, and single-earner households. Five additional studies of search effort found positive associations with age and some attitudinal variables and a negative association with income, but the degree of explanatory power was low. Hock *et al.* found that price responsiveness in 18 grocery product categories was generally positively related to family size, minority ethnic composition, and income; but was negatively related to education level and wealth of households in the immediate trading area. Responsiveness was unrelated to household age and dual-career status. Litvack *et al.* found that supermarket prices were significantly more price responsive for “stock-up” goods than for perishable grocery products.

5. The size and boundaries of retail trading areas have been formalized by retail-industry consultants with proprietary models that take into account population density, competitive store locations, road layouts, and other geographic characteristics (Hoch *et al.*:20). These models indicate that a metropolitan area like Chicago has dozens of trading areas; a city with one million population like Indianapolis may have about four trading areas (Knebel).

6. Bliss also assumes that there are well-defined product categories sold in the stores (i.e., there are low cross-price elasticities of demand across goods). One would think that independence in demand would apply to dry groceries as a group and fresh or chilled foods.

7. Because these studies support the inference of significant market power over selling prices in grocery retailing, they have not gone unchallenged. A study conducted by the Economic Research Service (ERS) of the USDA did not find a significant positive relationship between an index of store-level grocery prices and metropolitan-area C4;

indeed, the relationship is significantly negative in some of the models that were tested. The merits of this study were extensively debated in a panel discussion reported in Cotterill (1992). Among the criticisms mentioned were the small (ten) and possibly biased sample of cities, the inclusion of items whose quality varies considerably across stores (primarily fresh meats and produce), inclusion of a wide variety of possibly noncompeting store types, and a host of probable procedural errors in developing the sample.

8. In data sets containing a variety of retail formats, dummy variables can capture cost differences among store types (e.g., Cotterill and Harper). One study included a proxy for the cost of goods sold (metropolitan-area wholesale grocery prices) as an explanatory variable (Lamm). Cotterill incorporated distance from grocery warehouse to account for variation in delivered costs of goods sold.

9. The U.S. Bureau of Labor Statistics publishes cost-of-living data for urban workers, not managers, and covers few cities, whereas ACCRA currently makes available indexes for about 250 cities.

10. We used 26 of the 27 grocery items, omitting only cigarettes. The 26 grocery items are shown in Table 2.

11. Al the independent variables are extracted from the U.S. Census Bureau's 1987 City-County Data Book except for the following; C4 and SUPER from Franklin and Cotterill; GRO, SIZE and FAST from the 1987 U.S. Census of Retail Trade; RENT, CHURN, and ELEC from ACCRA; and EMPL/STR, WHS, and CHAIN from Progressive Grocer (1988).

12. This variable is rather crudely measured as the ratio of warehouse stores to the total number of grocery stores. Even if this measure referred to the individual SMAs, the direct effect may be absent. The ACCRA data is collected only in stores selling all products priced. The latter include meats and produce, items often not carried by warehouse stores. Hence, few warehouse stores are likely to be in the sample.

13. Some experimentation with a quadratic term in SALES provided little indication of a nonlinear effect.

14. There is an indication in the table that when pricing commodities, an important characteristic is whether they are predominantly prepackaged, branded items generally found in the "dry grocery" or "health and beauty aids" departments. In our sample, these prices tend to be positively correlated among themselves, and negatively associated with prices of items sold unbranded, especially fresh items. This is the only pattern discernible in the correlations in Table 1 and in those not presented, and it suggests combining items by categories ("produce," "dairy," etc.) is not likely to serve present purposes. One alternative would be to regress prices of individual items. We did not take this avenue because of the unmanageably large number of models and consequent difficulty in arriving at meaningful generalizations.

15. An inspection of the data shows that areas with many employees per store tend to be those with either the smallest or largest stores. This suggests a possible non-linear effect between these variables, but an attempt to capture this by including an interaction variable failed due to multicollinearity. Because of our city-level approach (and *a fortiori* because the variables involved apply not to those cities but to their *Progressive Grocer* region) we were unable to pursue this further.

16. An examination of the sample data revealed the number of price changes for produce and meat items far exceeded the number for all dry grocery items.

17. Under the more realistic case of a continuum of consumer types, all (at least potentially) consuming both goods, matters are yet less clear. For example, the incumbent supermarket may keep its P1 price intact, or at least considerably above the new competitor', and lower its price of P2, hoping to attract new P2 consumers, who (due to the cost and inconvenience of shopping at two stores) then remain to purchase P1, despite a higher price. If the price of P2 were lowered below cost, we have the loss-leader case, which has been shown to be optimal under some conditions.

18. We did this with tests of coefficient equality across the P2 and P2 equations, using a seemingly unrelated regression procedure. Since the same explanatory variables are the same in each equation, all estimated coefficients for both were precisely the same as those of OLS. But the SUR procedure is needed for cross-equation tests, since it incorporates the covariance of estimated coefficients across the two equations (and certainly one would expect the errors to be correlated).

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APPENDIX TABLES

Table A1. The 95 Cities in the Sample, (Alphabetically by State Zip Code).

City, State	**City, State**	**City, State**
Anniston AL	Greensboro NC	Wichita Falls TX
Birmingham AL	Raleigh NC	Salt Lake City UT
Dothan AL	Wilmington NC	Richmond VA
Huntsville AL	Omaha NE	Roanoke VA
Mobile AL	Albuquerque NM	Richland WA
Fayetteville AR	Reno NV	Tacoma WA
Fort Smith AR	Binghamton NY	Yakima WA
Phoenix AZ	Buffalo NY	Appleton WI
Fresno CA	New York NY	Green Bay WI
Merced CA	Syracuse NY	Janesville WI
Sacramento CA	Cleveland OH	LaCrosse WI
San Diego CA	Columbus OH	Charleston WV
Visalia CA	Lorain OH	Casper WY
Boulder CO	Youngstown OH	
Denver CO	Oklahoma City OK	
Fort Collins CO	Portland OR	
Wilmington DE	Salem OR	
Pensacola FL	Altoona PA	
Atlanta GA	Erie PA	
Augusta GA	Harrisburg PA	
Macon GA	Lancaster PA	
Cedar Rapids IA	Philadelphia PA	
Boise ID	York PA	
Decatur IL	Greenville SC	
Rockford IL	Rapid City SD	
Springfield IL	Chattanooga TN	
Anderson IN	Jackson TN	
Indianapolis IN	Memphis TN	
South Bend IN	Abilene TX	
Wichita KS	Amarillo TX	
Lafayette LA	Brownsville TX	
New Orleans LA	Dallas TX	
Jackson MI	El Paso TX	
Lansing MI	Houston TX	
St. Paul MN	Lubbock TX	
Columbia MO	McAllen TX	
Joplin MO	Odessa TX	
St. Louis MO	San Antonio TX	
Gulfport MS	Sherman TX	
Great Falls MT	Tyler TX	
Charlotte NC	Waco TX	

Table A2. Descriptive Statistics for Variables used in Regression Analyses.

Variable	Mean	Standard Deviation	Minimum	Maximum
Dependent:				
Price index (PI) (U.S. = 100)	99.425	4.608	87.833	111.033
Price Component One (P1)	100.007	6.755	86.287	113.378
Price Component Two (P2)	99.991	11.063	71.710	122.325
Independent:				
Sales concentration (C4)%	77.211	13.381	37.200	100.000
Demographic Factors:				
SIZE ($millions)	834.522	1,147.956	94.957	6,679.641
GRO (percent)	4.631	8.855	-9.500	30.900
INCOME ($ thousands)	10.275	1.470	5.490	13.378
EAST (ratio)	0.118	0.322	0	1
SOUTH (ratio)	0.400	0.492	0	1
WEST (ratio)	0.211	0.410	0	1
MIDWEST (ratio)	0.274	0.448	0	1
Retail Cost Factors:				
WAGE ($ thousands)	8.472	0.663	7.220	10.571
DENSITY (person/sq. mi.)	3.303	2.879	0.737	24.089
EMP/STR (persons/store)	42.452	7.1-3	31.300	57.600
SQFT (sq. footage/store)	20,598.850	2,353.110	16,160.000	26,275.000
RENT (U.S. = 100)	98.064	19.403	77.000	210.900
ELEC (dollars per mo.)	474.575	115.283	278.450	939.480
Rivalry:				
SUPER (ratio)	0.894	0.047	0.750	0.973
WHS (ratio)	0.060	0.069	0	0.279
FAST ($thousands/person)	0.224	0.054	0.102	0.337
CHURN (index)	20.295	4.981	11.000	37.000
CHAIN (percent)	54.158	12.997	20.000	83.000

Table A3. Predicted Effect of Concentration on U.S. Metropolitan-Area Grocery Price, Five Alternative Statistical Studies.

Source	Price Data	Local-Market Concentration[a]		Predicted Extreme Price Difference
		Lowest	Highest	
Marion, *et al.* (1979: Table 4.6)	Dry grocery foods, October 1974	C4=40, FRMS=10	C4=70, FMRS=55	8.6
Lamm (1981: Table I)	All foods, 1974-1977	C3=30	C3=70	1.9
Cotterill (1986: Table 2, Equa. 2)	Dry grocery foods, August 1981	HHI=193	HHI=10,000	6.3
Cotterill (1986: Table 3, Equa. 1)	Dry grocery foods, August 1981	C4=80.5	C4=100	3.3
Cotterill (1986: Table 2, Equa. 3)	Dry grocery foods, August 1981	MS1=12.5	MS1=100	5.3
Cotterill (1986: Table 3, Equa. 3)	Dry grocery foods, August 1981	C4=80.5, FRMS=13.1	C4=100, FRMS=100	6.3
Cotterill and Harper (1995: Table 2, reduced form)	Dry grocery foods, May 1982	C3=45	C3=100	4.9
Cotterill and Harper (1995: Table 2, structural price model)	Dry grocery foods, May 1982	C3=45	C3=100	9.9
Cotterill and Harper (1995: Table 2, chains and affiliates subsample)	Dry grocery foods, May 1982	C3=45	C3=100	5.1
Binkley and Connor (1996: Table 4)	Dry groceries, Spring 1986-88	C4=37	C4=100	6.3
Binkley and Connor (1996: Table 3)	All groceries, Spring 1986-1988	C4=37	C4=100	3.0

[a]Market concentration is measured using the following indexes (all in percentages):

C3 - the sum of the market shares of the three leading supermarket companies in the metro area,
C4 - same as C3, except for four leading retailers,
HHI - the Herfindahl-Hirshman index of supermarket company sales concentration,
FRMS - the ratio of a firm's market share to C4, and
MS1 - the market share of the leading supermarket company in the metro area.

Table A4. Comparison of Studies Explaining Variation in U.S. Retail Grocery Prices.

Variables	Marion, *et al.* 1979: Table 4.3, Equa. 1	Lamm, 1981: Table I, Equa. 3	Cotterill, 1986: Table 2, Equa. 2	Cotterill and Harper, 1995: Table 2, Equa. 1	Binkley and Connor, 1996	
					Table 3	Table 4
Dependent[a]	P1	P	P1	P1	P	P1
Independent:			*Coefficient (t-statistic)*			
Market concentration	16.07 (4.6)***	0.06 (2.6)**	7.78 (5.4)***	0.09 (2.8)***	0.047 (1.35)*	0.100 (1.93)**
Relative market share	6.26 (2.8)***					
Market Population:						
Growth	-0.08 (-4.1)***		-0.04 (-0.9)	0.001 (0.0)	0.057 (1.20)	0.129 (1.83)*
Income level			0.18 (0.8)	0.001 (1.8)*	-0.640 (-2.13)**	-1.001 (-2.27)**
Size	-0.2 (-0.4)				0.004 (1.86)*	0.006 (1.86)*
Northeast region		0.14 (7.5)***			6.938 (3.62)***	9.319 (3.31)***
Midwest region		-0.00 (-0.4)				
South region		-0.03 (-1.7)			0.424 (0.33)	-4.122 (-2.18)**
West region					-2.183 (-1.21)	-2.478 (-0.94)
Costs of grocery retailing:						
Retail wages	0.59 (0.6)	0.17 (3.7)***		0.44 (0.7)	2.032 (2.90)***	2.782 (2.70)***
Store size	-0.01 (-1.8)**	-0.07 (-3.8)***	-0.73 (-2.4)**	-0.48 (-2.8)***	0.001 (3.39)***	0.002 (3.68)***
Store size squared			0.03 (2.4)**	0.01 (2.4)**		
Labor/capital ratio					-0.244 (-2.12)**	-0.326 (-1.93)*
Unionization level				2.17 (2.1)**		
Population density					-0.461 (-1.40)	-0-776 (-1.60)
Cost of goods sold		0.64 (5.6)***				

Variables	Marion, *et al.* 1979: Table 4.3, Equa. 1	Lamm, 1981: Table I, Equa. 3	Cotterill, 1986: Table 2, Equa. 2	Cotterill and Harper, 1995: Table 2, Equa. 1	Binkley and Connor, 1996	
					Table 3	Table 4
Rent levels					0.005 (1.61)*	0.080 (1.61)*
Store independently owned			2.07 (2.5)**	-2.87 (-1.6)		
Distance to warehouse			0.002 (0.3)	-0.00 (-0.1)		
Store is warehouse type				-8.83 (-3.0)***		
Electricity costs					-0.001 (-0.31)	-0.006 (-0.91)
Market rivalry:						
Warehouse stores				-2.66 (-2.2)**	-22.39 (-3.35)***	-10.93 (-1.15)
Small grocery stores					6.582 (0.76)	15.35 (1.21)
Fast food stores					-16.48 (-1.59)	-37.08 (-2.44)**
Chain grocery stores					-01.27 (-2.71)***	-0.092 (-1.34)
Churning of prices					-0.250 (-3.42)***	-0.168 (-1.56)*
Market-share changes	-0.52 (4.7)***					
R^2 (percent)	69	78	64	29	62	63
F	11.9	----	6.8	3.2	6.2	6.6
Number of observations[b]	36	18	35	107	95	95

---- = Not available.

***, **, * = Significance from zero at the 1%, 5%, and 10% levels, respectively.

[a]PI is an index of prices of all grocery products sold in a metropolitan area; P1 is a similar index for branded, dry groceries only.

[b]The number of observations is *stores* in Cotterill and Cotterill and Harper, but metropolitan areas in the other studies.