Food Pricing, Competition, and the Emerging Supercenter Format

An unbelievably complete example proposal by Kyle W. Stiegert and Todd Sharkey†

Introduction

Over the past 150 years, grocery retailing has undergone numerous periods of major structural adjustment, antitrust challenges, and technological change. Arguably, the first attempt to capture in-store scale economies and consolidate across stores and cities began in the mid-1800s with the introduction of the chain grocery store by The Great American Tea Company, the precursor to A&P Inc. (Adelman, 1959). The typical chain store was 500 to 600 square feet, containing a relatively limited assortment of goods. From 1915 to 1930, the food marketing structure gave way to the introduction and proliferation of self-service stores, two-sided aisles, and checkout counters. During the 1930’s, supermarkets were introduced; stores characterized by very large floor designs (>5000 sq. ft), reduced warehousing, self-service, and cash and carry (Mayo, 1993). By 1941, thousands of chain grocery stores were replaced by supermarkets with new advances in store shelving and the introduction of the wheeled shopping carts.

From 1940 to 1980, supermarkets consolidated power through mergers, increased entry barriers, technological advancements, and new store formats. Antitrust cases emerged in the 1940s to challenge and/or redirect the industry to more competitive practices. Driven in part by economic recessions and energy crises of the 1970s, the no-frills warehouse supermarket format emerged and captured significant market share.

Wholesale clubs and hypermarkets were introduced in the latter half of the 1970s. The hypermarket concept originally began outside the U.S. in 1963 by Carrefour, a French retail firm. The format combined full-scale supermarket offerings and a wide range of general merchandise items. Although hypermarkets were not very successful in the U.S. in the 1970s, the concept was tried by Wal-Mart with a store opening in 1987. Though too large to be successful, the hypermarket provided Wal-Mart the opportunity to test the food retailing market and adjust its approach leading to the smaller supercenter format.

The latest major structural adjustment has been the advance of the supercenter. The supercenter, which is closely related to the hypermarket, combines food retailing with general merchandising and pharmacy under one roof, devoting up to 40 percent of floor space to grocery items. In 1988, Wal-Mart entered the food retailing sector with the supercenter format.† This was followed shortly thereafter by the first Super Kmart in 1991 and in 1995, the first

† This proposal is taken from a two completed projects: 1. research paper by Stiegert and Sharkey, in press at Agribusiness, An International Journal and 2. Food System Research Group publication by Sharkey and Stiegert, monograph #20, 2006. Sharkey’s MS thesis formed the backbone for the literature review and proposed estimation.
SuperTarget. Table 1 shows the exponential growth of supercenter outlets from 1988-2005. By 2004, there were over 1600 supercenters throughout the U.S., and estimated annual food sales of over $70 billion, that accounted for over 15% of total grocery sales (Tarnowski, 2004).

**Purpose and Motivation**

The primary purpose of the proposed research is to evaluate the role of food supercenters on U.S. food prices. Three objectives are proposed. First, propose to estimate the marginal effect of supercenter entry into 23 U.S. metropolitan statistical areas MSAs. Second, we propose to measure the price impacts from growing supercenter market share on food prices. As the supercenter segment eroded market share from traditional supermarket retailers during the 1990s, the supermarket industry underwent a substantial phase of mergers and acquisitions. Figure 1 shows the supermarket merger and acquisition activity from 1993-2002. Noteworthy is the period from 1997-2001 in which at least 24 mergers took place in each year. In 1992, the top five supermarket chains had control of 19% of the market; by 1999, that share had almost doubled to 33% (Bergmann, 1999). Two primary drivers behind this merger activity were thought to be increased buying power and economies of scale (Balto, 2001). To some extent, the merger wave that swept the industry may have been a response to the supercenter format (Foer, 1999). While our analysis is not structured to address questions about why the mergers occurred, we propose to measure the potential byproduct impact of increasing concentration on food prices in the 23 MSAs. Since the merger trend of the late 1990s, there have been, to our knowledge, no studies measuring the price-concentration relationship in U.S. food markets. Our study extends the literature to include pricing data in what is now the most concentrated food retail market in Over 100 years.

**Literature**

Price theory suggests that, if barriers to entry are present in a market, an oligopoly of firms producing an identical product will earn excess profits by charging prices above marginal costs. The fewer the number of firms in the industry, the higher the price and, subsequently, profit are expected to be. This is the foundation for the reduced form equation estimation in the structure-conduct-performance (SCP) paradigm (Wen, 2001).

Early studies tested the SCP paradigm across multiple industries, in an attempt to determine if increasing or larger levels of concentration led to higher firm profits. However, early measurement and conceptualization issues relating to profit analysis led to weak economic results. The Demsetz critique suggests that higher profits may be due to the superior efficiency of firms, not due to their use of market power (Demsetz, 1973). The use of accounting data to compute the firm’s or industry’s profit margin rarely equals true economic profit and may not represent costs correctly. Thus, accounting profits may not represent the true relationship between concentration and economic profits (Anderson, 1990). This, along with many hardships in interpreting the results of concentration-profit studies, helped deteriorate interest in performing research that concerned the relationship between concentration and profits.

As concentration-profit studies began to lose their appeal, those who believed in the SCP paradigm decided it was only natural to examine the relationship between price and concentration, instead of profits and concentration. Price is an embedded component in the price-cost margin used in concentration-profit studies. This allowed an easy extension of the SCP paradigm since price data was generally easier to access, and interpretations were easier to formulate. Since the first price-concentration study by Stigler (1964), well over 100 concentration-price studies have been performed across numerous industries, including cement,
gas stations, airlines, banking, and supermarkets, where the results "seem to give overwhelming support to the concentration-price hypothesis" (Weiss, 1989).

Early studies in the SCP tradition were criticized for using large cross-sectional datasets of unrelated industries with dissimilar cost and demand structures (Wen, 2001). Food retailing, a single industry with similar production technologies and distinctive spatially ordered markets, allows for cross-sectional analysis while reducing the concerns about misspecification of costs. To our knowledge, the earliest price-concentration study in grocery retailing, (Mori and Gorman, 1966) tested the relationships between various structural characteristics and market performance. Mori and Gorman (1966) used prices because they could be regarded as an approximation of such performance criteria as production efficiency, profit rates, and progressiveness.

Twenty-three cities from three Midwestern states were chosen due to divergent structural characteristics, namely the degree of market power (concentration) and the extent of chain dominance. A price index was created for each city and regressed against 1, 2, 3, and 4 firm concentration ratios, respectively. Mori and Gorman (1966) concluded that market share held by the largest firms in a market was not an effective variable in explaining differing price levels among cities. Furthermore, it was concluded that the degree of price competition was found to be largely an individual city structural relationship dependent upon many possible factors such as the goals of management of independent firms, growth of the market area, and recent entry of new firms.

Due to concerns about increasing concentration in food retailing, a study was commissioned by the Joint Economic Commission. In the study, Marion et al. (1977, 1979a,b) focused on the organization and competitive performance of the food retailing industry from 1970-74, focusing particularly on the price and profit performance of large U.S. grocery chains and the impact on the competitive environment. The authors revealed that, ceteris paribus, the greater the market structure variables, CR4 and relative firm market share, the higher the firm’s grocery prices. A negative relationship between store size and prices further reinforced the positive relationship between CR4 and prices. The negative relationship between market growth and price showed that chains tended to price lower in rapidly growing markets compared to slowly growing markets. Market rivalry was also negative, and highly significant, suggesting that prices are lowest in markets where firm rivalry is the most intense. In addition, the inclusion of private label products in the grocery basket of goods had little effect on the findings and did not introduce a bias in the results.

Lamm (1981) looked at the nature of the price-structure relationship for the food retailing industry. By using individual firm market shares and 1- through 4-firm concentration ratios as structural measures, he was able to perform "a more detailed perspective of the food retailing industry structure than had been previously possible." The analysis used a time-series cross-sectional pooled data set consisting of 18 urban areas from 1974 to 1977. Lamm (1981) suggested that studying the relationship between price and structure would allow the price effects from concentration to be “disentangled” from the cost depressing effects attributable to scale economy realization.

Cotterill (1983) found that a firm’s price level is positively related to HHI, in most cases at the 1% significance level. The warehouse supermarket binary variable was negative and significant, while warehouse store impact was negative and significant. Neither growth nor per capita income had a statistically significant impact on prices. Square feet of selling space was estimated in quadratic form as well, which was highly significant, suggesting that average store size is strongly related to price.
Concerns about the altered structure in the food retailing industry due to leveraged buyouts, mergers, acquisitions and financial restructuring during the 1980s, as well as increasing concentration levels as a result of the altered structure led Park and Weliwita (1999) to examine competitive conditions in the U.S. food retailing industry from 1967 to 1992. A model of firm conduct based on NEIO literature was used to measure the degree of competitive behavior in the food retailing industry, incorporated financial variables into the industry cost function to control for the effect of changes in industry financial structure on the costs. Park and Weliwita (1999) concluded that, because of merger activity and leveraged buyouts, financial leverage increased and shifted from short-term liabilities to long-term debt. Park and Weliwita’s results indicated that markets in the food retailing industry became more concentrated and segmented, offering opportunities for firms to exert market power by charging prices above the average cost of production. The estimated index of market power was significantly different from zero during the 1983 to 1992 time period, but had a low coefficient value, revealing only a slight shift in competitive conditions associated with merger and acquisition activity.

Analyzing the wholesale beef market, Schroeter, Azzam, and Zhang (2000) addressed the problem of measuring market power without a hypothesis of price taking behavior on one side of the market or the other. The wholesale beef market is thought to be an example of a bilateral oligopoly; both buyer and seller markets are highly concentrated. Three equilibrium concepts were suggested: bilateral price-taking, manufacturer price-taking, or retailer-price taking. The model was estimated using maximum likelihood estimation for the bilateral price-taking, manufacturer price-taking, retailer price-taking, and “hybrid” price-taking models. The authors found that manufacturer price-taking is favored over bilateral price-taking through the use of asymptotic t-tests; however, retail price-taking was found not to be an improvement over bilateral price-taking. Furthermore, the retailer price-taking model is rejected when tested against the “hybrid” model, whereas, the manufacturer price-taking model was not rejected. The conclusion was that food retailers enjoy market power in the wholesale market, but the manufacturers do not enjoy market power, suggesting that retailers have acquired buying power in the wholesale market compared to its manufacturing counterparts.

The study by Kadiyali, Chintagunta, and Vilcassim (2000) measured the power of market channel members in an attempt to understand the reasons for market power in the refrigerated juice and canned tuna markets. Game theory methods were used to develop models of market channel conduct, but the framework differed from previous studies since the model allowed for a continuum of possible channel interactions between the retailer and manufactures, compared to just three possible channel interactions (like that hypothesized by Schroeter et al. (2000)). Kadiyali et al. (2000) concluded that the major retailer had substantial pricing power for both the refrigerated juice and canned tuna product categories. This provided evidence that manufacturing pricing power was less than retailer pricing power for each of the national brands. The authors also found that the three channel interactions of previous studies were rejected in favor of the channel interaction continuum.

**Basic Model and Discussion of the Data**

The focus of this proposed study is to evaluate primarily entry and market share impacts from supercenters and secondarily the impacts of increased concentration in food retailing on annual food price changes across different markets in the U.S. from 1993 to 2003. We begin with a basic model, which is of the form:

\[ Y = \alpha + \beta_i X + e \]  

(1)
where \( Y \) is the annual percentage change in the CPI-Food at Home price index and \( X \) is a vector of market structure and exogenous control variables suggested by economic theory to explain food prices. The analysis is planned for a data set consisting of 23 different MSAs over the 1992-2003 time period, resulting in a total of 253 observations.

If food retailing markets were perfectly competitive, all firms would react by lowering prices in response to lower priced entrant. In other various oligopoly settings, perhaps involving store differentiation, it is possible that incumbent firms will react to entry, but perhaps not as forcefully as in the case of highly competitive situations. We test the null hypothesis of no incumbent reactions from supercenter entrants. The test cannot differentiate between the myriad of possible market structures, but a failure to reject the null would strongly suggest a market structure that reacts rather slowly to an important structural change. We augment our entry test with an evaluation of market impacts from increased market shares by supercenters in each MSA. This hypothesis test takes on a different approach. Because supercenter market share is growing and their price changes are part of the calculated CPI, the designed test measures longer term price impacts on incumbent set of supermarket and supercenter firms.

The formal model used in this study is:

\[
\Delta CPI - FAH_i = \alpha + \beta_1 RSMS_i + \beta_2 \Delta CONC_i + \beta_3 \Delta INC_i + \beta_4 \Delta POP_i + \\
\beta_5 \Delta ELEC_i + \beta_6 \Delta RENT_i + \beta_7 \Delta LABOR_i + \beta_8 E_i + \epsilon_i
\]  

(2)

where subscripts \( i \) and \( t \) refer to MSA and year, respectively and \( \epsilon \sim N(0, \sigma^2) \). Descriptions of the variables are in Table 2.a. The dependent variable and all variables that begin with delta (\( \Delta \)) are calculated as a percentage change from the previous year in the same MSA. For example, the percentage change in the CPI Food-At Home Index (\( \Delta CPI-FAH \)) is calculated for each market area as:

\[
\Delta CPI - FAH_{i,t} = \left( \frac{CPI - FAH_{i,t} - CPI - FAH_{i,t-1}}{CPI - FAH_{i,t-1}} \right) \times 100 \text{ for } i = 1, 2, ..., 23.
\]  

(3)

The data for \( \Delta CPI-FAH \) has been collected from the U.S. BLS website for 25 different locations, using the average annual figure for each MSA. Unfortunately, 2 MSAs (Washington-Baltimore and Phoenix-Mesa) were incomplete and subsequently dropped from the analysis to maintain a balanced data set, resulting in 23 MSAs representing many different geographic regions of the U.S. Table 2b contains a list of the MSAs included in the analysis. The FAH index includes smaller grocery stores (mom and pop stores) and convenience stores that would ideally be excluded for purposes of this analysis; however, the prices of these smaller stores receive relatively little weight in nearly all the MSAs (Marion et al., 1993).

The relative supercenter market share (RSMS) is calculated as

\[
RSMS_{i,t} = \frac{SCMS_{i,t}}{CR4_{i,t}} \times 100
\]  

(4)

where SCMS is the sum of the market shares for Wal-Mart, Target, and Kmart supercenters within a MSA and CR4 is the four-firm concentration ratio. The market share values are available from Trade Dimension’s Market Scope. RSMS serves as an approximation for the relative market power of supercenters within a market. Marion et al. (1979a) point out that because relative market share measures the relative competitive position of a firm in a market, it can be more appropriate than ordinary market share in cross-sectional analysis involving many
markets. Due to the distribution and cost efficiencies of supercenter retailers, it is hypothesized that RSMS is negatively related to price changes. To account for varied levels of influence in RSMS variable, some versions of the model include RSMS and RSMS in squared form. This design allows for growing marginal impacts of RSMS on price levels.

The variable ∆CONC is representative of two measures of concentration used in this study. The first, ∆CR4, was discussed earlier and represents percentages changes to the four-firm concentration ratio. The second, ∆HHI, represents percentage changes to the Herfindahl-Hirschman Index. The HHI is a more comprehensive measure of market concentration because it incorporates information about the distribution of market shares beyond the top four firms. In quantity setting games, it is easily shown that the HHI is positively linked to the Lerner Index of market power. As fewer sellers control more of the food sales within a market, the remaining sellers are potentially more able to act interdependently rather than as independent competitors. This interdependence is hypothesized to lead to implicit or explicit forms of collusion that maintains price above the competitive level. While economic theory does not specify what the critical level of concentration is in grocery retailing, it does predict that, increases in concentration lead to more firm interdependence, and hence, higher prices. Therefore, whichever measure of concentration is used, ∆CR4 or ∆HHI, we anticipate a positive relationship with price changes. Market share data used to construct both variables was collected from Trade Dimension’s Market Scope.

As demand shift variables income (∆INC) and population (∆POP) increase, we anticipate upward pressure on food prices. The variable ∆INC is the percentage point change in effective buying income. ∆INC is an approximation for average household after-tax disposable income. Data for effective buying income is available Sales and Marketing Management’s Annual Survey of Buying Power for each MSA. ∆POP is the percentage point change in a market’s population. Population data is available from Trade Dimension’s Market Scope.

Supermarkets and supercenters are in a complex multiproduct, multiservice industry, which makes a clear link to firm-level marginal costs rather difficult to disentangle. For this study, we control for store-level idiosyncratic costs that are likely to draw the attention of managers in setting overall prices. Specifically, we include in the model percentage changes in the CPI-Electricity index for each MSA (∆ELEC). The CPI-Electricity data is available from the U.S. BLS. ∆RENT is the percentage change in the CPI-Residential Rent index for each MSA. The residential rent index represents a proxy variable for commercial rental rates: the CPI does not calculate a commercial rent index. ∆RENT is used to explain changes in property values, rental rates and possibly property tax charges to grocery retailers within a market. ∆LABOR is the percentage point change in the ratio of payroll per dollar of sales. The change in labor costs, following from Marion (1993), is expressed as:

$$\Delta LABOR_{t,j} = \left( \frac{payroll_{t,j}}{sales_{t,j}} \right) \times 100$$

(5)

∆LABOR approximates the change in labor costs and productivity. Labor costs account for nearly 60 percent of total supermarket costs (Marion, 1998). There are many different wage levels, number of full- and part-time employees, and productivity across the different markets in the analysis. The change in payroll per dollar of sales is a ratio of productivity. It facilitates the comparison of labor costs across various markets and different forms of employment. Payroll
data was obtained from the BLS (NAICS 4451) for each MSA. Sales data is available from Sales and Marketing Management’s Annual Survey of Buying Power, which estimates the sales of all stores selling food primarily for consumption at home for each MSA. 

**Entry (E)** – \( E \) is a binary variable denoting when *de novo* entry by a supercenter occurs within a market.

\[
E_{i,t} = \begin{cases} 
1 & \text{if } \text{de novo entry in a market by a non-traditional food retailing supercenter} \\
0 & \text{otherwise}
\end{cases}
\]

The entry variable is included to account for the price change effects from the introduction of the first supercenter within a market. Entry acts as the one time pricing shock response of incumbent retailers to a supercenter. It is hypothesized that *de novo* entry by a supercenter will lead to a downward adjustment in prices by incumbent food retailers.

**Planned Pretests and Model Development**

To develop a model with the correct variables and statistical properties, several pretests are planned. First, we will determine if fixed (time dummies) and/or random effects (cross-section random effects) were present in the time-series cross-sectional data set. Additional tests are planned to test for autocorrelation and/or heteroscedasticity existed within the data set. Bhargava et al. (1982) modified the Durbin-Watson test for autocorrelation for use in fixed effects models. The new statistic arises from

\[
d = \frac{\sum_{i=1}^{n} \sum_{t=2}^{T} (e_{i,t} - e_{i,t-1})^2}{\sum_{i=1}^{n} \sum_{t=1}^{T} e_{i,t}^2}.
\]  

(7)

Standard correction procedures are anticipated if autocorrelation is detected. The Breusch-Pagen test is planned to test for the presence of heteroscedasticity. The test statistic from the Breusch-Pagen test is compared to the critical chi-squared level equal to detect heteroscedasticity in the model.

**Anticipated Pitfalls**

I anticipate no obvious pitfalls. The regression techniques are basic, the tests are well-defined in the literature, and the model is a variation of earlier models used to test the emergence of the warehouse store format in the 1970’s.

**References**

Suppressed here to save space.
Table 1 – Supercenter Store Count as of January 31, 2005

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<th>Super Target</th>
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Source: Wal-Mart Stores Annual Reports, Kmart Corporation Annual Reports, and Target Corporation Annual Reports

Table 2. Variable Descriptions and Markets

2A. Description of the variables

CPI-FAH = the percentage change in CPI Food-at-Home price index for area i at time t
RSMS = the relative market share of supercenters for area i at time t
ΔCONC = the percentage change in concentration (either ΔCR4 or ΔHHI) for area i at time t
ΔINC = the percentage change in income for area i at time t
ΔPOP = the percentage change in population for area i at time t
ΔELEC = the percentage change in CPI-Electricity price index for area i at time t
ΔRENT = the percentage change in CPI-Residential Rent price index for area i at time t
ΔLABOR = the percentage change in the payroll/sales ratio for area i at time t
E = 1 if de novo entry by a supercenter for area i at time t, 0 otherwise
2B. Metropolitan Statistical Areas Planned for the Study

Atlanta, GA
Boston-Brockton-Nashua, MA-NH-ME-CT
Chicago-Gary-Kenosha, IL-IN-WI
Cincinnati-Hamilton, OH-KY-IN
Cleveland-Akron, OH
Dallas-Ft. Worth, TX
Denver-Boulder-Greeley, CO
Detroit-Ann Arbor-Flint, MI
Houston-Galveston-Brazoria, TX
Kansas City, MO-KS
Los Angeles-Riverside-Orange County, CA
Miami-Ft. Lauderdale, FL
Milwaukee-Racine, WI
Minneapolis-St. Paul, MN-WI
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD
Pittsburg, PA
Portland-Salem, OR-WA
St. Louis, MO-IL
San Diego, CA
San Francisco-Oakland-San Jose, CA
Seattle-Tacoma-Bremerton, WA
Tampa-St. Petersburg-Clearwater, FL
1. Wal-Mart began operations in 1963 and is currently the largest U.S. retailer. Wal-Mart has opened supercenters at a pace of roughly 140 stores each year since 1994. Although known as a low price leader, the underlying strategic strengths of the Wal-Mart supercenter concept have been the distribution and procurement systems. As of January 31, 2005, there were 34 food distribution centers located throughout the U.S. Each supercenter is located no further than one day’s driving distance away from a distribution center. Wal-Mart uses the distribution centers and firm contractual arrangements with suppliers to gain a system-wide marginal cost advantage over competitors in the discount and food markets. The key driver of Wal-Mart profits is derived from this cost advantage, which allows for low prices, increasing market share, low cost of capital, and stable management.

2. Certain MSA geographical definitions from the BLS had different market definitions than those found from the other trade sources. The alterations to data obtained from various trade sources are explained in detail in the appendix.

3. \[ LM = \frac{NT}{2(T - 1)} \left[ \frac{T - 1}{SSE} \right]^2 = \frac{253}{2(11 - 1)} \left[ \frac{11^2 \times 3.5547}{490.6325} - 1 \right]^2 = 0.1924 \], where N is the number of MSAs (23), T is the number of time periods (11), \( e \) is the regression error vector, and SSE is the sum of the regression squared errors.

4. \[ F[22,222] = \frac{(R^2_{MSA} - R^2_{BASE})/(N - 1)}{(1 - R^2_{MSA})/(NT - N - k)} = \frac{(0.1229 - 0.0501)/22}{(1 - 0.1229)/222} = 0.8344 \], where N is the number of MSAs (23), T is the number of years (11), and k is the number of regressors (8).

5. \[ F[10,234] = \frac{(R^2_{TIME} - R^2_{BASE})/(T - 1)}{(1 - R^2_{TIME})/(NT - T - k)} = \frac{(0.2591 - 0.0501)/10}{(1 - 0.2591)/234} = 6.5744 \], where N is the number of MSAs (23), T is the number of years (11), and k is number of regressors (8).

6. \[ 100*(10.41*.012) = 100.877 \text{ or a .877 percent change in prices.} \]

7. \[ ($844 \text{ Billion in food purchases})*(53 \text{ percent purchased for at-home consumption})*(.00877) = $3.92 \text{ Billion Dollars} \]