Evaluating Traditional Share – Price and Residual Demand Measures of Market Power [redacted] in the Catsup Industry

by
Lawrence E. Haller
and
Ronald W. Cotterill

Food Marketing Policy Center
Research Report No. 31
January 1996

University of Connecticut
Department of Agricultural and Resource Economics

Evaluating Traditional Share–Price and Residual Demand Measures of Market Power [redacted] in the Catsup Industry

Lawrence E. Haller and
Ronald W. Cotterill

Assistant Research Scientist, Department of Management
Professor, Agricultural and Resource Economics
University of Connecticut at Storrs

Food Marketing Policy Center
Research Report No. 31

Table of Contents

Tables

Acknowledgements

This research was supported by Special Research Grant No. 91-34178-6330 with the Cooperative State Research Service, USDA, the Storrs Agricultural Experiment Station, and Cooperative Agreement No. 43-3J319-0065, Agricultural Cooperative Service. This report is Scientific Contribution No. 1652, Storrs Agricultural Experiment Station, Storrs, CT 06269. A revised version of this research report is forthcoming in *Review of Industrial Organization*.

Author Affiliation

Lawrence E. Haller is an Agricultural Economist and Head of Statistics Section, Packers and Stockyards, USDA and Ronald W. Cotterill is director of the Food Marketing Policy Center, Department of Agricultural and Resource Economics, College of Agriculture and Natural Resources, University of Connecticut.

Abstract

In this paper we specify a price determination model which can test both the traditional positive interbrand price - share hypothesis and the negative intrabrand relationship predicted by residual demand analysis. We evaluate this relationship empirically using three-dimensional panel data from the catsup industry. We find support for both hypothesized relationships, and conclude that market power exists in this industry. Further, we conclude that the results depend critically on the characteristics of the data set to be analyzed.

Key Words: Market power; Residual demand; Product differentiation

Evaluating Traditional Share–Price and Residual Demand Measures of Market Power [redacted] in the Catsup Industry

1. Introduction

This paper examines the strategic and structural forces that determine price in one processed foods industry, the catsup industry. Previous studies of brand level price determination include Wills (1985) and Nelson, Siegfried, and Howell (1992). Wills' pooled study of 1357 brands in 145 food product categories, using national market share and price data, reports a significant positive share–price relationship. Nelson, *et al.*, report that there is a positive intrabrand relationship between the price of Maxwell House coffee and its relative market share (measured by the ratio of the share of Maxwell House to its largest competitor's share) in a sample of 20 local food market areas. Following Cotterill (1986), Weiss (1989) and others, these positive share–price relationships are seen as evidence for market power in concentrated product markets. Other researchers, however, have been skeptical of the traditional structure - price approach, arguing that brand level price and quantity (or share) may be negatively related, that such relationships are demand curves, and that demand inelasticity measures market power (Bresnahan 1989). Baker and Bresnahan (1988), for example, derive a residual demand model for three brands of beer from the underlying supply and demand relationships. They conclude, based upon their empirical results, that two of the brands possess market power, but that the third does not.

In the first section of this paper, we both specify an empirical model of price in the catsup industry that can test the traditional price - share hypothesis and the residual demand hypothesis. In the second section, we evaluate the price–share relationship using Information Resources, Inc. (IRI) three dimensional panel data (6 brands in up to 64 local markets for 19 quarters). We find support for both theoretical approaches and conclude that the results depend critically upon the characteristics of the data set to be analyzed. Specifically, we find a positive share–price relationship across brands, but a negative relationship for any given brand, when viewed either across markets or over time.

2. Model Specification

Cotterill (1993) and Haller (1994) expand work by Harris (1985, 1988) on Bertrand pricing models in a dominant-firm differentiated oligopoly to formally specify a model wherein price is related to market share, and demand and cost shift factors. The firm's own perceived demand curve is specified as $q_1 = q[Q(p_p...), q_R(p_p...), P_R(p_p...)]$, where the p_is are the prices of all firms in the market, $Q = q_1 + q_R$ is total industry output, q_R is the sum of all rivals' output quantities, and P_R is the rivals' price response function. From this, and the first order conditions, they derive a relationship for price as a function of marginal cost, market share and demand and supply elasticities:

$$p_1 = MC_1 \frac{\eta_1}{\eta_1 - 1} = MC_1 \frac{\eta^M + \theta(1 - s_1) - \eta^C \eta^R s_1}{\eta^M + \theta(1 - s_1) - \eta^C \eta^R s_1 - s_1} \qquad (1)$$

where MC_1 is the firm's marginal cost, η_1 is the firm's own-price elasticity of demand, s_1 is the firm's market share, η^M is the price elasticity of market demand, θ is the conjectural own-price elasticity of rivals' supply, η^C is the cross-price elasticity of own-firm demand, and η^R is the conjectural rival price response elasticity. If we assume zero conjectures, this reduces to:

$$p_1 = \frac{MC_1}{1 - \frac{s_1}{\eta^M}} \qquad (2)$$

In the case of constant costs, this relationship is positive and indicates the existence of market power. If marginal cost is falling as market share increases, then we have an ambiguous result. Deneckere and Davidson (1985) present a different Bertrand model of differentiated oligopoly wherein price is also hypothesized to be positively related to market share. Any model of the share–price relationship, including equation (2) above, indicates that one must control for changes in marginal costs and market demand elasticity.

The Bertrand differentiated price models' hypothesized positive relationship between price and market share is an *inter*brand relationship. Brands with larger market shares have higher prices than smaller share brands. Alternatively, Bresnahan (1989), and Baker and Bresnahan have focused upon estimation of intrabrand residual (1988) and partial residual (1985) demand relationships. In the residual demand model, a given brand's price and share are negatively related over time in a given market due to demand behavior. In the 1988 study, Baker and Bresnahan estimate an inverse residual demand model with quantity as an explanatory variable, cost shift variables to instrument for residual supply elasticities of other brands and demand-related variables that instrument for market demand elasticity. Our specification of market share rather than quantity in the inverse demand model follows utility maximization-based derivations of demand systems such as the Almost Ideal Demand System (AIDS) model (Deaton and Muellbauer 1980) and recent work on full demand system estimations of brand-level elasticities in differentiated product industries (Cotterill 1994). The empirical model that we estimate can measure and differentiate between the hypothesized positive interbrand (traditional) and negative intrabrand (residual demand) share–price relationships.

We have chosen catsup as the focus of our study for several reasons. The catsup industry is a mature industry, with little entry or exit occurring during the period of study. Each manufacturer produces only one brand of catsup, so that there is no confusion between manufacturer-level *vs.* brand-level effects. While catsup is not completely homogeneous, quality differences between brands are not great. In *Consumer Reports*' (1983) review of catsups, Heinz shared the highest ranking with two store brands, each selling for substantially less than the Heinz brand. Given their equivalent quality, it is unlikely that any price premium that Heinz enjoys over the private label brands is due to higher quality-related production costs. The other two brands in our study which were included in the review (Hunts and Del Monte) shared the second-ranked tier with several other store brands. *Consumer Reports* notes that differences between the brands in the second ratings group and those in the first "were minor – and some of the differences might appeal to some people's taste buds" (p. 552). This suggests that there are factors besides quality which determine the price differentials between national brands and private labels.

The dependent variable used in our estimations is the **Real Average Price per Pound.**[1] This is the average price paid by consumers for the quarter, net of all discounts except manufacturers' coupons, deflated by the Food-at-home component of the Consumer Price Index as reported in the *Economic Report of the President*, using the first quarter of 1988 as the base.

Volume Share is the quantity of a brand sold during the quarter divided by the total quantity of all brands sold in the market that quarter. In our IRI pooled dataset, the relationship between price and share may be an interbrand relationship (Heinz *vs*. Hunts), a cross section intrabrand relationship (Heinz in Hartford *vs*. Heinz in Omaha), and/or a time series intrabrand relationship (Heinz in Hartford over time). To examine this expanded share–price relationship, we first regress price on share in a fully pooled model containing all brands. We expect a positive interbrand share–price relationship if variation across brands is significantly greater than intrabrand variation over markets and time, as is the case in this industry. Second, we specify slope and intercept shift variables for individual brands to control for interbrand effects and analyze the combined effects attributable to intrabrand variations across local markets and over time. Third, we add local market binary variables to remove market-specific effects in order to analyze the intrabrand share–price relationship over time within markets. Both intrabrand share–price relationships are hypothesized to be negative due to the demand-side effects. For example, if Heinz sells more catsup in the Hartford market over time, we hypothesize that the larger quantity of Heinz catsup sells at a lower price. This suggests that lower prices may drive higher share. To control for the possible endogeneity of share, we use volume share lagged one quarter as an instrument for contemporaneous volume share, and estimate our model with two stage least squares.

Manufacturers and retailers frequently use merchandising techniques that influence price and shift demand for their products. The **Percent Volume in Feature Ads** measures the percentage of a brand's volume sold during the quarter while featured in newspaper advertising. The **Percent Volume on Display** measures the percentage of a brand's volume sold during the quarter in conjunction with an in-store display, such as an end-of-aisle setup. The trade uses both of these strategies to publicize price reductions. We hypothesize that both are negatively related to price.

[1] *The source for all variables in this estimation is the Information Resources, Inc. InfoScan database, unless otherwise noted.*

The level of the **TV Ads as a Percent of Sales** variable is a measure of product differentiation. Thus, we hypothesize that it will have a positive impact on price. Our source for this variable is Leading National Advertisers *Class/Brand Year-to-Date* (LNA). Because LNA lists only national quarterly advertising expenditures, a given brand's TV ads as a percent of sales is uniform across all local markets within a quarter. It is constructed by dividing a brand's total quarterly TV advertising expenditures by its total national quarterly sales from the IRI database.

Nelson (1974) and others have argued that manufacturers use advertising to provide information on product quality. The level of advertising would then be an instrument for product quality. Higher prices associated with higher advertising levels would be due to greater manufacturing costs due to higher quality. However, Wills and Mueller (1989) find a positive coefficient for advertising in food products which are physically homogeneous, and Wills (1984) finds a positive relation between price and advertising when explicitly including a measure of product quality. As the *Consumer Reports* review indicates, variations in catsup quality, at least for the national brands, is not great, and many of the private label brands match the national brands' quality. A positive relationship between advertising and price, therefore, would be due to factors other than quality-based cost differences.

We use several variables as instruments for marginal cost. We use the cost of industrial tomato paste, catsup's primary agricultural input, expressed as dollars per pound, for paste shipped in 55 gallon drums. Its source is the *Food Institute Report*. **Private Label Price** is included as a possibly more inclusive measure for the price of manufacturing and retailing inputs. Connor and Peterson (1992) argue that private label price effectively equals marginal cost in processed food products.

The **Population** of the market area is included to capture the effect of market size on distribution costs. If there are increasing economies of scale in larger market areas, population should have a negative influence on price. However, if larger markets are more expensive to service due to congestion or other factors, then larger markets should have higher prices. This variable is constant over a calendar year and is obtained from *Market Profiles*, provided by IRI, supplemented with Progressive Grocer's *Market Scope*.

We include several other demographic and structural variables. **Real Median Family Income** may be considered a proxy for wage costs in the market. Second, assuming that catsup is a normal good, rising income will increase demand. Both, *ceteris paribus*, increase price. **Median Family Age** is expected to have a negative influence on the price of catsup since catsup tends to be used by younger people. Real Median Family Income and Median Family Age vary across markets but are constant over a calendar year and their source is *Market Scope*.

A measure of retailer power, the sum of the market shares of the top four grocery chains in the local market, **Market CR_4**, is included because IRI prices are retail as opposed to wholesale prices. When leading retailers in a local market have large shares, they may, *ex hypothesi*, be able to exercise market power and raise the price paid by consumers of catsup (Cotterill 1986). This variable changes across local markets, but is constant over a calendar year. Its source is *Market Scope*.

The **Units per Pound** variable is included to control for the lower prices charged per pound for products sold in larger "economy" size containers. It is constructed by dividing the total number of units (12 oz. bottles, large economy sizes, etc.) sold within a market by the number of pounds sold. Unless consumers actually pay more per pound for larger sizes, this variable should have a positive sign.

On August 10, 1990 the ConAgra corporation completed the takeover of Beatrice Foods, Inc., the manufacturer of Hunts catsup. To examine the impact this had on the price of Hunts, a **ConAgra Binary** variable is included in the model. It will have a value of one for Hunts observations beginning the third quarter of 1990 and a zero value for all other observations. We expect to see a positive impact on price as ConAgra increases cash flow to pay for the acquisition.

3. Estimation Results

Table 1 reports descriptive statistics and decomposes the variance for all variables[2] into the dimensions of brands, markets, and/or time. The columns "% of Variance Across Brands", "% of Variance Across Markets", and "% of Variance Over Time" report the percentage of total variation in a variable that is attributable to each of these dimensions. The remaining variance is unexplained.

The brand-specific variables generally exhibit much greater variation across brands and markets than over time. Most of these variables have less than a sixth of their variation in the temporal

[2] *Descriptive statistics for the individual brand variables included in equations 3 through 6 are reported in Haller (1994), p. 50.*

Table 1 Descriptive Statistics for Catsup: 1988 - 1992

	Mean	Standard Deviation	% of Var. Across Brands	% of Var. Across Markets	% Var. Over Time	Minimum	Maximum
Real Price Per Pound	$0.618	0.110	35.2	34.0	6.0	0.235	0.943
Volume Share	24.4	20.7	65.4	7.8	0.1	0.5	87.8
TV Ads as % of Sales	1.74	3.09	32.6	—	30.1	0.0	11.78
% Volume in Feature Ads	6.04	5.84	2.2	17.9	3.4	0.0	53.30
% Volume on Display	22.55	18.28	7.0	14.6	13.5	0.0	99.79
Real Paste Price ($/lb)	$0.373	0.105	—	—	100.0	0.231	0.526
Pvt. Label Price	$0.499	0.0721	—	68.7	20.8	0.362	0.744
Population	2,647,700	2,720,600	—	99.6	0.3	307,180	15,696,000
Real Median Family Income	$28,450	5148	—	44.2	49.9	15,686	44,710
Med. Family Age	33.03	2.18	—	95.1	1.8	24.1	41.8
Retail Mkt CR_4	65.52	13.05	—	87.9	3.4	23.9	88.1
Units Per Pound	0.537	0.0628	10.3	23.9	2.5	0.139	1.333

Note: There are 3,582 observations

dimension. Mean real price per pound of catsup for all observations in our sample is 61.9 cents. Average price varies widely from brand to brand. The greatest percentage of variation in price is across brands (35.2%), with one third more (34.0%) within brands from market to market. Only 6.0% is variation over time.

The mean share of all brands in the sample is 24.8 percent, ranging from a low share of 0.5 percent to a high of 87.8 percent. Interbrand variation accounted for the majority of share variation (65.4%). Individual brands' shares are also relatively consistent from market to market, with only 7.8 percent of their variation in that dimension. Brands' shares are quite stable over time, with only 0.1 percent of overall variation over time.

The average value of television ads as a percent of sales[3] is 1.77 percent. Nearly 33 percent of the variation is across brands, none is across markets since it is the national TV ad/sales ratio, and 30.1 percent is over time. In actuality only two brands used television advertising at all - Heinz and Hunts. Heinz was by far the largest advertiser, spending 5.6 percent of its sales on TV advertising. Hunts spent 3.5 percent of its sales on advertising prior to the ConAgra acquisition, but after the merger its advertising fell to almost zero (Haller 1994).

The percentage of volume sold using feature ads averages 6.1 percent. Use of in-store displays appears to be a more popular merchandising tool, with nearly 23 percent of catsup sold while on display. Manufacturers appear to offer similar promotions (there is little cross-brand variation in these variables), but the programs do exhibit more variation across local markets and time. Less than five percent of the variation in feature ads, and less than ten percent of the variation in use of displays is attributable to the interbrand dimension. Overall, less than forty percent of the variation of either of the merchandising variables can be accounted for within the time, market or brand dimensions. The majority of their variation is unexplained by these dimensions of the data set.

Private label price shows much greater variation across markets and over time than does the price of branded catsup. More than two thirds of its variation is across markets (68.7%). This is because "private label" is an average of the price of all store brands in each market. Real private label price also exhibits more than three times as much intertemporal variation and twice as much cross-market variation

[3] *In addition to national TV advertising, we alternatively estimated our system using total national advertising and national print advertising. We found that TV advertising held the greatest explanatory power.*

as the price of branded catsup, indicating that it is more sensitive to changes in marginal cost.

The data cover a very demographically diverse set of markets. The population mean is 2,647,700 and ranges from 307,180 (Boise, Id in 1988) to 15,696,000 (New York in 1992). The IRI market areas include surrounding counties, as well as the metropolitan area named, so the population of the market area is often larger than the census population for the MSA of the same name[4]. Mean real median family income is $28,447 and ranges from a low of $15,686 in Knoxville to a high of $44,710 for Baltimore-Washington. Median family age averages 33.0 years. The mean retail grocery CR_4 is 65.5 percent. This is lower than the U.S. Census mean CR_4 for all MSAs of 68.4 percent, but agrees with the Census CR_4 for MSAs with populations of 250,000 or more of 64.5 percent (Franklin and Cotterill 1993).

With the exception of median family income, the local market variables tend to be quite stable over time within a market, with less than five percent of their total variation occurring temporally. Median family income exhibits greater variation because the data set covers both the boom years of the late 1980s and the recession years of the early 1990s. Because of this lack of variation over time, we expect that the influence of the structural variables will be greatly diminished when we include the fixed effects local market binaries in our estimations. Since the cross-sectional fixed effects specification is equivalent to expressing each variable as a deviation from its mean within a local market (Hausman and Taylor 1981; Judge, *et al.* 1982), variables with little variation over time tend to be wiped out.

We turn now to the results of our regression analysis. Following Harris (1985), and Baker and Bresnahan (1988), we approximate complex theoretical relationships with a linear specification. This greatly simplifies the estimations and allows us to distinguish between the two classes of share-price models. The estimations presented in Table 2 explain a high proportion of the variation in the dependent variable.[5] Equations 1 and 2 represent our fully pooled model, using alternative instruments for marginal cost. In both equations the Volume Share is positive and significant at the 1 percent level. This confirms the hypothesis that a higher share is related to a higher price when

[4] *For comparison, the mean population for the 332 U.S. Census-defined MSAs in 1987 is 566,118 (Franklin and Cotterill 1993).*

[5] *Because of the ambiguity of interpreting the traditional coefficient of determination (R^2) in two stage least squares models, the R^2 reported here is the squared correlation coefficient between the observed and predicted values of the dependent variable.*

Table 2 Regression Results for Catsup Dependent Variable is Real Average Price per Pound

Explanatory Variable	Equation 1 Coefficient (t-ratio)	Equation 2 Coefficient (t-ratio)	Equation 3 Coefficient (t-ratio)	Equation 4 Coefficient (t-ratio)	Equation 5* Coefficient (t-ratio)	Equation 6* Coefficient (t-ratio)
Volume	0.00175	0.00160				
Share	(23.93)	(25.02)				
Heinz			-3.22 E-5	-0.000405	-0.000270	-0.000248
Vol Share			(-0.21)	(-3.14)	(-1.91)	(-1.79)
Hunts			-0.00282	-0.00206	-0.00162	-0.00164
Vol Share			(-16.80)	(-14.35)	(-10.75)	(-11.06)
Del Monte			-0.000981	-0.00158	-0.00132	-0.00133
Vol Share			(-3.83)	(-7.28)	(-5.69)	(-5.82)
Brooks			-0.00185	-0.00311	-0.00252	-0.00283
Vol Share			(-1.71)	(-3.41)	(-3.05)	(-3.47)
Stokely			-0.00165	-0.000348	-0.00311	-0.00398
Vol Share			(-0.59)	(0.15)	(-1.54)	(-1.99)
Red Gold			-0.00354	-0.00427	-0.00378	-0.00356
Vol Share			(-1.01)	(-1.45)	(-1.47)	(-1.41)
TV Ads as	0.805	0.812	0.171	0.203	0.191	0.198
% of Sales	(15.69)	(18.13)	(3.83)	(5.39)	(6.25)	(6.60)
% Volume in	-0.00144	-0.00195	-0.00145	-0.00180	-0.00184	-0.00187
Feature Ads	(-6.84)	(-10.55)	(-8.33)	(-12.26)	(-14.17)	(-14.70)
% Volume	-0.00218	-0.00200	-0.00159	-0.00144	-0.00162	-0.00159
on Display	(-30.80)	(-32.21)	(-25.69)	(-27.54)	(-35.36)	(-35.00)
Real	0.243	-0.00500	0.286	0.0701	0.219	0.141
Paste Price	(15.30)	(-0.32)	(21.44)	(5.55)	(20.44)	(11.11)
Real Private Label		0.606		0.550		0.277
Price		(33.07)		(37.42)		(10.90)
Med. Family	0.00379	0.00140	0.00306	0.00112	0.000832	0.000782
Income ($K)	(12.43)	(5.09)	(12.10)	(5.13)	(3.41)	(3.26)
Median	-0.00764	-0.00605	-0.00777	-0.00597	-0.00348	-0.00274
Family Age	(-12.43)	(-11.74)	(-15.90)	(-14.38)	(-2.64)	(-2.11)
Retail	-2.07 E-4	-5.83 E-4	3.51 E-6	-3.87 E-4	-3.33 E-4	-2.86 E-4
Market CR_4	(-2.05)	(-6.56)	(0.04)	(-5.40)	(-2.12)	(-1.85)
Units per	0.573	0.463	0.526	0.407	0.442	0.447
Pound	(24.36)	(22.23)	(24.73)	(22.32)	(26.70)	(27.43)
Conagra	0.0193	0.0189	0.00842	0.0136	0.0100	0.0101
Binary	(5.39)	(6.06)	(1.96)	(3.75)	(3.39)	(3.48)
Hunts			-0.0231	-0.0572	-0.0589	-0.0572
Binary			(-2.47)	(-7.19)	(-6.37)	(-6.29)
Del Monte			-0.122	-0.130	-0.129	-0.128
Binary			(-13.69)	(-17.32)	(-15.14)	(-15.25)
Brooks			-0.151	-0.143	-0.157	-0.155
Binary			(-15.16)	(-17.06)	(-17.54)	(-17.59)
Stokely			-0.180	-0.188	-0.188	-0.184
Binary			(-15.01)	(-18.60)	(-19.46)	(-19.40)
Red Gold			-0.232	-0.229	-0.226	-0.227
Binary			(-11.20)	(-13.12)	(-14.54)	(-14.83)
Constant	0.364	0.263	0.513	0.422	0.532	0.396
	(14.08)	(11.54)	(23.93)	(23.12)	(11.43)	(8.35)
R^2	0.556	0.662	0.715	0.797	0.869	0.873

* Equations 5 and 6 include fixed effects local market binaries.

Note: There are 3,518 observations.

viewed in the interbrand context. Increasing a brand's share by 10 percentage points leads to an increase in its price of about 1.7 cents, a 2.7 percent increase. TV Ads as a Percent of Sales is also positive and significant at the 1 percent level in both equations. An increase of one percent in TV advertising as a percent of sales results in a 0.81 cent increase in price. This represents a 1.3 percent increase in the average price of catsup in the sample, meaning that the additional revenue generated by advertising more than covers its cost. Turning to the local promotional variables, both the Percentage of Volume Sold in Feature Ads and the Percentage of Volume Sold on Display are negative and significant at the 1 percent level in both equations. With both a larger coefficient and a more significant t-ratio, displays appear to be more strongly tied to price reductions.

Paste Price is positive, as hypothesized, and significant at the 1 percent level in equation 1. Equation 2 introduces the alternative cost variable, Private Label Price. Its coefficient is positive and significant at the 1 percent level. Its inclusion also causes a significant increase in explanatory power, increasing the R^2 by 10 percentage points. Due to multicollinearity, including private label price reduces the coefficient of paste price to insignificance (the correlation between paste price and private label price is 0.432). Inclusion of private label price also has a marked effect on the coefficients and significance of the local retail market structural variables, as we will see.

Larger markets have higher prices, *ceteris paribus*. Population is positive and significant at the one percent level in both equations. The coefficient is not large, indicating a price spread between the smallest and largest markets in the sample of between three (eq. 2) and seven (eq. 1) cents. The effect of including private label price in equation 2 is striking. The coefficient for population falls by more than half. This suggests that population and private label price are similar proxies for local market distribution costs.

An increase in a market's real median family income also causes an increase in the price of catsup. Its coefficient is positive and significant at the 1 percent level in both equations. Median family age is negative, as hypothesized, and significant at the 1 percent level in both equations. The inclusion of private label price also has a marked effect on these variables. The coefficient for median family income falls by more than half and the coefficient for median family age drops by more than a fifth.

Without private label price, retail market CR_4 is negative and significant at the five percent level, but when private label price is included, CR_4 becomes negative and significant at the 1 percent level, and its coefficient nearly triples, although its magnitude remains minuscule. After controlling for costs with the private label price, the price of branded catsup is marginally lower in more concentrated markets. This may be an example of the Chicago school hypothesis that more concentrated markets have lower prices, when costs are controlled for. However, the fact that the spread between private label and brand price is lower in more concentrated markets may mean that retailer power elevates private label price; i.e., our assumption that private label price measures costs is violated. Also, catsup is only one of the more than 20,000 products that a typical grocery retailer sells and may not be indicative of the retailer's overall price level. In fact, catsup may be used as a "loss leader"[6] in more concentrated markets.

The ConAgra Binary variable is positive and significant at the 1 percent level in both equations, indicating that after ConAgra bought Beatrice Foods, Hunts' price increased by about two cents. Finally, the Units per Pound variable is positive and significant at the 1 percent level, confirming that consumers really do save money by buying catsup in "economy" sizes.

Equations 3 and 4 represent the second level of analysis. They relax the pooling assumption to allow different brands to have different share–price relationships. This analysis will tell us if the positive market share–price relationship is primarily an *inter*brand as opposed to an *intra*brand relationship. Individual brand market shares replace the Volume Share variable, and brand binaries allow for a unique intercept for each brand. Equation 3 is the multibrand equivalent of equation 1 and equation 4 is the equivalent of equation 2. The six brands included in this analysis, arrayed from largest national market share to smallest, are Heinz, Hunts, Del Monte, Brooks, Stokely, and Red Gold. To avoid the "dummy variable trap", the Heinz binary is omitted; the remaining brand binaries show their brands' deviations from Heinz' price.

In contrast to the pooled model presented in equations 1 and 2, the coefficients on individual brand market shares are negative. Three of the six brand share coefficients in equation 3 and four of the six in equation 4 are significant. The brand binaries are all negative and significant, clearly establishing Heinz as the premium brand. Note also that the Heinz premium increases as rival brands' shares fall. Heinz' premium relative to the smallest share brand, Red Gold, is the largest

[6] *Grocers sometimes advertise certain popular products at very low prices, at times below cost, to draw customers into their stores, while maintaining high overall margins. Such products are called "loss leaders".*

(23 cents). These results indicate that the positive market share–price relationship is an interbrand relationship[7].

Our negative intrabrand result seems to contradict Nelson, *et al.* They report a positive *relative* share–price relationship in the context of a simultaneous two equation model, but, since price was also negatively related to concentration in their paper, regressing price on market share may produce a negative share–price relationship. We specified a model similar to theirs for Heinz catsup but failed to find any relationship between relative share and price, whether using OLS, 2SLS, or 3SLS.

The above models include several market-specific structural variables to control for market-to-market variations in price. Some market level variation may, however, remain. To control for excluded local market variable bias, we use a fixed effects methodology. Employing local market binary variables captures variations in price levels from one market to the next. In essence, each market has its own intercept.

Equations 5 and 6 include the fixed effects local market binary variables as well as the brand binaries. Thus, all interbrand and cross-market variation is removed. Four of the six share coefficients in equation 5 and five of the six in equation 6 are now significant. The coefficient for Heinz' market share is now negative and significant at the 10 percent level in both equations. Its slope remains only about one sixth that of its largest rival, Hunts. Del Monte's share remains negative and significant at the one percent level. Stokely's share is now negative and significant at the 5 percent level in equation 6, but the coefficient for the share of Red Gold, the smallest brand included, remains insignificant. The inclusion of local market binaries has no consistent effect on the coefficients of brand market share. Comparing these results to equations 3 and 4, we find that in five cases the share -price relationship becomes steeper, while in four cases it is less steep but still negative. In three cases we find no share–price relationship from either viewpoint. This result is, perhaps, not surprising in light of the fact that the national manufacturers generally price and promote their brands on a national, rather than local or regional, basis. Zone

[7] *We also ran our brand-level estimations substituting the continuous variable national volume share for the brand binary variables. The national share variable was positive and highly significant, while the individual brand local market share variables were all negative and significant.*

pricing, selling at different prices in different parts of the country, is not generally practiced by catsup manufacturers.[8]

All brand binaries remain negative and significant at the 1 percent level in both equations. Heinz, the leading brand, enjoys a price premium of nearly 6 cents over number 2 Hunts, and as much as 23 cents over its smaller rivals. These results are similar to those reported in equations 3 and 4.

As expected, the inclusion of the fixed effects local market binaries causes the coefficients for the cross section variables to drop in magnitude and/or significance in both equations. Real median family income continues to be significant at the 1 percent level in both equations. Median family age is significant at the 1 percent level in equation 5, but drops to the 5 percent level in equation 6. Population loses all significance in both equations. Retail Market CR_4 is negative and significant at the 5 percent level in equation 5 and negative and significant at the 10 percent level in equation 6. Paste Price is positive and significant at the 1 percent level in both equations. The ConAgra binary retains its significance, indicating that Hunts' price increased after the ConAgra–Beatrice merger.

4. Conclusions

Our primary conclusion is that the nature of the share–price relationship seems to depend upon whether one is analyzing interbrand or intrabrand data. As differentiated Bertrand oligopoly models predict, there is a strong positive relationship between a brand's market share and the price it charges in the fully pooled model. This positive relationship is an interbrand relationship. The leader, Heinz, has higher prices that are related to its higher shares and to its advertising.

The *intra*brand relationship for each brand, in contrast, is flat or negative. As first suggested by Baker and Bresnahan (1985, 1988), the demand relationship seems to emerge in intrabrand data, i.e., increased share for a particular brand is related to lower brand price. Similar intrabrand results for several other products are reported in Cotterill and Haller (1994).

Regardless of the viewpoint, the results point to the existence of market power in this industry. The positive share–price relationship found in the interbrand results squares firmly with the traditional

[8] *Information concerning the pricing and promotion strategies of Heinz, Hunts, and Del Monte was obtained from the Food Institute, Fairlawn, N.J.*

Cournot or Bertrand differentiated products oligopoly model prediction that firms with larger shares have higher prices (Deneckere and Davidson 1985, Cotterill 1993, Haller 1994). The negative share-price relationship found in the intrabrand results agrees with the Baker - Bresnahan concept that such a result indicates power over price (Baker and Bresnahan 1988). This power does not exist for all brands, however. The two smallest brands in our panel, Stokely and Red Gold, exhibit no share-price relationship and appear to be price takers.

Finally, this study demonstrates that the newly available brand level scanner panel data can provide more refined insights into industry conduct and performance.

References

Baker, Jonathan B.; and Timothy F. Bresnahan. 1985. The Gains From Merger or Collusion in Product-Differentiated Industries, *Journal of Industrial Economics*, 33:(June) 427-444.

_____. 1988. Estimating the Residual Demand Curve Facing a Single Firm, *International Journal of Industrial Organization*, 6: 283-300.

Bresnahan, Timothy F. 1989. Empirical Studies of Industries with Market Power, Chapter 17. In Schmalensee, Richard; and Robert Willig, eds. *Handbook of Industrial Organization, Volume II*. New York: North Holland.

Class/Brand Year-to-Date. New York: Leading National Advertisers, 1987, 1988, 1989, 1990, 1991, 1992.

Connor, John M.; and Everett B. Peterson. 1992. Market-Structure Determinants of National Brand-Private Label Price Differences of Manufactured Food Products, *Journal of Industrial Economics*, 40: (June) 157-172.

Consumer Reports. 1983. Tomato Ketchups, 48:(10).

Cotterill, Ronald W. 1986. Market Power in the Retail Food Industry: Evidence from Vermont, *Review of Economics and Statistics*, 68: (3) 379-386.

_____. 1993. Introduction and Methodological Overview. In Cotterill, Ronald W. ed. *Competitive Strategy Analysis in the Food System*. Boulder, Co.: Westview Press.

_____. 1994. Scanner Data: New Opportunities for Demand and Competitive Strategy Analysis, *Agricultural and Resource Economics Review*, 23:(2) 125-139.

Cotterill, Ronald W.; and Lawrence E. Haller. 1994. Marketing Strategies in Branded Dairy Product Markets, in Cotterill, Ronald W., ed. *Competitive Strategy Analysis for Agricultural Marketing Cooperatives*, Boulder, Co.: Westview Press.

Deneckere, Raymond; and Carl Davidson. 1985. Incentives to Form Coalitions with Bertrand Competition, *Rand Journal of Economics*, 16:(4) 473-486.

Food Institute Report. American Institute of Food Distribution, Fair Lawn, N.J., Various issues.

Franklin, Andrew W.; and Ronald W. Cotterill. 1993. *An Analysis of Local Market Concentration Levels and Trends in the U.S. Grocery Retailing Industry*. Food Marketing Policy Center Research Report No. 19, University of Connecticut, Storrs, Ct.

Haller, Lawrence E. 1994. *Branded Product Pricing Strategies in the Catsup and Cottage Cheese Industries: The Effects of Brand Share and Cooperative Presence*, unpublished Ph.D. dissertation, University of Connecticut.

Harris, Frederick H. deB. 1986. Market Structure and Price-Cost Performance Under Endogenous Profit Risk, *Journal of Industrial Economics*, 35:(1) 35-59.

Harris, Frederick. 1988. Testable Competing Hypotheses from Structure-Performance Theory: Efficient Structure Versus Market Power, *Journal of Industrial Economics*, 36:(3) 267-280.

Hausman, Jerry A.; and William E. Taylor. 1981. Panel Data and Unobservable Individual Effects, *Econometrica*, 49:(6) 1377-1398.

IRI. *InfoScan Market and Regional Profiles 1992*. Chicago: Information Resources, Inc.

Judge, George E.; R. Carter Hill; William E. Griffiths; Helmut Lütkepohl; and Tsoung-Chao Lee. 1982. *Introduction to the Theory and Practice of Econometrics*. New York: John Wiley and Sons.

Nelson, Phillip. 1974. Advertising as Information, *Journal of Political Economy*, 82: 729-754.

Nelson, Philip; John Siegfried; and John Howell. 1992. A Simultaneous Equations Model of Coffee Brand Pricing and Advertising. *Review of Economics and Statistics*, 74:(1) 54-63.

Progressive's Grocer's Market Scope. Stamford, Ct.: Maclean Hunter Media, Inc., 1989, 1990, 1991, 1992, 1993.

Wills, Robert L. 1984. *Advertising and Quality as Sources of Price Heterogeneity Among Brands of Food Products*, Working Paper #77, Food System Research Group (NC 117), University of Wisconsin-Madison.

_____. 1985. Evaluating Price Enhancement by Processing Cooperatives, *American Journal of Agricultural Economics*, 67:(2) 183-192.

Wills, Robert L.; and Willard F. Mueller. 1989. Brand Price and Advertising, *Southern Economic Journal*, 56: 383-395.

FOOD MARKETING POLICY CENTER
RESEARCH REPORT SERIES

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

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

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