1994

Market Share Dispersion Among Leading Firms as a Determinant of Advertising Intensity

MS WILLIS

RT Rogers

Market Share Dispersion Among Leading Firms as a Determinant of Advertising Intensity

MICHAEL S. WILLIS
The Swedish Institute of Health Economics, Lund, Sweden, and Department of Economics, University of California at Santa Barbara, Santa Barbara, CA, U.S.A.

RICHARD T. ROGERS *
Department of Resource Economics, University of Massachusetts at Amherst, Amherst, MA 01003-2040, U.S.A.

Abstract. Previous advertising intensity models have failed to address adequately the rivalry effects of leading firms trying to protect and enhance the market shares of their brands. We argue that the relative degree of market share parity among leading firms in oligopolies is a crucial determinant of market advertising levels. This study presents a model that more thoroughly characterizes market structure by including the variance in the market shares of the top four firms along with the concentration ratio. This model is then tested using a unique 1987 data set of 58 well-defined U.S. food and tobacco manufacturing markets that used private data vendors for branded product market shares and media advertising aimed at household consumers. We find that industry advertising-to-sales ratios are highest in those industries with the highest price-cost margins, highest concentration, and those with equally-sized leading firms. Oligopolists seem unable to control advertising expenses as concentration increases and they likely overinvest in advertising rivalry when they have similar market shares.

Key words: Advertising intensity, market structure, market share equality.

While Industrial Organization economists have appreciated the importance of non-price rivalry since the 1950s, the empirical literature regarding the relationship between advertising intensity and market concentration is not overwhelmingly convincing. Although much of the empirical work finds a positive relationship between industry advertising intensity and concentration, the relationship often shows the maximum effect coming from low-grade oligopolies – those with four-firm concentration ratios under 50.

Dorfman and Steiner (1954), first linked the advertising-to-sales ratio (A/S) with market structure. They demonstrated that under simple neoclassical assumptions, a monopoly's optimal advertising-to-sales ratio must equal the ratio of its advertising elasticity of demand to the price elasticity of demand for its product. The subsequent elaboration of this model to cover oligopolistic competitors (e.g.,

* The authors thank Drs. Julie A. Caswell and Cleve E. Willis for helpful comments, as well as those of the Editor, Dr. William G. Shepherd.

Cable, 1972) is even more telling.[1] Following Waterson (1984), optimal advertising for an oligopolist i occurs where the A/S satisfies the following condition:

$$\frac{A_i}{S_i} = (PCM_i) \cdot (\eta_{aq} + \eta_{rq} \cdot \eta_{ar});$$

where PCM_i is firm i's price-cost margin, η_{ar} is a conjectural elasticity measuring the effect of firm i's advertising on that of rival's, η_{aq} is the effect of firm i's advertising on firm i's own demand, and η_{rq} is the effect of rival advertising on firm i's demand. Adequate estimates of these elasticities are difficult to determine, if not impossible, given data limitations. What one should infer from this model, however, is that optimal advertising intensity is determined by the interaction of the price-cost margin and several elasticities that reflect non-price rivalry among competing firms. Although non-price rivalry is embedded in these elasticities, the extension neglects the role of market structure, namely concentration. Waterson (1984, p. 131) further extends the model to demonstrate that optimal advertising intensity does not monotonically decline with an increasing number of firms. As Waterson (1984, p. 133) states, "Those who argue for a positive relationship and those who argue for a negative relationship between intensity and concentration can both be right over some range of values".

Markets do not advertise equally, either absolutely or relatively. To compete in some industries requires substantial investments in advertising, while success in other industries requires hardly any media advertising. The most common methodology in previous research has been to model econometrically the determinants of advertising intensity, advertising expenditures relative to market size, using cross-sectional data. Several factors have been identified that influence an industry's advertising intensity and thus explain the inter-industry variation. Farris and Albion (1981) found that profit margins, market size, amount and frequency of purchase, product durability, number of brands, and surrogates for "product differentiability" were consistently related to industry advertising-to-sales ratios. A glaring omission is the absence of any measure of industry concentration, though concentration has been included nearly universally and it is a significant determinant in many studies. Buxton, Davies and Lyons reviewed the empirical literature and found conflicting evidence in the relationship between concentration and A/S but their empirical results found support for a non-linear relationship which is first positive as concentration rises from very low levels but soon reaches a maximum at only medium levels of concentration and then the relationship becomes negative at higher levels of concentration.

We believe that previous research has failed to capture a key aspect of market structure that affects non-price rivalry. Although we agree that an oligopoly structure – with differentiated products, and selling to household consumers – is the

[1] Waterson (1984, Chapter 7) provides an excellent summary of the Dorfman–Steiner model and its several extensions.

most conducive to advertising rivalry, we contend that the distribution of market power among an industry's leading firms is an important element of market structure but it is masked by the concentration ratio, the most commonly used measure of concentration. The use of the Herfindahl–Hirschman Index lessens this concern but does not eliminate it. We argue that the variance of the leading firms' market shares is a useful complement to the four-firm concentration ratio in predicting which industries will use advertising most intensively.

The inclusion of the leading firms' market shares will help define the preeminent strategic group, be it one dominant firm or several equally sized competitors. Holding concentration constant, an oligopoly that consists of equally sized rivals is more likely to overinvest in advertising rivalry than an oligopoly that has a dominant leading firm. For example, compare two hypothetical industries each with a four-firm concentration ratio of 80 and identical except for the distribution of market shares among the leaders. Suppose the four largest firms in Industry A each have a market share of 20. In contrast, the four largest firms in Industry B have market shares of 70, 5, 3, and 2 percent, respectively. We expect greater rivalry and thus greater advertising expenditures in Industry A.

A common criticism of the single equation advertising intensity model is the potential endogeneity of profitability and concentration. If profitability or concentration is endogenously determined with advertising intensity, ordinary least squares estimates of the model parameters would be biased. Previous researchers have estimated advertising intensity within systems of simultaneous equations (e.g., Comanor and Wilson, 1974; Greer, 1971; Martin, 1979; Pagoulatos and Sorenson, 1983; Kardasz and Stollery, 1984; Zellner, 1989), though the issue of simultaneity remains unresolved (Buxton et al., 1984). For the purposes of introducing a new variable into the literature, we argue that the single equation approach is acceptable and offer evidence based on Hausman tests for independence of the regressors that suggest that our estimates do not suffer from simultaneity bias.

I. Model Specification and Data

We specify a model that closely resembles previous research, but includes a measure of the inequality in market shares among a market's leading four firms. The model explains variability in market advertising-to-sales ratios with price-cost margins, market concentration, the standard deviation of the leading four firms' market shares, and three control variables (market size, market growth, and the proportion of sales to final consumers) as given in the following equation:

$$\text{A/S} = \beta_0 + B_1 PCM + \beta_2 \text{CR4} + \beta_3 \text{CR4}^2 + \beta_4 \text{ Std Dev}$$

$$+ \beta_5 \text{VOS} + \beta_6 \text{ Growth} + \beta_7 CD/S + u.$$

We then estimate the model using both Census data at the 5-digit product class level[2] and data from private vendors for 58 processed food and tobacco markets for the year 1987.

1. ADVERTISING INTENSITY

The dependent variable is an industry's advertising intensity, measured by the advertising-to-sales ratio (A/S). The numerator consists of 1987 consumer-oriented expenditures for seven measured-media as reported by *Leading National Advertisers* (LNA).[3] These advertising data are well-suited to studying advertising rivalry by various brand manufacturers selling to final consumers. Promotion and advertising aimed at intermediate buyers are not included. The difficulties of using these data are their expense and their use of a coding system that does not match the Census SIC system. However, with effort, each brand's advertising can be classified into the Census SIC system and then aggregated to match the Census product class definitions (see Rogers and Tokle, 1995, for details). Census value of shipments comprise the denominator; though they have been criticized for including sales to food processors, food service operators, and foreign countries because these destinations attract little or no domestic media advertising (Connor and Weimer, 1986, p. 10). We prefer instead to use the Census shipments and control for non-advertised sales directly in the regression.

2. PRICE-COST MARGIN

The price-cost margin is the most obvious regressor to include in the regression as it is the core of the Dorfman-Steiner model and its extensions. The profit margin represents the reward for increased sales: the higher it is, the more incentive a firm has to advertise in attempting to generate additional sales. Thus, the price-cost margin should positively influence advertising intensity, though causality concerns could obscure this relationship.

Many studies have employed price-cost margins derived from Census data. However, Pagoulatos and Sorenson, among others, have suggested that any correlation existing between Census price-cost margins and advertising intensity is spurious because their calculation fails to net out advertising. That is, advertising exists simultaneously on both sides of the equation. While this problem is easily corrected, Census derived price-cost margins also rely on the quality of the Census data's approximation of marginal costs, which is often a concern (see Scherer and Ross, 1990, p. 418).

---

[2] Although the 5-digit product class typically offers the best correspondence between Census data and economic markets, there are exceptions and at times we used the 4-digit industry (e.g., beer) data because the 5-digit data were too narrowly defined (e.g., bottled beer). See Willis (1992) for a complete explanation as well as the entire data set.

[3] The measured-media are network, spot, and cable television; network radio; magazines; newspapers; and billboards.

We avoid such problems associated with using Census price-cost margins by taking advantage of our study's focus on food industries which sell both national brands (e.g., Kellogg's Corn Flakes) and the retailer's private label version of the branded product (e.g., Safeway's Corn Flakes). We used data from *Selling Area Marketing Information* (SAMI) and *Informational Resources Incorporated* (IRI) to obtain brand sales and private label sales at the retail level. These data ignore non-consumer channels of distribution and hence focus on sales to final consumers through typical supermarkets. Following Connor and Peterson (1992), we use the average private label price to approximate marginal cost. They argue that competition among private label manufacturers ensures a price closely resembling marginal cost, since major entry barriers into this strategic group are low. Thus, we define the price-cost margin (PCM) as the relative difference between average branded price and average private label price at the market level. We expect this measure will proxy the rewards for successful advertising at least as well as the Census measure, but without the problems.

3. Concentration

Some measure of concentration has been nearly universally employed in advertising intensity models as a dimension of industry structure although its effects on advertising are far less certain than those of profit margins. The four-firm concentration ratio (CR4), as reported in the Census of Manufacturing, is the most commonly used measure of concentration, but the Herfindahl–Hirschman Index (HI) has been used also (e.g., Cable, 1972).

Most studies have anticipated and found that advertising intensity, in general, increases with concentration, at least over some range of concentration. There is little doubt that an increase in concentration reduces the incentive of leading firms marketing differentiated products to compete with prices, which inevitably creates a greater reliance on advertising and, thus, a positive advertising-concentration relationship, but there is no reason to expect this relationship to be linear. Several studies have added a quadratic concentration term to allow for a non-linear relationship between concentration and advertising intensity. The quadratic advertising-concentration hypothesis is founded on the notion that recognized interdependence increases with concentration and after some level of concentration is reached, firms will cut back on their advertising expenditures. Thus, an inverted-U shape relationship is expected. However, we believe that a single measure of concentration fails to capture fully the relative degree of market dominance and hence contaminates the relationship (the HI less so because it is weighted to the largest firms).

We use the CR4 as our market concentration measure because of its wider use in previous studies and our interest in directly measuring size variations among the leading firms. We also estimate the model using the HI for comparison. Although the conventional inverted-U shape hypothesis is believable, it depends on conjectures about oligopolistic interaction. If this inverted-U relationship is found, we expect that the point of maximum advertising intensity will occur at a much higher level of concentration than found in most previous studies – at unbelievably low CR4s of 46 to 53 percent (Scherer and Ross, 1990, p. 598).[4]

4. Market Share Dispersion

The degree of market share dispersion is a critical element of market structure which should influence advertising intensities, once market concentration is held constant. Since symmetric leading firms in an oligopoly are more likely to recognize their collective interest in avoiding price competition, they are more likely to overinvest in advertising as they seek a competitive advantage and collectively raise entry barriers into their strategic group – sellers of national brands.

To capture this effect, we will use the standard deviation of the leading four firms' market shares in branded product sales to measure the size similarity of the leading four firms within the strategic group where advertising rivalry is attractive. The larger it is, the more unequal are the market shares of the leading four firms. Particularly large values reflect the presence of a dominant firm. Small values indicate the leading firms are essentially equal in size.

We expect market share dispersion to have a negative effect on advertising intensity. Holding market concentration constant, the presence of asymmetrical market shares yields better opportunities to reduce advertising expenditures toward the optimal level than a more symmetric distribution of leading firms. At the extreme, an oligopoly with one dominant firm should be able to hold advertising intensity close to the optimum level, whereas a more equal distribution should lead to overinvestment in advertising rivalry, once concentration is held constant.

The variance (and hence standard deviation) of the four leading firms' market shares in the jth industry, σ_j^2, is related to both the truncated four-firm Herfindahl Index (HI4) and the four-firm concentration ratio (CR4) as follows:[5]

$$\sigma_j^2 = 0.25\,\mathrm{HI4}_j - 0.0625\,\mathrm{CR4}_j^2.$$

Since the variance is a linear function of the four-firm Herfindahl Index and a squared function of the four-firm concentration ratio collinearity may pose a problem.[6] This relationship also suggests that perhaps the HI may have been more appropriate than four-firm concentration ratios in previous studies because of its better ability to account for a dominant firm market structure. We prefer to use two measures to capture more fully the market's structure – the concentration ratio for

[4] It seems unlikely that leading firms will recognize their interdependence sufficiently to reduce advertising budgets in unison at a concentration level considered workably competitive to loosely oligopolistic.

[5] The algebra is available upon request, or in Willis (1992).

[6] The simple correlation between the four-firm Herfindahl Index and the Herfindahl Index is 0.85 for the sample used.

measuring the degree of oligopoly and the standard deviation of the leading four firms' market shares to measure size similarity among the leaders.

We also estimate the model using a simple alternative to the standard deviation of the four leading firms' market shares. The alternative, which should also account for market share dispersion among the market leaders, is the ratio of market shares of the two largest firms in an industry. This alternative is easier to calculate and will still detect dominant firms and provide a measure of market asymmetry.

The Census does not reveal individual firm market shares and hence we used alternative private vendor data (SAMI and IRI) that provide market data for food industries on sales for household consumption. In each market we calculated the individual market share of retail sales of each of the four leading firms, along with an aggregated share of total sales accounted for by private label products.

5. Control Variables

The previous literature has demonstrated the importance of an array of control variables and hence we included three commonly used variables: market size, market growth, and the percent of market sales that are made to final consumers. Market size, measured by Census value of shipments (VOS), is included because advertising expenditures are often thought to rise less than proportionally to the size of the market, perhaps because of economies of scale in advertising. Farris and Albion (1981, p. 23) stated: "There seems to be little question that advertising intensity is lower, *ceteris paribus*, in large markets than in small markets".

Market growth, measured by percentage change in VOS from 1982 to 1987, is included to capture the effects of market dynamism. A growing market is thought to encourage advertising for two reasons. Typically, the rate of new product introductions is greater and thus periods of initial heavy advertising are more frequent. It is also likely that advertising is more successful since additional sales need not necessarily be at a rival's expense.

We included final consumer purchases as a proportion of total industry sales (CP/S) because professional buyers are unlikely to be persuaded by consumer-oriented media advertising. Thus, markets where the buyers are more likely to be professional, such as intermediate goods markets, should be less intensively advertised, *ceteris paribus*.[7] Furthermore, promotional techniques vary between consumer and producer buyers. For example, sales representatives are more appropriate when selling to a few purchasers (Buxton et al., 1984). The numerator, CP, was total sales to household consumers as reported by SAMI or IRI, whereas the denominator was Census product class VOS. Since these two sources measure food sales at two different vertical stages of the food system, the ratio exceeds the theoretical upper bound of one in a few cases. However, no superior measure was

[7] This effect theoretically holds constant the level of product homogeneity that such markets display. Because we are unable to control satisfactorily for product differentiation, this variable may capture those characteristics as well.

Table I. Descriptive statistics for 58 food and tobacco processing markets

Variable[a]	Mean	Standard deviation	Minimum	Maximum
A/S	2.667	3.143	0.040	18.050
PCM	0.351	0.131	0.135	0.747
CR4	60.810	19.146	22.000	97.000
HI	1.631	1.125	0.221	5.150
STD DEV	11.852	6.859	1.881	33.635
MS12	2.808	2.335	1.012	11.483
VOS	2.787	3.308	0.165	16.746
GROWTH	0.141	0.186	−0.429	0.425
CP/S	0.652	0.267	0.100	1.220

[a] The variables HI and VOS are in thousands, A/S, CR4, and STD DEV are in percent, and the rest are proportions. Also, all variables are measured in 1987, except growth is from 1982, 1987.

available that would allow us to control consumer sales relative to total sales (see Willis, 1992, for further details).

6. Data

The data assembled for this study represent a major contribution to empirical research. This study took great care to match observations with well-defined economic markets The blending of private vendor data on market shares and media advertising along with more commonly used Census data allows a novel opportunity to test the advertising intensity-concentration relationship. Although such blending is possible in food industries because of the private data providers, such industries are also well-suited to cross-sectional research on advertising issues. The food manufacturing sector outspends every other manufacturing sector in advertising expenditures and the industries within the sector contain a wide variety of market structures – from workable competition to shared monopolies.

We were able to compile information on the advertising-to-sales ratio and the six independent variables at the 5-digit SIC product class level (or occasionally at the 4-digit level if the product class level was too narrowly defined) for 58 food and tobacco manufacturing markets.[8] Observations range from canned soup to cheese and chewing gum to refrigerated yogurt. Rich variation is evident in the sample, as evidenced by the descriptive statistics in Table I. Advertising intensity varied from 0.04% (flour) to 18.05% (chewing gum), with a mean A/S of 2.7%.

The independent variables exhibit considerable variation as well. For instance, CR4 ranged from 22 to 97, with a mean of 60.8. The average market, thus, borders

[8] The complete list of observations used and their data values is given in Appendix Table A.1 of Willis (1992). Also, interested researchers may receive a complete copy of the data in electronic form.

on tight oligopoly, however, more than one-quarter (17) have a CR4 of less than 50. The derived price-cost margin varies from 0.135 to 0.747, with a mean of 0.351.[9] Exceptional variation exists in the standard deviation of the leading four firms' market shares. It ranges from 1.88 for the nonchocolate candy market, where the leading four firms controlled 12.1, 9.8, 9.4, and 6.8 percent of the retail consumer market, respectively, to 33.64 for the canned soup industry, where the leading four firms controlled 81.1, 8.3, 1.8, and 1.0 percent, respectively.

II. Empirical Results

The least squares estimates of the parameters for the model are shown in Table II. Because the disturbances are likely to be heteroscedastic, we used White's covariance estimator to compute the standard errors.[10] In column 1, the explanatory variables of our primary model explain nearly 41 percent of the variation in the advertising-to-sales ratio for this sample. In columns 2 and 3, two variants of the main model are reported. The original work (Willis, 1992) included several model variants with varying measures used for the price-cost margin (e.g., Census PCMs), concentration, and the degree of market share equality among the leading firms. The results proved robust to these variants and the three versions reported here reflect the main findings of the complete study. Although statistically insignificant,[11] the estimated coefficients for the control variables of market size, market growth, and consumer purchases as a percent of total sales, hint at their respective anticipated effects.

The estimated coefficient of the price-cost margin based on the relative difference of national brand and private label average prices, PCM, was positive as expected. Although this is the first use of this measure of PCM in an advertising intensity study, the result agrees with the bulk of previous theoretical and empirical findings that the profit contribution of additional sales positively influences advertising, a potential means of increasing sales. Moreover, the magnitude of the coefficient is generally consistent with previous empirical findings (Brush, 1976; Farris and Buzzell, 1979).

As with many previous studies, the four-firm concentration ratio was a positive determinant of advertising intensity. Although a linear specification yields a positive, significant result, we find that the best specification was quadratic. However, unlike nearly all other empirical studies, we find that the relationship curves upward

[9] Interestingly, the 1987 PCM calculated from SAMI data aligns well with the PCM calculated from the 1982 Census (see Willis, 1992, for details).

[10] Heteroscedasticity could theoretically arise for any number of reasons. First, the grouped industry structure of product classes likely implies a grouped disturbance structure, though we suspect that any arbitrariness in the Standard Industrial Classification scheme might weaken this relationship enough to justify use of a general-form heteroscedastic-consistent estimator of the standard errors. Additionally, statistical correlation between the disturbances and regressors will generate heteroscedasticity; in particular, we suspect that industry size may be an offending variable through economies of scale.

[11] All references to statistical significance are based on a 95 percent confidence level.

Table II. OLS regression results of the determinants of 1987 advertising-to-sales ratios in 58 processed food and tobacco markets

Variable	(1)	(2)	(3)
PCM	5.016*	5.030*	5.787*
	(2.03)[a]	(2.17)	(2.52)
CR4	−0.226*	−0.265*	
	(2.14)	(2.11)	
CR4^2	0.263[b],*	0.263[b],*	
	(2.24)	(2.12)	
HI			0.179[b],*
			(1.77)
STD DEV	−0.171*		−0.210*
	(1.85)		(1.76)
MS12		−0.348*	
		(2.20)	
VOS	−0.115[c]	−0.090[c]	0.038[c]
	(0.73)	(0.63)	(0.38)
GROWTH	2.203	1.710	0.347
	(1.50)	(1.42)	(0.24)
CP/S	0.686	2.036	1.257
	(0.27)	(1.12)	(0.56)
CONSTANT	5.553	6.003	−0.765
R^2	0.408	0.398	0.316
$\bar{R}^2$	0.326	0.314	0.235

[a] Absolute values of Student *t* ratios in parentheses.
[b] In hundredths.
[c] In thousandths.
* Estimated coefficient is statistically significant at the 95% confidence interval.

forming a lazy J-shape as opposed to an inverted U-shape. Our minimum effect occurs at 41 percent as opposed to previous maxima which occurred between 46 to 53 percent and we never reach a maximum effect over the theoretical range of CR4.

We speculate that other studies have been contaminated with observations that were over-aggregated by including observations with too many unrelated and non-competing products. Over-aggregation would bias true market concentration downward and might cause the relationship to reach a maximum at unlikely low levels of concentration. For example, SIC 2844 Toilet Preparations, is commonly used in cross-sectional studies. It is an intense user of media advertising, spending over $1 billion in 1982 – the largest amount of any single U.S. industry (Rogers and Tokle, 1995). The A/S was 11.0%, while the CR4 was only 30, a reflection of combining noncompeting products. This industry contains a wide variety of noncompeting products with nearly all heavy users of consumer-oriented media advertising. This industry includes five 5-digit product classes with CR4s ranging from a low 38 for the largest product class SIC 28445 – other cosmetics and toilet preparations – to a high of 74 for SIC 28444 – dentifrices, including mouthwashes, dental floss and denture cleaners. Even the five-digit product classes for this industry are overly broad – including such well-defined economic markets as: lubricating creams, suntan lotions, sunscreens, lipsticks, mascara and eye shadow, underarm deodorants, fingernail polishes, talcum powder, baby wipes, bubble baths, and depilatories, to name some prominent ones. The implications for estimating an A/S-CR4 relationship is clear – the expected positive relationship is lost due to poorly defined economic markets. Although the theory is correct to imply that at some level of concentration over-investment in advertising will be checked, intuition should warn us that such levels of concentration are unlikely to generate sufficient interdependence to sustain joint industry advertising reductions. We encourage the re-estimation of previous studies that included the 4-digit "toilet preparations" industry in their data, which involves most every previous study (e.g., Buxton et al., 1984).

The parameter estimate for the standard deviation of the leading four firms' market shares, STD DEV, was negative as expected and statistically significant.[12] This provides confidence that it is an important complement to concentration.[13] It suggests that when the standard deviation increases by one percentage point, the advertising-to-sales ratio decreases by nearly two-tenths of a percentage point. This estimated coefficient may seem small, but evaluated at the mean standard deviation of nearly 12 percentage points, advertising intensity is decreased by about 2 percentage points. This is quite an important effect given that the mean advertising-to-sales ratio is only 2.67 percent.

As an alternative measure of market share dispersion, we used the ratio of market shares of the two largest firms, MS12. The similarity of results (see column 2) suggests this simple measure can adequately capture the asymmetry that affects non-price rivalry. To appreciate this result, one need only consider the so-called "Cola Wars", where Coke and Pepsi compete heavily with massive spending on media advertising aimed at final consumers.

We also estimated the model with the Herfindahl–Hirschman Index, HI, as a regressor in place of the concentration ratio and the results are reported in column 3 of Table I. While the HI undoubtedly captures market share asymmetry better than the concentration ratio does, the standard deviation of leading firm market shares' estimate is robust to this change. Unlike with CR4, the results with HI suggested a linear rather than a quadratic functional form.

Concerns about the exogeneity of concentration and price-cost margins in a model of advertising intensity have not gone unnoticed. We used the Hausman test

[12] The use of White's covariance estimator actually reduced the calculated t-ratios by estimating larger standard errors than in the OLS results.

[13] As expected, the dispersion measures are highly insignificant when concentration is omitted.

for independence of regressors to test the hypothesis that our price-cost measure and concentration measures were exogenous. We found no evidence to conclude that either the concentration ratio or the price-cost margin was endogenous in this data set and feel confident that Ordinary Least Squares regression provides unbiased estimates of this model.

III. Conclusions

Our results support much of the previous research findings but also add in important ways. First, we challenge the finding that concentration exhibits its maximum effect on the industry's advertising-to-sales ratio at four-firm concentration values as low as 45, especially given that a four-firm concentration ratio of 40 is often the benchmark of workable competition. Our nonlinear relationship between concentration and advertising-to-sales shows the relationship is positive after reaching CR4s of 40 and continues to increase positively even at CR4 values in the 90s. In addition, the HI had a positive significant effect on advertising intensity.

Our findings give the first empirical support that the similarity of market shares among leading firms is a useful supplement to traditional measures of concentration. The results suggest that as a dominant firm emerges in a market without close rivals, it can relax advertising expenditures toward the industry's optimal advertising-to-sales ratio as defined by Dorfman and Steiner (1954). Overinvestment in advertising becomes unnecessary. Market leaders in oligopolies with close rivals, on the other hand, have many incentives to use advertising as a form of rivalry, which perpetuates overinvestment. Evidently, oligopolists either find it advantageous to compete via advertising or difficult to hold such rivalries in check when they have similar market shares and each is vying for an advantage. The highest advertising intensities are found in concentrated markets that have high price-cost margins and where the leading rivals have similar market shares. Although these results were found in a sample of food and tobacco processing markets, we expect they would hold for any manufacturing markets selling differentiated products to final consumers.

References

Albion, Mark S., and Paul W. Farris (1979) *Appraising Research on Advertising's Economic Impacts.* Cambridge, MA: Marketing Science Institute.

Brush, Brian C. (1976) 'The Influence of Market Structure on Industry Advertising Intensity', *The Journal of Industrial Economics*, **25**, 55–67.

Butters, Gerard R. (1976) 'A Survey of Advertising and Market Structure', *American Economic Review*, **66**, 392–397.

Buxton, A. J., S. W. Davies, and B. R. Lyons (1984) 'Concentration and Advertising in Consumer and Producer Markets', *The Journal of Industrial Economics*, **32**, 451–464.

Cable, J. (1972) 'Advertising Policy and Intermarket Differences in Advertising Intensity', in K. Cowling, ed., *Market Structure and Corporate Behavior.* London: Grayson Mills.

Comanor, William S., and Thomas A. Wilson (1974) *Advertising and Market Power.* Cambridge, MA: Harvard University Press.

Comanor, William S., and Thomas A. Wilson (1979) 'The Effect of Advertising on Competition: A Survey', *Journal of Economic Literature*, **17**, 453–476.

Connor, John M., and Scott Weimer (1986) 'The Intensity of Advertising and Other Selling Expenses in Food and Tobacco Manufacturing: Measurement, Determinants, and Impacts', *Agribusiness*, 2(3), 293–319.

Connor, John M., and E. B. Peterson (1992) 'Market Structure Determinants of National Brand-Private Label Differences of Manufactured Food Products', *The Journal of Industrial Economics*, **40**, 157–171.

Dorfman, Robert, and Peter O. Steiner (1954) 'Optimal Advertising and Optimal Quality', *American Economic Review*, **44**, 826–836.

Esposito, Frances F., Louis Esposito, and William V. Hogan (1990) 'Interindustry Differences in Advertising in U.S. Manufacturing: 1963–1977', *Review of Industrial Organization*, **5**, 53–80.

Farris, Paul W., and Mark S. Albion (1981) 'Determinants of the Advertising-to-Sales Ratio ... Applying Method to the Madness', *Journal of Advertising Research*, **21**, 19–27.

Farris, Paul W., and Robert D. Buzzell (1979) 'Why Advertising and Promotional Costs Vary: Some Cross-Sectional Analyses', *Journal of Marketing*, **43**, 112–122.

Gisser, Micha (1991) 'Advertising, Concentration and Profitability in Manufacturing', *Economic Inquiry*, **29**, 148–165.

Greer, Douglas F. (1971) 'Advertising and Market Concentration', *Southern Economic Journal*, **38**, 19–32.

Greer, Douglas F. (1973) 'Advertising and Market Concentration: Reply', *Southern Economic Journal*, **49**, 451–453.

Gupta, Vinod K. (1980) 'Factors Determining Interindustry Differences in Advertising Intensity: Canadian Manufacturing', *Quarterly Review of Economics and Business*, **20**, 60–76.

Henning, J. A., and H. Michael Mann (1976) 'Advertising and Concentration: A Tentative Determination of Cause and Effect', in Robert T. Masson and P. David Qualls, eds., *Essays on Industrial Organization in Honor of Joe S. Bain*. Cambridge, MA: Ballinger Publishing Company, pp. 143–154.

Kardasz, Stanley W., and Kenneth R. Stollery (1984) 'Simultaneous Equation Models of Profitability, Advertising and Concentration for Canadian Manufacturing Industries', *Quarterly Journal of Business and Economics*, **23**, 51–64.

Lambin, J. J. (1976) *Advertising, Competition and Market Conduct in Oligopoly Over Time*. Amsterdam: North-Holland Publishing Company.

Leading National Advertisers (1987) *Class/Brand $*. New York, NY: Leading National Advertisers, Inc.

Mann, H. M., J. A. Henning, and J. W. Meehan, Jr. (1973) 'Advertising and Market Concentration: Comment', *Southern Economic Journal*, **39**, 448–451.

Martin, Stephen (1979) 'Advertising, Concentration, and Profitability: The Simultaneity Problem', *The Bell Journal of Economics*, **10**, 639–647.

Nerlove, Marc, and Kenneth J. Arrow (1962) 'Optimal Advertising Policy under Dynamic Conditions', *Economica*, **29**, 129–142.

Ornstein, Stanley, I. (1977) *Industrial Concentration and Advertising Intensity*. Washington, DC: American Enterprise Institute for Public Policy Research.

Ornstein, Stanley I. (1976) 'The Advertising-Concentration Controversy', *Southern Economic Journal*, **43**, 892–902.

Ornstein, Stanley I., and Steven Lustgarten (1978) 'Advertising Intensity and Industrial Concentration – An Empirical Inquiry, 1947–1967', in David G. Tuerck, ed., *Issues in Advertising: The Economics of Persuasion*. Washington, DC: American Enterprise Institute for Public Policy Research, pp. 217–252.

Pagoulatos, Emilio, and Robert Sorenson (1983) 'The Competitive Impact of Advertising in U.S. Food Processing Industries: A Simultaneous Equation Approach', in John M. Connor and Ronald L. Ward, eds., *Advertising and the Food System*. Madison, WI: NC-117 Monograph No. 14, pp. 241–256.

Rogers, Richard T., and Robert J. Tokle (1995) 'The Economics of Advertising: Where's the Data?', *Review of Industrial Organization*, **10**(6), 675–687.

Scherer, F. M., and David Ross (1990) *Industrial Market Structure and Economic Performance*. Boston, MA: Houghton Mifflin Company.

Schmalensee, Richard (1972) *The Economics of Advertising*. Amsterdam: North-Holland.

Selling Areas Marketing Information (1992) *Million Dollar Brands: 1981–1990*. New York, NY: Selling Areas Marketing Information, Inc., joint purchase with University of Wisconsin at Madison.

Strickland, Allyn, and Leonard W. Weiss (1976) 'Advertising, Concentration, and Price-Cost Margins', *Journal of Political Economy*, **84**, 1109–1121.

U.S. Bureau of the Census (1993) *Statistical Abstract of the United States: 1993*, 113th edition. Washington, DC.

Ward, Ronald W., and Robert M. Behr (1980) 'Revisiting the Advertising-Concentration Issue', *American Journal of Agricultural Economics*, **62**, 113–117.

Waterson, Michael (1984) *Economic Theory of the Industry*. New York: Cambridge University Press.

Weiss, Leonard W., George Pascoe, and Stephen Martin (1983) 'The Size of Selling Costs', *The Review of Economics and Statistics*, **45**, 668–672.

Willis, Michael S. (1992) 'Leading Firm Heterogeneity as a Determinant of Advertising Intensity in Food and Tobacco Manufacturing', M.S. Thesis, Department of Resource Economics, University of Massachusetts, Amherst.

Zellner, James A. (1989) 'A Simultaneous Analysis of Food Industry Conduct', *American Journal of Agricultural Economics*, **71**, 105–115.