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ADVERTISING AND QUALITY AS SOURCES OF PRICE  
HETEROGENEITY AMONG BRANDS OF FOOD PRODUCTS

by

Robert L. Wills

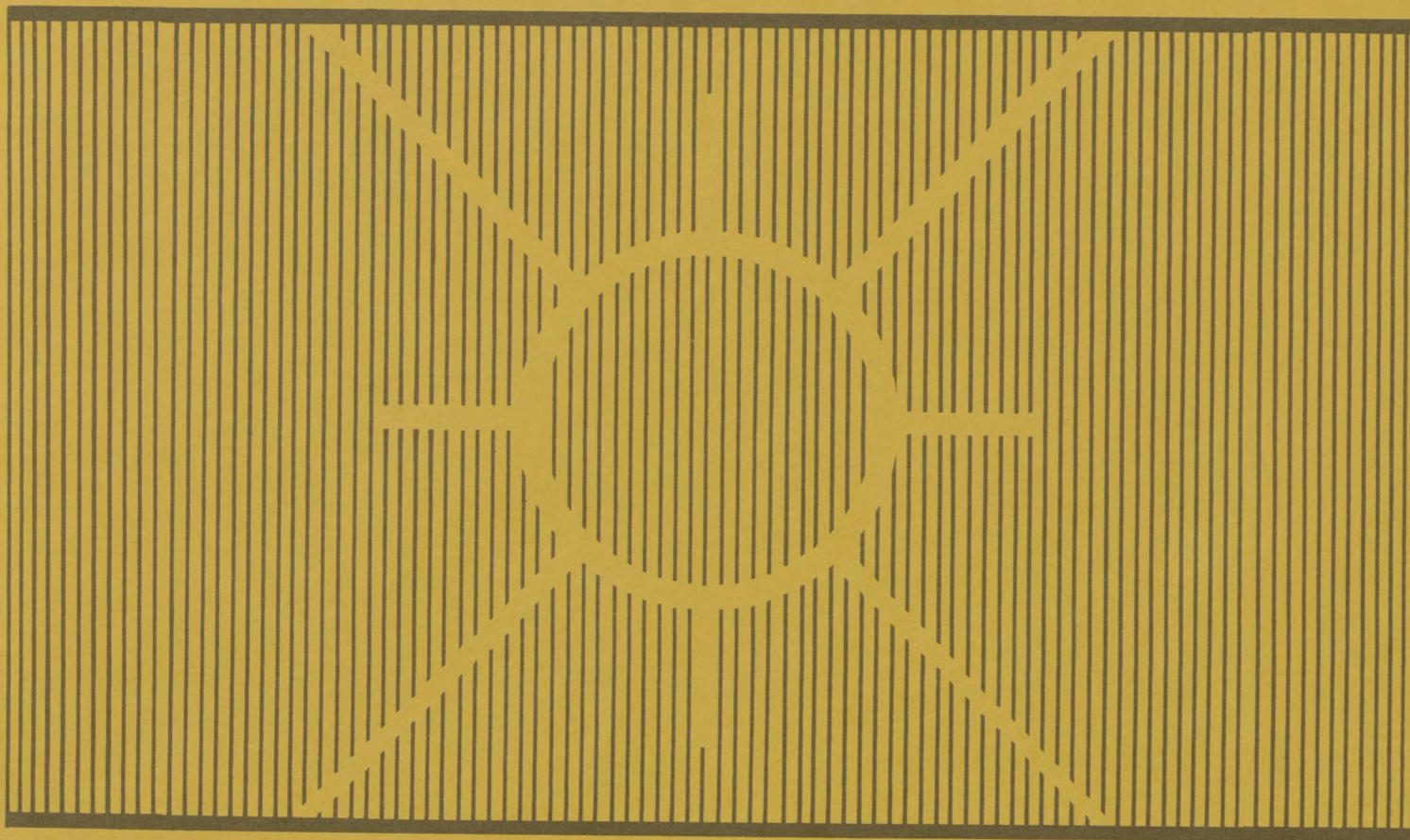
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The research reported here was conducted while the author was an employee of the Economic Research Service, U.S. Department of Agriculture. The author is currently employed by the Food System Research Group (NC117) at the University of Wisconsin-Madison, Department of Agricultural Economics. The views expressed are those of the author and do not reflect the opinions of the U.S. Department of Agriculture.

Stigler (1961, p. 214) observed that, "price dispersion is a manifestation ... of ignorance in the market." He noted that in some cases price differences reflect differences in quality or terms of sale of a commodity. "But," he continued, "it would be metaphysical and fruitless to assert that all dispersion is due to heterogeneity." Stigler's daring admission of imperfect information into economic analysis generated a torrent of theoretical and empirical analyses of price behavior under uncertainty, and helped earn him a Nobel prize.

Yet, industrial organization analysts have paid little attention to the implications of price dispersions. The axiom "you get what you pay for" is often invoked implicitly when interpreting empirical findings. To bridge the gap between microeconomics and industrial organization, the extent, magnitude and causes of price dispersions must be recognized. It is time to continue Stigler's ghost busting. This paper attempts to replace the metaphysical and fruitless assertion of price homogeneity with corporeal and productive exploration of the causes and implications of price differences among brands. Quality heterogeneity is shown to be only one of several systematic sources of price differences among brands. Relative quality, brand market share, advertising and ownership type influence brands' relative prices in fifty processed food products. The findings make it possible to use structure-price models to measure market power.

#### Price, Quality and the Interpretation of I.O. Models

Bain (1959) developed a basic outline of industrial organization theory that dominated the economics profession for 15 years. That theory argued that firms' behavior was limited by the structure of product markets. Either optimizing behavior or economic Darwinism would



produce a predictable relationship between a market's structure and the firms' ability to charge higher prices. As market share, concentration, product differentiation and barriers to entry rose, firms would have more opportunities to raise prices, improve profitability and reward employees. Most economists interpreted a series of regression studies relating structure to firm and industry profits as providing support for Bain's paradigm (Weiss 1979).

Over the past decade, an alternative interpretation of the structure-performance evidence gained ascendancy in government agencies responsible for competition policy and convinced many economists. Demsetz (1973; 1974), McGee (1971; 1974) and Brozen (1971) among others of the "Chicago School" argued that firms would grow if they sold brands with a higher value or had more efficient production or distribution systems; the growth of these superior firms would result in high market shares and concentration. They further argued that the relationship between advertising and performance was due to the use of advertising to inform consumers about the leading brand's better value.

Demsetz (1973; 1974) cited evidence that leading producers had higher earnings than smaller producers within an industry. By assuming that all firms provided goods of equal quality at essentially the same price, his "efficiency" view attributed those earnings differences to cost advantages of larger producers. The failure of efficient firms to lower their prices and eliminate their less efficient competitors was not explained. Demsetz did not consider the persistence of high profits and market shares to indicate a major flaw in the competitive system. Rather, Demsetz implied that the innovations would not have come about if high market shares and supranormal profits had not resulted; "...a

deconcentration policy, while it may reduce the ease of colluding, courts the danger of reducing efficiency either by the penalties it places on innovative success or by the shift in output to smaller, higher cost firms it brings about" (Demsetz 1973, p. 5). In other words, if his reinterpretation of the empirical evidence were valid, then policies designed to protect competition could instead prevent firms from achieving or being rewarded for efficiency gains.

Peltzman (1977) pointed out that the relative importance of efficiency gains versus supply restraints in various structural settings was unresolved; empirical evidence is unlikely to support either the implicit assumption in the original "market power" interpretation that competing firms' costs were unrelated to structure, or the "efficiency" protagonist's alternative assumption that quality-adjusted prices were equal across firms within an industry. Peltzman's challenge to industrial organization economists was to separate the influences of market structure on efficiency, innovation, market power and collusion: "As a matter of simple arithmetic, a causal relationship between concentration and profitability can operate either through an effect on price (the usual interpretation) or on average cost, or, of course, both." (Peltzman, 1977, p. 229).

Peltzman examined the relationship between census industry cost changes and concentration over a 20 year period. Comparing those coefficients with coefficients relating concentration and profits, Peltzman concluded that price levels as well as costs were negatively related to concentration. He interpreted this as supporting Demsetz's hypothesis that cost-saving innovations generally resulted in increased concentration.

That interpretation has been broadly challenged by Scherer (1979) and Vita (1984). Changes in the nature of the products, marketing innovations, poorly defined industries and geographic markets, and econometric problems all appear to undermine Peltzman's conclusions. His analyses failed to account for quality differences across time or among producers. Quality changes were imperfectly accounted for in Census measures of product output indexes; in fact, 34 of 165 industries were on Census's doubtful reliability list (Scherer 1979, p. 204).

Based on his examination of the Census industries, Scherer found a wide variety of products within most industries and large differences in specifications, quality, and prices among brands of products. Many consumer goods industries experienced rapid concentration growth between 1947 and 1967 due to product changes and large-scale television advertising rather than productivity improvements. Producer goods appeared to be less susceptible to major changes in style, packaging, distribution and promotion than consumer goods. Therefore, Scherer suggested that more reliable evidence of efficiency gains associated with increased concentration and advertising would be found in producer goods industries. Vita (1984), however, found no relationship between productivity and concentration increases in producer goods industries in an analysis similar and in some respects superior to Peltzman's. Vita's results indicated that Peltzman's findings pertained only to consumer products where they were subject to measurement and conceptual problems. Consequently, Peltzman's conclusions appear to be unwarranted.

The existence of quality differences and brand image promotion in consumer goods requires a more careful analysis than that conducted by Peltzman. Detailed cost data are, unfortunately, rarely available for

unregulated industries. A number of studies of consumer services have found positive relationships between prices and market structure (Marion, et al 1979; Kessel 1971; Hester 1979; Rhoades 1977, 1982; Marvel 1976, 1978). Among the services studied, specific banking and financial services and gasoline retailing seem to be fairly homogeneous. Food retailing is perhaps more heterogeneous but there is now no reason to believe that services are correlated with sales concentration in that industry.<sup>1</sup> Moreover, Marion, et al, eliminated most service variations by comparing prices of the same food chains across cities. Thus, for service industries, the structure-price half of Peltzman's bifurcation of the industrial organization challenge is coming into focus. In addition, Marion, et al, compared price and profit regressions and concluded that costs were higher in more concentrated food-retailing markets.

Wills (1983) conducted a similarly detailed analysis of price differences among brands of food products. Unlike the service industries, these products are among those that generated Peltzman's findings. On average, over the 145 food products examined, the brand with the largest sales volume was priced 6 percent higher than the mean price of the next three brands and 11 percent higher than the average price of brands ranked fifth or lower in national market share. The prices of retailers' and wholesalers' private label brands were 17 percent lower than the top selling brand and generics were 31 percent lower on average (Wills 1983, p. 196). Furthermore, regression analyses indicated that the more a brand was advertised the higher its price tended to be relative to those of other brands of the same product.



These results refute the hypothesis that all brands are priced at the same level. However, a crucial issue remains -- whether or not the observed price differences within food products can be explained by quality differences among brands. Price elevation due to brand market power must be distinguished from price elevation that is due to the higher quality of leading or advertised brands. The current analysis addresses that issue.

If price elevation can be attributed to brand market power, then the assertion that all price dispersion is due to brand heterogeneity can be exorcised and the market efficiency explanation must be changed. The hypothesized causality of the revised industrial organization theory -- from lower costs to high concentration and profits -- requires that the quality-adjusted prices of growing brands be lower, if only marginally so, than those of their competitors. Since consumers would have no incentive to purchase a high-priced brand of equal quality no matter how efficient the producer, the market share of a high-priced brand would not increase. Thus, a positive quality-adjusted price-structure relationship supported by advertising-created brand differentiation is compatible with traditional industrial organization but not with the simple efficiency theory.

#### Advertising: Information or Persuasion

In processed foods, value differences among brands persist because reliable information about some characteristics is costly or unavailable. In most cases, unit prices can be easily compared. But, ingredient shares, nutritional value, naturalness, and brand effectiveness are difficult to evaluate before purchase and may be hard to discern even after using the brand.

Advertising created brand differentiation is an important element of market structure. There is debate over whether advertising causes market power or provides useful information.

Nelson (1974) argued that, where experience was an important element of consumers' evaluation of a brand, advertising would provide a valid signal of brand superiority.<sup>2</sup> Although advertising messages may not be explicitly informative, he stated,

It is my contention ... that advertising is not distributed at random among brands of a product. Heavily advertised brands are likely to provide a lower  $p^*$  (Price per unit of utility) to the average consumer than less heavily advertised brands of the same product (Nelson 1974, p. 732--footnote omitted).

Since food products are principally experience goods (Nelson 1970), they should provide a valid test of Nelson's hypothesis that a shopper who buys the most heavily advertised brand would receive the highest value or pay the lowest quality-adjusted price. Examples of products which are consistent with Nelson's claim probably exist. Contradictory examples are more notorious. Two homogeneous products were the focus of antitrust cases. In FTC v. Procter and Gamble Co., et al (1967) and a subsequent shelf audit of liquid bleach prices (Scherer 1980, p. 381) it was found that Clorox, the dominant brand, sold for premiums as large as 30 percent above the price of chemically identical competitors. Similarly, in the Federal Trade Commission's case against the Borden Company on charges of monopolizing the market for reconstituted lemon juice, it was shown that Borden's ReaLemon brand captured 80 percent of the market even though it sold at a premium of 42 percent over the price of the next largest brand. Borden's 1971 Marketing Plan indicated that this premium could be attributed to successful promotion:

Although reconstituted lemon juice is virtually indistinguishable one brand from another, heavy emphasis on the ReaLemon Brand name through its media effort should create such memorability for the brand, that an almost imaginary superiority would exist in the mind of the consumer, a justification for paying the higher price we are asking (FTC, initial decision 1976, p. 83).

Here we are interested in the general pattern across many products. Does Nelson's hypothesis tend to be supported in general? This has been a difficult proposition to test. The hypothesis does not deny that misleading claims may continue to exist; it only argues that consumers would usually benefit from purchasing the most heavily advertised brands. A stronger version of this hypothesis is the belief that advertising is almost entirely informative. Some commentators have seemed to infer this conclusion from Nelson's observation that disgruntled consumers can discipline unscrupulous advertisers by refusing to repeat their purchases:

The amount of deceptiveness in advertising can easily be exaggerated if one simply looks at the incentives of advertisers to deceive without considering the incentives of consumers not to be deceived . . . . Deceptive advertising requires not only a misleading or untrue statement but someone ready to be misled by the statement (Nelson 1974; p. 747).

Consumers who are unwilling to be misled will not repeat an unsatisfactory purchase. This mechanism will effectively eliminate deceptive advertising if producers are unable to profit by undertaking forays that result in one-time sales and if consumers are able to detect the deception after one use. If these conditions are not met, a substantial amount of persuasive or misleading advertising could be successfully employed by firms. Consumers might be misled by following Nelson's rule and purchasing heavily advertised brands. Therefore, the empirical validity of Nelson's hypothesis of a positive relationship between

advertising and the value of a brand is an important concern for consumers and policymakers.

#### Evidence From Previous Studies

There have been two approaches to evaluating the informativeness of advertising. The first uses simple correlations between price, quality and advertising variables taken in pairs to infer a relationship between advertising and brand value. These simple correlations may be biased due to interaction between included and excluded variables.

The second approach evaluates advertising directly. Messages meeting certain criteria are classified as informative, all others as entertaining or persuasive. This approach suffers from the subjective nature of the classifications and the objection that if good brands can profitably advertise more than inferior brands, the mere fact that a firm advertises may provide a valuable signal to consumers.

The most complete analysis using the correlation approach and one making explicit reference to Nelson's hypothesis was MacDonald, Scheffman and Whitten (1980). They examined all simple correlations among brand price, advertising and quality. They found significant positive correlations at the 5 percent level between price and quality for three of ten products. They also found significant positive correlations between advertising and price for two of the ten products. Finally, only one of eleven products had a significant positive correlation between advertising and quality.

An earlier study by Riesz (1978) addressed the question of whether or not consumers get higher quality items when they purchase higher priced brands. He did not explicitly address the role of advertising. Comparing 685 food and non-food consumer items which were rated by

quality, Riesz (1978) found negative correlations between brand price and quality for 35 percent of non-durable goods and 17 percent of durable products. Riesz (1979) conducted a further investigation for 40 food products. He found that correlations for most of those products indicated no significant relationship between price and quality. Four of the 40 displayed positive relationships significant at the 5 percent level. Twelve of the products had negative correlations; in two of those the correlations were significant at the 5 percent level.

Conclusions by MacDonald, et al, and Riesz differed remarkably although their findings were generally consistent. The former interpreted the positive signs on correlations between price and quality in a majority of products as providing support for Nelson's hypothesis. Riesz (1979), on the other hand, concluded,

The results of this study suggest that the market for packaged food products, particularly convenience foods, is performing quite imperfectly. Much of this imperfection undoubtedly exists because consumers do not possess, nor can they easily obtain, the information necessary to make accurate assessments of product quality (Riesz 1979, p. 243).

Because the evidence is mixed, various interpretations are possible. The conflict between MacDonald, et al, and Riesz is interesting, but it is more important that neither study provides a test of Nelson's hypothesis. Simple correlations cannot provide unbiased estimates of the interactions among price, advertising and quality.

Two studies which used regression analyses reversed the direction of causality but provided some information regarding the relationship between the variables when price, advertising, and quality are all included. The studies by Buzzell and Farris used price and quality among other variables to explain the intensity of advertising (Buzzell and Farris 1976; Farris and Buzzell 1979). Both studies used proxies



for relative price and quality that are questionable -- marketing managers' perceptions of their product's position relative to competitors' products. The regressions revealed a positive relationship between price and advertising. Although neither study reported the sign of the quality-advertising relationship, a subsequent paper by Farris and Albion (1979) reported that no significant relationship had been found.

The positive relationship between price and advertising suggests that the theoretical basis for choosing advertising as the dependent variable is incorrect. Firms would be foolish to use their high relative price as a reason to advertise more heavily. It is more likely that the high price is made possible by the influence of advertising. Advertising by manufacturers to consumers rarely contains price information since the retailers have broad prerogatives to set prices. Thus, relative price rather than the level of advertising should probably be the dependent variable.<sup>3</sup>

Analyses of advertising content have been conducted using data from the United States and Australia (Resnik and Stern 1977; Stern, Resnik and Grubb 1977; Dowling 1980). Advertisements were examined for fourteen types of information. About 49 percent of American advertisements and 74 percent of Australian advertisements contained at least one of the fourteen messages required to be "informative". Advertisements for food, institutional and private health care products were judged to be less informative than other advertisements -- 46 percent of the advertisements in the United States and 60 percent in Australia had at least one type of information.

This evidence of the low level of messages containing identifiable information may still overstate the direct informative impact of advertising. Some of the messages identified as information may not have been factual. Other advertisements may have so much puffery or persuasion surrounding the identifiable information that their overall impact is misleading in spite of their classification.

Content analyses do indicate that major national media advertising may not be noticeably informative in most cases. But they do not enable us to reject the possibility that the act of advertising provides a valuable signal of product value -- one way or the other. Local newspaper advertising and flyers which are not included in this analysis are primarily informative about retailing and prices but contain little brand quality information. Local advertising is often used in conjunction with major media promotions to emphasize the availability of the advertised items.

#### Empirical Analysis of Advertising-Quality-Price Relationships

It is impossible to use the previous studies to determine whether price differences can be entirely explained by the value consumers place on quality differences, or to the contrary whether market share and advertising provide an independent power to raise price. This section presents a multiple regression model and data that can be used to address those issues. Just as the correlations differed between products in the studies discussed above, the relationship between advertising or quality and price in a regression may differ for individual food products due to factors such as the effectiveness of advertising copy that are not considered in this analysis. This analysis focuses on

the average relationships over differentiated food products to evaluate the extent to which consumers are accurately informed.

Brand prices (P) and market shares (M) were derived from Nielsen Early Intelligence System (NEIS) data purchased by the U.S. Department of Agriculture. NEIS data are from a sample designed to represent U.S. supermarket sales during April and May of 1979.

For each product, the most commonly purchased variety (flavor and container size) was identified. Sales of these modal varieties were divided by the number of units sold as reported by the A.C. Nielsen company to estimate the dependent variable, brand price.<sup>4</sup>

Relative sales volume was measured by the brand's share (M) of NEIS product market sales. Brands with larger sales generally receive more and preferable shelf space in supermarkets (Hamm 1983). This exposure may contribute to the credibility of the brand. In addition, the brand's share of product sales was expected to reflect persisting influences on consumer buying habits from past success in differentiating the brand. Finally, firms with higher market shares were considered more likely than those with low market shares to have undertaken a harvesting strategy: setting a price above that which would have enabled the brand to maintain its sales share in order to achieve high profits while its sales share declined.

The quality variable (Q) used in this analysis is the rank of individual brands based on analyses conducted by Consumers Union researchers between 1970 and 1981. For each product, the researchers selected a limited array of characteristics they judged most important to consumers and weighted those characteristics to arrive at an overall evaluation.

Products were prescreened to eliminate differences among brands that were not incorporated into Consumers Union evaluations. Examples of such differences included whether or not a brand was kosher and whether a brand of peanut butter was "old fashioned" requiring that surface oils be mixed in by the user. The selected sample included only items fitting essentially identical descriptions for characteristics that were not included in the evaluations. Brands that had quality described as "variable" were excluded. As a result of this prescreening procedure, quality differences among brands in the analysis other than those evaluated in Consumer Reports were largely eliminated.

A remaining problem was the possibility that consumers might vary greatly in their evaluation or emphasis on particular characteristics. In that case, the Consumers Union conclusions might coincide with those of only a portion of the population. Moreover, the importance given to each characteristic by the researchers may have inaccurately reflected the preferences of consumers.<sup>5</sup> Despite these possible shortcomings, the Consumers Union data provided the only objective data available of relative product quality for a large number of food products. Furthermore, they focus on characteristics on which most readers of Consumer Reports, at least, would agree. Most other differences among brands were eliminated in the prescreening process. Therefore, it seems unlikely that differences among consumers' preferences seriously distort the conclusions that follow. Products used and the date of the Consumer Reports issues are listed in Table 1.

Three measures of major-media advertising expenditures were developed from Leading National Advertisers, 1978 (LNA). The first advertising variable ( $A_1$ ) was LNA media advertising expenditures for all

Table 1 -- Consumer Report Products

Product	Container	Year
Fish Sticks, Frozen	8 oz.	1970
Ham, Canned	3 lb.	1970
Potatoes, Instant	16 oz.	1971
Tomato Soup	10.5 oz.	1971
Bean w/Bacon Soup	11.5 oz.	1971
French Fries, Frozen	32 oz.	1971
Pizza, Frozen Cheese Regular Crust	13 oz.	1972
Shrimp, Breaded Frozen	16 oz.	1972
Salisbury Steak w/Gravy	32 oz.	1973
Sliced Beef w/Gravy	5 oz.	1973
Cod Fillets	16 oz.	1973
Turkey Roast, White	32 oz.	1973
Tuna, Chunk Light	#.5 can	1974
Chili, Canned w/Beans	15.5 oz.	1974
Coffee Creamer	22 oz.	1975
Chicken Pie, Frozen	8 oz.	1975
Sardines, Oil	#.25 can	1976
Rice, Long Grain	32 oz.	1976
Rice, Instant	14 oz.	1976
Instant Chocolate Mix	16 oz.	1976
Hot Cocoa Mix	21-1 oz. env.	1976
Orange Juice, Frozen	12 oz.	1976
Instant Orange Drink	27 oz.	1977
Green Beans, Cut	#303 can	1977
Salad Dressing	32 oz.	1977
Mayonnaise	32 oz.	1977
Milk, Instant Nonfat Bulk	8 qt.	1977
Milk, Instant Nonfat Packets	8 qt.	1977
Instant Breakfast, Chocolate	6 env.	1977
Chicken Dinner, Frozen	11 oz.	1977
Imitation Orange Juice, Frozen	12 oz.	1977
Olive Oil	8 oz.	1978
Vegetable Oil	48 oz.	1978
Corn Oil	48 oz.	1978
Shortening	3 lbs.	1978
Peanut Butter, Creamy	18 oz.	1978
Spaghetti Sauce, Meatless	32 oz.	1979
Tuna, Chunk Light	#.5 can	1979
Spaghetti	16 oz.	1979
Pancake Flour, Complete	2 lb.	1979
Pancake Flour, Buttermilk	2 lb.	1979
Coffee, Instant	4 oz.	1979
Coffee, Instant Decaffeinated	4 oz.	1979
Margarine, Soft	1 lb.	1979
Tomato Soup	10.5 oz.	1980
Bean & Bacon Soup	11.5 oz.	1980
Instant Chocolate Mix	16 oz.	1980
Cheese Pizza, Frozen	13 oz.	1980
Beef Stew, Canned	24 oz.	1981
Beef Stew, Frozen	32 oz.	1981



items with the same brand name that were classified in the same seven-digit Census Standard Industrial Classification. Two other advertising variables were formed by dividing the advertising into electronic ( $A_2$ ) and print ( $A_3$ ) media components. Mueller and Rogers (1980) found that print media were less effective for restructuring markets than were electronic media. Similarly, Porter found that profitability was more strongly related to network television advertising than to total major media advertising. Electronic media were likewise expected to have a larger impact on price.

The LNA data did not correspond exactly with the dates of the other variables. However, if relative advertising expenditures are fairly stable over time, this small difference in time periods probably does not result in biased coefficients (Rogers). It is assumed that there were no systematic changes in the relative brand quality between the date of the Consumer Reports evaluation and the dates of the NEIS sample. Stability of product quality, especially for highly advertised brands, is one of the claims made by those who recommend buying advertised brands.

The price of a brand may also be influenced by whether or not the processor is a farmer cooperative. Unlike proprietary firms, cooperatives may be unable to reduce their supply to maximize profits when they face inelastic demand (Wills 1984). As a result, the prices of brands produced by cooperatives may have been lower, for given levels of advertising, than the prices of their proprietary counterparts. To test for this influence, separate slope coefficients on advertising variables were estimated for cooperatives ( $CA_1, CA_2, CA_3$ ).<sup>6</sup>

Finally, distributional and promotional savings and strategic pricing decisions by retailers and wholesalers result in lower prices for private label or control brand items (i.e. Ann Page, Surefine, Food Club, IGA, Lady Lee, Kroger, etc.). An intercept dummy variable (PL) was included to test for this influence. Private label market shares are the combined shares of all private label brands. Separate least squares analyses were performed for samples that excluded private label brands. No significant differences in comparable coefficients were found between regressions with and without private label brands.

Analysis of brand pricing in a regression framework was complicated by the fact that the quality rankings were neither continuous nor based on a standard scale that could be compared across products. It was expected, however, that the relative position of a brand's price, within the distribution of prices of all the brands, would reflect its relative position in terms of quality, advertising and market share. These four variables were, therefore, transformed to relative values that could be compared across products.

The following transformation of the variables was performed,

$$\frac{V_i - V_L}{V_H - V_L} = V_R$$

where  $V$  represented one of the four transformed variables (P, Q, A, M), the subscript  $i$  indicated the value of that variable for a brand, and the subscripts  $H$  and  $L$  represented the highest and the lowest values of the variable among all the brands of the product. Thus,  $V_R$  was the value of the variable for a particular brand relative to the range of values for the product. By construction, the relative values for each variable ranged between zero and one for every product and could be compared across products.<sup>7</sup>

The basic model was:

$$P_{Ri} = a_0 + a_1 Q_{Ri} + a_2 A_{Ri} + a_3 M_{Ri} + a_4 C_{iRi} + a_5 PL_i + e_i$$

where  $P_R$  is relative price,  $Q_R$  is relative quality,  $A_R$  is relative advertising,  $M_R$  is relative market share, and  $C$  and  $PL$  are zero-one dummy variables for cooperatives and private labels. The error term,  $e_i$ , was assumed normally distributed with an expected value of zero and variance-covariance matrix  $\sigma_e^2 I$ .

### Regression Results

Results from least squares analysis of the pooled sample of relative variables are presented in Table 2. The results shed light on some of the issues on which economists disagree.

Overall, quality was positively related to price. This reassuring result, which was not strongly evident in some previous studies, indicated that consumers were not entirely ignorant of product quality. Advertising had a significant positive impact on a brand's relative price even after accounting for quality differences among brands. Multiplying the coefficients of quality and advertising by their mean values -- presented in Table 3 -- the impact of advertising on price, at the mean, exceeded that of quality. The price effect of switching from the lowest to the highest advertised brand -- from one with a value of zero to one with a value of one for the transformed variable -- was four times as large as a similar switch from the lowest to highest quality brand, ceteris paribus.

If advertising has an informative component, it can be assumed, drawing on Nelson, that it is a function of quality ( $aQ$ ).<sup>8</sup> Using this assumption, the impact of advertising was separated into informative and

Table 2 -- Regression Results Explaining Relative Prices of Brands of 50 Food Products, 1979

Model	Constant	$Q_R$	$A_{R1}$	$A_{R2}$	$A_{R3}$	$CA_{R1}$	$CA_{R2}$	$CA_{R3}$	$M_R$	PL	$\bar{R}^2$
1) $P_R$	.515* (16.71)	.076 (1.81)	.305 (5.97)						.060 (1.47)	-.377 (-10.54)	.447
2) $P_R$	.521 (16.76)	.083 (1.96)		.266 (4.72)	.043 (0.83)				.071 (1.73)	-.386 (-10.76)	.440
3) $P_R$	.518 (16.81)	.079 (1.88)	.313 (6.11)			-.383 (-1.58)			.058 (1.42)	-.377 (-10.56)	.449
4) $P_R$	.524 (16.86)	.086 (2.04)		.269 (4.76)	.056 (1.05)		-.370 (-1.05)	-.076 (-3.29)	.068 (1.66)	-.386 (-10.75)	.442

\* t-statistics in parentheses. A t-statistic of 1.65 is significant at the 10% level; 1.96 is significant at the 5% level; and 2.58 is significant at the 1% level when testing against the null hypothesis that the coefficient equals zero.

Models have 407 observations on 50 products.

Table 3 -- Mean Values of Relative Variables

Variable	Mean
$P_R$ NEIS Price	.397
$Q_R$ Quality	.486
$A_{R1}$ LNA Total Advertising	.161
$A_{R2}$ LNA Electronic Advertising	.151
$A_{R3}$ LNA Print Advertising	.122
$M_R$ Market Share	.427
$CA_{R1}$ Co-op LNA Advertising	.112
$CA_{R2}$ Co-op Electronic Advertising	.117
$CA_{R3}$ Co-op Print Advertising	.167

persuasive (N) components. The original equation, ignoring the other variables, may be rewritten as:

$$(1) \quad P = b_0 + b_1Q + b_2(aQ + N) + e$$

with  $e'Q = e'(aQ + N) = 0$ .

If informative and uninformative advertising expenditures could be measured it would be possible to directly estimate an equation:

$$(2) \quad P = b'_0 + b_1Q + b_2N + e.$$

Because the information portion is defined as a direct function of quality and the uninformative portion is not related to quality, informative and uninformative advertising are uncorrelated by definition. The coefficient on advertising,  $b_2$ , in equation (1) is equal to the coefficient on uninformative advertising,  $b_2$ , in the decomposed model, equation (2).<sup>9</sup>



If the effect on price of the informative portion of advertising were the same as that of the persuasive part, then the coefficient "a" would equal one. An estimate of "a" less than one would indicate that the indirect impact of quality on price through advertising was smaller than the persuasive effect. An estimate of "a" equal to zero would indicate that advertising was uninformative in Nelson's sense.

The functional parameter of informative advertising (a) estimated from the data satisfied the formula:

$$a = \frac{\text{cov}(Q, aQ+N)}{\text{VAR}(Q)} = \frac{.022}{.111} = .198$$

This is equivalent to the coefficient estimated by least squares projection of relative advertising on relative quality and a constant. The estimated value of "a" was significantly greater than zero and smaller than one at the 1 percent significant level.

The estimates in Table 2 also indicate that the impact of electronic media advertising on price was substantially larger than the impact of advertising in newspaper supplements, magazines and billboards. The print media coefficient was not significantly different from zero at levels commonly used for hypothesis testing.

The negative coefficients on the cooperative brand advertising terms indicate that advertising had less effect on price for cooperative's brands than for others. The difference was significant for total advertising but not when advertising was split into print and electronic components. Apparently, as hypothesized, cooperatives charged relatively lower prices for a given level of product differentiation than other producers. This is consistent with the conclusions of Wills (1984).<sup>10</sup>

Table 4 -- Least Squares Estimates of Relative Brand Price with Quality Omitted

Model	Constant	A <sub>R1</sub>	A <sub>R2</sub>	A <sub>R3</sub>	CA <sub>R1</sub>	CA <sub>R2</sub>	CA <sub>R3</sub>	M <sub>R</sub>	PL	R <sup>2</sup>
1A)	.477 (.023) *	.314 (.051)						.066 (.041)	-.384 (.036)	.444
Difference	-.038 (-7.40%) **	.010 (3.18%)						.006 (9.16%)	-.006 (-1.71%)	
2A)	.480 (.023)		.271 (.056)	.048 (.052)				.078 (.041)	-.394 (.036)	.436
Difference	-.041 (-7.94%)		.006 (2.13%)	.005 (11.13%)				.007 (9.88%)	-.008 (-2.02%)	
3A)	.478 (.023)	.323 (.051)			-.362 (.243)			.064 (.041)	-.384 (.036)	.446
Difference	-.040 (-7.65%)	.010 (3.06%)			.021 (5.48%)			.006 (10.04%)	-.007 (-1.78%)	
4A)	.481 (.023)		.275 (.057)	.061 (.054)		-.344 (.353)	-.079 (.231)	.075 (.041)	-.394 (.036)	.437
Difference	-.043 (-8.22%)		.006 (2.05%)	.005 (8.25%)		.026 (7.09%)	-.003 (-4.23%)	.007 (10.80%)	-.008 (-2.10%)	

\* Standard errors in parentheses. Differences calculated by subtracting coefficients in Table 2, equations 1-4 from corresponding coefficients in equations 1A-4A.

\*\* Differences as percent of Table 2 coefficients.

# Observations = 407.

The coefficient on market share was positive as hypothesized and statistically significant when electronic and print media variables were used. The impact of market share on price was smaller than the effects of quality and advertising when evaluated both at the mean value and over the ranges of the variables.

Finally, the private label coefficient was large and significantly negative. It indicated that private label brands, which were not advertised, were generally priced quite close to the lowest price for a product.

The quality variable was omitted from the regressions summarized in Table 4. Omitting the quality measure had little effect on coefficients for the other variables. The coefficients on advertising were roughly 2 to 3 percent higher without the quality variable. The print advertising coefficient was biased much more than that of electronic-media advertising. Similarly, the shift in the coefficient on advertising by cooperatives when quality was left out of the equation was relatively large. The coefficient on market share was biased upward about 10 percent when quality was excluded.

Several factors should be kept in mind before applying these estimates of omitted variables bias to other data sets. First, the products evaluated by a group such as Consumers Union tend to be those in which brands differ significantly in important, measurable characteristics. As a result, the importance of quality characteristics and the resulting bias from omitting them from the analysis may be generally smaller than estimated here. In particular, the food products analyzed in Wills, 1983 (Chapter 6), tend to be more homogeneous than those considered here.

On the other hand, it has been noted that the Consumer Reports quality measures are imperfect. The measures summarize several dimensions of quality. Efforts were made in selecting the observations to eliminate any obvious problems resulting from ignoring important differences among brands. Nonetheless if the quality measure was not sufficiently detailed or accurate, the coefficients in the model that included the quality measure could also be biased. It is likely, however, that there are few relevant dimensions to consumer choice for particular products and that the included quality measure captures the largest component; any remaining bias is likely to be small. Until superior quality measures can be compiled for a large number of products, the findings presented here are the best available evidence of the relative importance of quality, advertising, market share and ownership on brand price.

#### Conclusion

The most important finding of this paper from the perspective of industrial organization theory and industrial policy is the conclusion that quality differences explain only a small portion of the price differences among brands. The assumption that quality adjusted prices are homogeneous across brands is unwarranted. A major part of price differences among brands reflects market power achieved through brand differentiation. This market power is one component of market concentration-profit models that can be measured reasonably accurately. The findings lend added credibility to Scherer's (1979) hunch that Peltzman's results reflect marketing of consumer goods.

Most brand market power for the products studied appears to result from advertising. After adjusting for quality differences, consumers

paid significantly more for advertised brands. Apparently, heavily advertised brands were generally superior to other brands, but were not sufficiently superior to justify their higher prices.

The findings of this study cover a large number of food products. Insofar as the strong impact of electronic advertising accurately represents food products in general, it represents an area in which about one-third of all electronic advertising expenditures occur (LNA).<sup>11</sup>

Using quality as an instrument to identify informative and persuasive impacts of advertising indicates that the informative impact of advertising was relatively small. Nelson noted that advertising need not be explicitly informative to inform. A corollary observation should be that it need not be demonstrably deceptive to deceive. In spite of restrictions on false, deceptive and unfair advertising, consumers appear to have been misled. Contrary to Nelson's (1974) hypothesis, even when quality differences among brands were accounted for, advertising was associated with higher prices. Simply put, if Consumer Reports ratings are a reasonable indication of relative quality, then consumers overpaid for quality differences among brands. These results show that advertising does more than inform consumers about quality differences; it also persuades them to pay more for particular brands even though they they have no identifiable quality advantages.

Omitting quality measures from the regression resulted in small and predictable biases in the coefficients. Advertising and market share coefficients were biased upward. Consequently, estimates of the cost of market power based on structure-price models may need to be adjusted downward when they are based on models with no quality measure.



However, the necessary adjustments are probably small for fairly homogeneous products.

Although this study is restricted to brand power rather than collusion, barriers to entry or other market imperfections that shift the prices of all brands of a product, the analysis enhances the ability to measure the impact of market power. It is one step toward evaluating the overall impact of market structure on the performance of the food industry. The relationship between advertising and brand price performance identified in this study is consistent with the traditional interpretation of structure-performance models but contradicts Demsetz's efficiency theory.

Notes

- 1 The U.S. Department of Agriculture is currently analyzing a national survey of food retailer costs, services and prices that should provide additional evidence.
- 2 Kilstrom and Riordan (1984) attempted to formalize a "faithful representation of Nelson's ideas" (p. 449). Their model, however, requires than an unadvertised brand never gets a reputation for high quality even if it is superior to advertised brands. This extreme ignorance seems inconsistent with Nelson's definition of experience goods.
- 3 An analysis by Gale and Branch (1979) of the data base used by Buzzell and Farris examined the relationship between the managers' perceptions of their relative price and relative quantity. The regression, reproduced here, includes market share but does not look at the impact of advertising.  

$$\text{RPI} = 1.05 + 3.14 \text{ RQ} + .51 \text{MS}, R^2 = .188, N=761$$
(.26)            (.26)
- Standard errors are in parentheses. RPI is Relative Price Index, RQ is Relative Quality and MS is a Market Share index. Their analysis included primarily large firms in non-food as well as food industries. The quality measure is highly significant, but the absence of a measure of advertising and the subjective nature of variables based on managers' perceptions throw doubt on the validity of the results.
- 4 For a few brands that did not offer items of the modal size, the price of a similar container was adjusted to represent the modal size by increasing or decreasing its price proportionately to its volume. Brands were eliminated from the analysis if the closest container size differed from the modal item size by more than 25 percent of its volume.
- 5 Hjorth-Andersen (1981) found that brand rankings by Danish experts on five characteristics of consumer goods differed by characteristic. For those products, quality was multidimensional and the weights assigned each characteristic would affect the overall quality ranking of the brands. A similar situation was likely to exist for the food products studied here.
- 6 Brand names owned by farmer cooperatives were compiled from several sources including Ward and Morrissy (1977).
- 7 Boundedness of the variables was not a problem for estimation. Other brands could theoretically exist with higher or lower prices, quality, advertising or market shares than those actually observed. In large samples there would not be high probability of boundary values being observed. As a result, ordinary least squares provided acceptable test statistics under the usual assumptions.

8 An infinity of other functional forms of the relationship are possible. The simplest form was chosen in the absence of further guidance. Any hypothesized relationship between quality and advertising should be simple enough that it could reasonably be expected to reflect the behavior of consumers who have limited information about advertising expenditures. If the relationship between advertising and quality were complex, advertising would be unlikely to serve as a practical signal of brand quality.

9 For both models the regression coefficient can be defined by the general formula:

$$(XX)^{-1} X'P$$

where X in equation (2) equals:

$$X_2 = (N - Q(Q'Q)^{-1} Q'N)$$

It can be shown that this is equivalent to X in equation (1) by substituting and cancelling:

$$\begin{aligned} X_1 &= (aQ + N - aQ(Q'Q)^{-1} Q'Q - Q(Q'Q)^{-1} Q'N) \\ &= (N - Q(Q'Q)^{-1} Q'N) \\ &= X_2 \end{aligned}$$

10 Only 18 items in the sample were identified as cooperative brands. The average relative market shares of these brands was .285 compared to the all brand average of .427. The few cooperative brands in this sample may not be representative of cooperative brands in food products in general because cooperatives tend to process undifferentiated products (Combs and Marion 1984).

11 The next largest advertising expenditure is for toiletries, a product category that would seem to have much in common with food.

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