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A SIMULTANEOUS EQUATION ANALYSIS OF ADVERTISING, CONCENTRATION AND PROFITABILITY

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Nearly two decades of econometric research have been completed in testing relationships between industrial market structure and performance. Recently, a number of authors have re-examined these studies and cautioned on a number of conceptual difficulties which subject the results and interpretation of previous empirical work to question. One primary criticism of previous research has been the failure to account for the simultaneous nature of the interrelation among elements of industry structure, conduct and performance[2, 4, 5, 11, 21, 24, 27]. While the determinants of variables such as profits, advertising and concentration have been examined separately within the context of single equation models, the underlying theory suggests that these variables are more properly considered as jointly determined within a system of simultaneous equations. Under such circumstances the potential of simultaneous equation bias leads to problems regarding the interpretation of the results obtained using single equation models. In addition, it has been argued that previous empirical studies suffer due to the omission of certain critical variables from the specification of structure-performance relationships. First, the role of international trade as an element of market structure has yet to be generally incorporated into empirical studies, in spite of recent theoretical work that has demonstrated its potential importance [3, 19, 20]. A second type of omission has been the empirical neglect of inter-industry differentials in price elasticity of demand, even though theoretical analysis clearly underscores the necessity of explicity accounting for demand elasticities, before any systematic relationship between a key structure element such as concentration and performance can be inferred [6, 7, 15, 22, 23].

It is the purpose of this paper to examine the importance of the basic empirical questions raised above. A simultaneous equation model of three important structure, conduct, and performance variables (concentration, advertising intensity, and profitability) is developed and estimated. The model is further designed to incorporate and evaluate the importance of international trade considerations and differentials in price elasticities of demand in influencing industrial organization relationships. The organization of the paper is as follows: in Section I the specification problems are discussed in detail. Section II describes the theoretical and empirical model. In Section III the results of the estimation of the model, applied to the U.S. food processing sector, are presented. Finally, the general conclusions of the study are presented in Section IV.

I. SPECIFICATION PROBLEMS IN PREVIOUS STUDIES

Simultaneity in Industrial Organization Relationships

A large literature has already been accumulated utilizing single equation techniques to test industrial organization hypotheses, but recent theoretical and empirical developments indicate that relationships between market structure, conduct and performance should be cast within a simultaneous equation framework.[1] These studies suggest not only that market structure may influence conduct and performance, but at the same time, market conduct and performance are likely to feedback and influence market structure. For example, in most studies of the relationship between structure and profitability it has been customary to include some measure of advertising intensity as a structural variable. This follows the traditional hypothesis that some combination of brand loyalty induced by advertising and economies of scale in advertising, result in a product differentiation barrier to entry which allows established firms to achieve and maintain higher profit rates. The clear implication of this kind of model is that advertising intensity determines profitability [5, 9, 32]. Yet, recent theoretical work concerning optimal advertising strategy suggest causation may run the other way [24, 27]. That is, higher profit rates induce greater advertising intensity, since, ceteris paribus, the higher the profit rate per unit of sales, the more worthwhile it becomes to advertise in order to capture an additional unit of sales.

We are, therefore, confronted with two contrasting theoretical hypotheses: that advertising leads to higher profits and, in turn, high profits lead to more advertising. But once it is recognized that the direction of causation may run both ways then any correlation obtained between profits and advertising within a single equation model provides no information as to whether high advertising creates high profits, high profits lead to high advertising or both lines of causation occur simultaneously.

Similar problems of potential simultaneity exist in other industrial organization relationships such as that between advertising and industry concentration. One line of reasoning suggests that concentration stimulates advertising. This argument is based upon the presence of advertising externalities, where overall industry demand along with demand for an individual firm's product increase in response to advertising expenditures [5, 11, 27]. To the extent that these externalities exist, higher levels of concentration should generate higher levels of advertising since the larger a firm's market share, the greater the proportion of the external industry effects and hence, the benefits of advertising, the firm is likely to be able to internalize.

A second view maintains that it is advertising which leads to increased concentration [9, 14]. This conclusion is based on the existence of potentially substantial economies of scale in advertising and the possibility that advertising activity creates barriers to entry. We are, therefore, confronted with the expectation that concentration and advertising may be casually interrelated, and the difficulty of interpreting single equation correlations between the two.

The above arguments lead to the conclusion that three variables of considerable interest within the traditional structure-conduct-performance paradigm (advertising, profits and concentration) should be viewed as mutually interdependent. This implies that all three should be considered as jointly determined endogenous variables within a system of simultaneous equations, and that single equations models are inappropriate for hypotheses testing. For this reason we develop a three equation model in which profits, concentration, and advertising are considered jointly determined. The model which is specified in detail later takes the general form provided below:

(I.1) PMG = f(CR, AD, X)
(I.2) AD = f(CR, PMG, Y)
(I.3) CR = f(AD, Z)

where PMG is profitability, AD is advertising intensity, CR is seller concentration and X, Y, and Z are vectors of exogoneous variables.

Price Elasticity of Demand

In addition to the problems relating to the simultaneity in structure, conduct, and performance relationships, a number of other specification improvements have recently been suggested. One of the most important of these is the accounting for inter-industry differentials in price elasticity of demand in structure-profits equations [5, 6, 7, 22, 23].

Virtually all prior empirical studies of the relationship between market structure and profits have neglected the existence of inter-industry differentials in price elasticity of demand and the role of demand elasticity as a structural variable.[2] This omission, however, is not justified by either the underlying theoretical models, or the available empirical evidence [1, 10]. The theoretical importance of price elasticity of demand can be clarified by reference to the familar profit maximizing price-marginal cost relationship

$$\text{(I.4)} \quad \frac{P - MC}{P} = \frac{1}{n_f}$$

where n_f is the price elasticity of demand for the firm's product. If, as is commonly assumed, concentration facilitates collective action by firms and yields cartel-like pricing, then it is easy to show that the elasticity of demand for the k largest firms (n_k), and hence the profit maximizing price-marginal cost spread, depends upon the market price elasticity of demand (n_m), the share of the market controlled by the k largest firms (S_k) and the output response of rivals to the k largest firms pricing decisions (E_r). Let Q_k, Q_m, and Q_r represent the levels of the k largest firms output, market output and rivals output respectively. Then elasticity of demand facing the k largest firms is

$$(\text{I.5})\quad \eta_k = -\left(\frac{dQ_k}{dP}\right)\left(\frac{P}{Q_k}\right) = -\frac{(dQ_m - dQ_r)}{dP}\left(\frac{P}{Q_k}\right) = -\frac{dQ_m}{dP}\frac{P}{Q_k} + \frac{dQ_r}{dP}\frac{P}{Q_k}$$

If S_k and S_r represent the market shares of the k leading firms and their rivals, and E_r is defined as $\left(\frac{dQ_r}{dP}\right)\left(\frac{P}{Q_r}\right)$ then (I.5) above can be expressed as

$$(\text{I.6})\quad \eta_k = \frac{\eta_m}{S_k} + E_r\left(\frac{S_r}{S_k}\right) = \frac{\eta_m + E_r(1 - S_k)}{S_k}$$

Substituting now expression (I.6) into (I.4) we obtain the profit maximizing price-marginal cost relationship for the k largest firms[3]

$$(\text{I.7})\quad \frac{P - MC}{P} = \frac{1}{\eta_k} = \frac{S_k}{\eta_m + E_r(1 - S_k)}$$

Equation (I.7) provides a clear implication for the likely empirical relationship between measures of concentration (S_k) and profitability. Specifically, it indicates that one should not expect to isolate a systematic relationship between concentration ratios and profits, unless the market price elasticity of demand across all industries studied is identical. Since available empirical evidence would indicate this is not the case, the omission of price elasticity of demand variables in cross-section profitability studies results in improperly specified models.

Even apart from the purely theoretical model presented above, price elasticity of demand should reinforce some of the non-competitive aspects of market structure as they are conventionally measured. For example, while it is true that any firm must consider the reaction of rivals to its price cuts, the potential risk associated with price experimentation is smaller in industries with price elastic demand, since overall industry sales would be expected to significantly increase even if rivals ultimately follow suit. Thus, given the level of concentration, the degree of firm interdependence and the ability to maintain tacit price agreements is likely to be higher in industries with relatively price inelastic demand. Finally, any entry barriers attributable to economies of scale become more critical at a lower percentage of industry output, as market demand becomes more inelastic.

Thus, price elasticity of demand is a theoretically important structural variable and, particularly so, in studies of the relation between profits and concentration.

Import Competition, Exporting and Industry Profitability

Finally, recent theoretical and empirical results [3, 19, 20] indicate that improvements in specification can be realized by explicitly incorporating foreign trade variables in structure-profit models. For example, the market power usually associated with highly concentrated industries can be seriously overstated if firms in these industries face significant degrees of actual or potential import competition. In effect, import competition increases the number of firms within an industry and dilutes the degree of domestic seller concentration. Therefore, given any level of domestic concentration, prices and profits ought to be closer to competitive levels in industries facing close competition from foreign suppliers.

Exporting should also affect the performance of firms in the domestic market, but no unambiguous relationship can be theoretically derived. Caves [3] has shown that for a monopolist who is unable to price discriminate internationally, the existence of export markets can result in domestic pricing outcomes which are closer to competitive levels. He has further argued that this result is equally plausible in the context of oligopoly, since expansion into foreign markets may render sellers less conscious of their mutual interdependence in the domestic market. The implication of this argument is that given the conditions of domestic market structure such as the degree of seller concentration, those industries relying more heavily upon foreign markets for sales should experience lower profitability. This argument, however, needs modification if domestic firms are able to engage in international price discrimination. Under this condition, and assuming the likely case of a more elastic demand in the foreign market, then those industries which have expanded into export markets will experience higher rather than lower profits.

Since industries differ in respect to the importance of import competition and the extent to which they export, any empirical analysis which includes only domestic elements of market structure provides an incomplete representation of market conditions within industries.

II. THE MODEL

In this section the simultaneous equation model presented earlier (equations (I.1), (I.2) and (I.3)) is specified in detail. The price elasticity of demand and international trade variables are included along with other exogenous variables to explain concentration, profits, and advertising.

The Concentration Equation

A large number of factors have been cited as influencing the observed degree of concentration within an industry. The most prevalent hypotheses suggest that concentration depends critically upon the number of firms in the industry, optimal firm size in relation to the size of the market (i.e. the extent of economies of scale), and the degree of barriers to entry.[4] Therefore, in explaining the four-firm seller concentration ratio (CR) the first variable included in the equation was the number of firms in each industry (NF).

Since most scale economies in production are apparently obtained at the plant level, a variable measuring plant scale economies was utilized in the concentration equation (ESD). This is a dummy variable based upon the familar Commanor and Wilson [5] measure of the average plant size among the largest plants accounting for 50% of industry output divided by total industry output. Industries with scale economies above the average for the sample were assigned a value of one, while those below were assigned a value of zero. The dummy variable as opposed to the actual number was utilized in order to minimize the spurious correlation which arises between this variable and the concentration ratio.[5]

Two additional variables were included in the equation in order to account for potential barriers to entry arising from either advertising intensity or high capital requirements. The advertising intensity variable was the advertising to sales ratio (Ad/S) for each industry in the sample. The height of capital requirements (KR) was measured as the dollar value of gross fixed assets required by a plant of minimum efficient size.

The resulting concentration equation with the expected signs indicated below is explanatory variable is thus:[6]

$$\text{(II.1)} \quad CR = f_1 (\underset{+}{KR}, \underset{+}{Ad/S}, \underset{+}{ESD}, \underset{-}{NF})$$

The Profit Equation

The measure of profitability in the profit equation was the price-cost margin (PMG).[7] The choice of the margin as the profit variable was predicated upon a number of factors. First, since it approximates a rate of return on sales measure, it constitutes the profit concept which according to theory should be directly related to price elasticity of demand and advertising intensity. Moreover, it can be estimated directly from Census data at the four-digit level, thus avoiding a number of aggregration and accounting problems which arise when using either Internal Revenue Service or individual firm data.[8]

Since gross capital costs are included in the margin, it is necessary to include a variable which accounts and corrects for differences in capital intensity across industries. The capital output ratio (K/S), measured as the book value of depreciable assets divided by value of shipments, was therefore included in the equation. Recognition of mutual interdependence and/or collusion by firms in an industry should allow the achievement of higher margins. Theoretically, then, higher levels or seller concentration through either increasing the degree of interdependence or the effectiveness of collusion (i.e. reducing the cost of collusion) should result in higher profit margins. The four-firm concentration ratio (CR) was thus included in the profit equation.

An implicit assumption regarding the published concentration ratios is that markets are national in scope. A number of industries, however, are more properly classified as regional or local in nature. In order to account for differences in the geographic differences in the dimensions of some industries in a sample, a dummy variable was constructed from information presented by Schwartzmen and Bodoff [25] and Siegfried and Grawe [26] to distinguish regional and local markets. The regional dummy (RD) was constructed to take the value of one if the industry were regional or local in nature, and a value of zero other-wise.

Two market characteristics, price elasticity of demand (EL) and growth rate in output (GVS) were also included in the profit equation. Lower absolute value of demand elasticity should result in higher margins. Unfortunately estimates of demand elasticity were not available. Nonetheless, within the food processing sector, sufficient data were available to make independent estimates of demand elasticity.[9] The absolute values of the coefficents obtained from the independent estimation of elasticities were then introduced into the equation and are expected to be inversely related to margins.

Growth in output is expected to influence margins in a positive direction. Growth in output is reflective of increases in product demand, decreases in cost conditions, or some combination of the two. Reductions in cost conditions should lead directly to greater margins, while increase in demand should ultimately do likewise, via increases in product prices or reductions in unit cost due to improved capacity utilization. The growth variable was measured as the percentage change in nominal value of shipments over the six year period preceeding the year in which the margin was measured.

Maintainable profit margins should also be higher in situations where barriers to entry, attributable to either advertising intensity or scale requirements exist. The advertising to sales ratio (Ad/S) and the economies of scale dummy (ESD) variable were thus also entered into the profit equation to account for potential barriers from the above sources.

Finally, profit margins are expected to be influenced by international trade factors. To account for potential import competition and exporting activity the ratios of current imports and exports to domestic value of shipments (M/S, X/S) were included in the equation.[10]

Therefore, the resulting profit equation and expected signs are:

$$\text{(II.2)}\quad PMG = f_2\,(\underset{+}{CR},\ \underset{+}{K/S},\ \underset{+}{GVS},\ \underset{+}{Ad/S},\ \underset{-}{EL},\ \underset{+}{RD},\ \underset{+}{ESD},\ \underset{?}{X/S},\ \underset{-}{M/S})$$

The Advertising Equation

Following the work of Schmalensee [24] and Commanor and Wilson [5], the profit margin was included as a determinant of advertising intensity. If profits affect advertising in the manner the above models predict, it is expected higher margins would induce higher advertising intensity.

Seller concentration was also included in the advertising equation. It is expected that concentration should exert a positive influence upon advertising intensity because increases in market share allow firms to internalize a greater proportion of the industry-wide effects associated with advertising. Furthermore, in industries tending toward oligopoly, advertising may become the main instrument of rivalry as opposed to price competition.

The two market demand variables-growth in output and elasticity of demand were also included in the advertising equation. A positive association is expected between advertising and growth. First, rapid growth often implies the introduction of new products which, generally, are heavily advertised. Moreover, when demand is growing, profits are likely to be available to finance further marketing and advertising effort.

Since the early work of Dorfman and Steiner [8] it has been recognized that advertising should be influenced by price elasticity of demand. Their well known result for the monopoly case, implies that for any given relationship between advertising and its affect upon sales, the optimum advertising to sales ratio is inversely related to price elasticity of demand. It is difficult, however, to generalize this rule to market structures outside the pure monopoly model. For example, in cases other than monopoly, differences arise between an individual firm's demand elasticity and the market price elasticity. Low market price elasticity may or may not imply low individual firm elasticities. Compounding the issue is the fact that the marginal returns from advertising may themselves depend upon market elasticity of demand. If, for instance, market demand is already price inelastic, then the marginal returns to advertising may be low compared to cases where market demand is elastic. For these reasons, the overall direction of impact of demand elasticity on advertising cannot be determined *a priori*.

A final variable in the advertising equation was a dummy designed to distinguish consumer goods from producer goods industries (CPD). Since consumer goods appear to be more differentiable through advertising, and because advertising, as opposed to direct sales, is likely to be a more effective means of reaching potential buyers in these industries, it is expected that advertising intensity would be higher in consumer goods industries. The dummy was constructed such that consumer goods industries were assigned a value of one and producer goods industries a value of zero. Delineation of consumer and producer goods was based upon Ornstein's calculations [18] of the percentage of industry output allocated to final demand as opposed to intermediate sales.[11]

Thus, the advertising equation and expected signs are:

$$\text{(II.3)}\quad Ad/S = f_3\,(\underset{+}{CR},\ \underset{+}{PMG},\ \underset{+}{GVS},\ \underset{?}{EL},\ \underset{+}{CPD})$$

III. MODEL ESTIMATION AND RESULTS

In the three equation model presented earlier, advertising appears in both the profit margin and concentration equations, concentration in the margin and advertising equation, and margins in the advertising equation. Thus it is necessary to treat all three variables as endogeneous whose values are jointly determined in the simultaneous equation system consisting of equations (II.1), (II.2), and (II.3). Each equation in the system, according to the order condition for identifiability, is over-identified. Moreover, the accounting relationship between profit margins and advertising intensity results in contemporaneous correlation of errors across equations. Since the profit margin is measured gross of advertising, transitory variations in advertising are correlated with profit margins. Indeed, the correlation of errors across the two equations is .49. Therefore, the estimation procedure choosen was three-stage least squares (3SLS).[12]

The industry sample utilized in the estimation of the model consisted of the 47 U.S. food processing industries defined by the Census at the four-digit level of aggregration.[13] The time periods studied were the years 1967 and 1972. The food processing sector was chosen primarily due to the constraint of identifying an industry group with sufficient data to estimate price elasticities of demand. Moreover, the food processing sector distinguishes itself not only in its importance relative to total manufacturing activity, but also as an area of current public concern.

The 3SLS estimation results for 1967 and 1972 are presented in Table 1. The values in parentheses underneath each coefficient estimate are "t" values. It should be noted, of course, that the "t" values generated from the 3SLS procedure are only asymptotically valid. With this in mind, it can be seen from Table 1 that most coefficients appear statistically significant and conform in

TABLE 1 = 3SLS REGRESSION RESULTS: 1967 and 1972

(t - ratios in parentheses)

Dependent Variable	Constant	$\widehat{CR}$	K/S	KR	$\widehat{PMG}$	GVS	$\widehat{Ad/S}$	EL	RD	CPD	ESD	NF	X/S	M/S
1967														
PMG	-6.04 (.795)	.303 (2.51)	8.07 (2.08)			.085 (2.12)	2.02 (3.94)	-.111 (2.13)	4.62 (1.74)		.537 (.184)		-.107 (1.34)	.005 (.060)
Ad/S	-2.89 (1.42)	.055 (1.98)			.101 (1.88)	-.003 (.187)		.006 (.322)		1.93 (2.58)				
CR	33.91 (11.14)			2.71 (1.72)			2.44 (3.20)				13.80 (3.75)	-.006 (3.59)		
1972														
PMG	-8.89 (.928)	.418 (3.28)	5.67 (1.26)			.084 (1.82)	1.14 (1.86)	-.136 (2.44)	7.03 (2.27)		1.41 (.462)		-.181 (1.76)	-.041 (.611)
Ad/S	-4.17 (1.89)	.046 (1.60)			.102 (1.65)	.010 (.678)		.001 (.023)		2.01 (2.45)				
CR	38.40 (12.35)			2.64 (1.53)			1.78 (2.08)				13.99 (3.60)	-.010 (4.17)		

sign to theoretical expectation. Since the results for 1967 and 1972 are similar, the interpretation of the results will be limited to the 1967 estimates.[14]

The results from the estimated model give considerable support to the hypothesized interrelationships and feedback effects between margins, concentration and advertising. For example, the results indicate that advertising intensity does exert a significant affect upon profit margins, but at the same time higher margins are seen to feedback and exert a statistically significant impact on advertising intensity. Similarly, concentration displays a statistically significant effect on both profit margins and advertising intensity, while higher advertising intensity results in significantly higher levels of concentration. The value of the advertising coefficient in the margin equation is of particular interest. Since advertising expenditures are included in the gross margin , one would expect that the coefficient for the advertising to sales ratio should approach one, even if advertising yielded no barrier effect. The value of the advertising coefficient turns out to be 2.02 and is greater than one by slightly more than two standard errors. Taking this result in conjunction with the already noted significant effect of advertising on concentration, suggests that high advertising intensity, at least within the food processing sector, does act as a barrier to entry. This result is in accordance with that found by the FTC in a much earlier study of the food sector [9], and lends further support to the importance of advertising and product differentiation in affecting concentration in consumer goods industries as suggested by Mueller and Hamm [14].

Viewing each equation independently also yields some interesting results. Looking first at the margin equation, the most striking finding is the significance of the market price elasticity of demand in affecting margins. Price elasticity is, therefore, found to be an important structural variable affecting inter-industry differentials in price-cost margins. The value of the estimated coefficient for the elasticity variable implies that roughly a 10% decrease in demand elasticity is associated ceteris paribus, with 1% increase in profit margins. The concentration ratio, growth in demand, capital intensity, and the regional market dummy also are significant in the profit equation and display the expected signs.

The inclusion of the foreign trade variables, however, did not seem to add much in the profit equation. The import share variable, for example, is not significant and displays an unexpected positive sign. Contrary to results obtained in other studies of manufacturing industries, this suggest that import competition has had little impact in affecting profitability of domestic firms. The differing results found here probably reflect some special aspects of the U.S. food processing sector. Many industries within the sector, for instance, are highly protected via tariffs, quotas, and government inspection standards [33]. Thus, in many of the industries virtually no imports entered at all which apparently rendered import competition ineffectual in influencing domestic profits.[15] The results for the export share variable were slightly better. The exporting variable displays a negative sign and is marginally significant via a one-tail test. Thus, some limited support is provided to Caves' conjecture, that expansion into export markets results in more competitive outcomes in the domestic market.

With regard to the advertising equation, again most of the variables are significant and have coefficients with appropriate signs. Advertising intensity is seen to increase in response to higher profit margins as predicted by Schmalensee [24]. Since profit margins are measured gross of advertising, the coefficient on the margin variable should not be interpreted as suggesting that 10 cents on every dollar of net profits (profits minus advertising expenditures) is allocated to advertising. Rather, since the average advertising to sales ratio for the sample is approximately 2.9 percent, a more accurate interpretation would be that an increase in net profits of $1 is associated with an increase in advertising of about 7 cents.

The coefficient for the concentration ratio was positive and significant suggesting that increases in industry concentration do result in greater advertising intensity. Also, as expected advertising intensity was found to be greater in consumer as opposed to producer goods industries. Finally, neither growth in demand, nor market price elasticity, had a significant influence upon advertising.

The last estimated relationship of the model was the concentration equation. All variables in the equation are statistically significant and have the hypothesized signs. As expected concentration is found to be inversely related to the number of firms in the industry. Higher levels of advertising intensity lead to higher levels of concentration. Evaluated at mean values, the coefficient for the advertising to sales ratio suggests that a 10 percent increase in advertising intensity is associated with approximately a 1.6 percent increase in concentration. Finally, concentration is found to be positively influenced by plant economies of scale and capital requirements. Various sources of barriers to entry are thus seen to be important in determining the level of industry seller concentration.

IV. CONCLUSIONS

Previous empirical studies of industrial organization have tended to ignore the simultaneous nature of the relationships between profitability, advertising and industry concentration. This study has taken explicit account of this simultaneity by specifying and estimating a simultaneous equation model of profits, advertising, and concentration. The model was estimated via three stage least squares utilizing data for the U.S. food processing sector for the years 1967 and 1972. In addition, the econometric model was designed to include the often omitted structural variables of price elasticity of demand and international trade.

Several conclusions emerge from the study. The results of the statistical estimation of the model indicate that, within U.S. food processing industries, seller concentration is an important structural variable in affecting both the profitability and advertising intensity of industries. Further, advertising intensity apparently does constitute a barrier to entry which yields both higher profits and higher levels of industry concentration. At the same time, higher profits and concentration seem to feedback and generate higher degrees of advertising intensity.

The results for the foreign trade variables indicate the limited role of international trade in influencing the competitive conditions in the U.S. food processing sector. Import competition appeared not to be sufficiently strong to affect industry profitability. Some evidence did surface, however, that expansion of markets through exporting has lead to more competitive domestic results. Finally, the results concerning market price elasticity of demand confirmed the theoretical importance of this variable as an element of market structure.

In general, our results suggest that further analysis of the structure conduct performance relationship should be couched in terms of a simultaneous equation framework, and further effort should be made in analyzing the role of international trade and variations in demand elasticities for more comprehensive industry samples.

FOOTNOTES

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1. A comprehensive survey of profitability studies can be found in Weiss [32]. For summaries of studies concerning the determinants of advertising and concentration see: Ornstein [17, 18].

2. A notable exception is Comanor and Wilson [5].

3. For a similar proof see: Saving [23] and Cowling [6, 7].

4. An excellent survey of the various theories of the determinants of concentration can be found in Ornstein, et al, [17].

5. The Commanor-Wilson measure of efficient plant size can be calculated as .5 times the reciprocal of the number of largest plants required to account for one half of industry output. It is thus highly correlated with levels of plant concentration. Since plant concentration is highly correlated with firm concentration, even in situations where little or no variations exist in relative scale economies,some spurious correlation occurs between concentration and minimum efficient plant size.

6. The data used to calculate concentration, number of firms and plant economies of scale were obtained from the Census of Manufactures [30]. Gross fixed value of capital was obtained from the Annual Survey of Manufactures. Finally, the advertising to sales ratios are those presented by Ornstein [18] which are calculated from the U.S. Input-Output tables at the four-digit level of aggregration.

7. From Census data the margin is calculated as: $\frac{\text{value added - payroll - rentals}}{\text{value of shipments}}$

8. The merits of the price-cost margin as opposed to other profit measures are more thoroughly discussed by Weiss [32]. The severity of the aggregration problem on food processing industries is discussed in Imel and Helmberger [12].

9. The variable denoting price elasticity of demand was obtained from regression estimates of demand equations for the industries in our sample. For each industry category a consumer demand equation was estimated using annual data for the 1952-75 period. The only exceptions were the chewing gum (1957-75) and soft drink (1960-75) industries where only a smaller sample was available. The general equation estimated was:

$$Q^i = a_0 + a_1 P^i + a_2 Y$$

where:

Q^i = an index of per capita consumption of goods in industry i (1967=100)
P^i = an index of retail prices for goods in industry i deflated by the retail food price index (1967=100)
Y = an index of disposable personal income per capita deflated by the implicit GNP deflator (1967=100)

The estimated value of the price elasticity of demand was calculated as $EL^i = \hat{a}_1 (\bar{p}^i/\bar{Q}^i)$, where $\bar{P}^i$ and $\bar{Q}^i$ are the mean values of the two variables.

Data for the above variables were obtained from various Department of Agriculture [28] and Department of Labor [31] publications. Our estimates of demand elasticity were compared to estimates calculated by Brandow [1] and George and King [10]. While their estimates for a number of cases did not conform to our industry classification, the general impression is that our own results are very similar to theirs.

10. The values for import and export shares were obtained from [29]. A more complete discussion of alternative measures of import competition and exporting intensity are provided by Pagoulatos and Sorensen [19, 20].

11. Utilizing data from the U.S. Input-Output Table, Ornstein considers industries which allocate 50% or more of their output to final demand to constitute consumer goods, while those allocating less than 50% to be producer type goods.

12. While two-stage least squares could provide consistent parameter estimates, the existence of contemporaneous correlation of errors across equations renders the two-stage estimates inefficient. Improvements in efficiency can be achieved under these circumstances with the three stage procedure. For example, see Zellner and Their [34] and Madansky [13].

13. The industries included in this study (with the 1972 S.I.C. number in parenthesis) are: 1) Meatpacking (2011); 2) Sausages and other prepared meats (2013); 3) Poultry dressing (2016, 2017); 4) Creamery Butter (2021); 5) Cheese (2022); 6) Condensed and evaporated milk (2023); 7) Ice cream and ices (2024); 8) Fluid milk (2026); 9) Canned specialities (2032); 10) Canned fruits and vegetables (2033); 11) Dried and dehydrated fruits and vegetables (2034); 12) Pickles, sauces and salad dressings (2035); 13) Frozen fruits, vegetables, and juices (2037, 2038); 14) Flour and other grain mill products (2041); 15) Cereal breakfast foods (2043); 16) Milled rice and byproducts (2044); 17) Blended and prepared flour (2045); 18) Wet corn milling (2046); 19) Pet food (2047); 20) Prepared feeds (2048); 21) Bread and bakery products (2051); 22) Cookies and crackers (2052); 23) Raw Cane sugar (2061); 24) Sugar refining (2062, 2063); 25) Confectionery products (2065); 26) Chocolate and cocoa products (2066); 27) Chewing gum (2067); 28) Cottonseed oil mills (2074); 29) soybean oil mills (2075); 30) vegetable

oil mills (2076); 31) Animal and marine fats and oils (2077); 32) Shortening, table oils and margarine (2079); 33) Malt beverages (2082); 34) Malt (2083); 35) Wines, brandy and brandy spirits (2084); 36) Distilled liquor (2085); 37) Soft drinks (2086); 38) Flavoring extracts and syrups (2087); 39) Canned and cured seafood (2091); 40) Fresh or frozen packaged fish (2092); 41) Roasted coffee (2095); 42) Manufactured ice (2097); 43) Macaroni products (2098); 44) Cigarettes (2111); 45) Cigars (2121); 46) Chewing and smoking tobacco and snuff (2131); 47) Tobacco stemming and redrying (2141).

14. Because advertising values are not yet available for 1972, the 1967 figures were used in both years estimation.

15. Our finding conforms to the results of a number of studies done for specific industries within the food processing sector, such as Novakovic and Thompson [16].

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