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CAUSALITY AND THE CONCENTRATION PROFITS CONTROVERSY

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ABSTRACT

Interindustry, cross-sectional studies of concentration and profitability assume, according to the market power doctrine, that concentration is an exogeneous variable, though this notion has been questioned at different times by a number of industrial organization economists. This study uses a time series approach to test the correctness of the conventional notion that market share determines profitability of an individual firm. Sims' causality tests were performed for three separate firms and the interrelationships over time between the firm's market share and rate of return were estimated (i.e., do changes in a firm's market share occur prior to changes in the firm's rate of return or do changes in the firm's rate of return occur prior to changes in a firm's market share). Two of the three firms examined failed to exhibit the unidirectional causality assumed by the conventional structure-performance paradigm. These results suggest that the cross-section, interindustry approach often uses industries as cases, which are aggregated from firms wherein the direction of causality of the profitability variable cannot be assumed.

I. Introduction

Interindustry, cross-sectional estimation of structure-performance relationships assumes, according to the market power doctrine, that concentration is an exogeneous variable, while industry profitability is not. This notion has been questioned at different times by a number of industrial organization economists. According to Bothwell, Cooley, and Hall (1984, p. 399), one of the three basic controversies involved in the discussion of the empirical estimation of the concentration-profits relationship is the exogeneity of the measures of market structure (or firm characteristics) with respect to profitability. Similarly, Domsimoni, Geroski, and Jacquemin (1984, p. 421) consider the crucial issue in forging a statistical link between structure and performance to be the direction of causality between the two. Plott (1982) has provided a survey of experimental approaches in establishing the conduct link between structure and performance. Another approach by Scherer (1980) discusses extensive case study examples of the impact of structure on inter-firm cooperation.

The common element in the estimation of the structure and performance hypotheses is that cross section comparisons are made at a point in time. This may be sufficient to establish a short-term, cross-sectional relationship, but a procompetition policy should be based upon a long-term, persistent monopoly problem in an industry. As Demsetz (1974, p. 166) has argued, the monopoly model assumes monopoly power exists, but it does not explain how it was acquired or maintained, and oligopoly models do not deal with the problem of colluding oligopolists maintaining their position in the face of actual and potential entry. If persistent monopoly power exists, its existence should be proven on the basis of persistent factors operating over periods of time sufficient to prevent the requisite entry from occurring.

In the past a number of investigators have looked at the determinants of changes in concentration using various functional forms. Kamershen (1968),

Shepherd (1964), and Nelson (1960) measured the impact of growth (measured as changes in shipments) and other determining variables to explain changes in concentration for various census periods and various classes of industries. Similarly, Mueller and Rogers (1980 and 1984) have examined the impact of advertising and other variables on changing concentration levels. In these early studies questions were raised concerning the joint determination of the structure and performance variables. William Shepherd [17, p. 27] utilized a time series approach in order to explain changes in market share using the initial level of rate of return, market share, sales intensity, size, and lagged levels in rate of return. Besides formulating a model where the change in market share is the dependent variable, this functional form was explicitly used to test a "declining dominant firm hypothesis." That is, leading firms may sacrifice their market shares over time as a long run profit maximizing strategy, and correspondingly, large firms may seek higher market shares at the expense of current profitability. These hypotheses posit a negative coefficient on lagged profitability to explain changes in firm market share. The empirical evidence, though not particularly strong, indicated a positive sign, which approximates the classical hypothesis.

More recent studies have utilized data collected over time for one firm or industry rather than using cross-secton data collected from two time periods. Caves and Porter (1980) and Mueller and Rogers (1980) attempted to observe fundamental causal relationships which could explain changes in concentration using lagged independent variables. Cave's and Porter's results were distinctly poorer than those using unlagged variables, they argued, because the cross section studies used variables which were related to concentration through identities. They strongly suggested that the robust looking unlagged results may reveal little about causal relations and that a careful look at time series modeling of the changing structure of individual industries would be more revealing.

In addition, several recent studies also indicate that cross-section, interindustry studies often contain industries which are not strictly comparable. David T. Levy (1984) estimated a pooled model similar to the Comanor and Wilson's cross-section model which utilizes the usual multiple regression, structure-performance specification. He demonstrated a non-homogeneous, concentration-profit relationship across industries. Similarly, Dennis Mueller (1977) showed that interindustry differences in profits are persistent over the long run--unlike the prediction that competition would cause rates of return across industries to converge toward the competitive level. These studies suggest that aggregation problems at the industry level may compromise the results of cross-section, structure-performance studies. By the same argument, it is possible that the aggregation of firms exhibiting conflicting causalities into industries may also lead to non-comparability between industries. This observation is supported by recent evidence of Raab and Wong (1985). Using pooled time series and cross sectional data, Raab and Wong found a bidirectional or jointly interdependent relationship between concentration and price-cost margins for a smaple of 41 industries. Inasmuch as the observed causality at the industry level represents the composite causal relationships between individual firms making up the industry, the causal relationships at the firm level could either be bidirectional or unidirectional in opposite directions. The next logical step to investigate the concentration-profitability controversy would be to examine the causal relationships at the firm level.

In this study we propose to perform causality tests for several selected individual firms, and the interrelationship between the firm's market share and its price-cost margins are measured to test whether changes in market share occur prior to changes in the firm's price-cost margins, or whether changes in price-cost margins occur prior to changes in firm market share. If bidirectional relationships occur, or if unidirectional relationships occur from the

price-cost margin to market share, then the conventional, interindustry concentration-profits study will contain industries aggregated from firms wherein causality between structure and performance measures cannot be assumed.

II. Methodology

The methodology employed is to determine whether selected individual firms exhibit market share changes prior to changes in the rate of return and/or vice versa. If the former relationship holds, but not the latter, then profitability could not be causing changes in market share. If the latter relationship holds, but not the former, then market share changes could not be causing changes in profitability. The Sims' Causality Test [14] is used to determine the directionality of these two variables.

The Sims' Causality Test can be represented by the following expressions:

$$X_t = \alpha + \sum_{i=-p}^{n} \beta_i Y_{t-i} + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Y_t = \sigma + \sum_{j=-p}^{n} \delta_j X_{t-j} + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where α and σ are constants, β_i and δ_j are coefficients on Y_{t-i} and X_{t-j} and e_t and u_t are white noise disturbance terms. A unidirectional causal relationship running from X to Y is established if $\Sigma\beta_i$ with $i < 0$ is significant while $\Sigma\delta_j$ with $j < 0$ is not significant. A unidirectional relationship going from Y to X is established if the reverse is true. A bidirectional relationship holds if both $\Sigma\beta_i$ and $\Sigma\delta_j$ with $i < 0$ and $j < 0$ are significant. However, in order to implement the Sims' test, two conditions must be satisfied. First, the original data series must be prefiltered to remove serial correlation and, second, the numbers of leads (p) and lags (n) for expressions (1) and (2) must

be pre-selected. For the removal of serial correlation, Sims suggests the filter $(1-kL)^2$ where L is the backshift operator and k takes the value of 0.75. There is no guarantee, however, that this particular k value is the most appropriate for our sample.

As suggested by Nerlove [10], a search procedure should be implemented over a range of possible k values $0 < k < 1$. For each k, an OLS is performed on the filtered series to obtain the least square residuals. An autoregression is then performed on the OLS residuals to test for serial correlation. If the second order filter fails to provide the proper k value, this process is continued with the 3rd order filtering $(1-kL)^3$ and so forth until a k is obtained which removes significant amounts of serial correlation from the original series.

Various methods have been proposed in the literature for selecting the appropriate periods of leads and lags for the test. Evidence available thus far seems to indicate that the test results are not invariant with respect to the methodology of lead/lag selection. To ensure consistency in our test, we follow Thornton and Batten (1985) by examining all possible lead/lag combinations relevant to our sample. In our application of the Sims test, we performed the test procedure on all relevant lead/lag specifications and obtained the same direction of causality over all specifications.

III. Data and Results

To implement the test we searched for undiversified and publicly owned firms from well-established relevant markets. A large number of firms from cereals, sugar refining, and tobacco industries were examined. Because practically all dominant firms are diversified, we could only analyze a small number of such firms. Dominant, or the largest, firms initially were sought because

they comprise the group of firms for which a concentration measure is computed. Undiversified firms were utilized because the relationship between the weighted average of shares across markets (showing little variation over time) with the weighted average of profitability across markets (showing a lot of variation over time) would be highly imprecise.

Market share (MS) was calculated from Census of Manufacturers' annual industry sales and the firm's sales from Moody's Industrial Manual for the years (1949-82). The profit margin (PM), defined as net income over sales, was also computed from Moody's on an annual basis. Although perhaps other more theoretically valid measures of economic rents such as Tobin's Q might be preferable, it is difficult or impossible to calculate on a time series basis. The results of the estimations for the three firms, Michigan Sugar Company, Kellogg's, and American Brands, are shown below.

Table 1

Company	Lag Form	k (second order filtering)	PM on MS (F-ratio)	MS on PM (F-ratio)
Michigan Sugar Co.	2 future 2 past	.3	3.815*	2.437
Kellogg Co.**	3 future 3 past	.9(MS) and .3(PM)	1.771	3.246*
American Brands**	3 future 3 past	.10(MS) and .12(PM)	0.940	0.810

* Significant at 5 percent level. All others were not significant.

** Autocorrelation of residuals eliminated to below the 10 percent level by taking logged first difference and filtering.

Table 1 summarizes the F-ratio of future values for various lag specifications. For Kellogg and American Brands logged first differences and filtering were

required to reduce autocorrelation of the residuals to insignificant levels. The results indicate unicausality from profit margins to market share for Michigan Sugar Company. This company was ranked in the 6th place for beet sugar sales and 14th place for the combined beet and cane sugar sales in the late 1970's. Total combined beet and can sugar sales were utilized in the calculation of market share.

For the Kellogg Company unicausality was observed from market share to profit margins. Kellogg's, the dominant firm in the cereal industry, has almost double the sales of the next competitor, General Mills. American Brands (American Tobacco) exhibited no causality in either direction. The company, however, had engaged in some diversification after 1969 and profits and sales were prorated accordingly.

The results from Table 1, which indicate that unicausality may flow from either direction or causality may not be present at all, support the observation that cross section studies are often aggregating heterogeneous firms. That is, the role of the dependent variable may vary for firms in the same industry. It is also possible, though not demonstrated here, that even single firms may be non-comparable in an intra-industry, structure-performance analysis since the exogeneity of the independent variable is in question. It is evident, however, that the correct specification and measurement of the structure-performance paradigm requires a great deal more of firm level information than past researchers have been willing to admit. Certainly the current aggregation of firms into an industry to estimate various functional forms of the concentration-profits model require that the causality issue be settled prior to estimation of the functional form of the model. Hopefully, these results suggest the usefulness of time series, as opposed to cross-section data in statistical approaches to the testing of the concentration-profits controversy.

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