VERTICAL INTEGRATION AND MARKET POWER*

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DISCLAIMER

VERTICAL INTEGRATION AND MARKET POWER

ABSTRACT

One of the continuing debates of industrial organization surrounds the importance of market structure in determining a firm's performance. This controversy develops naturally from the difficulties in measuring the relevant variables and the hazards of statistical analysis. The focus of this empirical study is the relationship between vertical integration, as an element of market structure, and market power, as a component of a firm's performance.

The model presented in this paper differs from previous efforts because vertical integration is measured by the Vertical Industry Connections (VIC) index. VIC is defined as a function of the relative net interactions among the industries in which a firm operates and is calculated using the national input-output tables.

A linear regression model is estimated using a random sample of firms selected from the Standard and Poor's COMPUSTAT data base for 1963, 1967 and 1972. Combined cross-sectional, time-series methods are employed. The dependend variable is the price-cost margin; the independent variables include not only VIC, but also the concentration ratio, diversification index, value of assets, capital-output ratio and sales growth.

The results indicate that VIC is significant in increasing the price-cost margin, supporting the hypothesis that vertical integration is a strategy to enhance market power.

VERTICAL INTEGRATION AND MARKET POWER

1. INTRODUCTION

One of the continuing controversies of industrial organization surrounds the importance of market structure in determining a firm's performance. The debate develops naturally from the difficulties of measuring the relevant variables and the hazards of statistical analysis.

The focus of this empirical study is the relationship between vertical integration, measured by the Vertical Industry Connections index (VIC), and the price-cost margin. It is hypothesized that the larger the value of VIC, the greater will be the firm's ability to set price above marginal cost. In other words, firms actively pursuing vertical integration across industries are postulated to thereby acquire market power. A long list of economists have developed strong theoretical arguments for such a hypothesis.[1]

The next section presents a model which links market structure and performance. Section 3 presents the estimated coefficients using a data set of 361 firms from the COMPUSTAT tapes for the years 1963, 1967 and 1972. The final section includes some concluding remarks.

2. VERTICAL STRUCTURE AND PERFORMANCE

The model used to examine the market-power hypothesis must include the variables expected to influence the price-cost margin. By extending the analysis beyond simple correlation, one can attempt to see the impact of structure on performance after accounting for the impact of other forces. A simple, linear model is assumed to best reflect the relationship between the variables. As Fig. 1 shows, the price-cost margin is assumed to be a function of concentration, vertical industry connections, diversification, the value of assets, the firm's sales relative to its industry, the firm's capital-output ratio and its growth in sales.

Price-Cost Margin

The price-cost margin can be used to measure performance. The margin is defined as the ratio of price minus marginal cost over price. Lerner (1934) suggested that this measurement is the best indicator of the existence of monopoly power. It is a simple exercise to show that the price-cost margin is equal to the negative of the reciprocal of demand elasticity.

As Rothschild (1942) explains, this variable has a stronger theoretical foundation than profitability as a measurement of monopoly power. Under competition, the firm faces a perfectly elastic demand function. The distinguishing characteristic of the firm operating under imperfect competition is that such a firm observes a sloping demand curve. As the firm increases its market power, the elasticity observed by the firm approaches that of the industry. A monopoly is the extreme; the firm and the industry are the same, and so is their observed demand elasticity.

The Lerner index reflects monopoly by measuring the variation in elasticity. Under perfect competition, demand elasticity is infinite, price is equal to marginal cost, and the price-cost margin is therefore equal to zero. An increase in the value of the margin corresponds to a decrease in the elasticity of demand. As the difference between price and marginal cost increases relative to the price, the firm can circumvent the disciplines of competition.

By assuming that demand schedules are curvilinear and that elasticity is not a function of quantity, comparisons can be made between firms and across time. Firms with identical demand functions will have identical price-cost margins.

The assumption of constant elasticity of demand is a modest contention. There is no special reason to assume that demand functions are linear; such an assumption is usually made for mathematical simplicity. A less heroic assumption would be that the demand curves of firms have constant elasticity over some relevant range of short-run production: from the quantity at which price is

equal to average variable cost to output capacity. The price-cost margin thereby reflects the amount of monopoly power in force at a given point in time.

The focus of this study is on the firm, and the price-cost margin is calculated at the firm level. It is assumed that the only fixed costs are capital costs. The fixed cost of physical capital is depreciation; and the fixed cost of investment capital is interest expense. Therefore, the price-cost margin is estimated as the ratio of net income after taxes plus depreciation plus interest expense over sales.

The price-cost margin represents a dimension of market power; it does not give the whole story. At least its measurement is consistent because profit, sales, and fixed costs are measured in current dollars. It has a theoretical foundation,[2] but one must interpret the results in terms of the assumptions of the underlying model: static profit maximization, constant elasticity of demand, and the absence of monopsony power.

Concentration

Much of the literature in industrial organization has focused on the relationship between horizontal concentration and performance. Alternate measures of concentration include: concentration ratios, the Herfindahl index, a Gini coefficient which gives the area under the concentration curve for the largest x-number of firms, and the number of firms that account for a fixed percentage of an industry's size.[3]

The various forms of the concentration ratio describe some aspects of the number of sellers in an industry, but do not capture all of the information about the market, as the Herfindahl index attempts to do. The concentration ratio measures the percentage of total industry shipments (or assets, or value added, or employment, or physical output) contributed by the top x-number of

firms, ranked according to their market shares.[4] The four-firm concentration ratio, based upon the value of shipments, can be the same for two industries while there are large differences in the number of firms which share the remainder of the market. Bailey and Boyle (1971) have reported that the four-firm concentration ratio is highly correlated with the Herfindahl Index. Such a close relationship between the two indicates that there is not much loss of information when one uses the concentration ratio.

In order to construct concentration ratios for the broader industry definitions, weighted average is used, the weights based on relative shipments.

A firm is classified as being a member of industry A if a majority of the firm's sales are in that industry. This classification corresponds with that given on the COMPUSTAT tapes. The use of the broader categories lessens the burden of classification because the industry definitions are so much easier to distinguish from each other. It is also consistent with the calculation of the other market-structure variables. However, it tends to understate the contribution of the concentration ratio because the broader industry may include products that are not effective substitutes for the buyer.

It is hypothesized that the higher the level of the concentration ratio, the greater will be the price-cost margin. This hypothesis has been upheld by several studies, including that by Weiss (1974), Kwoka (1977), Collins and Preston (1968), Imel and Helmberger (1971), and Rhoades (1973). However, these investigations have examined the relationship between concentration ratios and industries' price-cost margins. One can expect a difference in the results of this test using data on the firm.

Vertical Industry Connections

Through control of operations in several vertically connected industries, it is hypothesized that the firm can lower its costs. Therefore, the price-cost margin should also be a function of the Vertical Industry Connection index, VIC.[5]

VIC is calculated using the matrix framework of the Leontief (1951) model. A pair of matrices is defined for each firm according to the firm's product line. The index is then a synthesis of these matrices — a distillation of the information of two dimensions into a single point. The detail of the inter-industry relationships is lost, of course, but the resulting summary reasonably represents the connections.

The Leontief framework is manipulated to form the foundation of the index. Two matrices are created: A is a matrix of relative net inputs, and B is a matrix of relative net outputs.

Each element of matrix A, a_{ij}, shows the percentage of the value of industry j's net output contributed by industry i. In matrix notation:

$$A = I - [x_{ij}/(z_j - x_{jj})] + [y_{ij}]$$

where I = identity matrix, r x r

x_{ij} = the value of the ith industry's output used as an input to the jth industry; i,j = 1,...,r

z_j = total value of the output of industry j; j = 1,...,r

y_{ij} = $\{x_{ii}/(z_i - x_{ii})$ if i=j; 0 if i≠j; i,j = 1,...,r$\}$

The focus here is on net output. The more an industry produces for its own consumption reflects internal consumption rather than vertical integration. Inputs are negative as values used in production; outputs are positive.

The linkages between industries are expressed not only in the distribution of an industry's inputs, but also in the allocation of its outputs. Each element of matrix B, b_{ij}, is the percentage of the value of industry i's output used as an input to industry j:

$$B = [x_{ij}/(z_i - x_{ii})] - [y_{ij}] - I$$

Each firm is characterized by two matrices, C and D. These matrices are constructed using the rows and columns of matrices A and B, respectively, that correspond to the industries in which the firm produces output:

$$c_{ij} = a_{s(i)s(j)}$$

$$d_{ij} = b_{s(i)s(j)}$$

where $s(i)$ = one of the industries in which firm k operates, indexed by i; $i = 1,\ldots,n$ $(n \leq r)$

c_{ij} = the percentage of the value of industry s(j)'s net output contributed by industry s(i); $i,j = 1,\ldots,n$

d_{ij} = the percentage of the value of industry s(i)'s net output used as an input to industry s(j); $i,j = 1,\ldots,n$

As a practical matter, the designation of s(i) for each firm depends upon industry definitions. Classification of products into industries requires a balance between combining those that are close substitutes in use, such as glass and plastic bottles, or in production technology, such as men and women's clothing, and separating those that have unique characteristics, such as steel and plastic pipe. Therefore, the decision as to how to partition industries tends to be somewhat arbitrary. Once the industry structure has been established, however, the interrelationships among these industries can be described by c_{ij} and d_{ij}.

Using matrix notation and letting T represent the transpose of a vector, VIC for firm k can be defined as:

$$VIC_k = 1 - \left[1/\Pi_{i=1}^{i=n} (C^i)^T (C^i)(D_i)^T (D_i) \right]$$

where n = the number of industries in which firm k operates

C^i = column i of firm k's input matrix

D_i = row i of firm k's output matrix

The index is a function of the relative contribution of the firm's inputs and outputs to the industrial production process. It incorporates the square of each column of the input matrix and the square of each row of the output matrix.

In order to calculate VIC, one must obtain an estimate of the Leontief model. An input-output matrix for the United States is published by the Bureau of Economic Analysis (BEA) of the Department of Commerce. The matrix is based on a seventy-seven industry classification scheme. The values of VIC will be different using this level of disaggregation than it would be using a four-hundred industry input-output matrix. In addition to industries, BEA also includes governments, imports and dummy industries in their matrix. The input-output tables are available for the years 1947, 1958, 1963, 1967 and 1972.

Moody's Industrial Manual was used to classify the industries in which a firm operates. The written product descriptions are coded using the four-digit Standard Industrial Classification scheme for the year corresponding to the description. The product categories are then aggregated into the BEA industry classification. For a detailed example of how VIC is calculated, see Maddigan (1979).

One can construct several variations of the Vertical Industry Connections index depending on one's definition of industry linkages. This paper will consider only the primary industry linkages; that is, VIC Direct includes only those industries in which the firm operates through 100% ownership control.

In addition to reflecting the ability to reduce costs, VIC may also reflect the existence of barriers to entry. If a vertically-integrated firm has lower costs,

then it may be necessary for a successful competitor to enter at more than one level. Such entry may be more difficult because of problems newcomers may have in obtaining large amounts of investment capital.[6] Therefore, vertical integration may be a strategy to prevent successful entry.

Both of these hypothesis, the first suggesting cost-reduction and the second postulating the creation of barriers to entry, lead to the expectation of a positive relationship between the price-cost margin and VIC.

Diversification Index

It has been hypothesized that conglomerate firms are able to cut costs through easier access to credit markets and through lower advertising expenses because of volume discounts.[7] There are also arguments over whether there are diseconomies associated with one firm operating in several industries.

A measurement of the "conglomerateness" of the firm is the third element of structure to be included in the model.

The diversification index, DIV, is a count of the number of industries in which the firm operates. Honeycutt and Zimmerman (1976) compare this simple measurement with some of the more complicated indices. They find that the indices are highly correlated. As the industries are more broadly defined, the differences between the measures become even less important. Therefore, DIV can be considered to be a reliable indicator of diversification. It is "robust" in the sense that it is a dependable proxy for alternative, more complicated measures of diversification.

Honeycutt and Zimmerman (1976) show a negative, non-significant, relationship between profitability and the count of the number of industries in which the firm operates. Because of the hypothesized conflicting forces associated with increasing diversification, it is not possible to predict the expected sign of the relationship between the price-cost margin and the diversification index.

Value of Assets

Baumol (1967) has suggested that the larger the size of the firm, the higher should be the firm's profit. He postulates that large firms can invest in a greater range of projects than smaller firms because they can afford to invest on a grander scale. Since the price-cost margin is a function of profitability, the possible effect of assets on the ratio must be considered.

Assets are measured using their book value. Unfortunately, the book value of assets diverges from the economic value due to inflation and arbitrary accounting practices. However, the book value gives a rough proxy for relative capitalization.

Hall and Weiss (1967) and Winn (1975) find that the larger the firm's assets, the larger the firm's rate of return on assets.[8] A similar relationship is expected relating the price-cost margin to assets.

Relative Sales Ratio

A Chamberlin (1956) shows, firms with larger market shares can be expected to have relatively less elastic demand. For example, Scherer (1971) explains that when marginal costs are increasing, firms selling differentiated products will charge a lower price when they hold a lower market share, *ceteris paribus*. Therefore, one would expect the price-cost margin to be positively correlated with market share.

Unfortunately, market-share data is very difficult to obtain. A rough proxy for this variable is the firm's sales divided by the total sales in the industry in which the majority of that firm's sales were made.[9] Obviously, since most firms operate in more than one industry, this ratio will tend to overstate the firm's contribution. However, since the industries of this study are defined

using 51 highly-aggregated manufacturing categories developed by the Bureau of Economic Analysis, the distortion will tend to be less severe. The aggregation will result in a larger percentage of the firm's output being defined as a part of one of the industries.

Capital-Output Ratio

The price-cost margin includes the cost of capital as a fixed cost. However, one would expect profitability to reflect the normal return to capital. A firm that was relatively more capital intensive should have a higher profitability to compensate investors for their investment, *ceteris paribus*. Therefore, one would expect the capital-to-sales ratio to be positively correlated with the price-cost margin.

Collins and Preston (1968) and Weiss (1974) find that the capital-output ratio is significant in predicting the price-cost margin, and has a positive coefficient. There is conflicting evidence, however. Winn (1975) finds a significant negative relationship.

Winn (1975) interprets the capital-output ratio as a possible performance variable. He postulates that large, oligopolistic firms are under less competitive pressure and can employ production processes which make inefficient use of capital. Such a theory explains the negative relationship between profitability and the ratio of assets to sales. When viewing the capital-output ratio as a structural variable, Winn sees it as "a proxy for an absolute-capital-requirement barrier-to-entry variable and the degree of vertical integration."[10] Since the value of assets and the Vertical Industry Connection index are used to measure these effects, the model explores whether the capital-output ratio has any additional effect on the price-cost margin.

Sales Growth

It is possible that the value of the price-cost margin for any given year represents a temporary disequilibrium. In an attempt to adjust for possible short-run variations in costs, an industry growth variable is added to the equation.[11] In this formulation, growth is the average percentage change in the firm's sales over the previous five years.

A rapidly growing firm is expected to be able to earn a higher profit. As sales increase, the optimal scale of operation also increases. If there are economies of scale to be realized, the firm will find that its marginal costs may go down. It may take longer for there to be new entry to drive down the price. Therefore, the growing firm may earn excess profit for a while. Similarly, with contracting sales, the firm may see its costs rising because of less-than-capacity utilization of facilities. The gap between price and marginal cost could decline. Another point is that if the growing firm is increasing its market share, it may be able to increase the price of its differentiated product. One would expect a positive relationship between sales growth and the price-cost margin.

Industry Dummy Variables

It may be that firms in the same industries will tend to face similar environments which will affect the price-cost margin in the same way, either negatively or positively. The industry dummy variables are an attempt to account for these forces, without specifically enumerating them. Each firm is considered to be in the industry in which it sells the majority of its output; the corresponding industry dummy is equal to one. The other fifty dummy variables are equal to zero.

Other Variables Not Included

Other authors have suggested that alternate variables should be included in a model relating structure and performance. For example, Bain (1956) has suggested

dummy variables to reflect the existence of barriers to entry. Weiss (1974), and Imel and Helmberger (1971) have used the advertising-expense-to-sales ratio to serve as a proxy for how product differentiation can result in a wedge between price and marginal cost. Additional variables include mean industry plant size and industry geographic dispersion,[12] leverage,[13] research and development costs over sales,[14] profit variability[15] and sales size.[16] Although the variables included above seem the most reasonable, alternate specifications are possible.

Covariance Model

The equations in Fig. 1 represent a regression model which allows for the combination of cross-sectional and time-series data. The analysis of covariance was developed to account for the effects of variables that cannot be standardized between classes.[17] In the model used in this study, the classes are the four observation years.

It is to be expected that general economic conditions will affect the price-cost margin. There are no macroeconomic variables in the equation, but the year dummy variable serves as a proxy for economic effects. The dummy variable takes on the value of one when the price-cost margin is calculated for the corresponding observation year, and is zero otherwise.

By employing a cross-sectional, time-series model, one is assuming that there is stability in the relationships between the independent and dependent variables over time. The only postulated modification over time is the linear model's intercept. In other words, if the economy were suffering from a recession, it is postulated that all firms would suffer from a lower price-cost margin, but that the derivatives of the price-cost margin with respect to the independent variables of the model would remain the same.

Fig. 1 Structure-performance models

Manufacturing Firms

1963, 1967, 1972

$$(1)\quad M_{ij} = a_k + b_k CR_{ijk} + c_k VIC_{ij} + d_k DIV_{ij} + e_k ASSETS_{ij} + f_k REL_{ij} + g_k CAPOUT_{ij} + h_{km} GROWTH_{ij} + \sum_{p=2}^{3} r_{jkm} YR_{ijp} + u_{km}$$

$$(2)\quad M_{ij} = a + cVIC_{ij} + dDIV_{ij} + eASSETS_{ij} + fREL_{ij} + gCAPOUT_{ij} + hGROWTH_{ij} + \sum_{p=2}^{3} r_j YR_{ijp} + \sum_{q=14} s_q IND_{ijq} + u$$

$$i = 1,\ldots,N_j$$

$$j = 1,\ldots,3$$

$$k = 1,\ldots,4$$

M_{ij} = Price-cost margin for firm i in year j. Using data from the COMPUSTAT tapes, the margin is calculated as:
(Net Income + Depreciation + Interest Expense)/Sales

CR_{ijk} = Concentration ratio for firm i in year j estimated at level k. The four-firm concentration ratio, which gives the percentage of total shipments accounted for by the top four firms in the industry in which firm i contributes the greatest amount of output, corresponds to k = 1. When k = 2, the variable is the eight-firm concentration ratio; k = 3, the twenty-firm; and k = 4, the fifty-firm concentration ratio. Each ratio is a value-of-shipments weighted average of the Census Bureau's estimates of concentration for the approximately 400 four-digit SIC manufacturing categories for each of the four years. The Census Bureau's figures are aggregated into the 51 manufacturing industry classification used by the Bureau of Economic Analysis in the National Input-Output tables.

VIC_{ij} = Vertical Industry Connection index for firm i in year j. VIC is constructed using the product descriptions from Moody's Industrials, for each firm for each year, classifying the products into the 77 industries of the Bureau of Economic Analysis' National Input-Output tables and calculating VIC using these tables.

DIV_{ij} = Diversification index for firm i in year j. DIV is constructed using the product descriptions from Moody's Industrials for each firm for each year, classifying the products into the 77 industries of the Bureau of Economic Analysis' National Input-Output tables and forming a simple sum of the number of industries in which the firm operates.

$ASSETS_{ij}$ = Value of assets for firm i in year j. The asset figure is again on the COMPUSTAT tapes.

REL_{ij} = Relative sales for firm i in year j. Using firm sales data from the COMPUSTAT tape and industry output data from the National Input-Output tables. As with the concentration ratios, the firm is classified as a member of the industry in which it contributes the greatest amount of output. Relative sales is calculated as: Firm's Sales/Industry Sales.

$CAPOUT_{ij}$ = Capital-output ratio for firm i in year j. Using data from the COMPUSTAT tapes, the capital-output ratio is calculated as: Assets/Sales.

$GROWTH_{ij}$ = Sales growth for firm i in year j. Using data from the COMPUSTAT tapes, the sales-growth figure is calculated as:

$$\frac{1}{5}\sum_{t=X_i}^{Y_i} (Sales_t - Sales_{t-1})/Sales_{t-1}, \text{ where } i=1,\ldots,3;$$

$X_i \varepsilon \{1959, 1963, 1968\}$, $Y_i \varepsilon \{1963, 1967, 1972\}$

YR_{ijp} = Year dummy variable for firm i in year j, p = 2, 3 Where j=p, $YR_{ijp}=1$; when j=p, $YR_{ijp}=0$.

IND_{ijq} = Industry dummy variables for firm i in year j, q=1,...,51. As with the concentration ratios and the relative sales figure, the firm is classified as a member of the manufacturing industry in which it contributes the greatest amount of output.

N_j = The number of firms used to estimate equations for year j, $N_2=107$, $N_3=121$, $N_4=133$.

j = Year of observation. When j=1, year = 1963; j=2, year = 1967, j=3, year = 1972.

u_k = Random error term, assumed to be independently, identically distributed

u = Random error term, assumed to be independently, identically distributed

Fig. 1 Structure-performance models

3. RESULTS

The models presented in the previous section were estimated using a random sample of firms from the COMPUSTAT tapes for the years 1963, 1967 and 1972.[18]

The first step in any investigation of the relationships between variables is to examine how they move in relationship to each other. Table 1 shows the correlation coefficients between the variables of the model. Table 2 records the estimated regression coefficients of equation (1). Table 3 presents the results of the model using industry dummy variables. Three values are listed for each independent variable: the regression coefficient, which is the estimated derivative of the dependent variable with respect to the independent variable; the standard error of the estimated coefficient, which indicates whether or not the coefficient is significantly different from zero; and the elasticity, which is an estimate of the percentage change in the price-cost margin given a percentage change in the independent variable. The elasticity is calculated by multiplying the regression coefficient by the ratio of the average value of the independent variable over the average value of the price-cost margin.

The variables of the model tend to be significant in influencing the price-cost margin. Assets, relative sales, the capital-output ratio and sales growth all enter with the hypothesized sign. Relative sales are not significant when sales growth is added to the model which includes the industry dummy variables.

VIC and the diversification index are significant in predicting the price-cost margin. The model tends to reinforce the hypothesis that increasing vertical integration can increase a firm's market power.

Table 1. Correlation coefficients
Number of cases: 361
1963, 1967, 1972

	Price-Cost Margin	Relative Sales	Assets	Capital-Output Ratio	Sales Growth	Vertical Industry Connections	Diversification Index	Concentration Ratios CR4	CR8	CR20
Relative Sales	.25349									
Assets	.25271	.62610								
Capital-Output Ratio	.14791	-.01187	-.02959							
Sales Growth	.09859	-.03175	-.10053	-.01310						
Vertical Industry Connections Direct	.13971	.28550	.43183	-.10523	-.10551					
Diversification Index Direct	.02354	.37659	.43044	-.02466	-.00840	.72636				
Concentration Ratios CR4	.12021	.38398	.31115	.06671	-.00161	.13592	.30288			
CR8	.12708	.37019	.30760	.04892	-.02798	.14475	.29387	.94874		
CR20	.19551	.36423	.29006	.03087	-.00348	.16180	.28394	.91298	.93283	
CR50	.17290	.33181	.24657	.01892	-.01913	.12902	.23702	.81482	.89343	.95452

Table 2. Market-Power Hypothesis, 1963, 1967, 1972
OLS Linear-Regression Model*
Dependent Variable: Price-Cost Margin

	Concentration Ratios				VIC Direct	Diversification Index	Assets	Relative Sales	Capital-Output Ratio	Growth	Year Dummy Variables		Constant	R^2
	CR4	CR8	CR20	CR50							1967	1972		
(1)	.122				55.351†	-3.290†	.0255†	125.933†	47.689†	.594†	5.972	-10.728	66.766†	.18
	(.156)				(15.873)	(.817)	(.0099)	(45.144)	(13.419)	(.191)	(6.287)	(6.329)	(9.383	
	.041				.119	-.252	.059	.055	.223	.078	.021	-.041		
(2)		.180			56.008†	-3.347†	.0252†	122.856†	47.744†	.598†	6.408	-10.525	62.980†	.18
		(.153)			(15.808)	(.813)	(.0099)	(44.974)	(13.390)	(.191)	(6.300)	(6.318)	(10.307)	
		.083			.121	-.256	.058	.054	.223	.078	.022	-.041		
(3)			.379†		57.338†	-3.519†	.0244†	109.195†	47.498†	.587†	7.059	-9.722	49.726†	.20
			(.145)		(15.600)	(.801)	(.0098)	(44.705)	(13.284)	(.189)	(6.244)	(6.268)	(11.468)	
			.236		.124	-.269	.056	.048	.222	.077	.025	-.037		
(4)				.380†	56.710†	-3.431†	.0253†	110.622†	48.064†	.598†	7.266	-10.323	44.058†	.19
				(.153)	(15.600)	(.797)	(.0098)	(44.735)	(13.293)	(.190)	(6.261)	(6.258)	(13.421)	
				.285	.122	-.263	.058	.049	.225	.078	.025	-.040		

*Column format: regression coefficient, standard error (in parenthesis), followed by estimated elasticity

†Significant at .01 level

TABLE 3. Market-Power Hypothesis with Industry-Dummy Variables
OLS Linear Regression Model*
Dependent Variable: Price-Cost Margin
1963, 1967, 1972
41 Industries

	VIC Direct	Diversification Index	Assets	Relative Sales	Capital-Output Ratio	Growth	Year Dummy Variables 1967	Year Dummy Variables 1972	Constant	R^2
( )	45.504†	-2.998†	.0225	99.711	52.348†	.751†	6.148	-9.257	101.909†	.44
	(16.048)	(.848)	(.0108)	(55.452)	(12.682)	(.186)	(5.780)	(6.011)	(11.469)	
	.098	-.229	.052	.044	.245	.098	.022	-.036		
( )	43.934†	-2.770†	.0354†		49.699†	.765†	5.478	-11.324	101.177†	.43
	(16.081)	(.841)	(.0081)		(12.642)	(.187)	(5.788)	(5.921)	(11.502)	
	.095	-.212	.081		.232	.100	.019	-.044		

*Column format: regression coefficient, standard error (in parenthesis), followed by estimated elasticity

†Significant at .01 level

The concentration ratios are calculated for BEA's 51 manufacturing industries. At this level of aggregation, the twenty-firm concentration ratio is significant in the covariance model without industry dummy variables, while the four-firm concentration ratio is not.

The relative superiority of the twenty-firm concentration ratio is surprising. The Herfindahl index is sometimes considered to be the best way to reflect the structural concept of "the number of sellers." Since the four-firm concentration ratio is the one most highly correlated with this index, one would expect it to be the most powerful in predicting performance.

There are two possible explanations for the better performance of the twenty-firm concentration ratio. First, the concentration ratio is a variable specific to an industry, but it is being used to reflect the performance of a firm. The four-firm concentration ratio may be best suited to describe industry performance. Second, the twenty-firm concentration ratio encompasses information about a larger number of firms and thereby describes a larger proportion of the major industry in which the firm operates. As if to reinforce the importance of including the information above additional firms, the fifty-firm concentration ratio is also significant.

As expected, the higher the level of concentration, the greater the price-cost margin.

Although the covariance models have been valuable in highlighting the significance of VIC in contributing to market power, they have not been successful in describing a functional form which can be used to forecast the price-cost margin. A large percentage of the variation in the performance variable is unexplained. Such low values of R^2 are the rule rather than the exception in industrial organization studies.[19]

It is difficult to improve the model because the performance of the firm is influenced by variables that do not lend themselves to quantification, such as the relative competence of management and even the impact of luck, both good and bad. But to the extent that such variables are omitted and are correlated with the variables included in these models, it may be that the estimates of the coefficients are biased.[20] Biased estimates could lead to unreliable conclusions of significance.

Therefore, one can only use this study as an indicator of the relationship between vertical integration and performance. It is by no means suggested as the final word on the subject.

4.CONCLUSION

By lowering costs, by allowing for more efficient allocation of inputs under imperfect market structures, by erecting barriers to entry or by facilitating price discrimination and foreclosure, vertical integration is hypothesized to increase a firm's market power. A sample of 361 observations of manufacturing firms from 1963 to 1972 is employed to investigate this hypothesis.

Market power can be reflected by the firm's ability to set price over marginal cost. In a perfectly competitive market, the firm has no market power and price is equal to marginal cost. Lerner's index of market power, the price-cost margin, is used in this study as the dependent variable. The model's independent variables include concentration ratios, VIC, diversification index, assets, ratio of assets to sales, ratio of the firm's sales to that of the industry, and growth in sales.

VIC is found to be significant in determining the price-cost margin. Therefore one cannot reject the hypothesis that increasing vertical integration can lead to increasing market power. But there is no way to distinguish between the underlying causes of this effect. Higher values of VIC may increase the price-cost margin because of lowering costs, or because of better allocation, or both, or even because of some other reason altogether. The empirical results can give evidence regarding the existence of a relationship between VIC and the price-cost margin. But only economic theory can explain why such a relationship exists.

FOOTNOTES

1. For a review of this literature, see Kaserman (1978).

2. See Dewey (1976); Johnson and Helmberger (1967).

3. See Hall and Tideman (1967).

4. See Kilpatrick (1967), Mueller (1964), Rosenbuth (1955), and Winn (1975).

5. VIC is described in Maddigan (1979).

6. Peltzman (1969), Kaserman (1978), Kessler and Stern (1959) and Williamson (1971).

7. For a discussion of these and other proported advantages of diversification, see Edwards (1955) and Weston (1970).

8. These two studies use the reciprocal of the log of assets as an independent variable, rather than a simple linear relationship.

9. This variable is used in Neumann *et al* (1979).

10. Winn (1975), p. 48.

11. Other studies which use sales growth as an independent variable in a similar model include Collins and Preston (1968), Gale (1972), Kilpatrick (1968), Kwoka (1971), Minhas (1963), Shepard (1972), Weiss (1974) and Winn (1975).

12. Collins and Preston (1968), Kwoka (1971) and Weiss (1974).

13. Gale (1972), Hall and Weiss (1967).

14. Imel and Helmberger (1971).

15. Shepard (1972).

16. Gale (1972).

17. Johnson (1972), pp. 121-132.

18. The sample was selected from the COMPUSTAT tapes, a data base maintained by Investors Management Service. COMPUSTAT provides annual data on the major firms listed on the New York, American and Regional exchanges. It includes information from both the balance sheets and the income statements of the listed firms. For a list of the firms, see Maddigan (1979).

19. For example, see Collins and Preston (1968), Kwoka (1971), Weiss (1974) and Winn (1975).

20. Johnson (1972), pp. 168-169.

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