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A CROSS-INDUSTRY ANALYSIS OF VERTICAL INTEGRATION STRATEGIES: AN EXPLORATORY STUDY

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Abstract

The purpose of the paper is to conduct an industry analysis of vertical integration strategies. It identifies the major vertical integration strategies that companies use, examines industry differences in vertical integration strategies, and attempts to determine the industry factors that may explain those differences. The industry factors considered in the paper are industry competition, average size of an industry's companies, industry uncertainty, and industry's new capital expenditures.

A statistical analysis of a sample of 312 manufacturing companies has resulted in several findings. First, companies tend to follow the vertical integration strategy that is dominant in their industry. Second, industry characteristics significantly affect companies' levels of vertical integration strategies, but do not have a significant impact on trends of vertical integration strategies. Managerial as well as future research implications are discussed.

A Cross-Industry Analysis of Vertical Integration Strategies: An Exploratory Study

Introduction

Vertical integration may be defined as the extent to which a firm controls the production of its inputs or supplies and the distribution of its outputs or finished products. Vertical integration has been seen as a strategy that helps companies to reduce transaction costs and to increase market power (Chandler 1962; Williamson 1985). Accordingly, vertical integration would be attractive if the benefits that result from lowering transaction costs and increasing market power outweigh the costs of managing several value chain activities within a single organization. While organizational factors play a certain role in vertical integration decisions, the extent to which a company can realize these benefits is heavily dependent upon the structure of its industry. Industry factors such as competition, demand and technological uncertainty have been found to be associated with companies' vertical integration strategies (Balakrishnan and Wernerfelt 1986; Harrigan 1986).

Since the structural factors that determine the attractiveness of vertical integration may vary across industries, vertical integration strategies may be industry-specific. In his study of the emergence of the modern industrial enterprise, Chandler (1990) concluded that industries differed in the potential for their companies to realize economies of scale and scope. For him, companies in the industries where it was possible to realize substantial economies of scale and scope, increased their levels of vertical integration. On their part, Livesay and Porter (1969) found that when the leaders of an industry adopted a specific vertical integration strategy, most other companies in the same industry followed the same strategy. As a result, within an industry most firms were similarly integrated. Others (e.g. Casson 1984; D'Aveni and Ilinitch 1992; Lieberman 1991; Tucker and Wilder 1977) also linked vertical integration to industry-specific conditions.

As several studies have suggested (e.g. Chandler 1990; Quinn, Doorley, and Paquette 1990; Stuckey and White 1993), industry factors change over time. As a result, vertical integration strategies that were adopted in response to previous industry conditions may also change (D'Aveni and Ravenscraft 1994; Harrigan 1986; Livesay and Porter 1969; Stuckey and White 1993). Because the way industry factors change may be dependent upon each industry, it is likely that the resulting change in vertical integration strategies will also be industry-specific.

The purpose of this paper is to examine vertical integration strategies across manufacturing industries. The paper will identify the types of vertical integration strategies, determine the major strategic differences among industries, and discuss some of the factors that may help to explain those differences. The methodology of the study is discussed in the first section. The next two sections examine industry differences by types of vertical integration strategies. The last two sections will be devoted to the discussion of the results and to implications of the study.

Methodology

The methodology section starts with the measurement of the measurement of vertical integration and industry characteristics that will be used to explain industry differences in vertical integration strategies. The section will end with the discussion of the sample size, data collection, and statistical techniques.

Measurement of vertical integration

In studies of vertical integration, measurement is the most controversial issue. Several measures of vertical integration have been proposed in the literature, but nearly all of them have been criticized. One of the reasons why there is a lack of a generally accepted measure is because vertical integration is a multidimensional concept. As such, it cannot be summarized in a single statistic without a significant loss of information (Martin 1986). Only different measures, each operationalizing a specific dimension, can yield complementary insights into such a complex phenomenon. Depending on the study, each researcher should focus on the measure that captures the dimension under analysis.

In her work, Harrigan (e.g. 1984) identifies four dimensions of vertical integration, namely the breadth of integrated activities, the stages of integrated activities, the degree of internal transfers, and the form of ownership. This paper focuses on the breadth of integrated activities. Harrigan defines the breadth of integrated activities as the number of vertically integrated activities that a firm performs in-house. Building on this definition, the paper measures vertical integration as the ratio of the number of vertically related businesses over the total number of businesses. The paper uses an instrument proposed by Davis and Duhaime (1992) to measure this ratio. Davis and Duhaime's instrument is based on the concept of business segments. The Securities and Exchange Commission (SEC) divides companies into business segments, each having either one or two businesses (Financial Accounting Standards Board 1976). A business is defined as a 4-digit Standard Industrial Classification (SIC) code. When a segment has two SIC codes (that is two businesses), the first SIC code is the primary business and the second is the secondary business. Given the reasons advanced by the SEC to assign two businesses to a segment, Davis and Duhaime argue that if a segment has two businesses, those businesses are either related or vertically integrated. For them, vertical integration exists when the first two digits of the primary business and the secondary business are different (refer to Davis and Duhaime 1992).

Based on Davis and Duhaime's instrument, the paper develops an index of vertical integration. The index of vertical integration is estimated as the ratio of the number of vertically integrated segments over the total number of segments. For example, if a firm has five segments, and two of those segments are vertically integrated, the index of vertical integration is 0.40 (2 over 5). From this index, two statistics are calculated: a company's level of vertical integration which is the average of 18 annual indices of vertical integration, and a company's change in levels vertical integration determined by the trend of annual indices over the 18-year period (these two statistics will be discussed later).

Measurement of industry characteristics

The industry characteristics that will be discussed are industry competition, size of an industry's companies, industry uncertainty, and an industry's new capital expenditures. Several streams of research emphasize the influence industry competition can have on vertical integration strategies. The traditional industrial economic literature (e.g. Auerbach 1988; Baldwin 1987; Porter 1980), and the economic history research (e.g. Chandler 1962 and 1990; Herman 1981) for example argue that the number of existing and potential competitors in an industry has a major impact on vertical integration strategies that firms adopt. In strategy research, several empirical studies (Balakrishnan and Wernerfelt 1986; Harrigan 1985 and 1986) have shown that competition affects the type of vertical integration strategies. This paper will use competition to explain industry differences. Given that 2-SIC code industries are comprised of thousands of companies, the paper uses a 20-firm concentration ratio (instead of 4-firm concentration ratio) to measure industry competition.

Size can also be linked to vertical integration strategies. According to the size literature (e.g. Blau 1970; Blau et al. 1976; Kimberly 1976), as size (of the workforce) increases, the span of control of each supervisor widens, leading to economies of scale in managerial supervision. Given the costs advantages of big size, companies would adopt growth strategies in order to achieve cost advantages. Growth strategies include vertical integration. So large organizations

would tend to have higher levels of vertical integration. Empirical studies (e.g. Mpoyi 1997) have found that as compared to small companies, big companies had higher levels of vertical integration. Thus size can be considered a determinant of vertical integration strategies. Size is measured as the average number of employees in an industry.

Uncertainty is the third characteristic that will be used to explain industry differences. Though there is no consensus about whether uncertainty increases or decreases the levels of vertical integration, researchers agree that uncertainty is a significant determinant of the levels of vertical integration (e.g. Balakrishnan and Wernerfelt 1986; Harrigan 1986; Miles and Snow 1986; Mpoyi 1997 and 2000). Following Harrigan (1985), uncertainty will be measured as the growth rate of sales in an industry. The last characteristic, new capital expenditures, is included for the following reason. New capital is needed to either replace obsolete assets or expand the asset base of the company. In both cases, companies invest in assets that incorporate the most recent technologies. Given that capital is a scarce resource, the more vertically linked businesses a company has, the less capital is invested in each of those businesses. Industries whose companies have high levels of vertical integration would tend to have low new capital expenditures per company. Therefore, new capital expenditures can be used to explain differences in vertical integration strategies.

Sample size, data collection and statistical techniques

The analysis is based on a random sample of 312 companies. This sample includes parent companies in the manufacturing sector that were in existence from 1980 to 1997. Table 1 provides the distribution of companies by industry. The Office of Management and Budget (1987) divides the manufacturing sector into twenty manufacturing industries. The SIC codes for these manufacturing industries go from 20 to 39. Of these twenty industries, three were not included in the sample for the following reasons. Industry 31 (Leather and leather products) did not have a single company in the sample. Industries 21 (Tobacco products) and 39 (Miscellaneous manufacturing industries) were removed because they had very few companies in the sample. Each of them had only 2 companies selected in the sample. As for each of the remaining 17 industries, the number of companies varied from 4 in industry 24 (Lumber and wood products, except furniture) to 46 in industry 28 (Chemicals and allied products).
Data was collected from two main sources: Compustat, and Census of Manufactures. Compustat is a database that provides several data including each company's business segments. Data on company's business segments for the years 1993-1997 is found in the Compustat database at the Middle Tennessee State University Library. The agreements with Standard & Poor's that manages the Compustat Database require that the university keep the information on business segments for only the most current 6 years. As a result, tapes with back data prior to 1993 were purchased from Standard & Poor's.

In the discussion related to the determinants of industry differences in vertical integration strategies, a few factors will be introduced, including competition (approximated by industry concentration), uncertainty (based on industry sales), size (based on industry employees), and industry's new capital expenditures. Data on competition, uncertainty, size and new capital expenditures is collected from the Census of Manufactures. Finally, two statistical techniques will be used. Based on the nature of the dependent and the independent variables (continuous or categorical), ANOVA and chi-square will be used.

Table 1.

Distribution of companies by 2-digit SIC industry

Industry	# companies	Description of industries
20	32	Food and kindred products
22	11	Textile mill products
23	7	Apparel and other finished products made from fabrics & similar materials
24	4	Lumber and wood products, except furniture
25	10	Furniture and fixtures
26	18	Paper and allied products
27	18	Printing, publishing, and allied products
28	46	Chemicals and allied products
29	14	Petroleum refining and related industries
30	9	Rubber and miscellaneous plastics products
32	8	Stone, clay, glass, and concrete products
33	14	Primary metal industries
34	10	Fabricated metal products, except machinery and transportation equipment
35	33	Industrial and commercial machinery and computer equipment
36	32	Electronic and other electrical equipment/components, except computer equipment
37	24	Transportation equipment
38	22	Precision instruments, photographic, medical & optical goods, watches & clocks
TOTAL	312	All manufacturing industries

Industry Differences In Levels Of Vertical Integration Strategies

This section identifies the levels of vertical integration strategies, and then discusses industry differences and its determinants.

Levels of vertical integration strategies

A company's level of vertical integration (V.I.) is calculated as the average of the company's indices of vertical integration for each of the 18 years covered by this research (1980-1997). The level is 0 when no segment is integrated, and it is 1 when all segments are integrated. Most companies have levels between 0 and 1. Using the mean of all companies' levels (0.44), three levels of vertical integration strategies are identified: low level strategy, average level strategy, and high level strategy. Low level strategy corresponds to levels below 0.29. A company uses an average level strategy when its level is around the mean of 0.44 (between 0.29 and 0.60). Companies whose levels are above 0.60 follow a high level strategy. Table 2 provides the distribution of companies by levels of vertical integration strategy.

Table 2.

Distribution of companies by type of levels of V.I. strategies

Type of strategy	Mean level of V.I.	# of companies
Low level strategy	0.09	102
Average level strategy	0.45	105
High level strategy	0.80	105
Total companies		312

Industry differences

As can be seen in table 3, all three strategies are found in most industries. Two industries have companies that use one strategy, average level strategy for industry 21, and low level strategy for industry 39.

Table 3.

Industry comparison of companies' levels of V.I. strategies*

Industry	Companies with low level strategy	Companies with average level strategy		Total companies
20	17 (53%)	11 (34%)	4 (13%)	32
22	10 (91%)	1 (9%)	-	11
23	3 (43%)	1 (14%)	3 (43%)	7
24	2 (50%)	1 (25%)	1 (25%)	4
25	3 (30%)	3 (30%)	4 (40%)	10
26	11 (61%)	2 (11%)	5 (28%)	18
27	4 (22%)	10 (56%)	4 (22%)	18
28	13 (28%)	17 (37%)	16 (35%)	46
29	2 (14%)	2 (14%)	10 (72%)	14
30	2 (22%)	2 (22%)	5 (56%)	9
32	-	5 (63%)	3 (37%)	8
33	3 (21%)	8 (58%)	3 (21%)	14
34	1 (10%)	2 (20%)	7 (70%)	10
35	9 (27%)	11 (33%)	13 (40%)	33
36	9 (28%)	14 (44%)	9 (28%)	32
37	4 (17%)	9 (37%)	11 (46%)	24
38	9 (41%)	6 (27%)	7 (32%)	22
Total	102	105	105	312

*Percentages into parentheses are given within each industry

This paper will assume that a strategy is dominant in an industry when at least 50% of companies in that industry adopt the strategy. Seven industries do not have a dominant strategy, but ten industries have one dominant strategy. Low level strategy is dominant in 4 industries (20, 22, 24 & 26), average level strategy is dominant in 3 industries (27, 32, & 33), and high level strategy is dominant 3 industries (29, 30, & 34).

By relating each company's level of vertical integration (dependent variable) to the dominant strategy in that company's industry (independent variable), this study can attempt to test an argument that is made (e.g. Livesay and Porter 1969) that companies in the same industry tend to adopt similar vertical integration strategies. Dominant strategy is categorical variable with four values: 0 for no dominant strategy, 1 when low level strategy is dominant, 2 when average level strategy is dominant, and 3 when high level strategy is dominant. With a continuous dependent variable and a categorical independent variable, ANOVA is the appropriate technique. The results ($F=19.359$ significant at $p<.000$) support the suggestion that most companies in an industry follow a similar vertical integration strategy. The next step is to determine whether some industry characteristics are affecting industries' levels of vertical integration strategies.

Determinants of industry differences

Four industry characteristics serve to compare industries. The four characteristics are competition, size, uncertainty, and new capital expenditures. The dependent variable, the levels of vertical integration strategies, is continuous. All four independent variables, competition, size, uncertainty, and new capital expenditures, have three values, 1, 2 and 3 respectively for low, average and high. Since the dependent variable is continuous and the independent variables are all categorical, ANOVA is the appropriate statistical technique. Table 4 presents the results of the impact of the four characteristics on companies' levels of vertical integration strategies. All four industry characteristics, competition, size, uncertainty, and new capital expenditures, significantly explain the levels of vertical integration strategies.

Table 4.

Industry determinants of companies' levels of V.I. strategies

Industry characteristics	F value
Competition	6.569 ($p<.002$)
Size	3.652 ($p<.027$)
Uncertainty	7.806 ($p<.000$)
New capital expenditures	6.992 ($p<.001$)

Industry Differences in Trends of Vertical Integration Strategies

This section begins with the identification of the trends of vertical integration strategies. Then it will discuss industry differences and the influence of industry characteristics on the trends of vertical integration strategies.

Trends of vertical integration strategies

For each company, the trends of vertical integration are obtained by performing a time series analysis of the levels of vertical integration over 18 years from 1980 to 1997. The significance level considered in the time series analysis is $p<.05$. Table 5 provides the distribution of companies by trend of vertical integration strategies.

Table 5.

Trends of vertical integration strategies

Trend strategies	# companies	Frequencies*
No change	157	50.3%
Vertical disintegration	83	26.6%
Vertical integration	72	23.1%
Total companies	312	100.0%

Three trends of vertical integration strategies are identified: no significant change in levels of vertical integration (no change strategy), significant decrease in levels of vertical integration (vertical disintegration strategy), and increase in levels of vertical integration (vertical integration strategy). Of the 316 companies in the sample, 157 did not significantly change their levels of vertical integration. The remaining 155 companies significantly changed their levels. Of these, 83 adopted vertical disintegration by decreasing their levels, and 72 increased their levels.

Table 6.

Trends of vertical integration strategies by industry*

Industry	No change	Vertical disintegration	Vertical integration	Total companies
20	14 (44%)	12 (37%)	6 (19%)	32
22	9 (82%)	-	2 (18%)	11
23	4 (57%)	-	3 (43%)	7
24	3 (75%)	-	1 (25%)	4
25	4 (40%)	2 (20%)	4 (40%)	10
26	9 (50%)	6 (33%)	3 (17%)	18
27	7 (39%)	6 (33%)	5 (28%)	18
28	22 (48%)	14 (30%)	10 (22%)	46
29	6 (43%)	7 (50%)	1 (7%)	14
30	7 (78%)	1 (11%)	1 (11%)	9
32	5 (63%)	2 (25%)	1 (12%)	8
33	8 (57%)	3 (22%)	3 (21%)	14
34	7 (70%)	1 (10%)	2 (20%)	10
35	15 (46%)	9 (27%)	9 (27%)	33
36	18 (56%)	7 (22%)	7 (22%)	32
37	10 (42%)	5 (21%)	9 (37%)	24
38	9 (41%)	8 (36%)	5 (23%)	22
Total	157 (50%)	83 (27%)	72 (23%)	312

* Into parentheses are percentages within each industry

Industry differences

Table 6 shows that the three trends of vertical integration strategies are observed in most industries (14 industries). Companies in three industries adopt two of the three strategies. There is no industry where all companies adopt one strategy.

If it is assumed that a strategy is dominant in an industry when at least 50% of companies in that industry adopt the strategy, 10 industries are dominated by one trend of vertical integration strategy. In 9 of the 10 industries, the no change strategy is the dominant trend strategy. Vertical disintegration is dominant in one industry, and there is no industry where vertical integration is dominant. Seven industries don't have a dominant trend strategy. As is the case in the levels of vertical integration strategies, companies tend to follow the trend of vertical integration strategy that is adopted by the majority of firms in the industry. Companies' trend of vertical integration strategies are significantly related to the dominant strategy (Chi-square = 14.508 with $p<.006$).

Determinants of industry differences

Competition, size, uncertainty and new capital expenditures, are once again used to explain industry differences in trends of vertical integration strategies. The results of the impact of these industries characteristics are presented in table 7. The results clearly demonstrate that industry differences in trends of vertical integration strategies are not explained by the industry characteristics considered.

Table 7.

Industry determinants of trends of vertical integration strategies

Industry characteristics	Chi-square (p value are into parentheses
Competition	4.101 (p<.393)
Size	2.450 (p<.654)
Uncertainty	4.996 (p<.288)
New capital expenditures	3.219 (p<.522)

Implications

The findings of the paper highlight a significant feature of vertical integration strategies across industries. The levels of vertical integration strategies are affected by industry conditions, but the trends of vertical integration strategies are independent of industry factors. Table 8 summarizes the results of the research.

Table 8.

Significance of relationships between V.I. strategies and industry characteristics

Industry characteristics	Levels of V.I. strategies	Trends of V.I. strategies
Dominant strategy	Significant	Significant
Competition	Significant	Not significant
Size	Significant	Not significant
Uncertainty	Significant	Not significant
New capital expenditure	Significant	Not significant

The findings suggest that vertical integration strategies are partially dependent upon the type of industry. An implication of such suggestion is that at least some vertical integration decisions are made based on organizational characteristics. This implication lends support to an argument by Hrebiniak and Joyce (1985) that theories founded on environmental determinism (e.g. industrial economics, population ecology, institutional theory) as well as those based on strategic choice (e.g. resource-based approach) are all relevant to how strategic decisions are made.

The specific implications of the paper are discussed next. They include the implications for the practice of management and for future research are discussed next.

Managerial Implications

As mentioned earlier, the decision to change vertical integration strategies may be affected by company-specific factors. So while managers should set the levels of their companies' vertical integration consistent with those of other competitors in their industry, they can also make sound decisions about their vertical integration, on the basis on the strategic characteristics of their organization. Relevant organizational characteristics that managers need to consider include their company's resources, capabilities and competencies, their performance, and the type of competitive advantage (low cost or differentiation) they are seeking.

One practical implication that results from the analysis is that a substantial number of companies have performed vertical disintegration. The analysis of the trend of vertical integration showed that 83 companies, that is, about 27 % of firms, have vertically disintegrated between 1980 and 1997. This finding is significant because the management culture that came to dominate the corporate environment widely supported the pursuit of high levels of vertical integration as a distinctive feature of successful modern industrial enterprises (Chandler 1962; Harrigan 1984; Steingraber 1990). Increasingly, companies are reversing their vertical integration strategies by performing vertical disintegration (e.g. Chandler 1990; D'Aveni and Ravenscraft 1994; Stuckey and White 1993). Given the benefits of low cost or differentiation that can be achieved (Mpoyi 2000), corporate managers should consider vertical disintegration as a strategy to create or restore their company's competitive advantage.

Implications for future research

This paper conducted a cross-industry comparison of vertical integration strategies among manufacturing industries. Future research may focus on a comparison across economic sectors. For example, while several manufacturing companies tend to perform vertical disintegration, the health care management literature (e.g. Conrad and Shortell 1996; Greene 1997; Luke and Begun 1996) contends that the health care sector is experiencing a trend toward more vertical integration. Studies are needed to understand and explain the extent of strategic differences between the two sectors.

The paper suggested that the trends of vertical integration strategies might be affected by company-specific characteristics. Though attempts have been made to link vertical integration decisions to organizational factors (e.g. Mpoyi 1997), studies are needed to related changes in levels of vertical integration to company variables. Also, this research focused on one dimension of vertical integration. It would seem relevant to use any of the other dimensions of vertical

integration and duplicate the findings of this paper to see whether the results would be similar. Finally, this study included some industries with few companies (4 industries had less than ten companies). This precludes accurate generalizations of the results in those industries. Future research in this subject should address this issue by for example increasing the number of companies in each of the industries under discussion.

Conclusion

The purpose of the paper was to compare vertical integration strategies across manufacturing industries. Significant findings can be highlighted. First, when a specific vertical integration strategy (either levels of vertical integration strategy or trend of vertical integration strategy) is dominant in an industry, most firms in the industry tend to follow that strategy. Second, all four industry characteristics selected in the study (competition, size, uncertainty, and new capital expenditures) significantly determine industry differences in levels of vertical integration strategies. However, industry differences in trends of vertical integration strategies are not significantly explained by the four industry characteristics. From the findings, a proposition can be made that in general, companies choose their levels of vertical integration based on the type of industry they are in, but the type of industry does not affect the decision of whether and how to change those levels.

This paper may have some methodological limitations. The first is related to the measurement of vertical integration. Since a vertically integrated business segment has two businesses (the primary business and the secondary business), only the most important vertical link can be measured. As a consequence, if the primary business in the segment is vertically linked to more than one business, some vertical links would be ignored. So by using Davis and Duhaime's (1992) instrument, some vertical integration relations were left out. But because the most important vertical link is measured, this instrument can be considered to be acceptable. The second important limitation is related to the concept of industry. In this analysis, industry is defined in terms of a 2-digit SIC code. The problem may be that each 2-digit SIC industry includes several 4-digit SIC industries that may face different industry conditions. So the use of broad industries may have led to a loss of strategic information that could be important in explaining differences in vertical integration across industries. Despite these limitations, it is our hope that the paper has made a contribution to understanding some vertical integration decisions that companies make.

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