Valuation Impact of Strategic Investment

Contributions of Diversification, Promotion, and R&D to the Value of Multiproduct Firms: A Tobin's q Approach

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■ Outlays for diversification, promotion, and research and development (R&D) investments affect the expected cash flow from both existing assets and future investments. Procedures for discounting *ex ante* cash flows have been clearly established in the finance literature, but the actual market response to these investments has not been widely researched. Existing studies on the relationship between strategic investments and performance of the firm have been conducted in the industrial organization literature without financial market valuation concepts.

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Conclusions from studies on the "value" of diversification, promotion, and R&D investments have been limited by various empirical and conceptual problems. Most studies have used single period accounting profits as proxies for firm value. The few cases that adjusted profits used arbitrary discount rates.[1] Aggregate data have been used for multiproduct firms without regard for differences in product lines. Industry benchmarks for promotions and R&D intensity have not been integrated into the analysis to test hypotheses on how various combinations of strategies are valued.

This paper tests the contributions of diversification, promotion, and R&D to the value of the firm. A unique data set, the Federal Trade Commission's Line of Business survey, is used to construct variables that avoid the problems of previous studies. In addition, the conceptual framework of Tobin's q ratio is developed to produce absolute and relative q measures of firm

[1] One exception, Michel and Shaked [9], used financial market valuation measures to study excess value from diversification investment.

value that provide better insight into the capitalization process than the measures previously used.

I. The Traditional Approach to the Value of Strategic Investments

Research on the value of strategic investments of the firm has been conducted almost exclusively in the industrial organization literature. The structure-conduct-performance (S-C-P) framework has been used to estimate the effects of market structure and investment strategies on firm performance. While this literature is extensive, there is little consensus on the value of investment strategies.[2]

The traditional S-C-P approach hypothesizes that monopoly rents flow from the collusive effects of high concentration. Diversification, promotion, and R&D investment strategies contribute to monopoly rents by raising barriers to entry, thereby discouraging effective substitutes, and simultaneously increasing market concentration.

Two basic problems with the traditional S-C-P single equation approach to studies of firm value contribute to the disparity in findings. First, since promotional efforts and R&D expenditures affect market structure as well as performance, inclusion of all three measures on the right-hand side of equations explaining performance leads to biased estimates of the true effects of non-price strategies (see Schmalensee [15]). This paper corrects this bias by estimating a "reduced form" equation with *only* product market strategy variables on the right-hand side.

The second problem with the S-C-P approach is that the traditional performance measure, single period accounting profit, is often unrelated to firm value. Successful strategies are expected to produce rents for a number of years into the future, and these rents are capitalized into firm value. Both the risk-reducing and profit-enhancing effects of strategies are valued in this process. A measure of firm financial valuation is a much better reflection of this process than single period accounting profits. This study illustrates how market value data and the theory of finance can be applied to industrial organization issues.

[2] For example, Comanor and Wilson [4] found evidence supporting economies of scale in promotion while Simon [17] concluded the opposite. Scherer's review of many studies [14] concluded that diversification does not significantly affect profitability, but Michel and Shaked [9] found positive excess value from diversifying into unrelated product lines. Even the long held belief that firm strategy can create barriers to entry that enhance profitability has been disputed by Demsetz [5].

II. Hypotheses of the Relationships between Diversification, Promotion, R&D, and Firm Value

Much of the research on investment strategies has focused on either diversification, promotion, or R&D separately. This section provides a brief outline of the various expected links between each strategy and value, and develops measures of diversification, promotion, and R&D that allow for empirical testing of the hypotheses.

A. Diversification

Carter [2] and Berry [1] used the traditional approach to analyzing the consequences of diversification on firm profitability. Specific hypotheses on how diversification influences value include the following:

(i) Diversification allows managerial and production synergy.
(ii) Diversification creates a barrier to entry for the nondiversified firm.
(iii) Diversification allows "deep pocket" competition that can absorb temporary losses in one market to prevent entry.
(iv) Opportunity-poor firms may undertake profitable capital-budgeting projects through diversification rather than pay dividends that are taxed at a higher rate than capital gains.
(v) Diversification allows a "tax loss carry forward" advantage when profitable and unprofitable product lines are combined.
(vi) The variability of profits is reduced by diversification. Value is enhanced to the extent that this cannot be realized by shareholders diversifying their own portfolios.
(vii) Diversification may not result in profit maximization due to reduced control and firm decentralization.

Taken as a whole, these hypotheses provide conflicting predictions of the value from diversification. Therefore, the approach has generally focused on the net effect, which can only be determined empirically. In general, there has been little evidence to support the hypothesis that diversification enhances value. Results from studies of conglomerate mergers indicate that competitive bidding and optimism eliminate any gain to the acquiring firm (see Michel and Shaked [10]).

The Herfindahl-Hirschman index measure for diversification, developed by Berry, provides a composite measure of both the number of product lines and the dispersion of sales across product lines. The index is computed for each firm as follows:

$$DIV = 1 - \Sigma SLB_j^2,$$

where SLB_j is the share of a firm's total sales originating in the j^{th} line of business, where j ranges from 1 to n, the total number of lines. It is analytically and empirically useful to show that DIV is made up of two different diversification components — one based on the number of product lines (DIVNUM), and the other based on the size distribution or dispersion of sales shares across product lines (DIVSIZ). Subtracting and adding 1/n to both components of DIV yields:[3]

$$DIV = DIVNUM - DIVSIZ = (1 - 1/n) - \Sigma[SLB_j^2 - (1/n)^2]$$

Separation of the index into number and size distribution components allows specific hypotheses to be tested that increase the understanding of diversification effects. For example, capital markets may judge that a larger number of product lines makes a firm less dependent on any one line, presumably reduces the variance of cash flows and thus enhances firm value. But, the number component (DIVNUM) alone gives a misleading impression of the degree of diversification if a firm's sales are concentrated in one or a few product lines (producing a high DIVSIZ value). The composite index DIV summarizes the net effect of these two measures. By including the separate components of DIV as independent variables in a regression explaining q, the true source of market valuation of diversification can be isolated. If the market believes that "sticking to one's knitting," *i.e.*, concentrating on product lines that the firm has learned well over the years, is a higher value investment strategy, *ceteris paribus*, DIVSIZ should be negative. Comparisons of empirical models using the composite measure DIV as an alternative to the number (DIVNUM) and size (DIVSIZ) components should also provide information about the source of diversification's net effect on value.

B. Promotional Effort

A variety of hypotheses have been advanced to explain the expected value of investments in promotion. Many of the arguments are contradictory and empirical work has not resolved the issue. The most frequently suggested hypotheses are as follows:

(i) Advertising and promotion expenditures make it possible to differentiate the product and decrease the price elasticity of demand. This would give the firm a higher price-cost margin.

(ii) Advertising and promotional expenditures make it possible for the firm to mitigate the business cycle by creating a more income inelastic demand for the firm's product.

(iii) Economies of scale in advertising create a barrier to entry that increases the firm's pricing power.

(iv) Economies of scale in production can be achieved by promotional strategies that increase sales. Thus, profits are enhanced by lower unit production costs.

(v) Advertising makes it possible for new firms to enter an industry and compete with established firms.

(vi) Promotional rivalry forces firms to gravitate to similar intensity of promotional expenditures. Redundant promotion for the industry does not increase the overall market demand and a zero-sum game reduces industry profits.

Since some of these hypotheses are competing, it will be useful to distinguish between the effects of industry and firm level promotional effort. Industry level measures of promotional intensity are surrogates for umbrella effects on barriers to entry, business risk, and overall market demand that accrue to all firms in the industry. They may enhance or reduce value in their own right, independent of firm level promotional activity. Therefore, assessments of firm level promotional effort must be made *relative* to the industry norm. Even here, there are conflicting possibilities. Firms that invest more on promotion, per sales dollar, than their industry rivals may simply be less efficient. Alternatively, higher promotional expenditures per dollar of sales may signal a deeper commitment to product differentiation leading to higher prices and profits. Another possibility is that extreme values of promotional effort, relative to industry norms, are considered dangerous strategies and reduce firm value. It is also plausible that firm promotion-value relationships depend on the *level* of industry promotion intensity. To test these various hypotheses on firm-industry interactions, models using the ratio of firm level promotional activity to the industry level (PRORAT), and the absolute value of the deviation of firm and industry promotion intensity (PRODIF), are constructed. These

[3] Note that $\sum_j (1/n)^2 = n/n^2 = 1/n$ when j goes from 1 to n.

models test the competing hypotheses in a way that has not been conducted in prior research.

C. R&D Intensity

Research on the relationship between R&D investment and firm value has provided few concrete hypotheses about R&D-value relationships. The most widely advanced hypotheses are as follows:

(i) R&D activity creates a barrier to entry and precludes competition, leading to monopoly rents.
(ii) Firm R&D activity enables a firm to enter new product lines.
(iii) High R&D expenditures signal industry risk and hurt value on a risk-adjusted basis.
(iv) Firms may use R&D investments to dampen the volatility of cash flows since R&D can be adjusted during both good and bad years. Long-run benefits are independent of these short-run maneuvers resulting in enhanced value of the firm.
(v) Industry R&D signals expected growth prospects and enhanced cash flows.

As with promotion strategies, R&D activity at the industry level has been treated as a surrogate for barriers to entry, risk differences, and market demand factors that affect all firms in the same industry. Again, therefore, firm level R&D intensity must be considered relative to an industry benchmark. In the models corresponding to the firm-industry effects, the ratio of firm level R&D to the industry level (RDRAT), and the absolute value of the deviation of firm and industry R&D activity (RDDIF) are included. These measures allow testing of alternative hypotheses that parallel the promotion intensity hypotheses.

III. Financial Valuation Measures of Performance

Traditional short-run accounting profits are inadequate performance measures of a given investment strategy.[4] Short-run profitability is a disequilibrium measure that ignores risk. Arbitrary discount rates have been used in the few cases of risk-adjusted profits. Of more importance, short-run profits are poor proxies for firm value — a long-run equilibrium market judgment about future cash flows. As Schwert [16] pointed out, modern financial valuation concepts, based on efficient market capitalization of rents, provide important insights into issues that are normally studied in industrial organization.

The alternatives, used by Michel and Shaked [9], are the Sharpe, Jensen, and Treynor portfolio performance measures. While these measures are improvements, they require estimates of systematic risk. Roll [12] and Ross [13] argued that it is inappropriate to use such measures to rank portfolio performance, since differences in the rankings may only indicate inefficiencies in the market index used to estimate systematic risk. Even without these criticisms, measurement error and the instability of beta estimates require portfolio grouping that results in a loss of information for regression analysis.

Lindenberg and Ross [8] have demonstrated how financial market data and accounting data provide more accurate measures of firm rents. Tobin's q ratio, the ratio of market value to replacement costs, is a performance measure that uses efficient capital market concepts to represent value of the firm. In a competitive environment, q should gravitate toward one since the absence of barriers to entry mean no excess rents could persist, and thus the market value of assets equal their replacement cost. Lindenberg and Ross outlined four general reasons for deviations of q from one: (i) barriers to entry allow a firm with market power to extract monopoly rents capitalized in finance markets; (ii) the firm earns rents on factors of production or on intangible assets not included in replacement costs; (iii) the firm may be dying in the sense that its capital stock is not worth replacing ($q < 1$); and (iv) the firm may be growing so rapidly that it is outpacing its capital goods supply source, even though it has no excess rents ($q > 1$). Only the first reason is due to the immediate investment strategies of the firm.

The Tobin's q construct avoids problems associated with accounting profits and portfolio measures. Tobin's q is a long-run equilibrium market judgment that appropriately incorporates a risk-return pricing framework without using measures of systematic risk. Factors such as tax laws, various accounting methods, and deviations of nominal and real values are discounted in an efficient capital market and do not distort q.

Chappell and Cheng [3] have introduced measures of "relative q" to capture excess value achieved over a short-run interval. Relative q (RQ) is measured by[5]

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[4]See Fisher and McGowan [6] for a review of the problems with profit measures of performance. Smirlock, Gilligan, and Marshall [18] used Tobin's q ratio to avoid these problems.

[5]To check for the sensitivity of including years 1974–1977 in both the numerator and denominator, an alternative RQ with only 1963–1973 in the denominator was created. The correlation between the two measures

RQ_i = (Tobin's q for the i^{th} firm from 1974–1977)/ (Tobin's q for the i^{th} firm from 1963–1977).

If the q measure over the short-run period exceeds the long-run q, the higher relative q signals excess value unexplained by intangible assets embedded in absolute q measures. Relative q measures may be thought of as measures of relative under- or over-valuation much like Sharpe, Jensen, and Treynor measures of excess risk-adjusted returns. Without the long-run q benchmark, measures of q may signal excess value ($q > 1$) unrelated to the capitalized cash flows from the firm's investments. Cross-sectional variation of relative q explained by cross-sectional variation in diversification, promotion, and R&D investments is the focus of the empirical work to follow.

IV. Data and Empirical Models

This section defines the variables constructed for the empirical models. Measurement of these variables required a combination of CRSP, Compustat, and Federal Trade Commission Line of Business (LOB) Survey data.

A. Performance Measurement

Tobin's q performance measures were constructed following the methods used by Lindenberg and Ross [8] and Smirlock, Gilligan, and Marshall [18], as described in the Appendix. The long-run q ratio was defined as the arithmetic mean q over the period from 1963 to 1977. Since the LOB data for nonprice strategy variables were available for the four-year period from 1974 to 1977, the average q for the 1974–1977 period divided by the long-run q served as relative q (RQ). This measure was constructed for the 155 firms that were in the LOB data set and on the CRSP and Compustat tapes for the 1963–1977 period. While q is free of the problems associated with accounting income and risk-adjusted returns, it has its own unique limitations. Statistical tests of difference between the q measures of this study and those from Lindenberg and Ross are reported in the Appendix. The test results support the uniformity of the calculations with the Lindenberg and Ross calculations.

B. Nonprice Strategy Variables

Given the confidential nature of the LOB program and lack of published applications of the data in finance, a description of the data is required. The Federal Trade Commission's Line of Business survey compiled financial statistics from over 400 manufacturing corporations for the years 1974 to 1977, disaggregated to the "line of business" level. A line of business refers to a firm's operations in one of 261 manufacturing categories (similar or identical to the four-digit product categories defined by the Census of Manufacturers) and 14 non-manufacturing categories defined by the FTC.[6] The FTC obtained information from the top 250 of the *Fortune* 500 corporations, the top two enterprises in each industry category, and a sample of additional companies to give adequate coverage for most industry categories. When combined with census and input-output data, LOB data permit appropriately detailed testing of hypotheses emanating from industrial organization's S-C-P framework.[7]

Previous work using product market or structural variables with the firm as the unit of observation has assigned a firm to a "major" industry and assigned industry aggregates as independent variables in that firm's observation. In addition, overall firm data have been used as if all the activity of the firm/observation was in that one "major" industry. The Line of Business survey provides product line-specific data so that the extent and importance of "non-major" activity can be accounted for. This unique data set permits the construction of firm-specific variables with weights appropriate to the importance of a line to a firm (*i.e.*, sales shares).

Each of the following variables is an average for the years 1974–1977. The firm-industry interdependence variables were constructed from the firm and industry level measures described by the following:

DIVNUM = number component of firm product diversification, $1-(1/n)$, where n is the number of lines of business in which a firm generates at least 1% of its sales;

DIVSIZ = size component of the firm product diversification, $\Sigma[SLB_j^2 - (1/n)^2]$, where SLB_j is the share of a firm's total sales originating in line of business j.

DIV = DIVNUM − DIVSIZ

of RQ was 0.9975 for the firms in the study. With this high correlation the regression results are not sensitive to the choice of the two RQ measures.

[6] For explicit definitions and comparison to census categories, see any of the FTC's Annual Line of Business Survey Reports, 1974–1977, Washington, D.C., Government Printing Office.

[7] See Ravenscraft [11] for an example of published work based on LOB data.

FPRO = firm promotional effort, the sales share-weighted average of total promotional expense in line of business j divided by sales in line of business j for the i^{th} firm.[8] The firm's sales shares (weights) were computed by dividing the i^{th} firm's sales in the j^{th} line of business by the value of the firm's total sales.

INDPRO = industry promotional effort, or the average promotional intensity of the industries in which the firm competes. This is the firm's sales share-weighted average of promotional expense by industry j divided by total sales of industry j.[9]

FRD = firm R&D effort, sales share-weighted average of firm financed R&D expenditures in the line of business j divided by sales of the i^{th} firm in the line of business j.

INDRD = industry R&D effort, sales share-weighted average of firm financed R&D expenditures for all firms in line of business j divided by total sales of these firms.

C. Basic Models

The basic empirical models follow the most common measurement practices used for the diversification, promotion, and R&D strategies. Alternative models allow for empirical estimation of the hypotheses outlined in the previous sections. All the models were estimated with relative q measures of performance (RQ) to analyze value enhancement due to strategies measured over the interval of study.

The first model includes only firm level promotion and R&D measures and the composite diversification index. An alternative model using the size and number components of the diversification index is specified to test for the more important diversification component.

$$RQ = \alpha_0 + \alpha_1 DIV + \alpha_2 FPRO + \alpha_3 FRD + error \quad (1)$$

$$RQ = \alpha_0 + \alpha_1 DIVNUM + \alpha_2 DIVSIZ + \alpha_3 FPRO + \alpha_4 FRD + error \quad (2)$$

Industry level measures of promotion and R&D are added to the basic models to consider firm and industry relationships separately.

$$RQ = \alpha_0 + \alpha_1 DIV + \alpha_2 FPRO + \alpha_3 INDPRO + \alpha_4 FRD + \alpha_5 INDRD + error \quad (3)$$

$$RQ = \alpha_0 + \alpha_1 DIVNUM + \alpha_2 DIVSIZ + \alpha_3 FPRO + \alpha_4 INDPRO + \alpha_5 FRD + \alpha_6 INDRD + error \quad (4)$$

D. Firm-Industry Interdependence Models

The basic models were modified to allow for various hypotheses of how the market capitalization process is related to firm-industry interdependence. These models use the firm/industry ratio and firm-industry absolute deviation measures outlined in Section II.

$$RQ = \alpha_0 + \alpha_1 DIV + \alpha_2 PRORAT + \alpha_3 RDRAT + error \quad (5)$$

$$RQ = \alpha_0 + \alpha_1 DIVNUM + \alpha_2 DIVSIZ + \alpha_3 PRORAT + \alpha_4 RDRAT + error \quad (6)$$

$$RQ = \alpha_0 + \alpha_1 DIV + \alpha_2 PRODIF + \alpha_3 RDDIF + error \quad (7)$$

$$RQ = \alpha_0 + \alpha_1 DIVNUM + \alpha_2 DIVSIZ + \alpha_3 PRODIF + \alpha_3 RDDIF + error \quad (8)$$

Empirical results from these models are discussed in the next section.

V. Results

Exhibit 1 summarizes the results of estimating Equations (1) through (4).[10] In the simple models of

[8]For example, suppose a firm has two lines of business, with 75% of its sales originating in one and 25% in the other. Further, suppose the firm has a promotional expense/sales ratio of 5% in line of business one and 2% in line of business two. The measure of firm promotional effort is FPRO = (0.75)(0.05) + (0.25)(0.02) = 0.0425.

[9]INDPRO is computed in the same way as FPRO. To continue with the same share weights of Footnote 8, suppose that total promotional expense/total sales = 6% in industry one and 1.5% in industry two. The measure of the industry promotional effort for this firm is INDPRO = (0.75)(0.06) + (0.25)(0.015) = 0.04875.

[10]One of the anonymous referees suggested that promotion (R&D) strategies may affect value differently in high promotion (R&D) firms than in low promotion (R&D) firms. To test this possibility, the firms were segmented according to their rank in each variable (top ⅓ = high, bottom ⅓ = low, middle ⅓ = medium). High, medium, and low dummy variables were used to create interaction variables that represent the effect of the level of the variable on the response coefficient. Complete models with interactions of all variables and models with interactions for only one variable (*i.e.*, promotion) were estimated to allow F-tests of the significance of interaction effects. In each case the null hypothesis, that the coefficients of interaction variables are equal to zero, could not be rejected at the 0.05 level of significance. The results suggest that segmentation of the sample by promotion, R&D, or diversification did not affect the estimated coefficients of the models.

Exhibit 1. Regression Results from the Basic Empirical Models*

Independent Variable	Dependent Variable = RQ (1)	(2)	(3)	(4)
DIV	0.09‡		0.14§	
	(2.36)		(2.98)	
DIVNUM		0.12‡		0.16‡
		(1.96)		(2.44)
DIVSIZ		−0.08		−0.12†
		(−1.25)		(−1.79)
FPRO	−0.54‡	−0.53‡	−0.14	−0.13
	(−3.20)	(−3.12)	(−0.47)	(−0.46)
INDPRO			−0.59	−0.59
			(−1.34)	(−1.33)
FRD	−1.25†	−1.11†	0.49	0.45
	(−1.86)	(−1.65)	(0.44)	(0.40)
INDRD			−2.36†	−2.34†
			(−1.7)	(−1.68)
Intercept	0.66§	0.64§	0.66§	0.64§
	(19.99)	(10.95)	(19.85)	(11.11)
R^2	0.129	0.129	0.158	0.159
Overall F	7.03§	5.25§	5.37§	4.47§

*Results based on 155 observations; t-statistics are in parentheses.
† = significant at the 0.1 level (two-tailed tests).
‡ = significant at the 0.05 level.
§ = significant at the 0.01 level.

Exhibit 2. Regression Results from Firm-Industry Interdependence Models*

Independent Variable	Dependent Variable = RQ (5)	(6)	(7)	(8)
DIV	0.06		0.08‡	
	(1.62)		(2.0)	
DIVNUM		0.11†		0.12‡
		(1.95)		(2.2)
DIVSIZ		−0.02		−0.04
		(−0.38)		(−0.71)
PRORAT	−0.04†	−0.04		
	(−1.7)	(−1.54)		
RDRAT	0.01	0.009		
	(0.6)	(0.44)		
PRODIF			−0.64	−0.62
			(−1.51)	(−1.44)
RDDIF			−3.49‡	−3.34‡
			(−2.42)	(−2.3)
Intercept	0.66§	0.62§	0.66§	0.61§
	(17.06)	(10.82)	(24.7)	(12.59)
R^2	0.041	0.044	0.075	0.082
Overall F	1.8	1.67	3.7‡	3.08‡

*Results based on 155 observations, t-statistics are in parentheses.
† = significant at the 0.1 level (two-tailed tests).
‡ = significant at the 0.05 level.
§ = significant at the 0.01 level.

Equations (1) and (2), where only firm level variables were used, diversification had a statistically significant and positive effect on firm value. When the traditional diversification index was broken down into its components in Equation (2), the number of product lines (DIVNUM) measure proved to be the most important dimension. Higher firm level promotional and R&D intensity significantly *reduced* value. This somewhat surprising finding will be discussed later in conjunction with tests of more precise hypotheses.

Equations (3) and (4) added industry level measures of promotion and R&D. Diversification remained statistically significant and positive, and the size dispersion component (DIVSIZ) as well as the number component was significant.[11] Thus, the results indicate that diversification investments do indeed enhance the value of the firm.

Of the remaining investment strategy variables, only the industry level of R&D intensity was significant, and it lowered the value of the firm. The drop in significance of the firm level variables when industry level variables were introduced illustrates the interdependence of firm-industry measures and the need for specific tests on the nature of that interdependence. This is precisely why Equations (5) through (8) were introduced. The basic models have significant overall F-tests and respectable R^2 measures, given their simplicity.[12] Over 15% of the cross-sectional variation of firm value can be explained by the simple models.

Regression results for alternative models based on firm-industry interdependence hypotheses are provided in Exhibit 2. As with the basic models, the R^2 values for the models were respectable and the overall F-tests were significant. With the exception of Equation (5), the statistically significant and positive effect of diversification is supported, with the number of product lines again emerging as the significant component of the composite index.

Mixed results are found in Equations (5) and (6), where the ratio measures of firm-industry promotion

[11]Recall that as DIVSIZ approaches zero, the more equally are a firm's sales distributed across product lines. Thus the negative sign in Equation (4) indicates that as a firm's sales shares become more balanced *i.e.*, as the firm gets more diversified, q rises.

[12]The tradeoff between presenting low R^2 values from multiple regression using firm specific observations and loss of information from analysis of variance (ANOVA) of portfolio groups was debated. The multiple regression results were chosen since the low R^2 values are actually high for this type of firm-specific research, and the highly significant F-statistics reflect significance of the basic hypotheses that are tested by three-way ANOVA. More basic ANOVA results, following the Michel and Shaked approach, are available upon request.

and R&D intensity are specified. The statistically significant and negative coefficient of PRORAT in Equation (5) supports the hypothesis that firm-level promotion beyond the industry benchmark is considered by the market to be excessive and inefficient. However, this result is sensitive to the specification of the diversification variable and is not confirmed in Equation (6).

Equations (7) and (8) indicate support for an additional valuation relationship with respect to R&D efforts. The statistically significant and negative coefficient for RDDIF indicates that extreme values of R&D intensity, above or below the industry benchmark, reduce firm value. This finding does not apply to promotion intensity, since the PRODIF variable is insignificant.

The most comprehensive picture of the effects of various investment strategies on the value of the firm can be drawn by considering the results as a whole. High industry R&D intensity apparently lowers the value of firms within that industry, *ceteris paribus* [Equation (2)]. This is most likely because high R&D intensity signals a high probability of product obsolescence. The insignificance of RDRAT [Equations (5) and (6)] indicates that spending more than the industry norm neither helps nor hurts a firm, but the clearly negative effect of RDDIF [Equations (7) and (8)] suggests that significant *deviation* from the industry benchmark in either direction makes a firm appear more risky.

The insignificance of PRODIF, on the other hand, indicates that there are many levels of promotional intensity consistent with a stable equilibrium value of the firm. The hypothesis that promotional activity is a zero-sum game, though, is given some support by Equations (1) and (5). The first because the level of firm promotional intensity was significantly negative when industry spending was ignored, and the second because PRORAT was negative. Together, these results imply that spending more on promotion in general and spending more than one's rivals in particular reduces the value of the firm. This zero-sum hypothesis is only weakly supported, though, because PRORAT was insignificant in Equation (6) and neither promotional variable was significant in Equation (2).[13]

VI. Conclusion

The primary purpose of this paper was to test the relationships between diversification, promotion, and R&D investment and the value of the firm. A number of improvements over the methodology and data in other studies were undertaken, including the use of relative q variables, a reduced form regression approach, and data from the Federal Trade Commission's Line of Business survey.

Diversification was found to have a statistically significant and positive influence on the value of the firm. This finding was robust across various specifications of empirical models. The number of product lines component of diversification proved to be more important than product line-sales share distribution in most models. This result is consistent with Michel and Shaked's [9] finding that unrelated diversification increases firm value.[14]

Promotional intensity was found to influence the value of the firm in several ways consistent with zero-sum-game nonprice competition. Limited support was found for the hypothesis that higher individual firm promotional investment, both absolute and relative to the industry norm, reduces the value of the firm. Both of these findings are consistent with non-cooperative oligopoly theory applied to promotion as a form of nonprice competition. Promotion investment below the industry norm was not found to be discounted. While additional research along the lines of this study is needed to provide stronger statements, it does not appear as if outspending one's rivals with promotional effort enhances firm value from a financial market perspective with the possible exception of industries with high concentration (see Footnote 13).

The findings for the relationships between value and

[13]Reduced form models were used to avoid simultaneous equation bias from including a concentration variable. Nevertheless, to address the concern that the estimated coefficients are sensitive to the level of industry concentration, the firms were segmented based on share-weighted concentration measures, much like the procedure in Footnote 10. In a full model, such as Equation (4), with concentration-promotion, concentration-R&D, and concentration-diversification interaction variables, the interaction coefficient vector was marginally significantly different from zero at the 0.05 level. Further tests of subsets of interactions indicated that the concentration-promotion interaction was significant and responsible for the overall significant F-statistic. This finding indicated that the net effect of promotion on value is *positive* for firms in highly concentrated industries and negative for medium and low concentration segments. This is a potentially important finding if verified in simultaneous equation specifications. Complete results of these tests are available upon request, subject to clearance from the FTC.

[14]For purposes of comparison, the Sharpe, Jensen, and Treynor measures of performance were used in all the models in Exhibits 1 and 2. The R^2 values were much lower for these performance measures, probably reflecting the measurement error problems of market line performance variables that force the use of portfolio groupings to enhance R^2. Only one major difference was noted in the statistical significance of variables, the DIVSIZ component as well as the DIVNUM component of diversification was significant.

R&D effort were slightly different from those found for promotional effort. There was evidence that deviations of R&D intensity (per dollar of sales) from the industry norm are discounted in the finance market. These findings indicate that firms may be well advised to follow industry benchmark R&D investment strategies.

In general, this study designed a new approach to answer a question of significant interest to management, "Which investment strategies contribute most to the value of a firm?" This approach facilitates interpretation of some complex interactions among strategies of multiproduct firms and their rivals. Further work exploring these interactions seems to be a very promising path toward definitive conclusions about the value of investment strategies to the firm.

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Appendix

Measurement of Tobin's q followed the basic methodology of Smirlock, Gilligan, and Marshall [18] and Lindenberg and Ross [8] as closely as possible. The only major exception was the use of estimated average life for plant and equipment, and straight line depreciation to get the reduction in replacement costs of plant and equipment before inflation adjustment. By contrast, Smirlock, Gilligan, and Marshall used a simple 5% annual depreciation schedule.

Tobin's q Construction

Separate calculations for market value and replacement cost were conducted for each firm in each year of the period under study. The average of the annual ratios of market value to replacement costs represents the measure of q for the period.

Replacement Cost — The Denominator of q

The denominator of q was measured by valuing the firm's assets at estimated costs of replacement. The firm's assets were categorized as plant and equipment, inventory, and other. The book value of plant and equipment in 1962 was assumed to be the replacement cost. For the following years, the value of plant and equipment was reduced using straight line depreciation and the firm's average life for plant and equipment (estimated over the years under study). Simultaneously, the preceding values were adjusted to the new price level using the GNP implicit price deflator. One half-year's depreciation and price level adjustment were made for new additions or sales, calculated as the change in gross plant at book value.

Adjustments for various inventory accounting methods followed Lindenberg and Ross [8]. When more than one method was reported by Compustat, the primary method was assumed to be the only one used. Average cost inventories were adjusted for a half-year's inflation. The producer price index was used to adjust the excess of beginning over ending inventory for FIFO, and changes in reported inventory were adjusted for a half-year's inflation. The average markup for the firm (*i.e.*, sales divided by cost of goods sold) was used to deflate inventories under the retail method. Inventories were maintained at book value for all other inventory accounting methods. Replacement cost was assumed to be equal to book value for all other assets.

Market Value — The Numerator of q

The market value of the financial claims against the firm was calculated to get the numerator of q. The value of equity was taken at the year-end market price. Preferred stock was assumed to be a perpetuity discounted at the average yield for the year reported by Moody's. Current liabilities, including that portion of the debt maturing within one year, and other liabilities were valued at book.

For years after 1973, Compustat provides data on the debt maturing in two, three, four, and five years. For years prior to 1974, the maturity of outstanding debt was assumed to have been issued in equal amounts over the preceding 20 years and to have 20-year maturities at issue. Coupon rates were assumed to have been equal to the long-term corporate bond return from Ibbotson and Sinquefield [7]. For the years after 1973, the debt with more than five years to maturity was assumed to be issued in equal increments and was treated like the debt prior to 1974. Debt was valued each year by using the current year's issue coupon rate to calculate the price. The market value of an issue is always equal to par during the year of issue with this method. The value of other liabilities was taken as the difference between the book value of total assets and the book values of common stock, preferred stock, current liabilities, and long-term debt.

Program Validation

To validate the preceding program, the results of Lindenberg and Ross were used to see if the program could duplicate their q ratios. Average q ratios for the years 1963 to 1977 were calculated for 160 firms in the Lindenberg and Ross study. Exhibit 3 provides summary statistics of the comparison between Lindenberg and Ross' (L&R) findings and the results of the modified program.

The difference in means and variances was tested. In each case, the null hypotheses of no difference in the matched means and no difference in the matched variances could not be rejected at a 5% significance level. These statistics and tests indicated that modifications to the L&R approach produced reliable estimates of Tobin's q ratios.

Exhibit 3. Summary Statistics for a Comparison of the Lindenberg and Ross q Measures and q Measures from the Modified Program over the Same Sample of Firms

	Lindenberg and Ross 1960–1977	Modified Program 1963–1977
Matched Sample Size	160	160
Mean	1.55	1.54
Standard Deviation	1.05	1.01
Minimum	0.50	0.59
Maximum	8.53	8.70

Correlation Coefficient = 0.98