To the Graduate Council:

I am submitting herewith a dissertation written by Michael Timothy Dugan entitled "An Empirical Examination of the Association Between the Degree of Operating Leverage and the Incidence of Receipt of Uncertainty Qualifications." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Business Administration.

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We have read this dissertation and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

AN EMPIRICAL EXAMINATION OF THE ASSOCIATION BETWEEN THE DEGREE OF OPERATING LEVERAGE AND THE INCIDENCE OF RECEIPT OF UNCERTAINTY QUALIFICATIONS

A Dissertation

Presented for the

Doctor of Business Administration

Degree

The University of Tennessee, Knoxville

Michael Timothy Dugan

December 1982

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DEDICATION

To my parents,

Mr. and Mrs. Albert F. Dugan

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ABSTRACT

The purpose of this study is to examine whether an association exists between firms' degree of operating leverage (DOL) coefficients and their incidence of receipt of uncertainty qualifications. An experimental sample of firms that received uncertainty qualifications during 1972-1975 and in 1981 and a comparison sample of an equal number of firms that received unqualified opinions during that same time period were selected. Analysis of variance (ANOVA) was used to test for the existence of an association between firms' DOL coefficient values (as calculated from a time-series regression model) and the incidence of receipt of uncertainty qualifications.

The DOL main effect was consistently significant in all of the analyses attempted, which corroborated the hypothesis that such an association exists. In addition, those firms with DOL coefficients around a value of one were those that were the least likely to receive an uncertainty qualification. Firms with both extremely small and extremely large DOL coefficients had the highest incidence of receipt of qualifications.

Finally, an attempt was made to develop a series of DOL prediction models based on accounting ratios using the technique of multiple regression analysis. The explanatory power of the models developed was poor. A potential explanation for such poor explanatory power is that a degree of operating leverage coefficient

captures certain factors and/or attributes of a firm's operating cost structure that are not impounded in traditional financial accounting ratios.

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CHAPTER ONE

INTRODUCTION AND DESCRIPTION OF THE RESEARCH PROBLEM

I. INTRODUCTION TO OPERATING LEVERAGE

Corporate finance textbooks (8, pp. 586-87; 37, pp. 771-78; 40, pp. 76-80) often present a discussion of the effects of leverage on firms' net earnings, and explanations are also offered about the volatility in earnings caused by these effects. Specifically, these texts describe the impact of two different types of leverage--financial leverage and operating leverage. Financial leverage is generated from the use of long-term debt in firms' capital structures and the increased rate of return on shareholders' equity brought about by the constructive use of such debt. Operating leverage is generated from the use of fixed cost assets in firms' production activities.

The degree of operating leverage (DOL) is an elasticity coefficient that measures the intensity of the effect of operating leverage. This coefficient measures the extent the variability in a firm's sales volume is reflected in that firm's operating earnings before interest and taxes. The computational formula for DOL is the percentage change in operating earnings before interest and taxes divided by the percentage change in dollar sales volume. This relationship may be expressed mathematically as follows:

$$DOL = \frac{\frac{\Delta EBIT}{EBIT}}{\frac{\Delta Q}{Q}}$$

where EBIT = operating earnings before interest and taxes

ΔEBIT = change in operating earnings before interest and taxes

Q = dollar sales volume

ΔQ = change in dollar sales volume

An awareness of the effects of operating leverage on a firm's earnings can be an important facet of the financial management of the firm. A knowledge of the magnification of sales variability arising from the use of fixed assets in operations, as reflected in the degree of operating leverage coefficient, could provide the financial manager with useful information for the types of decisions he has to make. For instance, a firm's financial manager may decide to defer the acquisition of an expensive fixed asset if there has been a reduction in that firm's sales volume because of the effect that such an acquisition would have on the magnification of the sales volume reduction.

Individuals external to the firm, such as shareholders and creditors, may also benefit from information about a firm's degree of operating leverage. Many studies have appeared in the accounting and the finance literatures that assess the ability of accounting variables to predict various events of interest such as bankruptcy, bond ratings, and mergers (2,4,22,30,31,36). The introduction of the degree of operating leverage coefficient as a predictor of one of these events may improve the predictive ability of the particular model employed.

II. DESCRIPTION OF THE RESEARCH PROBLEM

Auditors should also be interested in their client firms' degree of operating leverage coefficients. Researchers in the finance

literature have concluded that a firm's degree of operating leverage is a determinant of its level of systematic risk (as measured by beta in the Capital Asset Pricing Model) (16,18,28,33). There is an implication from these findings that the DOL component of systematic risk and the resulting magnification effect on earnings are firm-specific. Given the firm-specific nature of operating leverage, an association may exist between those factors that motivate a firm's auditor to render an uncertainty qualification (either a "subject to" opinion or a disclaimer of opinion, depending on the pervasiveness of these factors) and the firm's degree of operating leverage. Testing for the existence of such an association is the purpose of this research.

The research is accomplished in two phases. The first phase is the testing for the existence of an association between DOL and the incidence of receipt of uncertainty qualifications. The second phase is an attempt to develop a multivariate model for the prediction of DOL based on accounting variables.

III. RESEARCH APPROACH

In the first phase of the research, DOL coefficients are computed for an experimental sample of those firms that received uncertainty qualifications during a specified time period and a comparison sample of firms that received unqualified opinions during this same time period. A two-way analysis of variance (ANOVA) is then employed to test the research question as stated in alternative hypothesis form:

> An association exists between a firm's degree of operating leverage and its likelihood of receipt of an uncertainty qualification in its audit report.

This hypothesis is tested in the belief that DOL is capturing the underlying firm-specific factors that motivate the auditor to issue an uncertainty qualification. Insight into the nature of these firm-specific factors may be able to be gained from the particular reasons for which the qualification was rendered, as described by the auditor in his opinion.

The second phase of the research is the development of a multivariate model for the prediction of degree of operating leverage. A multiple regression model is developed to attempt to determine which accounting variables have the greatest ability, acting in concert, to predict DOL. If a strong association between DOL and incidence of uncertainty qualifications exists, an auditor might benefit from an awareness of the accounting variables that are acting in concert. For example, some linear combination of a long-term debt ratio and the ratio of net fixed assets to total assets may be associated with a specific level of DOL. However, such a combination may also indicate impairment of ability to obtain future financing, which is one of the several circumstances that could motivate the auditor to render an uncertainty qualification. If the DOL model does possess substantial predictive ability, the auditor may be able to use it as a tool in the analytical review phase of the audit.

IV. CONTRIBUTIONS OF THE STUDY

If a significant association between DOL and incidence of receipt of uncertainty qualifications is found in this study, such a finding could offer the auditor valuable insights about what operating attributes of firms (e.g., fixed vs. variable cost intensive) make them more prone to experiencing those types of problems, such as difficulties with realization of certain assets or inability to obtain future financing, that would make the rendering of an uncertainty qualification necessary. Even though no link or direction of causation would be established by the existence of this association, such insights might take the form of signals about a client's changed circumstances that require the auditor to render an uncertainty qualification or accumulate additional audit evidence (3).

A particular DOL value for a client may encourage the auditor to initiate certain actions (most likely related to the scope of the examination) that could result in a reassessment of his prior beliefs about the probability of that client's receiving a qualification. Even if no significant association is found between DOL and incidence of uncertainty qualifications in the study, there may still be other factors that would motivate the auditor to examine a client firm's DOL coefficient during the course of the audit.

Finally, this study is an interdisciplinary attempt at determining both the relevance and the practical usefulness of risk concepts developed in the finance literature for the kinds of

problems the auditor faces in conducting examinations of his clients' financial statements. The results of the study should also advance the state of knowledge about how accounting variables, systematic risk, and the real-asset risk determinants of systematic risk are related to each other.

V. ORGANIZATION

This dissertation is organized in a five-chapter sequence. The first chapter is devoted to an introduction of the concept of operating leverage and a description of the research problem. The second chapter is a review of prior research appearing in both the accounting and the finance literatures germane to the present study, and the third chapter presents the methodology employed in the conduct of the study. Chapter Four is a description of the results of the tests of association conducted, and Chapter Five is devoted to a presentation of the conclusions of the study and its implications for future research.

CHAPTER TWO

REVIEW OF RELEVANT PRIOR RESEARCH

I. INTRODUCTION

The purpose of this chapter is to summarize the results of several theoretical and empirical studies whose findings are relevant to the present study. All of the papers discussed in this section, with the exception of the final one, deal with the topic of operating leverage. Criticisms of studies are noted where the criticism has implications for an approach either undertaken or not undertaken in the current study.

II. STUDIES FROM THE FINANCE LITERATURE

Rubinstein

Rubinstein's paper (33) was an analytical attempt at a synthesis of various contributions to the mean-variance asset pricing paradigm made during the previous decade. His article was the first in the finance literature to consider operating risk as a component of systematic risk and to describe the relationship between operating risk and expected return in the context of the Capital Asset Pricing Model (CAPM). He concluded that operating leverage is one of four components of operating risk and affects a firm's systematic risk through the unit contribution margins of the products in a firm's product mix.

Percival

Percival's analysis (28) also attempted to define the role of operating leverage as a determinant of systematic risk. He concluded, as did Rubinstein, that operating leverage affects systematic risk through the unit contribution margin. Unfortunately, Percival failed to recognize the effect that an increase or decrease in fixed costs has on the equilibrium value of the firm and, accordingly, treated firm value as a constant throughout his analysis.

Gahlon and Gentry (1982)

This paper (18) is an extension of an earlier paper authored by Gahlon (16), which was the first discussion of operating leverage in the literature that considered explicitly the role of the degree of operating leverage (DOL) coefficient. Gahlon and Gentry found that the systematic risk element of the common shareholders' return "that derives from the firm's existing after-tax cash flow [is] a function of three macroeconomic variables and four types of real-asset risk" (p. 18). One of the four types of real-asset risk that they hypothesize to contribute to systematic risk is the firm's degree of operating leverage.

Lev

Lev (25) selected three homogeneous industries--electric utilities, steel companies, and petroleum companies--to test the hypothesis that a positive association exists between the extent of a firm's operating leverage and both the overall risk and the systematic risk of its common stock.

He obtained data on the firms' total operating costs and their physical output or volume and developed a regression model for each firm to derive an estimate of that firm's unit variable cost. He used the regression-based estimate of unit variable cost (i.e., the estimate of the slope of the regression line) as his surrogate for the effect of operating leverage. Per the theoretical framework developed by Rubinstein (33), Lev reasoned that the lower the unit variable cost of the firm, the greater is its use of operating leverage. This estimate was employed in a simple regression model to predict the systematic risk of the firm's common stock and its overall risk. Though the observed relationships were in the proper direction of association, the explanatory power of the unit variable cost estimate, as measured by the coefficient of determination (R^2), was not very good. The R^2 values ranged from .05 to .23 for systematic risk, and from .12 to .38 for overall risk.

Lev's approach to this study is open to debate. A plausible explanation for the low R^2 values is model misspecification. Lev believed that unit variable cost captured the effect of operating leverage. However, it is highly likely that unit variable cost does not completely capture the operating leverage effect and captures other factors that have no relationship with operating leverage. In their critique of an article authored by Abdel-Khalik and McKeown (1), Boatsman and Revsine (7) present several numerical examples and come to the conclusion that ". . . under uncertainty, the relationship between [variable] cost per unit and systematic risk is complex" (p. 99). A more appropriate surrogate for the effect of operating

leverage (in particular, the magnification effect) might have been an estimate of the firms' DOL coefficients over the time period covered in the study.

Mandelker and Rhee

The primary purpose of this paper (27) was to conduct an empirical test of the hypothesis of the existence of a trade-off between operating leverage and financial leverage in financial management, as espoused by corporate finance textbook authors (37, p. 784; 40, p. 682). Mandelker and Rhee found consistent negative correlations between the elasticity measures of the degree of operating leverage and the degree of financial leverage, which corroborated the trade-off hypothesis. Their other major contribution was methodological. They proposed a new econometric technique for the calculation of the leverage coefficients. The specifics of this technique are discussed in Chapter Three.

Ferri and Jones

Ferri and Jones (15) attempted to test the association between a firm's financial leverage and its industrial class, size, variability of earnings, and operating leverage. In particular, they asserted a negative association between the relative amount of debt in a firm's capital structure and its operating leverage. They believed that the reason for the negative association is that "the variability of the firm's future income is the chief factor in ex ante estimates of its ability to meet fixed charges" (p. 632). The logic implicit in this

argument is that the greater a firm's use of operating leverage, the more volatile are its earnings and cash flow, and, accordingly, the less its ability to meet the fixed interest charges that the existence of debt in its capital structure requires. The null hypothesis of no association between operating leverage (as measured by the ratio of net fixed assets to total assets) and financial structure (as measured by the ratio of total liabilities to total assets) was rejected for both years considered in the analysis, and the observed association was in the hypothesized direction.

Gahlon and Gentry (1977)

The major empirical effort of this paper (17) was an evaluation of the contributions of the various components of real-asset risk. They gathered data from 23 SIC industries and 385 "Fortune 500" companies. Their results showed that operating leverage represented from 20% to 40% of total corporate risk during the time period considered in the study.

III. STUDY FROM THE ACCOUNTING LITERATURE

Shank and Murdock

Shank and Murdock (34) undertook their study to test the validity of an assumption made by Warren in his two studies on the uniformity of auditing standards (38,39). Warren assumed that "audit conditions" are distributed uniformly among the members of the "Big Eight" public accounting firms. Based on their own intuition and

discussions with practitioners, Shank and Murdock questioned the validity of this assumption. Only the portion of their study germane to this study is discussed in this chapter.

Shank and Murdock studied over 1,100 uncertainty qualifications that were rendered during a four-year period (1972-1975). They found that a majority (79%) of these qualifications "related to uncertainties of asset realization or future financing" (p. 826). The authors reasoned that beta, the measure of the systematic risk of a firm's common stock in the Capital Asset Pricing Model, might be an appropriate surrogate for audit risk, where they describe audit risk as the "attributes of the financial situation of a client company [that] would be related to the expected incidence of uncertainty qualifications in the audit report" (p. 825).

Shank and Murdock selected 2,716 companies that had received audit opinions (both uncertainty qualifications and unqualified opinions) during the period studied and formed ten portfolios of these companies based on the ranges of the magnitudes of their beta coefficients. They ran a one-way analysis of variance (ANOVA) with beta as the treatment effect and audit opinion as the criterion variable. They reported that the F-statistic was significant at an alpha level of .10, implying an association between beta and incidence of qualifications, though they did not disclose the actual value of the statistic.

They ran additional tests to determine the association between incidence of qualifications and SIC industry classification, the debt-to-equity ratio, and the cumulative abnormal return residual metric to

verify that beta was not acting as "a proxy for some other factor" (p. 828). No statistically significant associations were found, leading the authors to conclude that "these data do seem to confirm that underlying variables which lead the auditor to qualify the audit opinion are positively related to the variables impounded in beta" (p. 829).

Despite this conclusion that Shank and Murdock reach, the viability of beta as a surrogate for audit risk is questionable. Audit risk is inherently an ex ante concept, while beta is computed ex post from the market model. There would seem to be a problem of expectations versus realizations with regard to information about the client available to the auditor prior to the issuance of the audit opinion.

In addition, economy-wide effects are impounded in beta through the return on the market portfolio. Though there may be some positive covariance with macroeconomic factors, uncertainty qualifications generally arise from firm-specific problems, such as the lack of ability to obtain financing or realize certain assets. The desire to develop a firm-specific measure of audit risk was the original motivation for the present study. The degree of operating leverage, a firm-specific real-asset risk determinant of beta, would seem more likely to be able to capture these firm-specific problems.

IV. SUMMARY

The purpose of this chapter was to describe the results of previous theoretical and empirical research on operating leverage that has appeared in the finance literature during the past decade.

In addition, the implications for the current study of a study that recently appeared in the accounting literature concerning the uniformity and comparability of auditing standards were presented.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

I. INTRODUCTION

The purpose of this chapter is to describe in detail the methodological approach that is employed to test the hypothesis of association between degree of operating leverage and the incidence of uncertainty qualifications. In addition, the procedure used for the development of a prediction model of the degree of operating leverage based on accounting variables is explained. After the specific statistical techniques and their limitations are discussed, the validity of these techniques for the research question addressed in this study is asserted.

II. SAMPLE SELECTION

An experimental sample of firms that received uncertainty qualifications from 1972 through 1975 and during 1981 is selected from the subset of uncertainty qualifications filed with the Securities and Exchange Commission during that period. This subset was determined by making a manual search of the Disclosure Journal (11) for the qualifications issued from 1972-1975 and by retrieving all uncertainty qualifications issued during 1981 from the DISCLO

computerized data base (19).[1] For a firm to be included in the experimental sample, it must meet the following criteria after its initial random selection from that subset:

1. The description of its filings with the Securities and Exchange Commission must appear in the Disclosure Journal.
2. It must be included on Standard and Poor's Industrial COMPUSTAT tape.
3. Its stock must be traded on either the New York or the American stock exchange.
4. It must have been in existence for five years prior to the year in which it received the uncertainty qualification.

The reason for the existence of the fourth criterion is that a sufficient number of observations are required for the calculation of the firms' degree of operating leverage coefficients.

In addition to the selection of a sample of uncertainty qualifications, a comparison sample of unqualified opinions of equal size to the experimental sample is chosen randomly from the population of unqualified opinions filed with the Securities and Exchange Commission to ensure that a certain range of degree of operating leverage coefficients is not specific to firms that received uncertainty qualifications during the time period covered in this study. For a

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[1]A portion of the search requires the use of DISCLO because publication of the Disclosure Journal was discontinued after the release of its January-April 1976 company resumés. Unfortunately, DISCLO contains only current filings, which is why data are not available for year ends 1976-1980 (12).

firm to be included in the comparison sample, it must meet the four criteria delineated for the experimental sample, and, additionally, its audit opinion must be unqualified. The implication of the inclusion of the final criterion is that firms that received consistency exceptions during the time period under study are excluded from the comparison sample.

III. CALCULATION OF DEGREE OF OPERATING LEVERAGE COEFFICIENTS

The degree of operating leverage coefficients that will be used in the test of association with the likelihood of uncertainty qualifications are those values derived from performing the following regression for at least five years and, if the data are available, at most ten years preceding the year in which the qualification is rendered to firm j:

$$\log E_{jt} = a_j + b_j \log S_{jt} + \varepsilon_{jt}$$

where E_{jt} = the annual operating earnings before interest and taxes for firm j in year t.

S_{jt} = the annual dollar sales of firm j in year t.

ε_{jt} = the disturbance term.

log = the natural logarithm operator.

The estimate of the slope of the regression line, $\hat{b}_j$, is the j^{th} firm's degree of operating leverage:

$$\hat{b}_j = \frac{\partial \log E_j}{\partial \log S_j} = \frac{\partial E_j}{\partial S_j} \cdot \frac{S_j}{E_j}$$

Thus, $\hat{b}_j$ is the point elasticity of operating earnings before interest and taxes with respect to sales, which is the mathematical definition of degree of operating leverage.[2]

An econometric problem that arises in employing this technique is the question of how many years of observations should be used in performing the regression. There is an assumption in this regression model that the slope coefficient is constant during the time period from which the observations were drawn. Accordingly, the time period should not be large enough to allow inclusion of structural changes that render the calculated degree of operating leverage coefficient meaningless.

In addition, given the time period covered in the study, it is important to consider the effects of the structural changes in financial reporting (in terms of both quality and quantity of disclosure) that

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[2]Here is a mathematical proof of the relationship proposed in this equation: Using the standard rule for taking derivatives of natural logarithms, the following can be derived:

$$\frac{\partial \log E_j}{\partial E_j} = \frac{1}{E_j} \rightarrow \partial \log E_j = \frac{\partial E_j}{E_j}$$

$$\frac{\partial \log S_j}{\partial S_j} = \frac{1}{S_j} \rightarrow \partial \log S_j = \frac{\partial S_j}{S_j}$$

Therefore,

$$\frac{\partial \log E_j}{\partial \log S_j} = \frac{\frac{\partial E_j}{E_j}}{\frac{\partial S_j}{S_j}} = \frac{\partial E_j}{\partial S_j} \cdot \frac{S_j}{E_j},$$

which was to be proved.

occurred as a result of the issuance of the Opinions of the Accounting Principles Board of the American Institute of Certified Public Accountants throughout the decade of the sixties (21, pp. 36-41). Operating earnings observations from the pre-APB era are really not comparable with those from later years. On the other hand, if too few observations are used in the regression to calculate the degree of operating leverage coefficient, the coefficient will be potentially affected by outlier observations that result from circumstances that are not expected to recur in the near future. Given the existence of these previously described trade-offs, an estimation period of at least five years and at most ten years is selected as being most appropriate for the purposes of this study.

IV. TESTS OF ASSOCIATION

The criterion measure in this research design is audit opinion. Intervals of degree of operating leverage coefficients computed from both the experimental and the comparison samples are formed so that the number of qualified opinions in each interval as a percentage of the total number of firms in that interval can be calculated. This percentage represents the incidence of uncertainty qualifications within an interval of degree of operating leverage coefficients. The hypothesis of association between degree of operating leverage and incidence of uncertainty qualifications is tested with the analysis of variance (ANOVA) procedure. A two-way ANOVA, with degree of operating

leverage interval and industry category as the levels of the treatment effects, is developed for the hypothesis testing.

Though the use of the ANOVA technique on a dichotomous criterion variable violates the homoscedasticity assumption of ANOVA, Lunney (26) states:

> If the proportion of responses in the . . . response category is not extreme, that is, if it is equal to or greater than .2 and the number of degrees of freedom for the within cell variance is equal to 20 or more, it is permissible to use ANOVA when the dependent variable is dichotomous. If these conditions hold and a researcher is using a fixed ANOVA model with equal cell frequencies, he can use dichotomous data in ANOVA and use values from the F-table with great confidence that the tabled values of the Type I error and Power are close to the true values for his situation (p. 367).[3,4]

A paper by D'Agostino (10) appearing in the same journal a year after the Lunney article extends Lunney's analyses and modifies his conclusions about when it is appropriate to employ dichotomous data in an ANOVA. D'Agostino asserts that "probably a safe rule of thumb for deciding when the . . . ANOVA techniques may be used on dichotomous data with equal sample sizes in each cell is: the sample proportions

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[3]The problem of violation of the homoscedasticity assumption arises because the variance of a binomial distribution equals np(1-p), where

n = cell sample size
p = probability of one outcome
1-p = probability of the other outcome

Even with equal cell sample sizes, the variance will differ across cells as the likelihood of one outcome versus the other varies.

[4]In a fixed effects ANOVA model, the researcher does not intend to infer to any levels of the factor(s) not incorporated in the research design (20, pp. 428-29).

for the cell should lie between .25 and .75 and there should be at least 20 degrees of freedom for error" (p. 329). The size of the sample in the current study will provide an ample number of degrees of freedom for the error term, and the DOL intervals can be created so that every interval of coefficient values contains the same number of observations.

Based on the evidence offered by Lunney and D'Agostino, it is appropriate to use the ANOVA technique on the dichotomous data appearing in this study. The other factor in the ANOVA design, industry, is partitioned by the first digit of the firms' Standard Industrial Classification (SIC) codes. This approach to industry classification is comparable to the one employed by Warren in his two studies on the uniformity of auditing standards (38,39). There are nine potential industry classification categories. A schematic diagram of the two-way ANOVA design is depicted in Figure 1.

In addition, a one-way analysis of variance, with degree of operating leverage as the single treatment effect, is planned. The results of the one-way ANOVA can be compared with those obtained from the two-way ANOVA to examine the sensitivity of the significance level of the operating leverage effect to possible industry-specific concentrations of degree of operating leverage coefficients at certain values or ranges of values. A schematic representation of the one-way ANOVA design is depicted in Figure 2. Finally, the number of degree of operating leverage categories will be varied to test the sensitivity of the results of the two-way and one-way ANOVAs to changes in the number of categories.

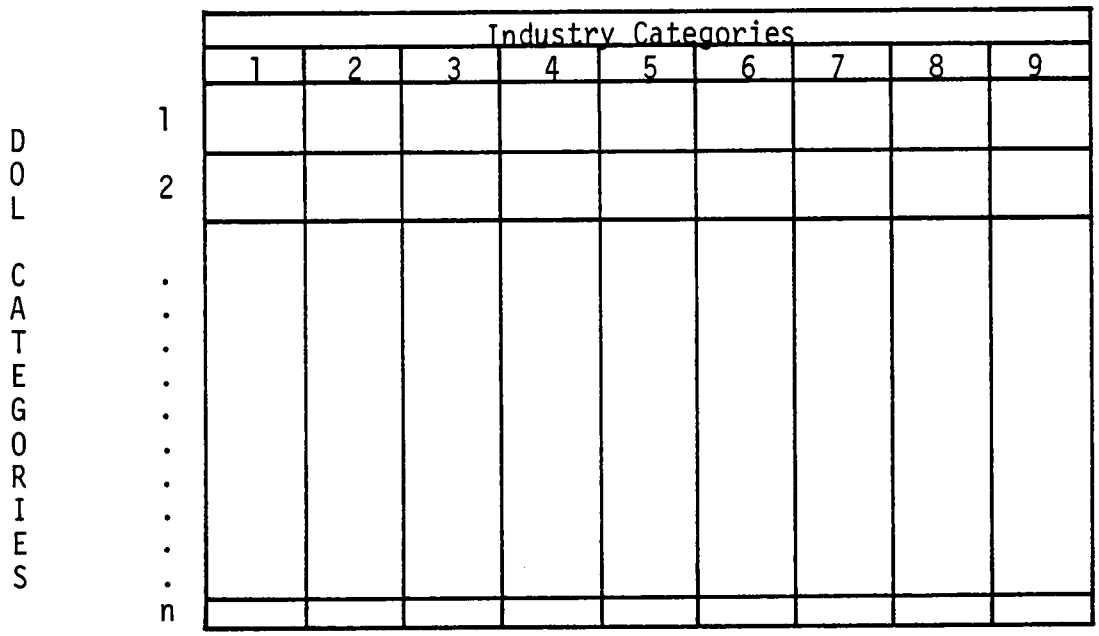


Figure 1. Representation of two-way analysis of variance design. n = number of DOL categories selected for the analysis.

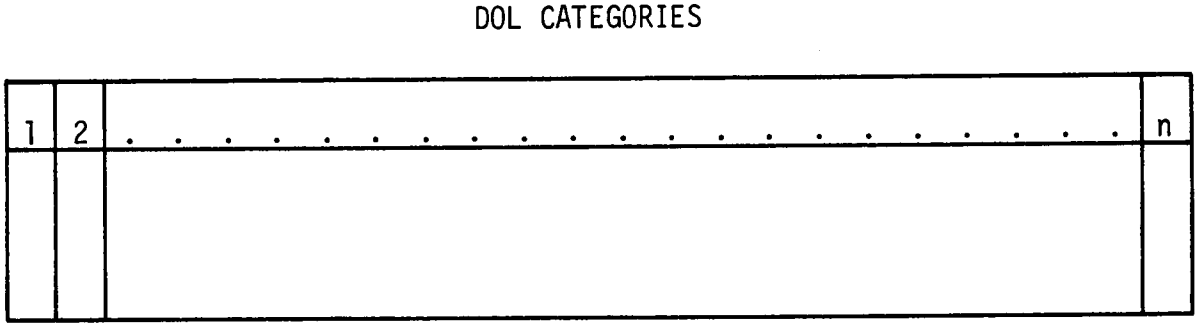


Figure 2. Representation of one-way analysis of variance design. n = number of DOL categories selected for the analysis.

V. MODELING OF DEGREE OF OPERATING LEVERAGE

The final segment of this research is an attempt at developing a multivariate model for the prediction of the degree of operating leverage. The predictor variables that are included in the model are those accounting ratios employed in various previous empirical studies, such as Beaver, Kettler, and Scholes (5), Pettit and Westerfield (29), and Rosenberg and McKibben (32) and those derived from an appreciation of the extant hypotheses about the relationship between the operating leverage and the financial leverage effects (15,23,27).[5] These variables are:

1. Current Ratio
2. Inventory to Total Assets
3. Net Fixed Assets to Total Assets
4. Asset Turnover
5. Long-Term Debt to Total Assets
6. Total Debt to Common Equity
7. Operating Profit (before Interest Expense and Tax Provision) to Sales
8. Sales to Net Fixed Assets

The statistical technique employed to develop the prediction model is multiple regression analysis. Both the direct and the stepwise approaches to the technique (13) are attempted in this final

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[5]The studies by Beaver, Kettler, and Scholes; Pettit and Westerfield; and Rosenberg and McKibben examined the relationship between many different accounting variables and systematic risk.

phase to find the approach and/or the set of predictor variables that offers a model with the greatest explanatory ability.

VI. SUMMARY

The analysis of variance technique is used in this study to test for the hypothesized existence of association between the degree of operating leverage coefficients calculated from the time-series regression analyses and the incidence of uncertainty qualifications. Given the description of the research design offered in this chapter, it is appropriate to use ANOVA in this study even though the criterion measure, which is audit opinion, is dichotomous in nature. Finally, an attempt is made at modeling degree of operating leverage based on a set of accounting ratios believed *a priori* to possess some level of predictive ability.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

I. INTRODUCTION

The purpose of this chapter is to present the results of the analysis of the sample data and to interpret the significance of these results for corroboration of the major hypothesis tested in this study. This hypothesis is that there exists an association between firms' degree of operating leverage (DOL) and their incidence of receipt of uncertainty qualifications. The presentation of this chapter appears in four segments. These segments include a description of the samples of firms selected; an explanation of the results derived from the econometric calculation of the firms' degree of operating leverage coefficients; the results of the analysis of variance tests of the major hypothesis; and the results of the attempt to predict degree of operating leverage through the use of multiple regression models based on accounting predictor variables.

II. SAMPLE SELECTION

Based on the sample selection criteria presented in Chapter Three, a total of 126 firms from the subset of uncertainty qualifications filed with the Securities and Exchange Commission during 1972-1975 and in 1981 were selected for inclusion in the experimental sample. In addition, a comparison sample of 126 firms that received unqualified opinions during the same period and that met the

criteria delineated in Chapter Three for this sample was formed. Table 1 is a segregation of the total sample of firms by year and by type of audit opinion rendered. Table 2 lists the names of the firms included in the experimental and the comparison samples, the first digit of their industry codes, and, for the experimental samples of uncertainty qualifications, presents the explanation for the rendering of the qualification as described in the Disclosure Journal.

The criterion that a potential firm failed to meet most often was its being listed on either the New York or the American stock exchanges. There were a rather large number of firms whose shares are traded over-the-counter that received uncertainty qualifications during the time period covered in this study that were excluded from the study because of the existence of this selection criterion. There were other firms that received uncertainty qualifications because of questions about the realizability of certain of their deferred start-up costs. However, many of these firms were also excluded from the sample because they had not been in existence for five years previous to the year in which they received the qualification and, accordingly, failed that selection criterion. The potential sample was further reduced by the occurrence of a statistical phenomenon in the calculation of the degree of operating leverage coefficients. This phenomenon is described in the next segment of this chapter.

The reasons offered in the Disclosure Journal for the rendering of the uncertainty qualifications by the firms' auditors include problems of asset realizability, litigation, questions about the

Table 1. Classification of firms by year and by type of audit opinion rendered.

Type of Opinion/Year	1972	1973	1974	1975	1981	Total
Uncertainty qualifications	22	31	30	21	22	126
Unqualified opinions	22	31	30	21	22	126
Total	44	62	60	42	44	252

Table 2. List of firms in samples.

Number	Firm Name	Code*	Reason(s) for Qualification
1972--Experimental Sample of Uncertainty Qualifications			
1	American Controlled Inds.	3	Asset Realization; Deferred Costs
2	Belco Petroleum Corp.	2	Asset Realization; Government Contracts
3	Black & Decker Mfg. Co.	3	Contingencies; Antitrust
4	Boise Cascade Corp.	2	Loss Allowances; Asset Disposal
5	Continental Group	3	Asset Realization; Discontinued Operations
6	Crystal Oil Co.	2	Asset Realization; Contingencies
7	Dayco Corp.	3	Asset Realization; Litigation
8	DCL Inc.	7	Asset Realization; Leased Equipment
9	Dial Corp.	6	Income Taxes; Consolidated Subsidiaries
10	Fieldcrest Mills	2	Contingencies
11	Hecla Mining Co.	1	Asset Realization; Deferred Costs
12	International Stretch Products	2	Asset Realization
13	Iowa Electric Light & Power	4	Asset Realization; Litigation
14	Katy Industries	3	Asset Realization; Contract Breaching
15	Lydall Inc.	2	Excess Profit Margins; Government Contracts
16	McIntyre Mines Ltd.	1	Going Concern; Asset Realization
17	Ogden Corp.	5	Claims; Government Contracts
18	RPS Products Inc.	5	Asset Realization; Inventory
19	Stanley Works	3	Asset Realization; Divestiture
20	Superior Oil Co.	1	Asset Realization; Rate Cases
21	United Brands	2	Loss Allowances; Asset Disposal
22	Zapata Corp.	1	Asset Realization; Discontinued Operations
1972--Comparison Sample of Unqualified Opinions			
1	Borden Inc.	2	
2	Brown & Sharpe Mfg. Co.	3	
3	Ceco Corp.	3	
4	Certain-Teed Corp.	2	
5	Colt Industries, Inc.	3	
6	Conrac Corp.	3	
7	Diebold, Inc.	3	
8	Dover Corp.	3	
9	Fab Industries, Inc.	2	
10	Fleming Companies, Inc.	5	

Table 2 (Continued)

Number	Firm Name	Code*	Reason(s) for Qualification
11	Imperial Corp. of America	6	
12	Lenox Inc.	3	
13	Louisiana Land & Explora.	1	
14	Pacific Scientific Co.	3	
15	Pratt & Lambert Inc.	2	
16	Reece Corp.	3	
17	Rogers Corp.	3	
18	Rowan Cos. Inc.	1	
19	Square D Co.	3	
20	Stride Rite Corp.	3	
21	Teledyne Inc.	3	
22	Watkins-Johnson	3	
1973--Experimental Sample of Uncertainty Qualifications			
1	Applied Devices	7	Going Concern; Working Capital Deficiency
2	Black Hills Pwr&Lgt Co.	4	Loss Allowances; Litigation
3	Breeze Corp.	3	Litigation; Warranty Breaching
4	Central Vermont Public Service	4	Asset Realization; Litigation
5	Circle K Corp.	5	Contingencies; Antitrust
6	Coleman Co. Inc.	3	Asset Realization; Taxes
7	Consolidated Oil & Gas	1	Asset Realization; Litigation
8	Diodes Inc.	3	Asset Realization; Bankrupt Investees
9	Eastern Air Lines	4	Asset Realization; Asset Disposal
10	Edo Corp.	3	Contract Renegotiation; Fixed-Price Contracts
11	Esterline Corp.	3	Contract Defaulting; Litigation
12	First Mississippi Corp.	2	Contract Breaching; Litigation
13	B. F. Goodrich Co.	3	Asset Realization; Discontinued Operations
14	H. J. Heinz Co.	2	Loss Allowances; Discontinued Operations
15	Horn & Hardart Co.	5	Loss Allowances; Discontinued Operations
16	Husky Oil Ltd.	2	Asset Realization; Deferred Costs
17	International Banknote	2	Going Concern; Financing
18	International Stretch Products	2	Asset Realization; Discontinued Operations
19	Lehigh Press Inc.	2	Asset Realization; Unrecorded Assets
20	Ogden Corp.	5	Asset Realization; Contract Price Redetermination

Table 2 (Continued)

Number	Firm Name	Code*	Reason(s) for Qualification
21	P&F Industries Inc.	3	Asset Realization; Litigation
22	Plessey Co. Ltd.	3	Asset Realization; Government Contracts
23	Resorts International	7	Asset Realization; Long-Term Investments
24	Savin Corp.	5	Asset Realization; Deferred Costs
25	Springs Mills Inc.	2	Loss Allowances; Discontinued Operations
26	Standard Metals	1	Asset Realization; Deferred Costs
27	TFI Cos. Inc.	5	Asset Realization; Tax Refunds
28	Warner-Lambert Co.	2	Asset Realization; Tax Refunds
29	Western Union Corp.	4	Asset Realization; Deferred Costs
30	Wrather Corp.	7	Going Concern; Asset Realization
31	Zapata Corp.	1	Asset Realization; Deferred Costs
1973--Comparison Sample of Unqualified Opinions			
1	American Motor Inns	7	
2	American Sterilizer Co.	3	
3	Banister Construc. Ltd.	1	
4	Branch Industries	4	
5	Bristol-Myers Co.	2	
6	Brockway Glass Co.	3	
7	Carnation Co.	2	
8	Certain-Teed Corp.	2	
9	Church's Fried Chick. Inc.	5	
10	Eastman Kodak Co.	3	
11	Emhart Corp.	3	
12	Ennis Business Forms	2	
13	Fabri-Centers of America	5	
14	General Cinema Corp.	2	
15	Honeywell Inc.	3	
16	Ideal Toy Corp.	3	
17	Interphoto Corp.	5	
18	Mite Corp.	3	
19	Monsanto Co.	2	
20	Mount Vernon Mills Inc.	2	
21	Newbery Energy	1	
22	Niagara Mohawk Power	4	
23	Olla Industries	3	
24	Pacific Lumber Co.	2	
25	Pepsico Inc.	2	
26	Quaker Oats Co.	2	
27	Riegel Textile Corp.	2	

Table 2 (Continued)

Number	Firm Name	Code*	Reason(s) for Qualification
28	Selas Corp. of America	3	
29	Sherwin-Williams Co.	2	
30	Squibb Corp.	2	
31	Trane Co.	3	
1974--Experimental Sample of Uncertainty Qualifications			
1	ACF Inds.	3	Financing; Foreign Subsidiaries
2	Amalgamated Sugar Co.	2	Litigation; Price Fixing
3	American Agronomics	0	Litigation; Litigation Loss Allowances
4	American Controlled Inds.	3	Contingencies; Divestiture
5	Apache Corp.	3	Asset Realization; Inventory
6	Arcata Corp.	2	Asset Realization; Receivables
7	Argo Petroleum	1	Asset Realization; Oil & Gas Property
8	Arundel Corp.	1	Asset Realization; Litigation
9	Avco Corp.	3	Asset Realization; Receivables
10	Cook United Inc.	5	Fixed Assets; Financing
11	DCL Inc.	7	Asset Realization; Leases
12	Dorchester Gas Corp.	2	Asset Realization; Investments
13	Florida Power & Light	4	Litigation; Rate Increases
14	Hoffman Industries Inc.	3	Going Concern; Financing
15	Hudson General Corp.	7	Asset Realization; Fixed Assets
16	ITI Corp.--Ohio	6	Asset Realization; Subsidiaries
17	Litton Industries Inc.	3	Asset Realization; Receivables
18	McDonnell Douglas Corp.	3	Asset Realization; Deferred Costs
19	Mickelberry Corp.	2	Asset Realization; Investments
20	Movielab Inc.	7	Asset Realization; Litigation
21	National Gypsum Co.	3	Asset Realization; Antitrust
22	National Presto Inds. Inc.	3	Contract Renegotiation; Government Contracts
23	Ramada Inns Inc.	7	Asset Realization; Marketable Securities
24	Solitron Devices Inc.	3	Contingencies; Excess Profit Margins
25	Stanley Works	3	Asset Realization; Divestiture
26	Sterling Electronics	5	Contract Defaulting; Government Contracts
27	Stop & Shop Cos.	5	Asset Realization; Litigation
28	Union Corp.	3	Asset Realization; Damages
29	Viatech Inc.	7	Going Concern; Financing
30	White Consolidated Inds. Inc.	3	Asset Realization; Investments

Table 2 (Continued)

Number	Firm Name	Code*	Reason(s) for Qualification
1974--Comparison Sample of Unqualified Opinions			
1	Adams Russell	3	
2	Alpha Portland Inds.	1	
3	Amerada Hess Corp.	2	
4	Aro Corp.	3	
5	Badger Meter Inc.	3	
6	Barclay Industries	2	
7	Crompton Co., Inc.	2	
8	Crompton & Knowles Corp.	2	
9	Cyclops Corp.	3	
10	Federal Co.	2	
11	Flexi-Van Corp.	7	
12	Genstar Ltd.	1	
13	Gross Telecasting	4	
14	Hayes-Albion Corp.	3	
15	Houghton-Mifflin Co.	2	
16	Interna'l Flav.&Frag.	2	
17	Interpace Corp.	3	
18	Massey Ferguson Ltd.	3	
19	Materials Research	3	
20	Movie Star, Inc.	2	
21	Norton Simon Inc.	2	
22	Perini Corp.	1	
23	Pioneer Texas Corp.	7	
24	Rite Aid Corp.	5	
25	Sterchi Bros. Stores Inc.	5	
26	TEC Inc.	3	
27	Union Electric Co.	4	
28	United Inns Inc.	7	
29	Watkins-Johnson	3	
30	Wellco Enterprises	3	
1975--Experimental Sample of Uncertainty Qualifications			
1	Aeronca Inc.	3	Asset Realization; Receivables
2	Armada Corp.	3	Asset Realization; Investments
3	Baruch-Foster Corp.	1	Asset Realization; Contract Termination
4	Bausch & Lomb Inc.	3	Asset Realization; Deferred Costs
5	Browning-Ferris Inds.	4	Asset Realization; Receivables
6	Circle K Corp.	5	Asset Realization; Contract Breaching
7	Crown Central Petroleum	2	Asset Realization; Deferred Costs

Table 2 (Continued)

Number	Firm Name	Code*	Reason(s) for Qualification
8	Deltona Corp.	6	Asset Realization
9	General Tire & Rubber Co.	3	Contract Breaching; Litigation
10	Glasrock Medical Services	3	Asset Realization; Subsidiaries
11	Gulf Resources & Chemical	1	Asset Realization; Disputed Receivables
12	Hazeltine Corp.	3	Asset Realization; Contract Negotiation
13	Hudson General Corp.	7	Asset Realization; Leases
14	E. F. MacDonald Co.	7	Asset Realization; Investments
15	Met-Pro Corp.	3	Asset Realization; Contract Renegotiation
16	Mississippi Valley Gas Co.	4	Asset Realization; Rate Increases
17	P&F Industries Inc.	3	Asset Realization; Discontinued Operations
18	Poloron Products Inc.	2	Going Concern; Financing
19	Ryerson & Haynes Inc.	3	Financing
20	Scovill Inc.	3	Divestiture; Loss Allowances
21	Tidwell Industries	2	Asset Realization; Discontinued Operations

1975--Comparison Sample of Unqualified Opinions

1	American Broadcasting	4
2	Beatrice Foods Co.	2
3	Bobbie Brooks Inc.	2
4	Cities Service Co.	2
5	Cox Broadcasting Group	4
6	Crown Zellerbach	2
7	Eaton Corp.	3
8	Heublein Inc.	2
9	Hoffman Industries	3
10	Malone & Hyde Inc.	5
11	Marshall Industries	5
12	National Health Enterpr.	8
13	Numac Oil & Gas Ltd.	1
14	Proler International Corp.	3
15	Rockaway Corp.	3
16	Technicolor Inc.	7
17	Toledo Edison Co.	4
18	Trinity Industries	3
19	Vesely Co.	3
20	West Chemical Prod. Ind.	2
21	Wyle Laboratories	5

Table 2 (Continued)

Number	Firm Name	Code*	Reason(s) for Qualification
1981--Experimental Sample of Uncertainty Qualifications			
1	Allied Supermarkets	5	Going Concern; Litigation
2	Apache Corp.	3	Going Concern
3	Argo Petroleum	1	Litigation
4	Armada Corp.	3	Litigation
5	Ceco Corp.	3	Litigation
6	Centronics Data Computer	3	Financing
7	Cooper-Jarrett Inc.	4	Going Concern
8	Eazor Express Inc.	4	Going Concern
9	Federal Resources	1	Asset Realization
10	Fotomat Corp.	7	Litigation
11	Gaynor-Stafford Inds.	2	Asset Realization
12	Halliburton Co.	1	Litigation
13	Intermountain Gas Inds.	4	Asset Realization
14	International Systems & Controls	3	Going Concern
15	Massey Ferguson Ltd.	3	Financing
16	Medco Jewelry Corp.	5	Going Concern
17	Nalco Chemical Co.	2	Litigation
18	Publicker Industries, Inc.	2	Asset Realization
19	Ranchers Exploration & Development	1	Asset Realization
20	Reading Industries	3	Going Concern
21	Struthers Wells Corp.	3	Asset Realization
22	Vendo Co.	3	Going Concern
1981--Comparison Sample of Unqualified Opinions			
1	CBS Inc.	4	
2	Conrac Corp.	3	
3	Delta Air Lines, Inc.	4	
4	DeLuxe Check Printers	2	
5	Felmont Oil Co.	1	
6	Hanna Mining Co.	1	
7	Holiday Inns, Inc.	7	
8	Insilco Corp.	2	
9	Mattel Inc.	3	
10	Merrill Lynch & Co.	6	
11	Parsons Corp.	8	
12	RCA Corp.	3	
13	Rockwell Internat'l Corp.	3	
14	Rorer Group	2	
15	Salem Corp.	3	

Table 2 (Continued)

Number	Firm Name	Code*	Reason(s) for Qualification
16	Shell Oil Co.	2	
17	Spectro Industries Inc.	5	
18	U&I Inc.	0	
19	UMC Industries	3	
20	Westcoast Transmiss. Ltd.	4	
21	Wheelabrator-Frye	3	
22	Wilson Brothers	2	

*Industrial Code.

viability of the going concern assumption, and the firm's potential for obtaining future financing. It could be argued that the intensity of the incidence of uncertainty qualifications varies as a function of the then current macroeconomic environment. Such an argument would imply that it is inappropriate to test for the existence of association between the incidence of uncertainty qualifications and a factor that is purely firm-specific, namely, the degree of operating leverage. For the purposes of this study, it is assumed, as is assumed in the authoritative auditing pronouncements (3), that the underlying reasons for the rendering of the qualifications by the firms' auditors are predominantly firm-specific in nature and that such predominance mitigates the effects of any economy-wide factors. Additionally, inclusion of an industry effect, as captured by the first digit of the firms' SIC codes, in the analyses of variance aids in controlling for any factors that affect more than one firm within an industry.

III. CALCULATION OF DEGREE OF OPERATING LEVERAGE COEFFICIENTS

The econometric technique for calculating degree of operating leverage (DOL) coefficients, as presented in the paper by Mandelker and Rhee, was employed to compute DOL coefficients for each firm included in the sample. At least five years and at most ten years of sales and operating earnings (before interest expense and the provision for income taxes) data for the firms included in the samples were retrieved from the COMPUSTAT tape and were used to develop the following time-series regression model for each firm with the SPSS subprogram REGRESSION:

$$\log E_{jt} = aj + bj \log S_{jt} + \varepsilon_{jt}$$

where E_{jt} = the annual operating earnings before interest and taxes for firm j in year t

S_{jt} = the annual dollar sales of firm j in year t

ε_{jt} = the disturbance term

log = the natural logarithm operator.

The estimate of the slope of the regression line, $\hat{b}_j$, was the j^{th} firm's degree of operating leverage. Ten years was selected as the maximum estimation period because there is an assumption that the degree of operating leverage was constant over the time period from which the observations used to develop the model were drawn.[1]

The calculated DOL coefficients ranged from .004 to 7.995, though a majority of the coefficients were clustered between .300 and 2.000. A frequency distribution of DOL coefficients is depicted in Table 3. The fact that there exist a large number of firms with degree of operating leverage coefficients between 1.000 and 2.000 has implications for the results of the tests of association between DOL and the incidence of uncertainty qualifications, which will be described in a later segment of this chapter. Those calculated DOL values that were excessively small (below .100) or excessively large

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[1]In their paper, Mandelker and Rhee (27) used twenty years of sales and operating earnings before interest and taxes observations and partitioned the observations into two sub-periods of ten years each. They employed a variation of the analysis of covariance, called the Chow Test (9), to examine if the degree of operating leverage coefficients remained stable from one ten-year sub-period to the next. They found that for their sample of firms, they could not reject the null hypothesis of the equality of the coefficients between the two sub-periods at standard levels of significance.

Table 3. Frequency distribution of DOL coefficients.

	Ranges of Coefficients												
	0-.100	.101-.200	.201-.300	.301-.400	.401-.500	.501-.600	.601-.700	.701-.800	.801-.900	.901-1.000	1.001-1.500	1.501-2.000	Above 2.000
Frequency	13	7	8	12	10	12	17	22	20	21	74	20	16

(above 3.000), as deemed by the values of a majority of the observations, were examined carefully to verify that the data were not coded incorrectly, and the SPSS subprogram REGRESSION was rerun to assure that the SPSS control cards were correctly sequenced. In all cases of these extreme values, there were no errors of either type described noted.

During the phase of the study in which the firms' degree of operating leverage coefficients were calculated, an interesting phenomenon surfaced. There were several firms whose calculated DOL coefficients were negative. Theoretically, DOL coefficients should take on values between zero and positive infinity. Though these firms with the negative DOL coefficients were excluded from both the experimental and the comparison samples, it is important to attempt to explain why this phenomenon occurred.

A statistical explanation for the occurrence of this phenomenon is depicted in Figure 3. In those cases where a negative DOL coefficient was computed for a firm, some of the series of sales and earnings before interest and taxes observations deviated from the trend of remaining observations in the series to such an extent that the fitted regression line had a negative slope. Given that the slope of the regression line represents an estimate of the firm's DOL coefficient, the negative slope is the negative DOL coefficient for that firm. A potential substantive explanation for the occurrence of this phenomenon is structural change. Such structural change might take the form of active attempts on the part of operating and

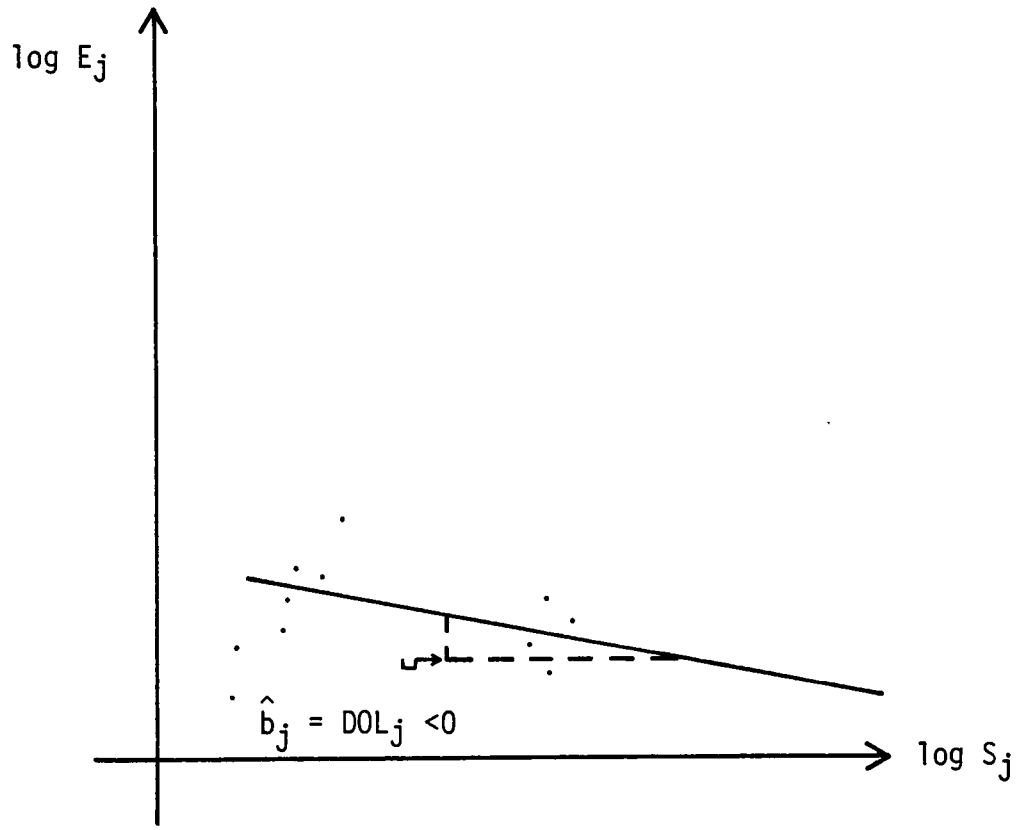


Figure 3. Statistical explanation for occurrence of negative degree of operating leverage coefficients.

financial management to change the mix of variable and fixed costs in a firm's production activities; other examples of such structural factors include changes in product mix, input prices, and technology that could cause a firm's breakeven point to shift permanently.

In an attempt to gather evidence about the plausibility of structural change as an explanation for the negative DOL coefficients, a judgment sample of firms that had negative DOL coefficients and another judgment sample of firms with DOL coefficients around a value of one were selected. Several traditional accounting ratios were calculated for these firms to determine if any of these ratios captured or served as a surrogate for other variables that captured this structural change. The ratio that seemed to be the most frequently volatile and, accordingly, was deemed to be a viable surrogate for structural change was the ratio of sales to net fixed assets. Table 4 lists the names of these samples of firms and their ratios of sales to net fixed assets for the year in which these observations were initially retrieved and for the two preceding and, where available (i.e., for all firms except those retrieved from 1981), the two subsequent years. The volatility of this ratio of fixed asset turnover for the sample of firms with negative DOL coefficients, as compared with the reasonably stable time series of this ratio for the firms with DOL coefficients around one, provides some evidence that some type of structural change might have occurred.

Table 4. Ratios of sales to net fixed assets for judgment samples of firms with negative DOL coefficients and firms with DOL coefficients of approximately one.

Firm Name	Two Prior Years		Year Initially Retrieved	Two Subsequent Years	
Negative DOL Firms					
Callahan Mining Corp.	2.985	4.608	5.269	6.424	2.779
Cellu-Craft Inc.	5.651	5.358	7.058	7.458	7.316
King Optical Corp.	3.625	2.531	1.706	-	-
Lehigh Valley Inds.	6.877	7.930	7.194	8.280	7.947
Tobin Packing Co. Inc.	15.272	10.436	11.579	-	-
Firms with DOL Coefficients of Approximately One					
American Sterilizer Co.	8.935	8.833	7.773	8.224	7.701
Beatrice Foods Co.	8.152	8.557	8.564	8.307	8.365
Deluxe Check Printers	3.325	3.342	3.323	-	-
General Cinema Corp.	3.300	2.978	3.221	3.634	4.153
Husky Oil Ltd.	0.951	1.029	1.170	1.761	1.609

IV. RESULTS OF THE TESTS OF THE MAJOR HYPOTHESIS

Justification for using the analysis of variance (ANOVA) technique on a dichotomously measured criterion variable was provided in the papers by Lunney (26) and D'Agostino (10) discussed in Chapter Three. D'Agostino asserted that it is probably safe to employ an ANOVA model with equal cell frequencies in such a circumstance when "the sample proportions for the cell . . . lie between .25 and .75 and there [are] at least 20 degrees of freedom for error" (p. 329). The size of the experimental and the comparison samples provided a sufficient number of degrees of freedom in the error term, and intervals of DOL coefficients were created so that every interval of coefficient values contained an equal number of observations. Analyses using category sizes of four, six, eight, and ten intervals of DOL coefficients were attempted. With one minor exception, for all category sizes the within-interval proportions of uncertainty qualifications fell within the bounds suggested by D'Agostino. Table 5 depicts the within-interval proportions of qualifications for each category size attempted in this phase of the analysis and the ranges of the DOL coefficient values that fall within these intervals. The results for each category size are described separately.

The next section of this segment of the chapter will present the results of the analysis of variance tests. The first set of analyses described is the two-way ANOVA with degree of operating leverage and industry as the treatment effects. As was mentioned

Table 5. Within-interval proportions of qualifications for the four category sizes attempted in the study and ranges of DOL coefficients within each interval.

Category Number	1	2	3	4	5	6	7	8	9	10
Four DOL Categories										
Range of DOL coefficients	.004-.600	.602-.918	.922-1.249	1.251-7.995						
Proportion of qualifications	67%	48%	38%	48%						
Six DOL Categories										
Range of DOL coefficients	.004-.424	.426-.725	.730-.918	.922-1.134	1.136-1.413	1.413-7.995				
Proportion of qualifications	64%	57%	50%	31%	43%	55%				
Eight DOL Categories										
Range of DOL coefficients	.004-.355	.356-.602	.605-.782	.785-.918	.922-1.073	1.076-1.248	1.249-1.557	1.560-7.995		
Proportion of qualifications	57%	78%	38%	56%	25%	53%	34%	60%		
Ten DOL Categories										
Range of DOL coefficients	.004-.269	.277-.501	.504-.671	.671-.796	.813-.918	.922-1.043	1.048-1.163	1.183-1.325	1.331-1.619	1.722-7.995
Proportion of qualifications	58%	72%	64%	36%	56%	32%	36%	44%	40%	62%

in Chapter Three, the partitioning of industry was by the first digit of the firms' SIC codes. A listing of the types of companies classified within each industry category appears in Table 6.

V. RESULTS OF THE TWO-WAY ANALYSES OF VARIANCE

Four Categories

The source of variation table for the two-way ANOVA with four categories of DOL is presented in Table 7. The DOL main effect is significant with a p-value of .006, and the industry main effect is not significant at alpha levels of .01, .05, or .10, which are described as conventional significance levels throughout the remainder of these results. In addition, the two-way interaction between DOL and industry is also not significant. Figure 4 depicts a graph of the incidence of uncertainty qualifications plotted as a function of degree of operating leverage. It is obvious from this graph that firms with both very low and very high DOL coefficients were the most likely to receive uncertainty qualifications and that firms with coefficients between the two extremes had a lower incidence of receipt of qualifications.

Six Categories

The source of variation table for the two-way ANOVA with six categories of DOL is presented in Table 8. The DOL main effect is significant with a p-value of .037, and neither the industry main effect nor the two-way interaction effect between DOL and industry is significant at conventional significance levels. Figure 5 depicts

Table 6. Listing of types of companies within each SIC one-digit industry category.

1st SIC Digit	Types of Companies within Classification
0	Agricultural
1	Mining
2	Manufacturing (I)
3	Manufacturing (II)
4	Transportation and Public Utilities
5	Wholesale and Retail Trade
6	Finance, Insurance, and Real Estate
7	Services (I)
8	Services (II)

Table 7. Source of variation table for two-way ANOVA with four categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
Degree of operating leverage (DOL)	3.151	3	1.050	4.266	0.006
Industry (IND)	2.224	8	0.278	1.129	0.345
Main effects	4.938	11	0.449	1.823	0.051
Interaction between DOL and IND (DOL x IND)	3.649	19	0.192	0.780	0.729
Total explained	8.587	30	0.286	1.163	0.266
Residual	54.413	221	0.246		
Total	63.000	251	0.251		

R^2 = .078

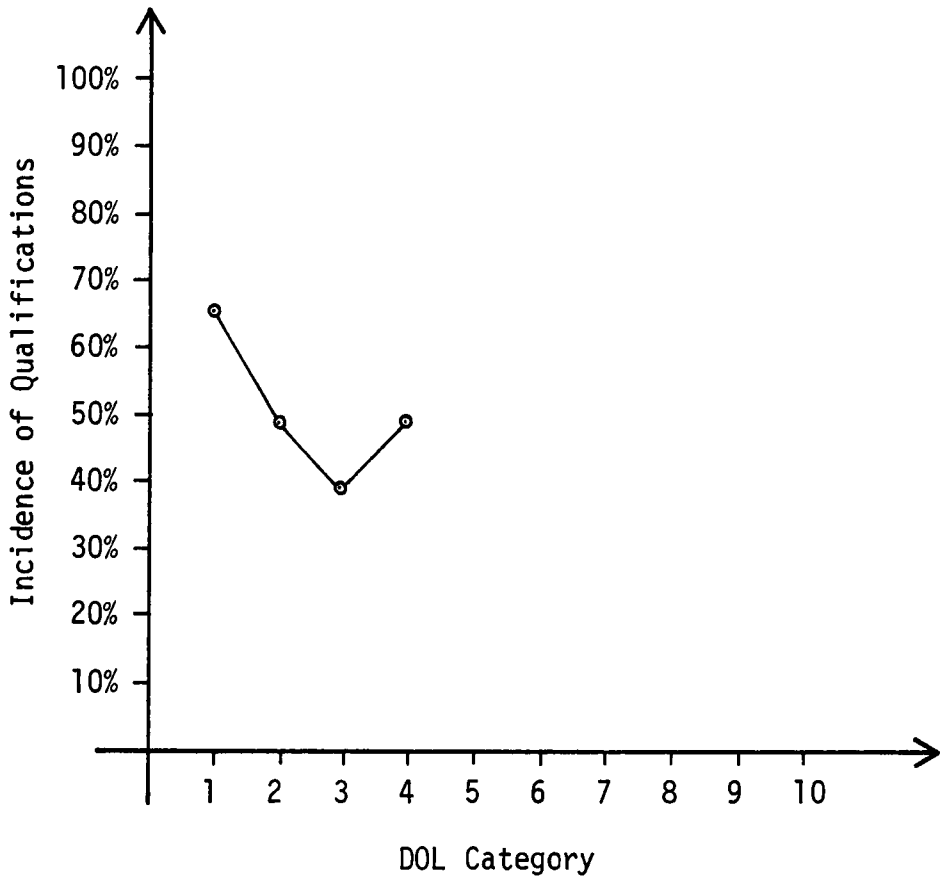


Figure 4. Incidence of uncertainty qualifications as a function of DOL--four categories.

Table 8. Source of variation table for two-way ANOVA with six categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
DOL	3.041	5	0.608	2.414	0.037
IND	1.923	8	0.240	0.954	0.473
Main effects	4.828	13	0.371	1.474	0.129
DOL x IND	6.272	32	0.196	0.778	0.799
Total explained	11.100	45	0.247	0.979	0.516
Residual	51.899	206	0.252		
Total	62.999	251	0.251		
R^2 = .077					

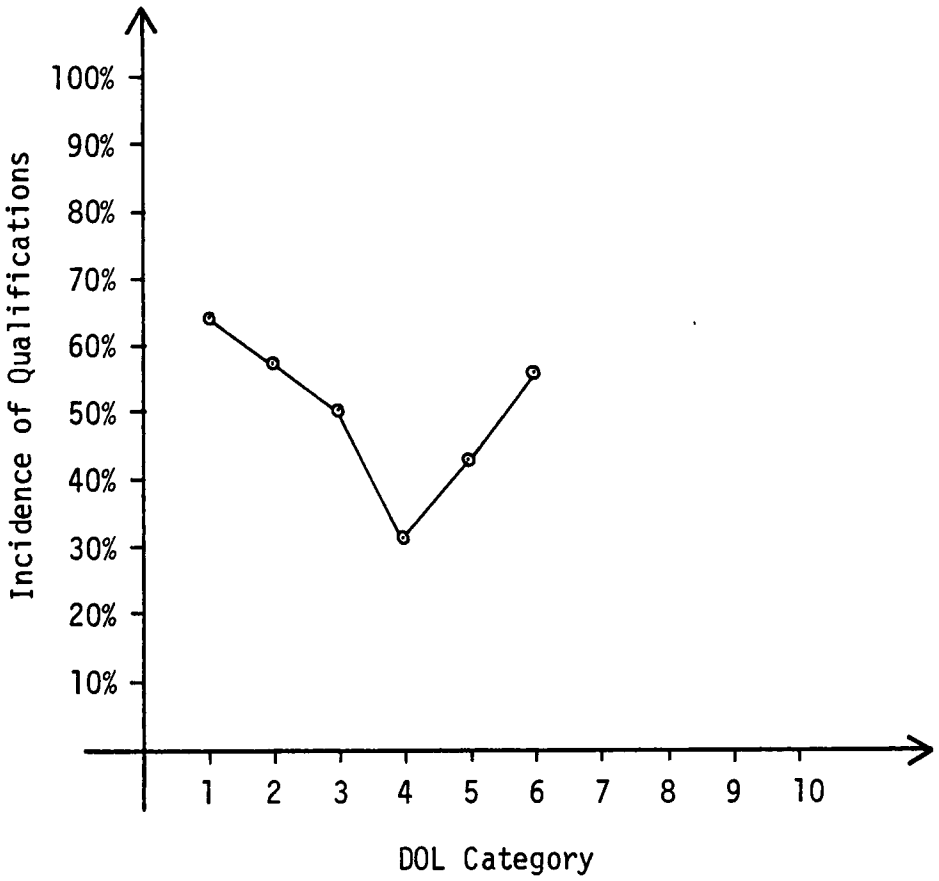


Figure 5. Incidence of uncertainty qualifications as a function of DOL--six categories.

a graph of the incidence of uncertainty qualifications as a function of DOL. This graph offers the clearest picture of the association between degree of operating leverage and incidence of uncertainty qualifications of any of the category sizes selected for inclusion in this study. Those firms in the lowest and the highest intervals of DOL coefficients clearly had the greatest incidence of receipt of qualifications, and those firms whose coefficient values fell in the middle categories were less likely to receive a qualification.

Eight Categories

Table 9 depicts the source of variation table for the two-way ANOVA with a category size of eight intervals for DOL. As was the case with the two previous category sizes, the DOL main effect is strongly significant, and neither the industry main effect nor the two-way interaction between DOL and industry is significant at conventional levels of significance. Figure 6 is a graph of the incidence of uncertainty qualifications plotted against DOL. With this category size, the relationship between DOL and likelihood of qualifications is not obvious, and this pattern is exhibited in the "saw tooth" picture of the graph. Comparison of this graph with the graph generated from the category size of six intervals of DOL coefficients reveals that the depicted relationship between DOL and the incidence of qualifications is very sensitive to the selection of the DOL category size.

Ten Categories

Table 10 displays the source of variation table for the two-way ANOVA with a ten-interval category size for DOL. The DOL main effect

Table 9. Source of variation table for two-way ANOVA with eight categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
DOL	6.887	7	0.984	4.173	0.000
IND	2.271	8	0.284	1.204	0.298
Main effects	8.674	15	0.578	2.453	0.003
DOL x IND	8.353	41	0.204	0.864	0.704
Total explained	17.027	56	0.304	1.290	0.106
Residual	45.972	195	0.236		
Total	62.999	251	0.251		
$R^2 = 0.138$					

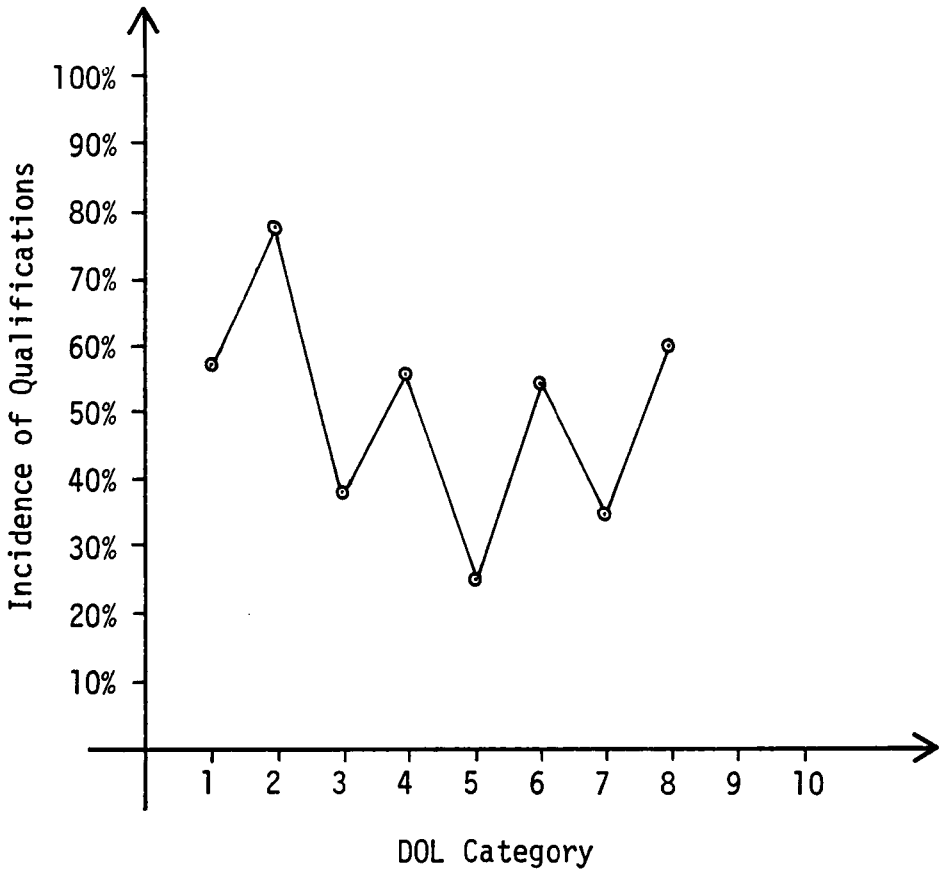


Figure 6. Incidence of uncertainty qualifications as a function of DOL--eight categories.

Table 10. Source of variation table for two-way ANOVA with ten categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
DOL	4.772	9	0.530	2.274	0.019
IND	2.139	8	0.267	1.147	0.334
Main effects	6.559	17	0.386	1.655	0.055
DOL x IND	13.536	50	0.271	1.161	0.238
Total explained	20.095	67	0.300	1.286	0.097
Residual	42.904	184	0.233		
Total	62.999	251	0.251		
$R^2 = 0.104$					

is significant with a p-value of .019, and the industry main effect is not significant. The interaction effect between DOL and industry classification is also not significant at conventional significance levels. Figure 7 is a graph of the incidence of qualifications as a function of DOL. As was the case with the eight-interval category size, the pattern depicted in the graph is unclear and appears to fluctuate randomly across the ten DOL categories. This graph also provides additional evidence about the sensitivity of the depicted relationship to choice of category size.

General Comments about the Results of the Two-Way Analyses

To summarize the results of the two-way analyses of variance, the DOL main effect is clearly significant across all category sizes, and the industry main effect and the interaction effect between DOL and industry are consistently not significant at conventional significance levels. To more effectively isolate the effect of degree of operating leverage, one-way analyses of variance, with degree of operating leverage as the sole treatment effect, were attempted. The results of these analyses are presented in the next section.

VI. RESULTS OF THE ONE-WAY ANALYSES OF VARIANCE

One-way analyses of variance were run with DOL as the single treatment effect. The DOL main effect was consistently significant across all four of the category sizes for DOL coefficients attempted. Tables 11-14 depict the ANOVA source of variation tables for DOL category sizes of four, six, eight, and ten intervals, respectively.

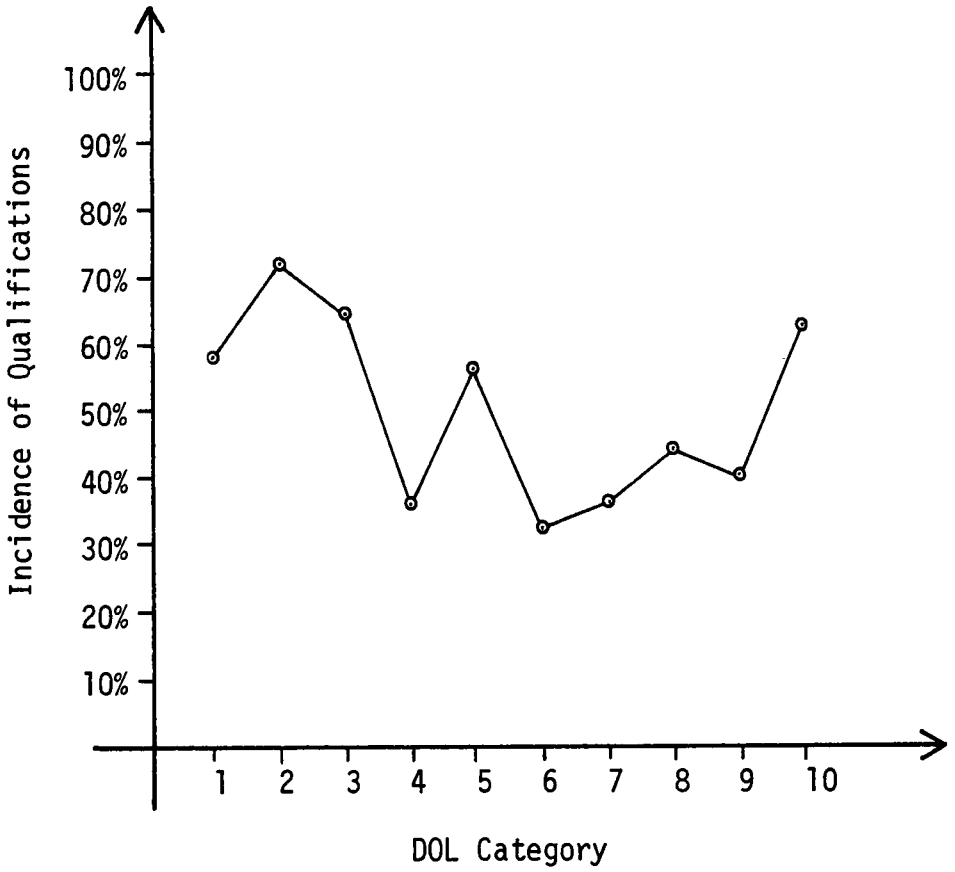


Figure 7. Incidence of uncertainty qualifications as a function of DOL--ten categories.

Table 11. Source of variation table for one-way ANOVA with four categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
DOL	2.714	3	0.905	3.722	0.012
Residual	60.286	248	0.243		
Total	63.000	251	0.251		
R^2 = 0.043					

Table 12. Source of variation table for one-way ANOVA with six categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
DOL	2.905	5	0.581	2.378	0.039
Residual	60.094	246	0.244		
Total	62.999	251	0.251		
R^2 = 0.046					

Table 13. Source of variation table for one-way ANOVA with eight categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
DOL	6.402	7	0.915	3.943	0.000
Residual	56.597	244	0.232		
Total	62.999	251	0.251		
R^2 = 0.102					

Table 14. Source of variation table for one-way ANOVA with ten categories of DOL coefficients.

Effect	Sum of Squares	Degrees of Freedom	Mean-Square	F Statistic	P-Value
DOL	4.420	9	0.491	2.029	0.037
Residual	58.579	242	0.242		
Total	62.999	251	0.251		
R^2 = 0.070					

The fact that the DOL main effect remained significant at conventional significance levels even after the industry effect was added in the two-way ANOVA and that both the industry main effect and the interaction effect were consistently not significant reinforces the strength of the association found in the one-way analyses.

VII. SUMMARIZATION OF RESULTS OF TESTS OF THE MAJOR HYPOTHESIS

On the basis of the results of the tests of significance that appear in this section of the chapter, it can be asserted that the evidence presented in this study provides support for the existence of an association between degree of operating leverage and the incidence of receipt of uncertainty qualifications. Though there is evidence to support this association, no statements can be offered about any link or direction of causation or, more basically, whether such link or direction of causation even exists.

VIII. DESCRIPTION OF RESULTS WITH SELECTION OF SIX CATEGORIES FOR DOL

As was stated in an earlier section of this chapter, the graph depicting the relationship between DOL and the incidence of uncertainty qualifications in the clearest way is the one generated from a category size of six intervals of DOL coefficients. Figure 5, page 50, depicts the six-category graph of incidence of qualifications as a function of DOL. Based on an examination of this graph, it is apparent that firms with both very low and very high DOL coefficients are those

firms that are most likely to receive uncertainty qualifications. Firms with DOL coefficients of approximately one (those values in category four ranging from .922 to 1.134) are the least likely to receive such qualifications. As the DOL values approach category four from either direction, the incidence of uncertainty qualifications decreases toward the minimum proportion obtained in that category.

It could be argued that firms with DOL coefficients around the value of one are stable as a function of achieving a "happy medium" of mixture of fixed and variable costs in their operating cost structure. They do not encounter the tremendous amount of volatility in operating earnings that firms with a high usage of fixed cost assets in productive activities face. In addition, they do not have to cope with the problems in obtaining financing that companies with relatively few fixed assets in their asset structure might endure.

It is logical that firms with very high DOL coefficients would have a high incidence of uncertainty qualifications. Firms with very high DOL coefficients have a large magnification of any macroeconomically induced decrease in their sales, resulting in a large reduction in their operating earnings before interest and taxes. It is plausible that such operating earnings reductions might be positively associated with those firm-specific factors and problems that motivate the auditor to render an uncertainty qualification.

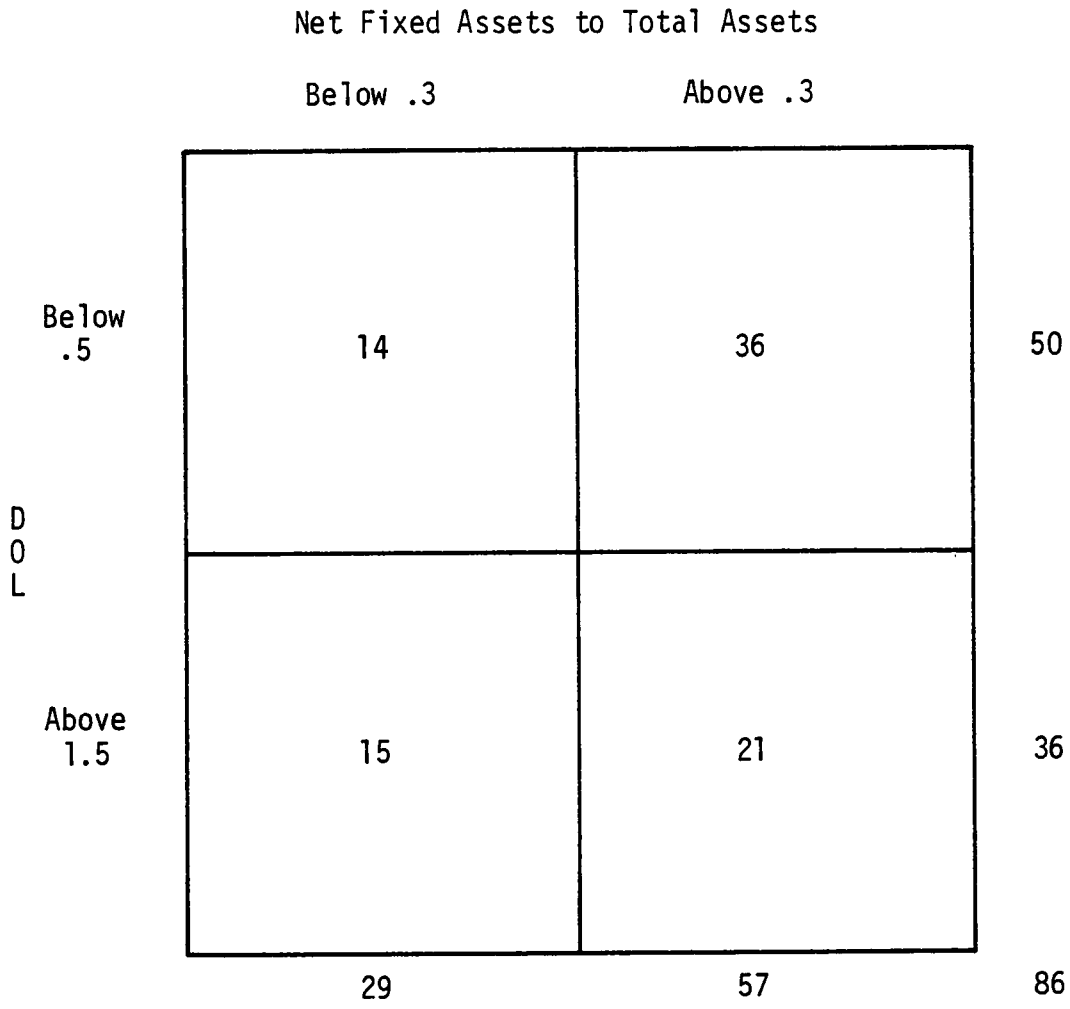
On the other hand, it is not as equally obvious why firms with very low DOL coefficients have such a high incidence of qualifications.

An attempt was made to gain insight into this phenomenon by performing several chi-square tests. Only those firms (both those with uncertainty qualifications and those with unqualified opinions) with DOL coefficients below .500 and above 1.500 were included at this stage of the analysis. Five chi-square tests of association (35) were performed to determine if any relationship existed between level of degree of operating leverage (at either the low extreme or the high extreme) and several traditional accounting ratios: net fixed assets to total assets, the current ratio, inventory to total assets, sales to net fixed assets, and long-term debt to total assets. An additional chi-square test was run to determine whether or not an association existed between level of DOL and industry classification. The contingency matrices and the computed chi-square test statistics are presented in Figures 8-13. None of the chi-square test statistics was significant at conventional levels of significance, which indicates that the null hypothesis that no association exists between DOL and either any of the five financial ratios tested or industry classification cannot be rejected.

Another potential explanation for why the firms in the sample with low DOL coefficients had such a high incidence of qualifications is that, other things equal, firms with a low DOL employ a greater amount of variable costs in their operating cost structure.[2] The

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[2]Even though any assumption of "other things equal" is violated in real world data, the relationship described in this section between level of degree of operating leverage and variable-fixed operating cost mix still has sufficient descriptive validity.



$\chi^2 = 1.7485$

Figure 8. Chi-square contingency matrix for net fixed assets to total assets.

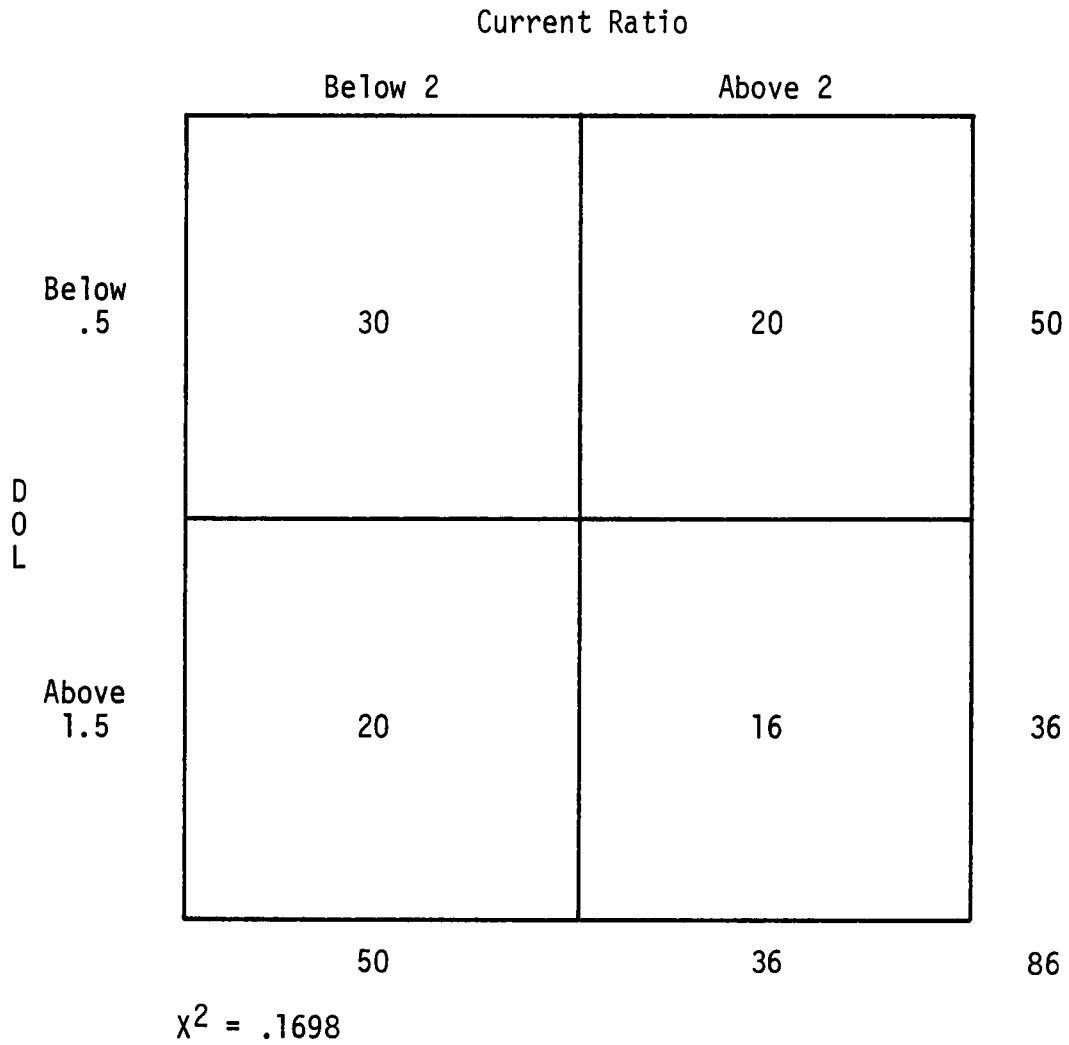


Figure 9. Chi-square contingency matrix for current ratio.

Inventory to Total Assets

DOL	Below .25	Above .25	
Below .5	32	18	50
Above 1.5	23	13	36
	55	31	86

$X^2 = .000083$

Figure 10. Chi-square contingency matrix for inventory to total assets.

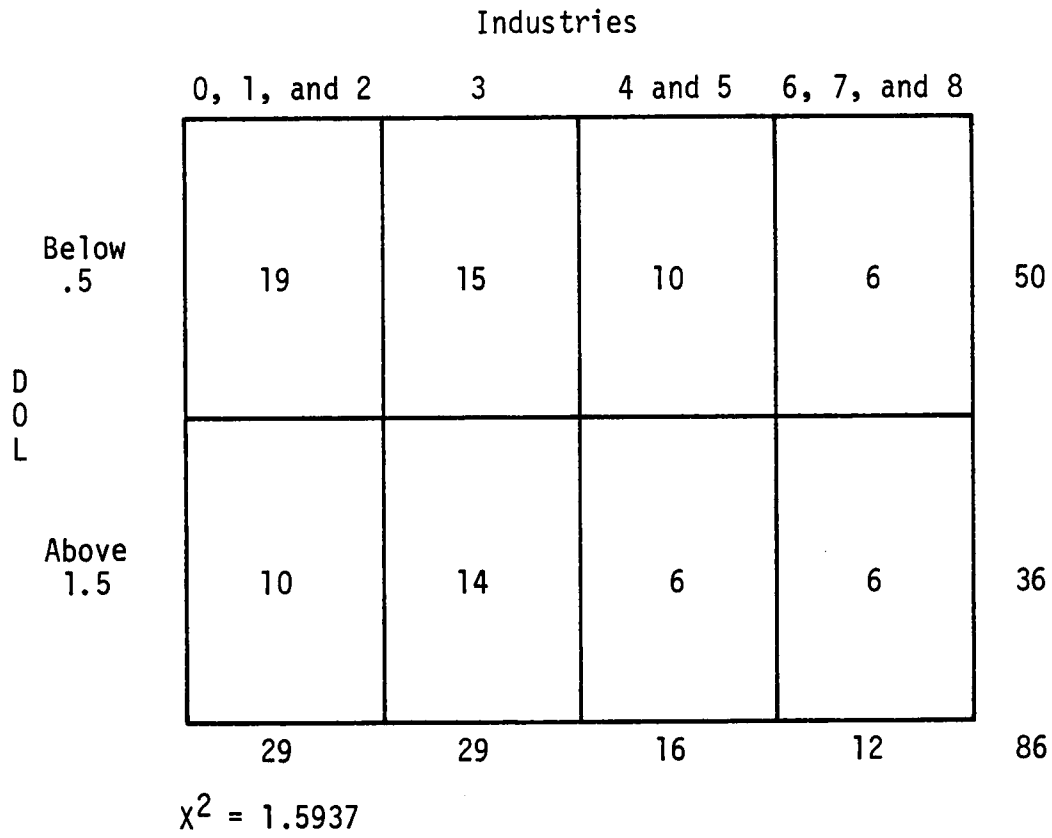


Figure 11. Chi-square contingency matrix for industries.

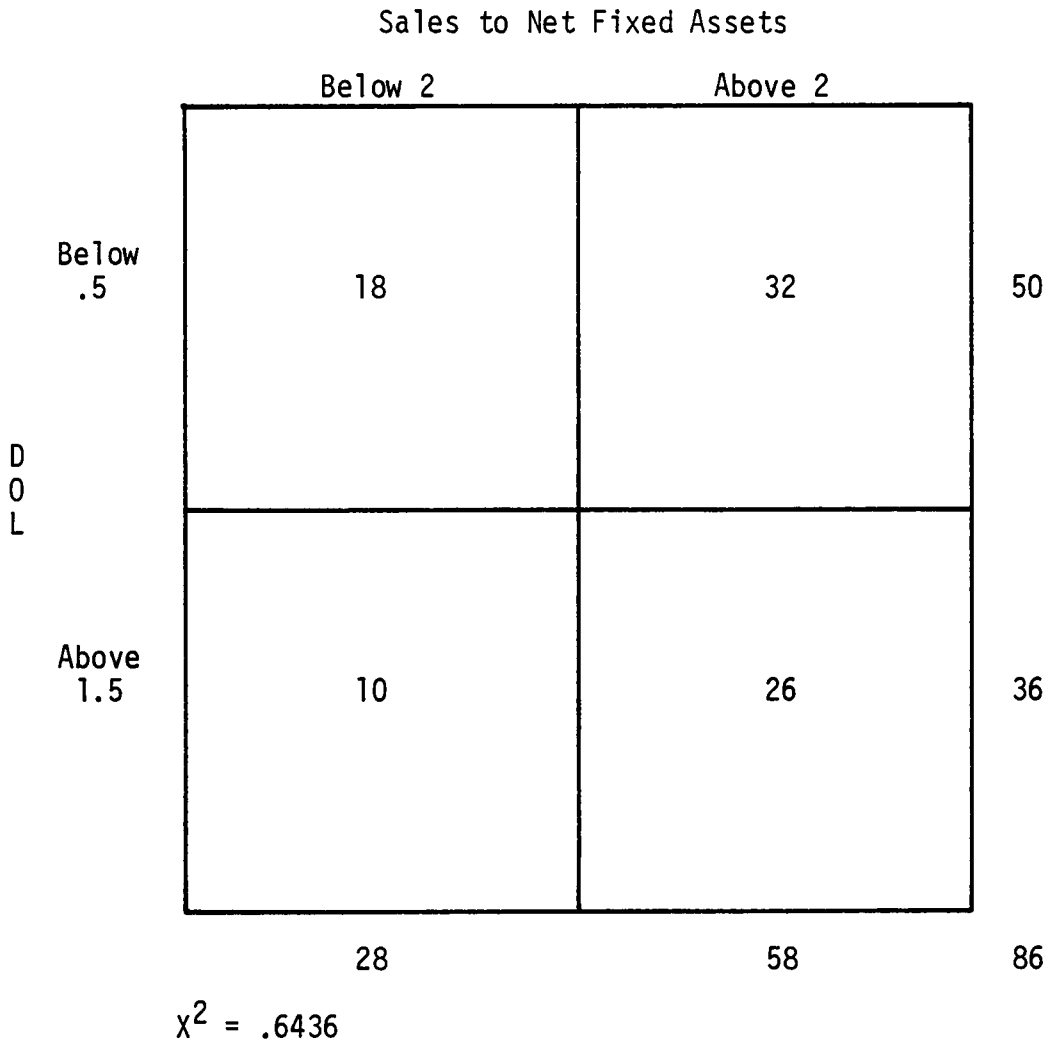


Figure 12. Chi-square contingency matrix for sales to net fixed assets.

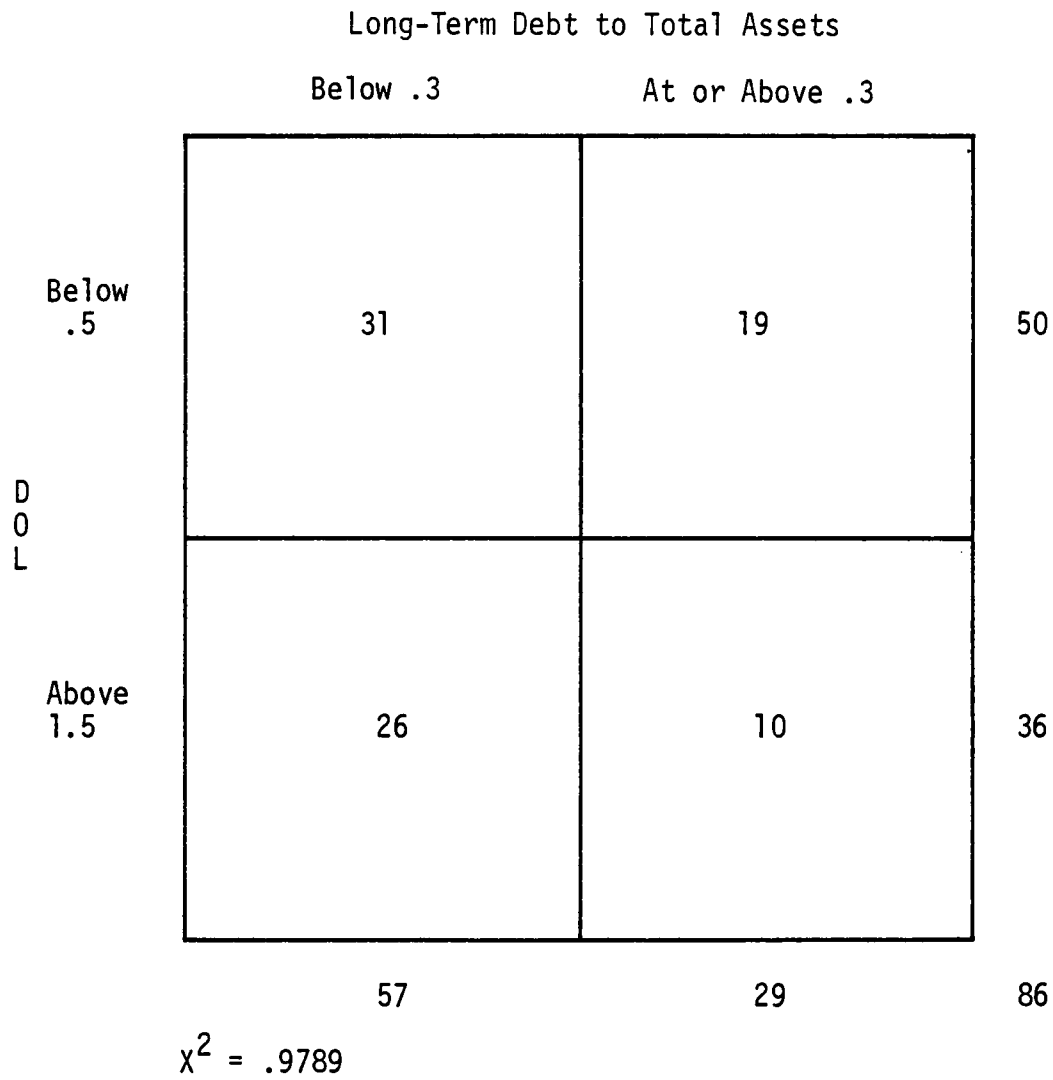


Figure 13. Chi-square contingency matrix for long-term debt to total assets.

implication of a firm's having such a variable cost-intensive operating cost mix is that with relatively few fixed assets in its asset structure, it might have fewer substantive assets to use as collateral. In this situation such a firm could have difficulty obtaining financing, which might be either positively associated with or possibly even be a cause of those factors that would motivate an auditor to render an uncertainty qualification. This explanation is difficult to verify empirically, especially given that a qualitative analysis of the specific types of uncertainty qualifications revealed that the specific reasons for having received a qualification are fairly evenly dispersed across firms with both very low and very high degree of operating leverage coefficients.[3]

Nevertheless, an attempt was made at such empirical verification by performing four additional chi-square tests of association to try to discriminate between those firms with low (below .500) and those with high (above 1.500) DOL coefficient values on the basis of the ratio of sales to net fixed assets. Four additional partitionings of the ratio of sales to net fixed assets were examined in these tests to determine if this ratio captured any fixed asset structural differences between the low and the high levels of DOL coefficient values. The chi-square contingency matrices for these four tests appear in

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[3]Any quantitative analysis of the distribution of specific types of uncertainty qualifications across the firms in the sample would be extremely difficult (if not impossible) because of the paucity of detailed information about these qualifications available in the Disclosure Journal or elsewhere.

Figures 14-17. Unfortunately, none of the calculated chi-square test statistics was significant at conventional significance levels.

There are several other plausible explanations for why firms with very low DOL coefficients had such a high incidence of receipt of uncertainty qualifications. The degree of operating leverage effect may be acting in concert with some (currently) unidentifiable financial factor(s) to bring about this high incidence. Additionally, this high incidence could be a function of some non-financial factor such as the age of the firms with the low DOL coefficient values. There might be a disproportionate share of young, struggling firms likely to receive an uncertainty qualification (for example, because of questions about the realizability of certain deferred start-up costs) in the low DOL coefficient value category.

Finally, DOL might be capturing factors that are not reflected in financial accounting variables and might be offering unique insights into certain firm-specific attributes (maybe related to structural change) that would motivate an auditor to render an uncertainty qualification. The fact that there are several plausible explanations for the occurrence of this high likelihood of receipt of uncertainty qualifications among firms with low DOL coefficient values indicates the need for additional exploratory research in this area.

In summary, there is a range of DOL coefficients, clustered around a value of one, in which there is a statistically significant smaller incidence of uncertainty qualifications. Firms with DOL

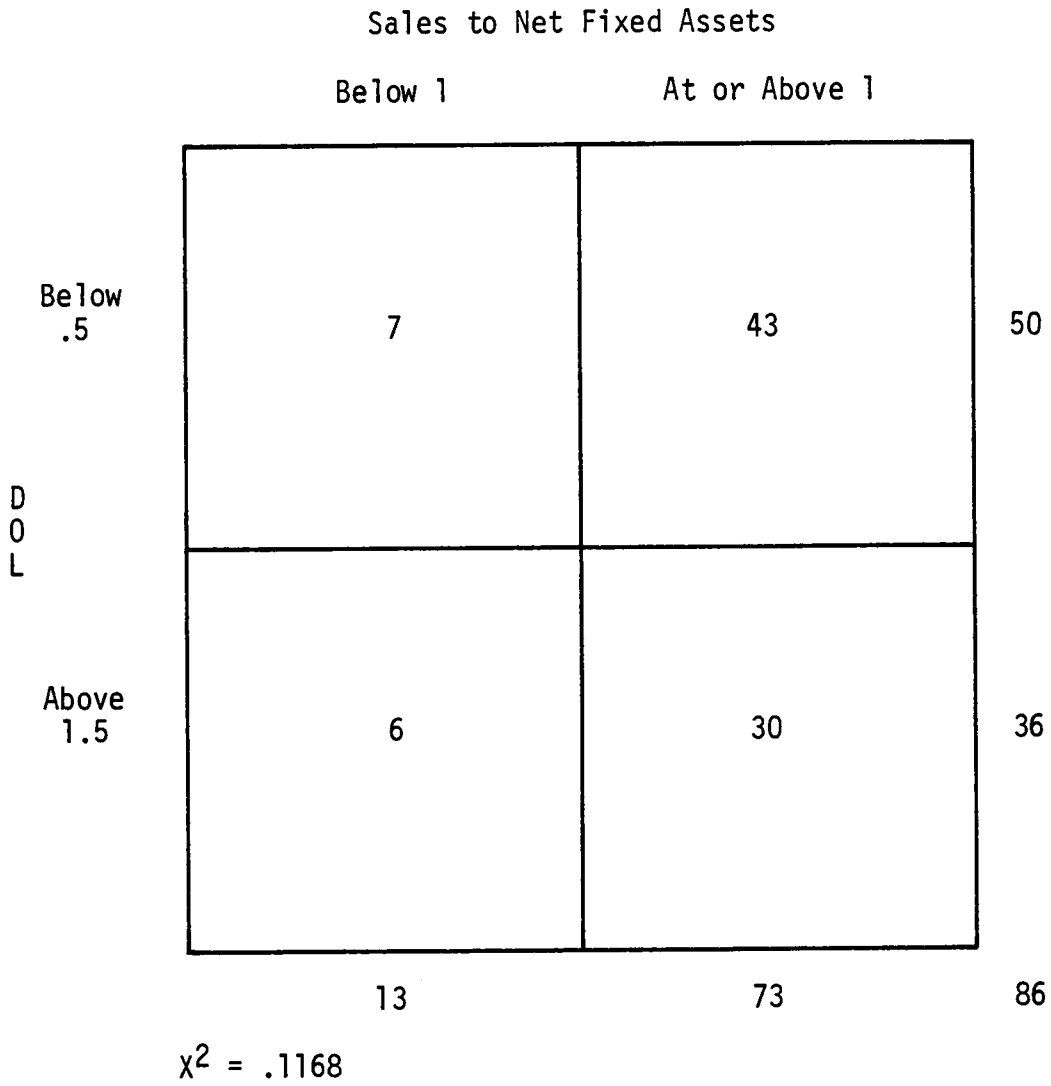


Figure 14. Chi-square contingency matrix for first additional partitioning of sales to net fixed assets.

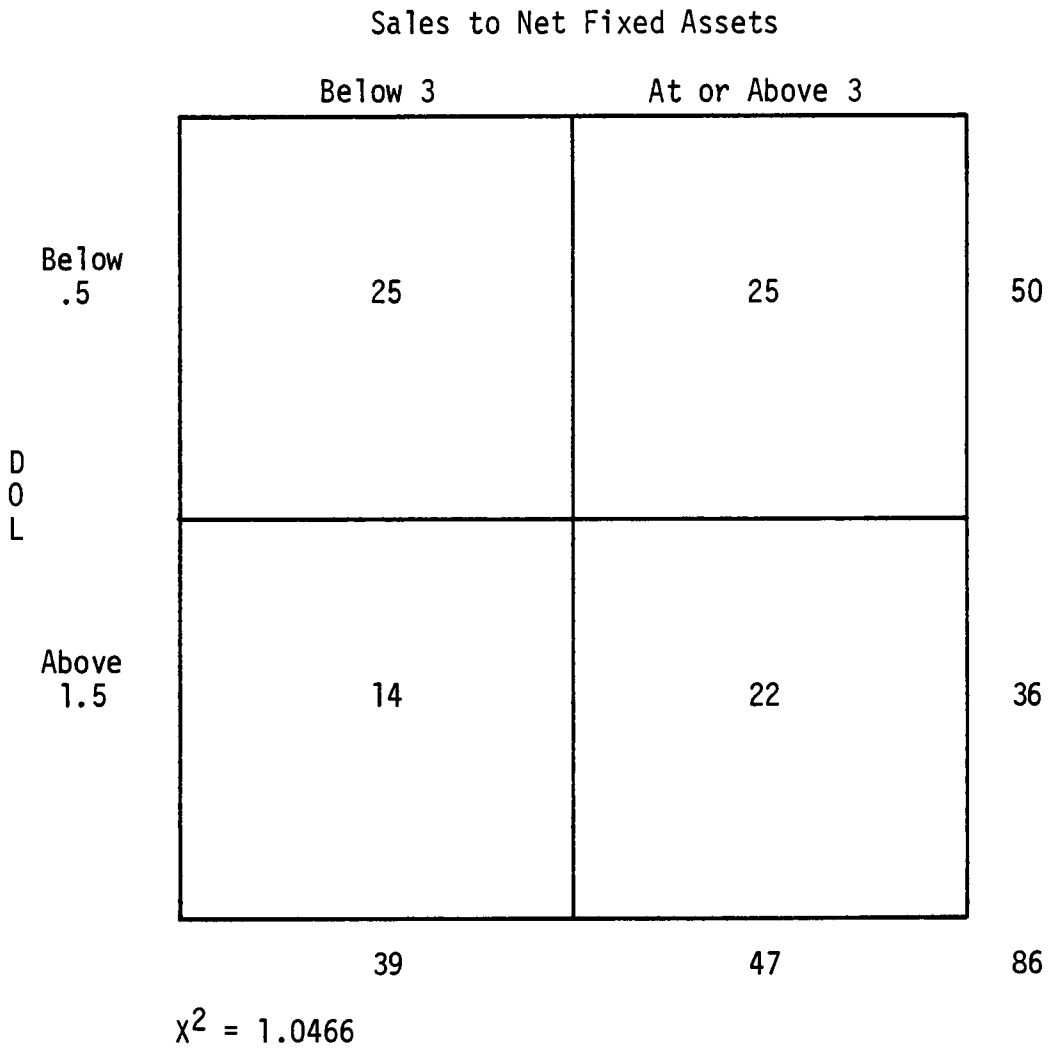


Figure 15. Chi-square contingency matrix for second additional partitioning of sales to net fixed assets.

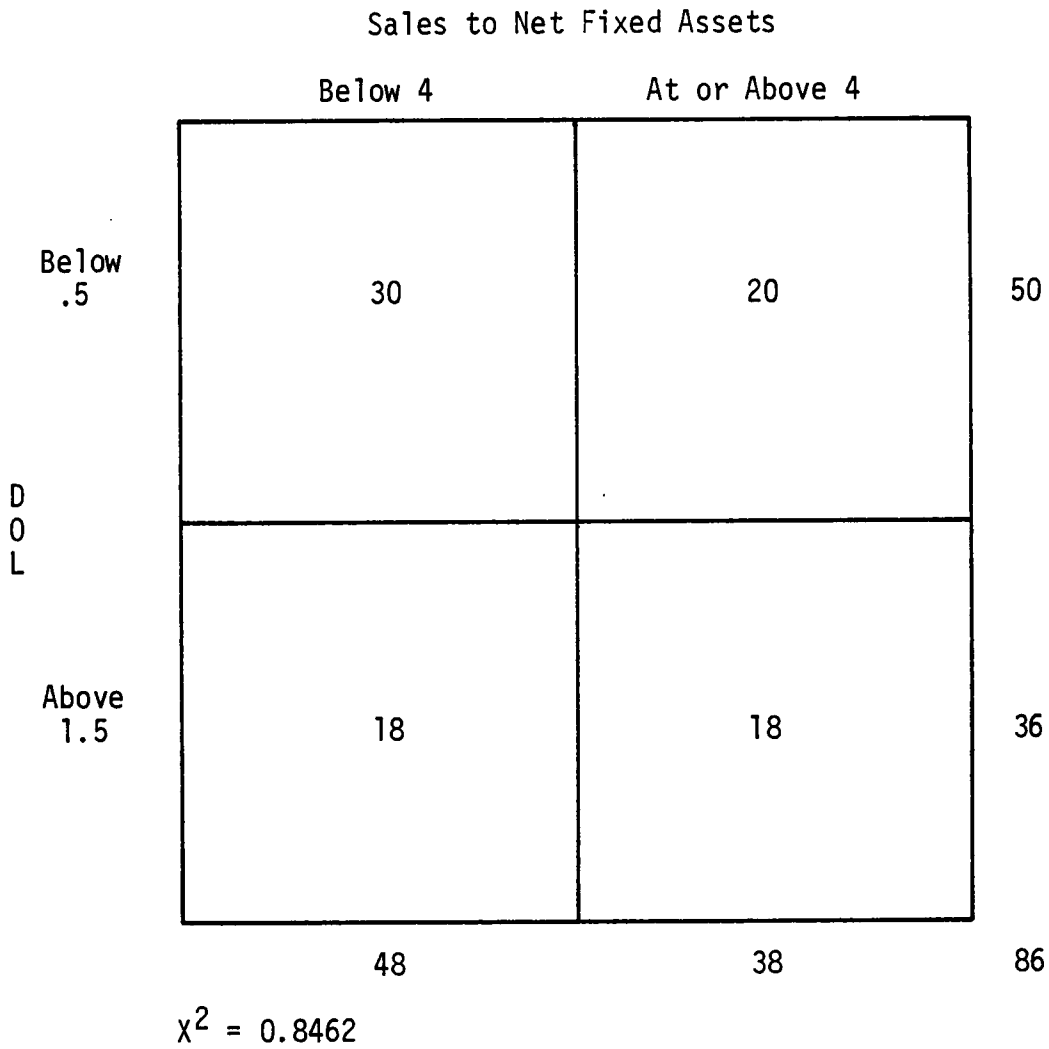


Figure 16. Chi-square contingency matrix for third additional partitioning of sales to net fixed assets.

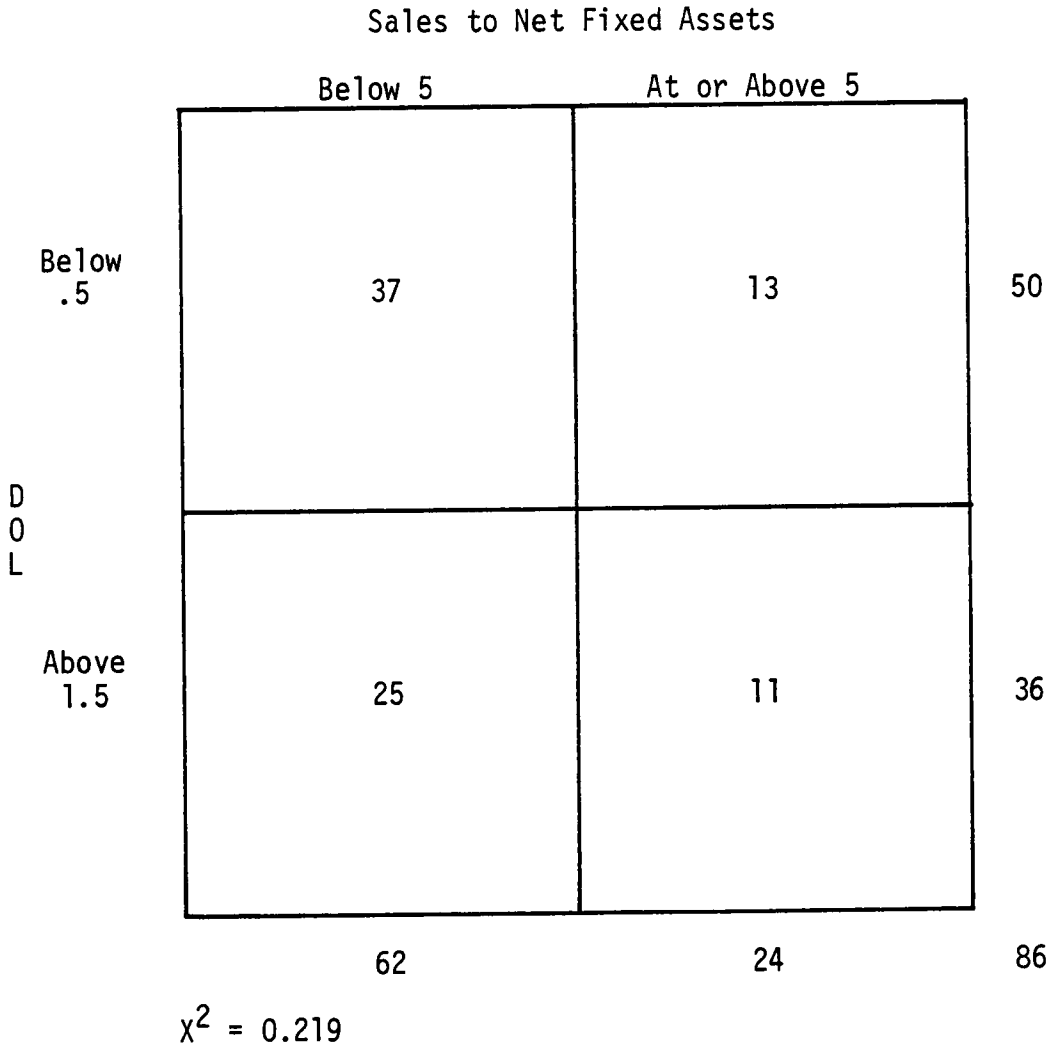


Figure 17. Chi-square contingency matrix for fourth additional partitioning of sales to net fixed assets.

coefficients at either the low or the high extreme have a greater likelihood of encountering those factors that would motivate their auditors to render such qualifications.

IX. DEVELOPMENT OF MULTIPLE REGRESSION PREDICTION MODEL FOR DOL

The final phase of the data analysis in this study was the development of a series of multiple regression models for the prediction of DOL. The predictor variables selected for potential inclusion in the models were those employed in some previous empirical studies and those derived from an appreciation of existing hypotheses about the relationship between the operating leverage and the financial leverage effects. These variables were listed in Chapter Three. The results of the multiple regression analyses are presented in the following paragraphs.

The first set of analyses performed was the development of a separate stepwise regression model for each of the years considered in the study. Tables 15-19 present the models generated for 1972, 1973, 1974, 1975, and 1981, respectively. The explanatory power of the models, as measured by the coefficient of determination (R^2), was meager except for the model developed for 1972. This 1972 model had an adjusted R^2 of .475 after the ratios of total debt to common shareholders' equity, long-term debt to total assets, operating earnings before interest and taxes to sales, net fixed assets to total assets, and inventory to total assets had been included in the model. The adjusted R^2s for the other years included in the analysis were extremely small.

Table 15. DOL multiple regression model for 1972.

Variable	Coefficient	Partial F
Total debt to shareholders' equity	0.9010	27.269**
Long-term debt to total assets	-5.8060	13.766**
Operating income to sales	1.1841	1.831
Net fixed assets to total assets	-1.9069	4.492*
Inventory to total assets	-1.8285	2.576
Intercept	2.6545	
R^2	.5357	
Adjusted R^2	.4747	
SE of estimate	.9629	
N	44	

*Significant at .05 level.

**Significant at .001 level.

Table 16. DOL multiple regression model for 1973.

Variable	Coefficient	Partial F
Net fixed assets to total assets	1.0508	6.214*
Operating income to sales	-2.4736	5.655*
Current ratio	0.1209	2.364
Intercept	0.5131	
R^2	.1289	
Adjusted R^2	.0839	
SE of estimate	.5934	
N	62	

*Significant at .025 level.

Table 17. DOL multiple regression model for 1974.

Variable	Coefficient	Partial F
Sales to net fixed assets	-0.0998	1.215
Total debt to shareholders' equity	-0.0026	0.994
Intercept	1.0603	
R^2	.0422	
Adjusted R^2	.0086	
SE of estimate	.5527	
N	60	

Table 18. DOL multiple regression model for 1975.

Variable	Coefficient	Partial F
Long-term debt to total assets	-1.1480	2.075
Total debt to shareholders' equity	0.0349	4.171*
Operating income to sales	1.3149	1.517
Net fixed assets to total assets	-0.7223	1.338
Intercept	1.3219	
R^2	.2469	
Adjusted R^2	.1655	
SE of estimate	.6608	
N	42	

*Significant at .05 level.

Table 19. DOL multiple regression model for 1981.

Variable	Coefficient	Partial F
Long-term debt to total assets	-0.7932	5.344 *
Total debt to shareholders' equity	0.0037	1.509
Intercept	1.0969	
R^2	.1294	
Adjusted R^2	.0869	
SE of estimate	.4844	
N	44	

*Significant at .05 level.

Additional analyses were run for all years considered in the study, and both the direct and the stepwise approaches to multiple regression were attempted at this phase. Tables 20 and 21 depict the multiple regression models developed using the direct and the stepwise approaches, respectively. As was the case with the models developed for the individual years, the explanatory power of these two models was very small. In addition, a different set of predictor variables entered into the model for each of the individual years considered in the study. Table 22 depicts a frequency distribution of the variables that entered into all the stepwise regression models developed in this phase of the research that illustrates this point.

There are several potential explanations for the lack of explanatory ability of any of these models. One possible explanation is errors-in-variables bias (also called attenuation bias), which occurs because the DOL coefficients that were used as the dependent variables in the regression equations were not known numbers. They were calculated from performing the time-series regression technique described in Chapter Three and, accordingly, were measured with error. Such errors in the measurement and the reliability of the DOL coefficients might explain the poor explanatory ability of the multiple regression models.

Another possible explanation is that seven of the eight predictor variables considered for inclusion in the model were balance sheet-based ratios. It is possible that given the post-1930 emphasis on the quality of the income statement and its components often at the expense

Table 20. DOL multiple regression model for all years--direct approach.

Variable	Coefficient	Partial F
Current ratio	0.0306	0.386
Inventory to total assets	-0.6132	2.077
Net fixed assets to total assets	-0.6082	3.616*
Sales to total assets	-0.0294	0.223
Long-term debt to total assets	0.0049	0.003
Total debt to shareholders' equity	0.0001	0.002
Operating income to sales	0.1798	0.182
Sales to net fixed assets	0.0003	0.002
Intercept	1.3366	
R^2	.0278	
Adjusted R^2	-.0042	
SE of estimate	.7881	
N	252	

*Significant at .10 level.

Table 21. DOL multiple regression model for all years--stepwise approach.

Variable	Coefficient	Partial F
Net fixed assets to total assets	-0.6614	5.678**
Inventory to total assets	-0.6888	3.233*
Intercept	1.4189	
R^2	.0232	
Adjusted R^2	.0154	
SE of estimate	.7804	
N	252	

*Significant at .10 level.

**Significant at .025 level.

Table 22. Frequency distribution of variables that entered into stepwise regression models.

Variables	Models					
	1972	1973	1974	1975	1981	All Years
Current Ratio		X				
Inventory to Total Assets	X					X
Net Fixed Assets to Total Assets	X	X		X		X
Asset Turnover						
Long-term Debt to Total Assets	X		X	X		
Total Debt to Shareholders Equity	X		X	X	X	
Operating Profit to Sales	X	X		X		
Sales to Net Fixed Assets			X			

of the quality of the balance sheet (21, pp. 28-29), the balance sheet-based ratios might be lacking in predictive ability because of the dearth of emphasis on the balance sheet in current financial reporting. In a somewhat related line of reasoning, another factor that could account for the poor explanatory ability of the models is the possibility that the degree of operating leverage coefficient is capturing variables related to the fixed-variable operating cost mix and to a firm's nearness to its breakeven point (37, pp. 771-78; 40, pp. 76-80) that are not impounded in the traditional accounting ratios employed in the development of the regression models.

X. SUMMARY

The major research hypothesis of this study--that there exists an association between firms' degree of operating leverage coefficients and their incidence of receipt of uncertainty qualifications--was corroborated with the analysis of variance tests described in this chapter. The DOL main effect was consistently significant across various category sizes of intervals of DOL coefficients in both the two-way and the one-way analyses attempted. Firms with very low and very high DOL coefficients were those that were most likely to receive an uncertainty qualification. Additionally, an attempt was made at modeling DOL based on accounting variables. The explanatory power of the multiple regression models generated in this phase of the study was generally very poor.

CHAPTER FIVE

CONTRIBUTIONS, LIMITATIONS, AND CONCLUSION

I. INTRODUCTION

The purpose of this chapter is to assess the potential contributions of this study for the auditor and for empirical researchers in accounting and in finance; to describe the limitations inherent in the research design of the study; and to recap the results and implications of the research and offer suggestions for extensions of the research question and for methodological improvements of previous work in the area of operating leverage.

II. CONTRIBUTIONS

The results of this research could be of value to the practicing auditor. He could use the econometric technique employed in this study for calculating degree of operating leverage coefficients as a tool in the analytical review phase of the audit. If the auditor were to use this technique and calculate either a very low or a very high DOL coefficient for a particular client firm, such a coefficient value would serve as a "red flag" warning for him to be on guard for those factors that might motivate him to render an uncertainty qualification to that client. Such a warning might revise the auditor's prior probabilities about the likelihood of the client's receiving such a qualification and might motivate the auditor to accumulate additional audit evidence. In addition, if the auditor were to employ the time-series regression

technique and calculated a negative DOL coefficient, he would be alerted to the occurrence of some type of structural change in the client firm's operating cost structure, such as a change in the fixed-variable operating cost mix, etc. It is possible that a DOL coefficient can capture factors that other analytical review techniques currently available to the auditor do not provide.

In addition, this study represents one of the first inter-disciplinary attempts at determining what kind of relationship (if any) exists between traditional accounting ratios, such as those employed as predictor variables in the multiple regression models, and degree of operating leverage. Even though the explanatory power of the multiple regression models developed was rather poor, such a finding still represents a contribution because an awareness of this poor explanatory power should alert future researchers that accounting-based surrogates for the operating leverage effect, such as the ratio of the net book value of fixed assets to total assets used by Ferri and Jones (15), are inferior to a direct calculation of DOL.

Another contribution of this study is the fact that it provides a second application of the econometric time-series regression technique described in detail in Chapter Three.[1] It is valuable to gain additional insight into the viability of this technique both as a

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[1]Based on an exhaustive review of the economics, finance, and accounting literatures, no researchers other than Mandelker and Rhee (27) have used this time-series regression technique in a specific application of the technique to calculations of degree of operating leverage. However, econometricians have always used this technique in the calculations of price and income elasticity coefficients (24, pp. 458-60).

methodological tool for future empirical research and as a tool for the auditor as described in a preceding section of the chapter.

III. LIMITATIONS

The research design used in this study to test the hypothesis of the existence of association between degree of operating leverage and likelihood of receipt of uncertainty qualifications is subject to several limitations. As was stated in the previous chapter, the DOL coefficients estimated from the regression technique for the firms in the sample are measured with error and, accordingly, are potentially not reliable surrogates for the firms' true DOL coefficients. To the extent that this errors-in-variables (attenuation) bias exists, the tests of association appearing in the study are affected by the existence of such error.[2]

In addition, the mathematical definition of degree of operating leverage, on which the time-series regression technique is based, assumes that exogenous factors such as changes in product mix and changes in input prices and technology do not occur. Though these changes do occur in the real world, it is assumed that any such changes that occur in either the experimental or the comparison samples "wash out." Though the subset of uncertainty qualifications from which

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[2]Unfortunately, no research has yet appeared in the literature concerning the effects of errors-in-variables bias on the calculations of degree of operating leverage. However, Fama and MacBeth (14) recognized the problem of such bias in the calculation of firms' beta coefficients and made an attempt to ameliorate the effect of such bias by combining individual firms into portfolios, which reduced the standard error of the beta coefficients.

the experimental sample was formed is inherently not a random sample, the experimental sample of uncertainty qualifications in this study was initially selected randomly (though eventually tempered by the restrictions of the selection criteria described in Chapter Three), and the comparison sample of firms that received unqualified opinions during the time period covered in the study was randomly selected from the population of firms that received unqualified opinions that filed with the SEC (again tempered by the restrictions of the selection criteria). These attempts at randomization should eliminate any sources of systematic biases created by the existence of those previously described exogenous factors.

Finally, another source of potential systematic bias in the data is the existence of auditor (auditing firm)-specific decision criteria or heuristics (6) for deciding when to render an uncertainty qualification. Auditors (Auditing firms) may differ with respect to which factors warrant the rendering of such a qualification and to what extent such factors have to be present. However, given the previously described attempt at randomization in the selection of the experimental and the comparison samples, it is assumed that any such auditor (auditing firm)-specific differences cancel out across the samples.

IV. CONCLUSION AND IMPLICATIONS FOR FUTURE RESEARCH

The major research hypothesis examined in this study was that there exists an association between firms' degree of operating

leverage coefficients and their incidence of receipt of uncertainty qualifications. Based on the tests of association performed using the analysis of variance technique, this hypothesis was corroborated. Firms with extremely low and extremely high degree of operating leverage coefficients were the most likely to receive uncertainty qualifications, and those firms with DOL coefficients around a value of one were the least likely to receive such qualifications. Those firms with extremely high DOL coefficients might face the magnification of any decrease in sales created by the operating leverage phenomenon, and those firms with extremely low DOL coefficients might face any of several factors that could motivate their auditors to render an uncertainty qualification. These potential factors were discussed in Chapter Four.

An attempt was made at developing multiple regression prediction models for degree of operating leverage with selected accounting ratios as the predictor variables. The explanatory power of the models developed, as measured by the coefficient of determination, was very poor. It is possible that either DOL was measured with excessive error or DOL captured certain firm-specific attributes that traditional financial accounting ratios do not capture.

There are several possible extensions of the current study that could result in additional insight into the relationship between degree of operating leverage and uncertainty qualifications. One example of such an extension would be the inclusion of the financial leverage effect as impounded in the degree of financial leverage (DFL) coefficient. Researchers in the finance literature (16,18) have

determined that the degrees of operating leverage and of financial leverage act in a multiplicative way to generate a composite firm-specific magnification factor for business risk. An interesting hypothesis to test would be whether there exists an association between this composite magnification factor and the incidence of uncertainty qualifications. It would then be possible to compare and contrast the results obtained from such a test with the results reported in this current study to determine if the degree of financial leverage factor captures or is positively associated with any additional underlying factors that cause a firm to receive such a qualification. Another interesting extension of the research would be a cross-sectional study across the membership of the "Big Eight" accounting firms. Given the results obtained in the current study, a question could be raised as to whether the Big Eight firm with the largest number of clients with DOL coefficients around the value of one is the firm that issues the fewest qualifications. Assuming the results obtained in the current study are valid, such a study would have implications for the uniformity of auditing standards and, as such, would be considered an extension of the work already performed in this area by Warren (38,39) and Shank and Murdock (34).

Another interesting extension of the study would involve an examination of the association between the DOL coefficients and the coefficient of determination (R^2) values from the time-series regression equations developed to estimate the DOL coefficients. There might be a systematic relationship between the explanatory

power of the regression models, as measured by R^2, and the levels of the coefficient values. For example, those firms with relatively low DOL coefficients might have consistently smaller R^2 values from their time-series regression equations. In substance, the R^2 values could be operating as surrogates for some type of structural change or discriminating factor(s) between firms with very low and those with very high DOL coefficients.

Finally, it would be interesting to replicate the Lev (25) study described in Chapter Three by substituting DOL in place of Lev's unit variable cost surrogate for the operating leverage phenomenon. It would then be possible to examine the association between DOL and both systematic risk (as measured by beta) and overall risk (as measured by the standard deviation of return) and to compare the results obtained with those results reported in the Lev paper.

In conclusion, there are several fruitful areas into which research of this nature can progress. It is important that there be continued application of the concepts of risk developed in corporate finance theory to accounting and auditing research questions. The extent of such applications is limited only by the creativity of researchers in both the accounting and the finance disciplines.

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