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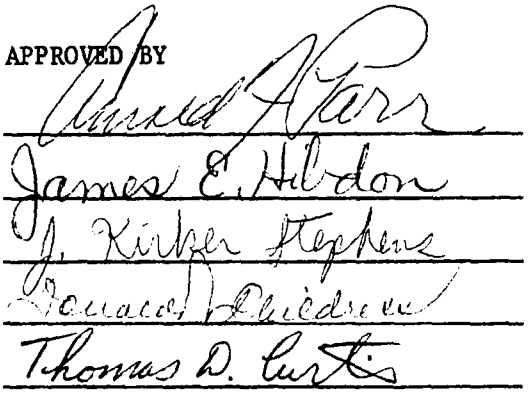

DISSERTATION COMMITTEE

THE LEVERAGE IMPLICATION OF THE PORTFOLIO EFFECT FOR MULTI-INDUSTRY FIRMS

The objective of this dissertation is to examine the dynamics of corporate diversification and capital structure theoretically and empirically. As a main thesis, corporate diversification is predicted to induce increased debt capacity of conglomerate firms. The thrust of the argument in this paper is predicated on the theoretical and empirical merit of the net income hypothesis. Similarly, the financial advantage of conglomerate firms, in terms of augmented leverage capacity, is based on inverse relationship between operating risk and financial leverage maintained by the traditional school of finance. To pursue this line of inquiry, in addition to the introductory and concluding chapters, the study is divided into three main parts: theoretical framework, review of selected empirical studies on conglomerate mergers and capital structure, and empirical analysis regarding the leverage effects of corporate diversification.

Other empirical studies concerning conglomerate performance have, either relied on a naive view of diversification, or have diligently avoided the complexity of conglomerate portfolio analysis at the operating level. The unique feature of the present study is the application of the portfolio model for measuring the operative risk of a conglomerate firm. Although the empirical investigation is limited to a sample of one conglomerate firm, due to the paucity of financial information, the theoretical framework underlying the hypothesis and the model developed for testing it are general. The empirical analysis consisted of three principal and successive steps: analysis of subsidiaries, conglomerate portfolio analysis, and regression analysis. As a preliminary step, parameters of individual subsidiaries are computed in terms of variance of operating returns, covariances among operating returns, and participation levels for eight subsidiaries of the LTV Corporation. A model of portfolio standard deviation is employed to determine the variability of the parent company's operating return, at the end of each year during the period 1962-1971. Finally, the proposition pertaining to the leverage implication of the portfolio effect is tested by separately regressing four different standards of leverage on the parameter of operating risk. Although it is not proper to make a generalization about the universe on the basis of evidence derived from a case study, the hypothesis of this paper is supported: diversification increases the leverage capacity of conglomerate firms.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

THE LEVERAGE IMPLICATION OF THE PORTFOLIO EFFECT FOR MULTI-INDUSTRY FIRMS

CHAPTER I

INTRODUCTION

Background and Purpose of the Study

With reference to the growth of firms externally, the economic history of the United States distinguishes three major merger movements.[1] The first merger wave took place at the turn of the century. During the period 1898-1902, business combinations were largely limited to firms within the same industry. Hence, horizontal mergers were the dominant feature of the first merger activity.[2] The second merger wave occurred in late 1920's and was characterized by a large number of vertical mergers. During this period, many firms integrated different stages of the economic process by moving backward to sources of supply, or forward to distribution outlets.[3] The third and longest merger wave dates back to

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[1]Harry H. Lynch, Financial Performance of Conglomerates (Boston: Harvard University Press, 1971), 17-46.

[2]Samuel Richardson Reid, Mergers, Managers, and the Economy (New York: McGraw-Hill Book Company, 1968), 39.

[3]George D. McCarthy, Acquisitions and Mergers (New York: Ronald Press Company, 1963), 3-10.

the end of World War II with the activity persisting to date. A unique feature of the third merger movement was the increasing number of conglomerate business combinations. This trend has been characterized as many firms becoming a "general store of businesses."[4]

The first two merger movements stimulated a great deal of academic interest in the area of mergers, both from the view point of the firm and the economy in general. Economic forces propelling horizontal and vertical mergers were explained in terms of monopoly power and operating economies. Increases in industrial concentration were studied and the implications for a competitive market structure were noted. In terms of national economic policy, steps were taken to preserve competition with the passage of antitrust laws. Shift of emphasis in economic analysis from a classical model of pure competition to monopolistic and oligopolistic markets was not a matter of accident. To suggest that merger movements may have contributed to the evolution of economic analysis within a setting of imperfect markets is more than mere speculation.

In spite of its persistence and momentum, the third and recent merger movement has not been credited for stimulating much scholarly thought on conglomerate mergers. Reid presents a documented indictment against the economic profession for a benign neglect of an important area in the study of industrial structure.[5] According to Reid, in the Index of Economic Journals for the period 1954-66, only twenty-six articles could be counted on topics related to mergers. In the American Economic

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[4]Reid, Mergers, Managers, and the Economy, 80.

[5]Ibid., 111.

Review, the official publication of the American Economic Association, only three articles appeared on mergers during the period 1954-63. A few broadly stated hypotheses that attempt to explain the incidence of conglomerate mergers exist; but there appears to be a general lack of coherent theory and body of empirical evidence on such mergers.

In the preface to the paperback edition of the Foundations of Economic Analysis, Paul Samuelson, with characteristic perceptiveness, observed that one of the outstanding differences between art and science is the cumulative impact of the latter. Heeding the wisdom of the elder economist, the purpose of this dissertation is to examine the dynamics of corporate diversification and capital structure by drawing from the theory of corporate finance, portfolio theory, and microeconomics.

Prior to the publication of the famous article by Franco Modigliani and Merton H. Miller in 1958, financial theory had maintained that the cost of capital and, hence, the value of the firm was a function of leverage.[6] The traditional position (net income hypothesis) is based on observations about investor preference for securities of firms using unique mixes of financing. Modigliani and Miller countered the traditional position by asserting that the cost of capital or, its equivalent, the value of the firm is independent of leverage. The argument of the two scholars (net operating income hypothesis) rests on two critical assumptions regarding the mechanism of the arbitrage process and the absence of tax effects. Whereas the net operating income hypothesis is a precursor of

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[6]Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," American Economic Review, XLVIII (June, 1958), 261-97.

the separation theorem, both concepts treat investment and financing decisions as dichotomous.[7] In a subsequent paper, Modigliani and Miller conceded that, when tax effects are taken into consideration, the cost of capital is dependent on leverage.[8] Although this is a minor concession, the dispute over capital structure effects vanishes when the restrictive assumptions governing the leverage-independence hypothesis are relaxed.

The thrust of the proposition in this paper derives from the traditional theory of capital structure and the modified version of the Modigliani-Miller position. Before defining the hypothesis of this dissertation, the major arguments of the traditional school merit a restatement. First, the concept of optimal capital structure is theoretically sound and empirically valid. Second, the optimal debt capacity of a firm depends on its operating risk. Third, operating risk and financial leverage vary inversely. An inverse relationship between operating risk and financial leverage signifies important implications for examining the effect of diversification on capital structure. A conglomerate firm is the equivalent of a portfolio of subsidiaries from different industries. Diversity of industries composing the conglomerate portfolio implies that the co-movement of their operating returns are, at least, less than

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[7]Without requiring assumptions of homogeneous-risk class and the arbitrage process, Hamada has reconciled Propositions I and II with the capital asset pricing model under conditions of market equilibrium. For more detail see Robert S. Hamada, "Portfolio Analysis, Market Equilibrium and Corporation Finance," Journal of Finance, XXIV (March, 1969), 13-31.

[8]Franco Modigliani and Merton H. Miller, "Corporate Income Taxes and the Cost of Capital: A Correction," American Economic Review, LII (June, 1963), 433-43.

perfectly positive. Provided that correlations among operating returns are neither zero nor perfectly positive, the operating risk of a firm can be reduced by means of diversification. Since operating risk and financial leverage are inversely related, a diversified firm will adjust its capital structure by using more debt in its financing mix. On the basis of the preceding relationships, the hypothesis of this paper states that some amount of increased debt capacity can be induced by corporate diversification. The secondary purpose of the study is to measure diversification performance at the operating level by using the portfolio approach.

Organization of the Study

This study consists of five chapters in the following order: introduction, theoretical framework, review of selected empirical studies, methodology and results of empirical investigation, and summary and conclusions. In Chapter I, the purpose and background of the study are stated, the organization of the study is described, and the limitations of the empirical analysis are explained.

In Chapter II, the theoretical foundation for the stated hypothesis is developed. Although this chapter is divided into seven subtopics, four main areas are covered. In the first two parts, an interdependence between operating risk and financial leverage is examined and the implications are extended to the effect of diversification on capital structure. Although they do not follow each other, for reasons to be explained subsequently, two sections are devoted to survey and evaluation of the theory of conglomerate mergers. A review of standard portfolio analysis, in which

securities are the decision variables, is followed by portfolio analysis of conglomerate diversification. In the last part of Chapter II, the leverage implication of the portfolio effect is contrasted with the various concepts of financial economies ambiguously attributed to conglomerate firms.

In Chapter III, seven selected empirical studies are critically reviewed. Five articles cover various aspects of conglomerate performance. Three of these concern evaluation of diversification performance within a portfolio framework. A number of empirical investigations relating to optimal capital structure have been published. Almost all these studies use the industry as a surrogate for equivalent-risk class. The two articles on capital structure, included in this review, avoid the popular approach of equating an industry to a homogeneous-risk class.

Chapter IV combines the methodology and results of empirical analysis for testing the proposition that corporate diversification can increase the leverage capacity of conglomerate firms. The empirical investigation is a case study of the LTV Corporation during the period 1962-71. For a period of ten years, the pattern of diversification and the trend of capital structure are compared by means of regression analysis. A portfolio analysis of conglomerate diversification is preceded by analysis of subsidiaries. The outstanding feature of this dissertation is the use of the portfolio model for measuring the effect of corporate diversification on operating risk. After regressing portfolio operating risk on financial leverage, the degree of association between the bivariate sample is tested for statistical significance.

The employment of dynamic portfolio analysis in evaluating a complex organization, such as a conglomerate firm, cannot be properly appreciated without some historical perspective about the subject company. Accordingly, a chronological account of major developments with respect to acquisitions, divestitures, and organizational changes are briefly reviewed for the period covered in the study. These developments, coupled with the necessity of adjusting time series, underscore the difficult task of subjecting corporate diversification to portfolio analysis at the operating level.

Scope and Limitations of Empirical Analysis

In a recent study conducted by the Federal Trade Commission, nine of the largest conglomerate corporations were surveyed to determine the competitive effects of conglomerate mergers.[9] The fifth chapter of the report was devoted to an evaluation of information loss resulting from conglomerate expansion. While wide variations were found among the nine conglomerates in the degree of detail provided in published annual reports, all were criticized for failing to furnish pertinent information on divisional and product-line basis.[10] The companies sampled were declared notorious for using high level of aggregation in their reporting practices. If the basic functions of financial reporting are to enhance efficient allocation of resources, promote efficiency of management, and

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[9]U.S., Federal Trade Commission, Economic Report on Conglomerate Merger Performance: An Empirical Analysis of Nine Corporations (Washington, D.C.: Government Printing Office, 1973), 12.

[10]Ibid., 187-89.

protect the interest of stockholders, the survey companies were found remiss:

> Perhaps the most valuable contribution of this study is that it points out how little is known about the operations of conglomerate firms. There is a serious "information gap" between the information available to managers of conglomerates and that available to the public. Typically, conglomerates publish little or nothing in the way of divisional profit information. It is difficult for stockholders, researchers, potential entrants, or regulatory agencies to understand either the present performance or the future prospects of conglomerate firms. Their continued growth brings a deterioration in the quantity and quality of economic intelligence publicly available.[11]

The existing quality of publicly obtainable financial information renders the task of performing portfolio analysis of conglomerate diversification at the operating level rather arduous. Standard portfolio analysis begins with security analysis. Similarly, conglomerate portfolio analysis should be preceded by generating information about the elementary units of the portfolio: average operating returns, variance of returns, and covariances among operating returns. But the computation of covariances requires parallel and continuous time series for each subsidiary during the period covered by the study. As noted earlier, conglomerate firms are not reputed for providing balance sheets and income statements by subsidiary, much less on continued basis. In view of paucity of financial information, in a form suitable for portfolio analysis, a larger sample of conglomerate firms could not be included in the empirical analysis. Nevertheless, the theoretical framework underlying the hypothesis of this study and the model developed for testing it are

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[11] Ibid., 13.

general for examining the dynamics of corporate diversification and capital structure.

Problems of data were the only consideration in limiting the scope of the empirical investigation to a sample of one conglomerate firm: the LTV Corporation. Moreover, the FTC report singles out LTV as the only exception in providing annual reports by subsidiary.[12] Even in the case of LTV, frequent acquisitions and abandonments by the parent company and its subsidiaries, coupled with occasional internal reorganizations, prevented a more comprehensive portfolio analysis. Consequently, both direct and indirect LTV subsidiaries were reduced to eight manageable subsets. Information gap concerning some subsidiaries, such as the Okonite Company, was surmounted by means of reasonable approximation.

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[12] Ibid., 162.

CHAPTER II

THEORETICAL FRAMEWORK

Introduction

An aspect of the doctrine of corporate finance, designated as the traditional theory, acknowledges inter-industry variations in capital structure as a direct consequence of differences in business risk characteristics of industries. According to the traditional school, operating risk and financial leverage are predicted to vary in an inverse fashion. A specification of this relationship implies the validity of optimal capital structure.

With the traditional view of corporate leverage as a point of departure, this paper is primarily concerned with examining a special case of the interdependence between operating risk and financial leverage: the effect of conglomerate diversification on capital structure. Specifically, it is argued here that some quantum of additional debt capacity is bound to be induced by conglomerate diversification.

To develop a theoretical basis for the main thesis, several related issues are discussed and integrated with the principal line of inquiry. In the first part, the interdependence of investment and financing decisions is argued in general terms. In the second part, the relationship between operating risk and financial leverage is

specified and the implications are extended to conglomerate diversification.

Two sections are devoted to a survey of the theory of conglomerate mergers. The various explanations of the "urge to merge" across industrial lines are discussed under three broad categories: the size-maximization hypothesis, the profit-maximization hypothesis, and the risk-independence hypothesis. Diversification and its by-product financial synergy are singled out as a salient explanation of the conglomerate phenomenon. After criticizing the popular but naive measure of corporate diversification, the portfolio approach is proposed as a better alternative. Analysis of conglomerate diversification within a portfolio framework is preceded by a review of portfolio analysis of securities as a point of departure.

In the last section, the various notions of financial economies, frequently cited in conjunction with conglomerate mergers, are juxtaposed with the effect of corporate diversification on capital structure. High leverage capacity relating to multi-industry firms is underscored as a logical result of diversification.

This chapter covers a broad spectrum of issues related to diversification and capital structure. Whereas a comprehensive treatment of a complex problem is partly desirable, a pursuit of thoroughness entails opportunity cost, such as, discontinuity of the main line of inquiry. In conclusion to this chapter, the dynamics of diversification and capital structure are brought into focus without the interference of lateral issues.

Interdependence of Investment and Financing Decisions

According to positive economic theory, the objective of the firm is to maximize owners' utility from wealth. Because of the impracticality of designing a model that maximizes owners' utility, the maximum market value of the firm is pursued, therefore, as a surrogate goal. The price of shares on the market depends on the firm's major decision variables: the investment and financing decisions.[1]

The investment decision deals with the asset side of the balance sheet as a stock and with operating income as a flow. The financing decision encompasses the manner in which funds are obtained to implement the investment decision. The dichotomy of decisions arises from a tradition of partial-equilibrium analysis in which the two decision variables are separately manipulated in search of their respective optimal levels.[2]

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[1]In the theory of finance dividend policy is surrounded with controversy as much as leverage. To Modigliani and Miller dividend policy is a mere detail except for tax considerations. See Merton H. Miller and Franco Modigliani, "Dividend Policy, Growth, and the Valuation of Shares," Journal of Business, XXXIV (October, 1961), 411-433. According to Gordon, dividend policy is a third major decision variable. See Myron J. Gordon, "The Savings, Investment, and Valuation of a Corporation," Review of Economics and Statistics, XLIV (February, 1962), 49-50. In the opinion of Walter, retention of earnings for reinvestment is an active decision variable, and the payment of dividends is a passive residual. Refer to James E. Walter, "Dividend Policy, Its Influence on the Value of the Enterprise," Journal of Finance, XVIII (May, 1963), 280-291. In this paper, the dividend policy is treated as a subset of the financing decision.

[2]Economic models based on assumptions of perfect and general market equilibrium treat the investment decision and the financing decision as dichotomous variables. The two cases in point are Modigliani and Miller's leverage - independence hypothesis and Tobin's Separation Theorem encountered in the theory of capital markets. For more detail, refer to Modigliani and Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," 261-297 and James Tobin, "Liquidity Preference as a Behavior Towards Risk," Review of Economic Studies, XXIV (February, 1958), 65-86.

The separation of the two decisions is more apparent than real. The investment decision of the firm cannot be treated separately from its financing decision. The simultaneity of the two decisions calls for casting them in a setting of general equilibrium where the interdependence between the investment and financing decisions is explicitly recognized. Lerner and Carlton acknowledge this interdependence of decisions by incorporating their LC and FC functions in the dividend valuation model.[3] The LC function portrays the investment decision in imperfect input and output markets and is the equivalent of the familiar marginal efficiency of capital. The FC function with its positive slope expresses the imperfect market conditions surrounding the financing decision. A simultaneous solution for the two decision variables maximizes the value of the firm.

In recognition of the interdependence between the investment and financing decisions, a general equilibrium model was suggested in place of a naive partial-equilibrium approach. When economic analysis abandons a model of perfect markets with its simplistic assumption of certainty, conditions of uncertainty become important considerations in making decisions. On the basis of the dichotomy of decisions cited earlier, conditions of uncertainty facing the firm can be partitioned as business risk

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When market imperfections are acknowledged, the entity theory of value or the independence of investment and financing decisions no longer holds. For a representative example of the traditional school, see Ezra Solomon, "Leverage and the Cost of Capital," Journal of Finance, XVIII (May, 1963).

[3]For a general equilibrium approach of the investment and financing decisions, refer to Eugene M. Lerner and Willard T. Carleton, A Theory of Financial Analysis, (New York: Harcourt Brace Jovanovich, 1966), 179-202, and Yusuke Horiguichi, "Corporate Financial Decisions General Equilibrium Approach" (unpublished Ph.D. dissertation, Rice University, 1971), 1-6.

and financial risk. However, the two elements of risk are inseparable.

Business risk is generated by the investment decision and is determined by the probability distribution of operating income. From the perspective of economic theory, operating income can be disaggregated into the nature of the input and output markets in which the firm participates, or the demand and supply situations facing it. A related view in the theory of finance would separate the variability of operating income into its constituent elements of operating revenue and operating cost. By means of such a detailed analysis more insight can be achieved about the behavior of operating income. The distinction made between an "economic" and a "financial" perception of the components of operating income pertains more to nomenclature than substance. Since the portfolio of the firm's assets is primarily responsible for generating operating income, the quality of these assets also can be held to reflect the quality of earnings with regard to variability.

The third view of business risk uses the concept of the industry as a frame of reference. Although the classification of firms into industrial categories is based on the physical characteristics of outputs, the industry is frequently used as an equivalent-risk surrogate. This line of reasoning rests on the homogeneity postulate. The homogeneity assumption asserts that the operating incomes of firms in an industry have nearly perfect positive covariances. A more realistic view recognizes differences in business risk among firms but considers inter-industry differences to be more significant. The latter approach is implicit in

Sharpe's dichotomy of systematic and unsystematic risk.[4] The shortcomings of the industry approach to business risk in general, and with regard to conglomerate firms in particular, will be pointed out subsequently. The variability of operating income will be adopted as an operational definition of business risk throughout this paper.

Broadly viewed, the financing decision under conditions of uncertainty determines the manner in which risks and returns attending investment decisions are distributed among the various suppliers of capital. Although the analysis of financial risk is complicated by the order of priority of capital suppliers, behavioral assumptions, and tax treatment, risk invariably arises from the investment decision. However, in most of the literature, financial risk is treated as a function of leverage. This straited conception uses stockholders as a frame of reference in both decisions and does not imply that the return of an all-equity capital structure is risk-free. Whereas the introduction of more leverage increases both risk and return to stockholders, a total withdrawal of leverage will not reduce the risk inherent in the investment decision. Having established a general interdependence between investment and financing under conditions of uncertainty, attention can next be diverted to specifying the direction of change between operating risk and financial leverage.

Inverse Relationship between Business Risk and Leverage

The financing decision of the firm can be partitioned in a number

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[4]The basis of Sharpe's dichotomy of risk is that some elements of uncertainty underlie the whole market and are not diversifiable. Unsystematic risk, on the other hand, is peculiar to a given industry or a given firm and can be eliminated with diversification. See William F. Sharpe, Portfolio Theory and Capital Markets (New York: McGraw-Hill Book Company, 1970), 96-98.

of ways: debt and equity, internal and external, short-term and long-term, and variable and fixed-cost sources. The leverage subset of the financing decision and the manner of its relationship with the investment decision under conditions of risk is the principal concern of this paper. The two underlying premises of leverage analysis, shared by both the antagonists and the protagonists of optimal capital structure, are general risk-aversion prevailing in capital markets and the different tax treatment of debt and equity financing. The fact that various instruments of financing (used in different proportions by different firms) carry associated costs is a reflection of general risk-aversion by investors. Within this framework, two aspects of the leverage issue can be delineated. The first part of the leverage problem is concerned with whether or not the use of leverage exerts some influence on the value of the firm. The second part deals with an attempt to identify a unique point or range of optimal leverage.

In a world of perfect capital markets and no taxes, the doctrinal controversy over the optimality of capital structure is still far from resolved. The leverage issue has divided scholars in the field of theoretical finance into two camps. The opposing views are the leverage-independence hypothesis with Modigliani and Miller (hereafter M & M) as the chief spokesmen, and the so-called traditional school.[5]

The essence of the dissension over optimal leverage addresses itself to whether or not the value of the firm is independent of its

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[5]The traditional school does not have a designated standard banner carrier like Modigliani and Miller and will include all those who reject the leverage-independence hypothesis on both theoretical and empirical grounds.

capital structure. To proceed along the main line of inquiry with minimal digression, it is unnecessary to revive a complete account of the "great debate." In fact, when the restrictive assumptions embraced by the leverage-independence proposition are dismantled, the contention between the two camps vanishes. In this regard, this paper takes a traditionalist stance.

In the remainder of this section the inverse relationship between business risk and the leverage ratio will be explained with a particular emphasis on the behavioral assumptions posited by the "leverage-dependence" argument.[6]

The following notations will be used:

A = Market value of total operating assets

S = Market value of total equity

R_i^a = A random variable for return on operating assets

P_i = Probability of occurrence of the i^{th} random event

R_i^s = A random variable for return on equity

R_d^a = Fixed interest charge corresponding to different degrees of leverage (d = o, ---1)

$E(R)$ = Expected return

L = Leverage ratio ($L = \frac{A-S}{A}$)

L^* = Optimal leverage

R^f = Return on a leverage-free capital structure

$o^2(R)$ = Variance of return

$i = 1 \ldots\ldots n$

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[6]For the underlying assumptions of the leverage-dependence hypothesis refer to Glen A. Mumey, Theory of Financial Structure (New York: Holt, Rinehart and Winston, Inc., 1969), 115-121 and Ezra Solomon, The Theory of Financial Management (New York: Columbia University Press, 1963), 91-118.

The effect of taxes will be assumed away and a simple capital structure consisting of one form of equity and debt will be assumed. The liberties taken in these assumptions are dictated by the need for minimal digression. Given the investment decision by the probability distribution of return on assets, the following four equations specify the risk and return dimensions of assets and equity:

Expected return on assets:

$$E(R^a) = \sum_{i=1}^{n} R_i^a P_i \qquad (2\text{-}1)$$

Variance of return on assets:

$$\sigma^2(R^a) = \sum_{i=1}^{n} \left[R_i^a - E(R^a)\right]^2 P_i \qquad (2\text{-}2)$$

Expected return on equity:

$$E(R^s) = \sum_{i=1}^{n} \frac{A}{S} \left[R_i^a - R_d^a\right] P_i \qquad (2\text{-}3)$$

Variance of returns on equity:

$$\sigma^2(R^s) = \sum_{i=1}^{n} \left[R_i^s - E(R^s)^2\right] P_i \qquad (2\text{-}4)$$

Equation (2-3) requires some elaboration. To circumvent the multiple steps necessary to compute expected return on equity, interest charges on debt (R_d^a) are expressed in terms of total assets. In addition to the mathematical convenience, this view of interest is justified

by the notion of cost of capital as the required rate of return on assets. The term (R_d^a) is not a random variable, but the subscript (d) is used to denote interest charges corresponding to varying levels of leverage.

Having specified the risk and return measures of assets and equity, attention can now be devoted to examining the interplay of the investment and leverage decisions. Beginning with an all-equity capital structure and in the assumed case of no taxes, the ordered pairs of returns and variances in (2-1) and (2-2) are equal to the pairs of returns and variances in (2-3) and (2-4).[7] It is to be noted that the equality of operating risk and return to risk and return on equity is a demonstration of the fact that financial risk does not exist under circumstances where the capital structure is not levered. In such cases, the variability of equity return is only due to operating risk inherent in the investment decision.

When debt is introduced into the capital structure, equalities between the ordered pairs of risk and return cease to hold. Inequality between the variance of operating return and the variance of equity return signals the emergence of financial risk accompanying the use of leverage. Increases in leverage are reflected in the changing values of interest charge (R_d^a) and the leverage ratio $(\frac{A}{S})$ in Equation (2-3), holding the scale of operation constant.

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[7] In an all equity capital structure A = S and $R_d^a = 0$. Substituting these values in (2-3), the following equality emerges:

$$E(R^s) = \sum_{i=1}^{n} \frac{A}{A} \left[R_i^a - 0 \right] P_i = \sum_{i=1}^{n} R_i^a P_i$$

Repeating the same procedure:

$$\sigma^2(R^a) = \sigma^2(R^s)$$

Increase in equity return, induced by the use of more leverage, is easily explained. As long as the rate of return on investments is greater than the cost of debt, return on equity will increase with more utilization of leverage. With reference to Equation (2-3), and assuming no change in the rate of interest, the expected return on equity ($E(R^S)$) is an increasing function of the leverage ratio ($\frac{A}{S}$). Implicit in the preceding statement is the additional assumption that the investment decision as specified by the probability distribution of operating returns, in Equations (2-1) and (2-2), remains the same. The assumption pertaining to the apparent independence of interest rates and leverage will be relaxed after the variance of equity return has been examined.

The variance of equity return is defined in Equation (2-4). As shown in the equation, since the variance of equity return is partly dependent on the expected value of equity return, a rise in the latter is accompanied by a corresponding rise in the former. When the probability distribution of operating returns is held constant, it is to be noted that the underlying cause of both changes in equity risk and return is the increased use of leverage. Return on equity and its dispersion will increase simultaneously with additional leverage in a manner shown in the following expression:

$$\frac{d(E(R^S),\ \sigma^2(R^S))}{dL} > 0 \qquad (2\text{-}5)$$

In addition to the terms of trade between risk and return, the value of the firm is partly dependent on relative changes in $E(R^S)$ and $\sigma^2(R^S)$ with respect to leverage. This point will be pursued further after considering

the interaction between interest rates and leverage.

In the preceding discussion, the response of equity risk and return to leverage was explained without allowing for possible rise in interest rate as leverage increases. The assumption that the rate of interest is invariant with leverage is only valid within a limited range. Provided that each random variable for operating return (R_i^a) is greater than or equal to fixed interest charges corresponding to different degrees of leverage (R_d^a), there is no conceivable reason to expect a rise in interest rates due to leverage. The inequality in (2-6) stipulates the condition for preventing increases in the marginal rate of interest within moderate bounds of leverage:

$$R_i^a \geq R_d^a \qquad (2\text{-}6)$$

From the view point of creditors, as long as the sense of the above inequality is not violated, interest on debt is the equivalent of return on a riskless investment. However, the interest charged on debt is not a risk-free rate, but a certainty-equivalent of expected interest after allowing for lenders' risk. Since the rate of interest has been adjusted for a moderate risk of default, the use of more leverage can be slightly extended beyond the limits set by the inequality in (2-6), without causing increase in the marginal rate of interest. When a moderate amount of debt in the capital structure is surpassed, the rate of interest becomes an increasing function of leverage. Unless equity yield is simultaneously examined, the interaction between interest rates and the capital structure is merely a partial picture of the valuation process.

As pointed out earlier, equity return and its variance change in the same direction. The general direction of change between leverage and the two variables is nowhere disputed.[8] The main controversy over leverage and valuation pertains to rates of change in equity risk and return with respect to leverage, and particularly to the value imputed to the trade-off between risk and return. Without some basis for specifying the rate of change in the two dependent variables, with respect to leverage, the effect of capital structure on the value of the firm remains a moot question. Even if the two rates were somehow known, the effect of leverage on valuation cannot be assessed unless the price of "reward-to-variability" is defined.[9]

Both the opponents and the proponents of optimal capital structure circumvent the problem of valuation and leverage by introducing behavioral assumptions which are exogenous to the interaction of equity risk and return with leverage. According to the leverage-independence

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[8] A direct relationship between equity yield and financial leverage has always been a point of truce between the leverage-independence hypothesis and the traditional proposition. Ibid., 108 and Fred Arditti, "Risk and the Required Return on Equity," Journal of Finance, XXII (March, 1967), 19-36.

[9] In this context, reward-to-variability refers to the ratio:

$$\Theta = \frac{E(R^s) - R_f'}{\sigma^2(R^s)}$$

The numerator is the difference in equity return between a levered and a non-levered capital structure. The negative term in the numerator refers to equity return that is free from financial risk. This concept was used by Sharpe in evaluating the performance of mutual funds. In his study, ex-post data was used for equity risk and return, and the risk-free rate of interest for the negative term in the numerator. The higher the ratio (Θ), the better the performance of the mutual fund. For more detail refer to William F. Sharpe, "Mutual Fund Performance," Journal of Business, XXXIX (January, 1966), 119-138.

hypothesis, the effect of increase in equity return is exactly counterbalanced by the effect of increase in equity variance so that the value of the firm is kept invariant with leverage. Stated differently, increases in earnings per share are exactly offset by decreases in the earnings' multiplier at all levels of leverage. The advocates of the leverage-independence hypothesis, therefore, maintain that the value of the firm is independent of leverage.

The traditional theory denies the leverage-independence hypothesis by contending that investors have different preferences for different degrees of leverage. In instances where leverage is too much or too little, the market imputes opportunity cost to improper capital structure by raising equity yield or, what is the equivalent, by lowering the earnings' multiplier. According to the traditional view, three degrees of financial leverage can be identified: deficient leverage (L_d), optimal leverage (L_o), and excessive leverage (L_e). Figure (2-1) portrays the effect of leverage on the value of the firm.

When leverage is excessive, investors perceive the net effect as unfavorable because the disadvantage of increased financial risk outweighs the benefits of higher return. Beyond the point or range of optimal capital structure, each increment of the leverage ratio is accompanied by a disproportionate change in earnings per share and its multiplier such that the relative rise of the former is less than the relative decline of the latter. A glance at Fig. (2-1) would suggest that if L_o has been surpassed, a reasonable action would be to unlever the capital structure to the point of optimality.

In the range of L_d, the increased use of leverage is favorable to

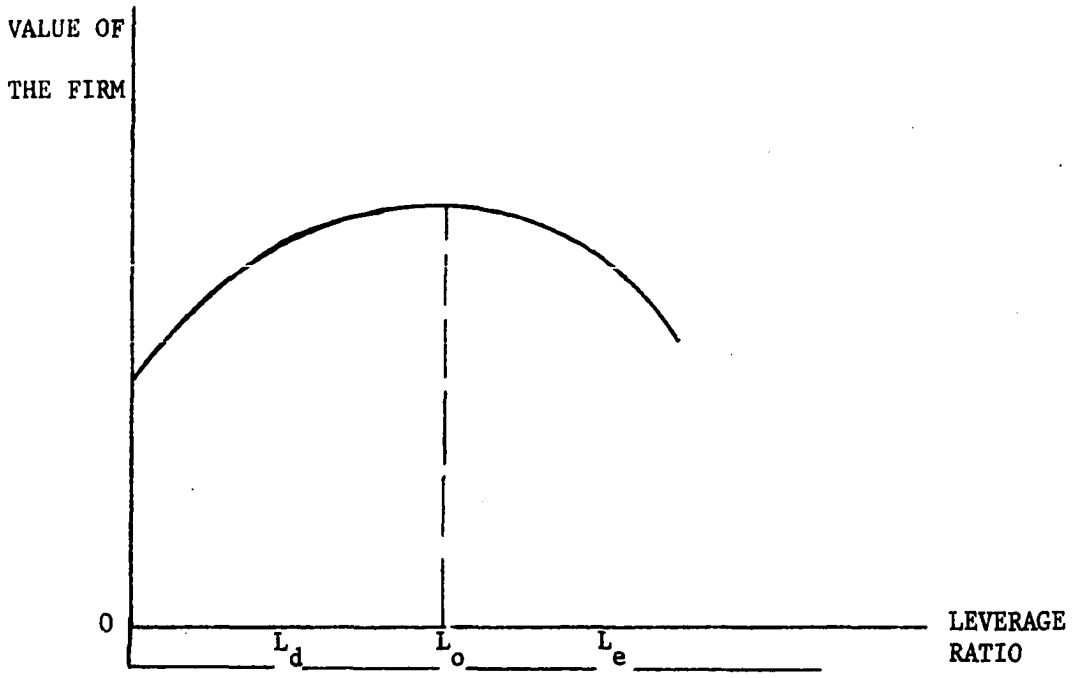

FIGURE 2-1. Effect of Leverage on the Value of the Firm

equity value. Below L_o, each addition of the debt-equity ratio adds more to equity return than financial risk. Although equity yield will rise slightly due to increased variance, it does not rise fast enough to offset increases in return. A management intent on maximizing the value of the firm will increasingly lever the capital structure as long as the terms of trade between risk and return are favorable to equity value. The increased use of leverage should stop at the point L_o where the marginal rate of substitution between equity risk and return is in equilibrium. Hence, the traditional theory of capital structure affirms that leverage exerts a definite influence on equity value and that optimal leverage lies in the intermediate zone between defficient and excessive leverage. In

addition, the traditional position states that an optimal leverage, such as L_o, is uniquely associated with the given investment decision.

In the preceding analysis, the investment decision, described by the probability distribution of operating returns, was held constant. By holding expected operating return and its variance the same, the leverage ratio was varied in search of optimal capital structure. To study the direction of change between operating risk and leverage, it is necessary to alter the investment decision so that the response of optimal leverage can be observed once again. Repeating the foregoing exercise is intended to accomplish two purposes. First, in an operating risk-leverage space, at least two points are required to form opinion about the direction of change between the two variables. Second, the result of the observation has an important implication for examining the effect of conglomerate diversification on capital structure which is the main thesis of this paper. With these two considerations in mind, the probability distribution of operating returns will be changed so that the variance of operating returns is lower than in Equation (2-2). No change in the level of the expected operating return ($E(R^a)$) will be assumed. Retaining the earlier set of assumptions and following the same line of reasoning, a new point of optimal leverage will emerge such that:

$$L_o^2 > L_o^1 \qquad (2\text{-}7)$$

Holding the level of expected operating returns constant, the second investment decision was changed to allow more compactness in operating risk in relation to the first:

$$\sigma^2(R^a)_2 < \sigma^2(R^a)_1 \qquad (2\text{-}8)$$

From the sense of the inequalities in (2-7) and (2-8), the relationship between operating risk and financial leverage may be generalized as inverse:

$$\frac{d\,\sigma^2(R^a)}{dL} < 0 \qquad (2\text{-}9)$$

There are a number of studies attesting to optimal capital structure. These studies show significant differences in inter-industry capital structure, and a definite pattern in the differences is evident.[10] If a cross section of industries were ordered in terms of operating risk, the corresponding optimal leverage would emerge in an inverse fashion. More than a precise form of relationship, the general change of direction between operating risk and leverage is of special interest in this paper.

Before concluding this section, it would be appropriate to be explicit about what has been implicit in the foregoing discussion. If an inverse relationship between operating risk and leverage is theoretically sound and empirically defensible, a case can be made for explaining the advantage or conglomerate mergers in terms of financial leverage. As a conglomerate engages in a series of acquisitions in unrelated industries, the process of diversification is reflected in progressively stabler operating returns. The increased stability of operating earnings

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[10] For example, see Ronald F. Wippern, "Financial Structure and the Value of the Firm," Journal of Finance, XXI (December, 1966), 615-633 and David F. Scott, "An Inquiry Into the Existence of Optimum Financial Structure" (unpublished Ph.D. dissertation, University of Florida, 1970), 103-170.

will enable the firm to push its optimal leverage to successively higher points. The leverage induced by diversification is hereafter designated as the "leverage implication of portfolio effect." The secondary objective of this paper is to examine the inverse relationship between operating risk and leverage in (2-10) by studying conglomerate diversification and its leverage responses as a special case.

Current State of Conglomerate Merger Theory

There is a broad concensus over economic forces that induce vertical and horizontal mergers. The reasons frequently cited are monopoly power and economies of scale. A great deal of uncertainty prevails with regard to the economic gains of conglomerate mergers. An unsatisfactory theory of conglomerate mergers is evidenced by the conjectural nature of existing views. In this section, an attempt will be made to classify the fragmented explanations of the conglomerate phenomenon and to evaluate them in the light of other forms of growth.

At one extreme, the very need of the conglomerate form of organization is questioned under the title of the risk-independence hypothesis.[11] The point of departure in this view is the quest for the maximization of the value of stockholders' equity. This goal can be accomplished by increasing returns, reducing risk, or both. The prospects of increasing return are considered to be the result of scale economies which are more in the domain of vertical and horizontal mergers. In a setting of perfect capital markets, the reduction of risk can be achieved by substituting

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[11] Haim Levy and Marshall Sarnat, "Diversification, Portfolio Analysis and the Uneasy Case for Conglomerate Mergers," Journal of Finance, XXV (September, 1970), 795-802.

personal portfolios for the securities of a conglomerate firm. By assuming away market imperfections and synergistic effects, the benefits of the conglomerate form of economic organization are denied. This argument is pursued within a framework of portfolio theory. Therefore, a detailed presentation of the risk-independence hypothesis is deferred to the latter part of this chapter.

The other polar position on conglomerate mergers accepts growth across industrial lines as given, and then attempts to rationalize the flurry of conglomerate mergers during the last merger wave. This group of views may be broadly classified as the growth- maximization and the profit-maximization hypotheses. In conventional economic theory, profit maximization is invariably taken for granted in explaining the behavior of the firm. The profit-maximization hypothesis subsumes no separation of ownership and control or accepts the compatibility of managers' and owners' interests. In the light of the growing separation of ownership and stewardship, a conflict of interest between managers and owners is considered to be a logical consequence.

Following this development, the growth-maximization hypothesis is posed as a direct challenge to the profit-maximization hypothesis. Since the gain of market power and synergism is more strongly identified with other forms of economic integration, conglomerate firms are often cited to substnatiate the growth-maximization thesis.[12] Both in scope

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[12]The growth-maximization thesis alleges that both the pecuniary reward and the non-pecuniary satisfaction of managers is directly related to growth in size. For a theoretical discussion of this view, see Dennis C. Mueller, "A Theory of Conglomerate Mergers," Quarterly Journal of Economics, LXXXIII (November, 1969), 643-660. For an attempt to substnatiate the thesis with a study of conglomerate mergers, refer to Reid, Mergers, Managers, and the Economy, 117-207.

and tone, conglomerate mergers as a means of achieving bigness in size only, with no consideration for growth in profit, falls outside the limits defined for this study.

Most of the items in the following discussion proceed from profit as the operating premise of conglomerate firms. Beginning at the very top of the operating performance statement, mergers are justified if they can increase revenue by gaining market power. Conglomerate mergers are very unlikely candidates as a source of monopoly power for obvious reasons. Economic theory is in general agreement that the potential for monopoly power belongs to other forms of consolidation. However, predatory pricing or the "deep pocket hypothesis" is suggested as a possible source of monopoly power.[13] There is no evidence supporting the exercise of predatory pricing by conglomerate firms. Even if feasible, the deep pocket hypothesis is not a cause but a consequence of conglomeration. Moreover, according to the principle of comparative advantage, the potentials for monopoly power belong to other types of mergers.

The next logical point of reference on the operating statement

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[13]With regard to the competitive effects of pure conglomerate mergers, conflicting views are prevalent. Some of the consequences are considered to be harmful to competition and others are considered to enhance competition. The anticompetitive effects are suggested in the form of four hypotheses: predatory pricing or the deep pocket hypothesis, mutual forbearance, reciprocal buying and the leading firm acquisition hypothesis. The procompetitive effects are suggested in the toehold theory. These opposing views on the competitive effect of conglomerate mergers are merely conjectural. There is no empirical evidence supporting either point of view. For more detail, refer to F. M. Scherer, Industrial Market Structure and Economic Performance (Chicago: Rand McAnally and Company, 1970), 273-283 and U. S., Federal Trade Commission, Economic Report on Conglomerate Merger Performance: An Empirical Analysis of Nine Corporations, 87-127.

is cost. If a conglomerate's opportunities are not based on the possession of monopoly power, potentials for a reduction of cost is offered as a justification for the incidence of mergers. Technological economies, managerial economies, and financial economies are often mentioned under the general name of synergism as sources of efficiency in cost.[14] The three economies are apparently related to size. Whereas technological and managerial economies are a function of scale, there is some subtlety to financial economies which has a particular significance within the context of conglomerate mergers. This subtlety emanates from a joint consideration of size and risk, and will be elaborated under the appropriate title subsequently.

Synergism is a concept loosely used in advancing positions both for and against conglomerate mergers, and requires clarification. Total synergy can be partitioned into its operating and financial components. These economies are also known as operating leverage and financial leverage, and are a result of the structure of the firm's costs with fixed and variable elements. A common measure of operating leverage compares relative change in operating income to relative change in sales. The resulting coefficient is known as the degree of operating leverage. The coefficient of operating leverage is independent of the financing decision. The degree of financial leverage is obtained by dividing relative change in operating income before taxes by relative change in operating income before financial charges.[15]

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[14]Mueller, "A Theory of Conglomerate Mergers," 650-651 and Michael Gort, "Diversification, Mergers and Profits," in William W. Alberts and Joe Segall (eds.), The Corporate Merger (Chicago: University of Chicago Press, 1967), 33-35.

[15]In the measurement of the coefficient of financial leverage

The coefficient of financial leverage reflects the financing decision. Financial leverage takes over from operating leverage. For this reason, their internal structure is characterized in sequence as first-stage leverage and second-stage leverage. Without decomposing "total synergy" into its two stages, the differential effects of operating and financial leverage on the form of merger cannot be fully appreciated. The use of synergism in its generic sense is the common failure of those arguments that appeal to synergistic effects as a justification for conglomerage mergers.

Now, the question arises if conglomerate mergers are susceptible to operating leverage. On the basis of the measure of operating leverage, if changes in sales are accompanied by a more-than-proportionate change in operating income, there is valid ground to suspect positive contribution of operating synergy.[16] The likelihood of operating synergy for conglomerate mergers can be judged by viewing technological and managerial economies separately, coupled with a distinction between plants and firms. If conglomerate mergers entail diverse products using different technologies, the advantage of technological economies is not easily discernable at the plant level. However, opportunities for realizing efficiency

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earnings before taxes (EBT), earnings after taxes (EAT), and earnings per share (EPS) are used in the numerator interchangeably. In order to exclude the effects of stock splits, stock dividends, rights options, and changes in tax rates, earnings before taxes (EBT) is preferred as an unbiased measure of the numerator.

[16]It should be noted that a disproportionate change between revenues and operating costs can also be attributed to imperfections in the product and factor markets. Therefore, the coefficient of operating leverage can be free of the influence of market imperfections only if unit selling price and unit variable costs remain unchanged.

deriving from managerial economies seems to be feasible. This is particularly true in instances where management is regarded as an amorphous factor which can be applied to diverse lines of business. The operating leverage of conglomeration lies at the firm level. Whether or not this in itself is strong enough to warrant conglomerate mergers is frequently disputed by invoking antitrust legislation against other forms of consolidation. Aside from legal considerations, vertical and horizontal mergers can be distinguished from conglomerate mergers by a higher coefficient of operating leverage. A priori, a higher coefficient of financial leverage is a distinguishing feature of conglomerate mergers relative to intra-industry union, because conglomerate diversification is expected to create more debt capacity. A detailed account of the thesis that corporate diversification calls for adjustment in capital structure will be covered later.

The fact that horizontal and vertical mergers are legally restrained does not necessarily imply that operating economies will be achieved by conglomerage mergers. The evidence cited in a study by the Federal Trade Commission suggests that operating economies for conglomerate mergers are more apparent than real.[17] According to this study, conglomerate firms make so little change in the administrative functions of the firms they acquire that operating economies are minimal. Post-merger centralization of managerial functions are considered to correspond to more operating economies. The acquired firms of the surveyed companies remained largely

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[17]Federal Trade Commission, Economic Report on Conglomerate Merger Performance, 14-43.

decentralized. A measure of operating leverage employed by the FTC is based on a simple frequency count of changes in organizational and administrative functions. Due to its qualitative nature, this evidence should be taken with some reservations.

Some economists argue that firms search for profitable opportunities, even if it means entering an unfamiliar industry.[18] This proposition will be summarized with the aid of Figure (2-2). MCC is the capital

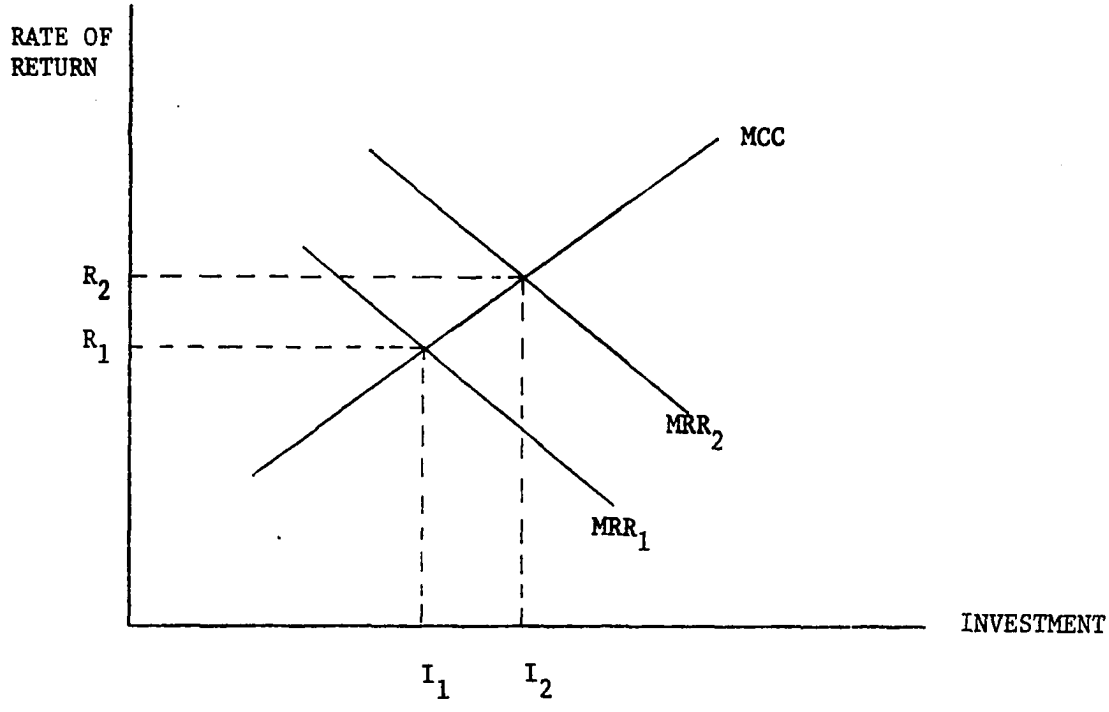

FIGURE 2-2. Shift in the Marginal Efficiency of Capital as a Reason for Diversification.

[18] Gort, "Diversification, Mergers and Profits," 38-39.

supply curve, and MRR is the investment opportunity curve. I_1 and I_2 are the pre-merger and the post-merger levels of investment, respectively. When a firm finds profitable opportunities higher than the average of what is available from the existing portfolio of assets, acquisitions in diverse industries will take place. The result of this action is reflected in the shift of the profit opportunity curve from $\overline{MRR}_1$ to $\overline{MRR}_2$. It is not necessary to give a list of the factors that cause a shift in the investment opportunity curve, but it must be emphasized that these forces are not necessarily related to synergistic effects.[19]

No one will dispute the desirability of pursuing higher profits through diversification. But when the acquired company originates in a sector characterized by easy entry, the high rates of return become a short-run phenomenon. If diversification is pursued with long-run objectives in mind, considerations other than short-run profit objectives must be given more importance to justify inter-industry mergers. Moreover, the pursuit of higher profits by all legitimate means is a prescribed and accepted goal for the firm. The principle applies to all forms of growth with comparable appeal. The proposition of diversification to enter profitable industries is the equivalent of invoking a general capital budgeting process to validate an isolated case. The above argument, while valid, is not overwhelming to justify conglomerate mergers in itself.

The most frequent--and in this researcher's opinion the most persuasive--explanation of conglomerate mergers is the pursuit of diversifi-

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[19]For a detailed enumeration of causes of shift in the investment curve, refer to John C. Narver, Conglomerate Mergers and Market Competition (Los Angeles: University of California Press, 1967), 64-67.

cation. In some instances, financial economies or financial leverage are offered as separate explanations. In this study increased use of leverage is treated as a by-product of diversification. In economic theory, diversification is sometimes explained in terms of cross-elasticity and resource-mobility.[20] By far the most popular analogue of diversification is the old adage of warning against putting all eggs in one basket. This ancient homily derives from the likelihood of adverse and random events confronting different industries at the same time. The hazards of random events can be reduced by spreading a firm's investments across industry lines. The concept of diversification is relatively straight-forward, but a measure of the extent of diversification or the degree of insulation against risk is elusive.

Many studies concerning inter-industry differences of risk-related variables treat risk as if it is given by the nature of the industry. This approach to risk entails a definite limitation because the notion of industry based on the Standard Industrial Classification system is oriented towards similar physical characterisitcs. For example, in

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[20]If the cross elasticity between two products is high, the products are close substitutes and belong to similar markets. Therefore, the higher the cross elasticity, the less diversified the products and the markets. When productive inputs can be shifted around between different outputs, the products are perceived as similar from the point of view os suppliers. Therefore, a high resource mobility is an indication of operation within the same industry although products are sold in diverse markets. Ease in resource mobility from the supply side coupled with diverse markets from the demand side is like having the best of the two worlds. A view of diversification in terms of factor mobility and product cross-elasticities is oriented towards the physical characteristics of outputs and productive inputs. Investment in products with high cross-elasticity is similar to investment in products with high positive covariances. See Michael Gort, Diversification and Integration in American Industry (Princeton: Princeton University Press, 1962), 8-9.

empirical investigation of interindustry differences in capital structure, these limitations are present, but they are less severe when firms in different industries are not held to interact. On the other hand, in situations where the interplay of industries is ever present the problem of risk measurement becomes formidable. Past measurements of diversification were based on the multiplicity and heterogeneity of product lines or markets entered by conglomerate firms.[21] The extent of diversification was gauged by the number of industrial categories in which a conglomerate firm operated plants. A simple frequency count of industrial categories implies equal weighting factors, which is hardly the case. Heterogeneity of product lines presumably indicates the extent of dissimilarity between physical products. In the context of risk analysis, the notion of heterogeneous products is not a useful concept, unless risk magnitudes are indicated in an ordinal or cardinal sense. Another major shortcoming of the industry approach to risk is the total disregard for explicit risk-interdependence when firms in different industries are brought together as in conglomerate mergers. Although naive diversification can be both deficient and superfluous, one thing can be said in its favor: it is still better to diversify than not to diversify.[22] In light of these simplistic measures of diversification, an alternative guide to conglomerate decisions is critically needed, and the most likely candidate is the portfolio

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[21] Ibid., 9-11. The fourth chapter of the FTC report also uses SIC product categories and digit details in the measurement of diversification. See Federal Trade Commission, Economic Report on Conglomerate Merger Performance, 87-128.

[22] The implicit condition of this assertion is that a decline in expected return is not compromised, and that the subsidiaries of the conglomerate firm are characterized by less than perfect positive covariances.

technique.

Portfolio Analysis of Securities

The genesis of portfolio theory can, perhaps, be traced back to the agrarian society when man first learned not to put all his eggs in one basket. Although this ancient wisdom is as old as the discipline of economics its contemporary economic impact was not fully captured until it was given a formal mathematical treatment in 1952. The man given unanimous credit for raising diversification to a scientific status is Harry Markowitz.[23] Markowitz rejected the maximization of expected return as uni-dimensional and, therefore, inconsistent with utility maximization. He dismissed the "eggs and baskets" approach to diversification as naive and proposed a more efficient rule. A rational investment behavior was redefined as the maximization of utility, or its equivalent, the optimization of a trade-off between risk and return.

In this section, the merits of the portfolio approach to risk analysis are listed and explained using securities as decision variables. First, the structure of a basic portfolio problem is in order:

Expected portfolio return:

$$E(R_p^s) = \sum_{i=1}^{n} X_i E(R_i^s) \qquad (2\text{-}10)$$

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[23] Harry Markowitz, "Portfolio Selection," Journal of Finance, VII (March, 1952), 77-91. There is no dispute that it was Markowitz who revived and popularized portfolio theory, but the origin of risk analysis can be pushed further back to the works of Daniel Bernoulli in the early eighteenth century.

Portfolio variance:

$$\sigma^2(R_p^s) = \sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \rho(R_{ij}^s)\sigma(R_i^s)\sigma(R_j^s) \qquad (2\text{-}11)$$

Subject to:

$$\sum_{i}^{n} X_i = 1 \quad \text{and} \quad X_i \geq 0 \qquad (2\text{-}12)$$

Where:

$E(R_i^s)$ = expected return of security i

$E(R_p^s)$ = expected portfolio return

$\sigma^2(R_i^s)$ = variance of return of security i

$\sigma^2(R_p^s)$ = variance of portfolio return

$\rho(R_{ij}^s)$ = correlations between securities i and j

X_i = proportion of investment in security i

j = 1, 2

i = 1, 2 ... n

First, unlike the qualitative view of diversification, relevant variables or portfolio inputs are isolated and more precisely quantified. The inputs of a portfolio consist of expected returns, variances of returns, and covariances between returns.[24] These parameters are obtained from security analysis which presages portfolio analysis. For a portfolio of

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[24]Criticisms have been levelled against portfolio analysis for disregarding higher statistical moments such as skewness and kurtosis and for giving equal importance to upward and downward variances. See Jack Clark Francis and Stephen H. Archer, Portfolio Analysis (Englewood Cliffs: Prentice-Hall, Inc., 1971), 211-227.

n securities, n expected returns, n variances, and $(n^2 - n)/2)$ covariances or correlation coefficients are required.[25]

Second, in sharp contrast with naive diversification, interdependence between variables is explicitly recognized. As indicated in (2-10), a portfolio return is linearly related to its decision variables. It is evident from (2-11) that portfolio risk is quadratic. Stated differently, portfolio return is additive whereas portfolio risk is multiplicative. Because of its special significance to the analysis of conglomerate mergers, in the context of the thesis advanced in this paper, more attention will be given to the risk dimension of a portfolio.

The extent of a portfolio's synergistic effects depends on the parameters of the critical inputs: variances of returns, covariances between returns, and values assigned to the decision variables. At one extreme, the variance of the portfolio can be eliminated--reduced to $\sigma^2(R_p^s) = 0$. To eliminate portfolio variance, the three necessary conditions are perfect negative correlations between the returns of each security, identical variances of returns, and equal levels of participation by each security. For example, if the right-hand member of Equation (2-11) is expanded for a two-security case, the two-security portfolio variance

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[25] On the basis of interrelationships between securities returns through common indices, Sharpe has proposed a simplified model for portfolio analysis. The diagonal model reduces substantially the number of covariances needed, and renders economical both the task of security analysis and portfolio analysis. It is not known as yet whether the computational efficiency of index models more than offset the accuracy of the comprehensive full covariance Markowitz approach. See William F. Sharpe, "A Simplified Model for Portfolio Analysis," Management Science, IX (January, 1963), 277-293 and Kalman J. Cohen and Jerry A. Pogue, "An Empirical Evaluation of Alternative Portfolio Selection Models," Journal of Business, XL (April, 1967), 166-193.

will emerge in the form of the following equation:

$$\sigma^2(R_p^s) = X^2\sigma^2(R_1^s) + (1-X)^2\sigma^2(R_2^s) + 2X(1-X)\sigma(R_1^s)\sigma(R_2^s)\rho(R_{1,2}^s) \quad (2\text{-}13)$$

The right-hand side of (2-13) can reduce to zero if the sum of the first two terms is equal to the third term, but opposite in sign. To satisfy a zero solution to (2-13), the three conditions stipulated in terms of variances, correlations, and participation levels must be met.

At the other extreme, the variance of the portfolio can be the sum of the weighted average of each security's participation level and variance, as shown in (2-14):

$$\sigma^2(R_p^s) = \sum_{i=1}^{n} X_i\sigma^2(R_i^s) \quad (2\text{-}14)$$

To satisfy (2-14), the two required conditions are perfect positive correlations between the returns of each security and identical variance of returns. It should be noted that for Equation (2-14) to hold, equality of investment proportions in each security of the portfolio is not necessary. Hence, portfolio variance is a linear function of the proportions invested in each security, provided that the two conditions with respect to correlations and variances are satisfied. In the two asset case, if one of the investments is a riskless asset, Equation (2-14) remains unviolated. This final observation is a mere restatement of the linearity of the capital market line which is the locus of combinations of the market portfolio and lending-borrowing at the risk-free rate of interest. Instances of eliminating portfolio risk or keeping portfolio

risk as a weighted average of its components' variances would amount to overextending the logic of diversification. The two theoretical cases are neither feasible, nor, in the case of the latter, desirable.[26] Reality invariably lies between opposite poles and symbolically,

$$\sum_{i=1}^{n} X_i \sigma^2(R_i^s) \geq \sigma^2(R_p^s) \geq 0 \qquad (2\text{-}15)$$

Expression (2-15) defines the upper and lower bounds of portfolio variance.

Third, in juxtaposition with a simple frequency count of investment in unrelated industries, portfolio analysis defines exact standards of efficient diversification. According to the efficiency maxim, a portfolio is efficient if it attains the highest return for its risk class, or if it attains the lowest risk for its return class. In Figure (2-3), the curve EF portrays these properties of efficient sets of portfolios where EFABCD circumscribes the feasible region. Efficient sets of portfolios, along EF, can be generated by using different procedures: the MRP (maximum return portfolio) approach, the MVP (minimum variable portfolio) approach, the QP (quadratic programming)alogarithm, and simplified models.[27] The MVP procedure will be used for illustration.

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[26]Diversification can reduce risk only to its systematic level and not below. The technique is potent only against unsystematic or diversifiable risk. No amount of diversification can reduce systematic risk to its lower limit as indicated in (2-15). See William F. Sharpe, "Capital Assets Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance, XIX (September, 1964), 436-442.

[27]For a summary comparison of the different tools of portfolio analysis refer to Francis and Archer, Portfolio Analysis, 78-107.

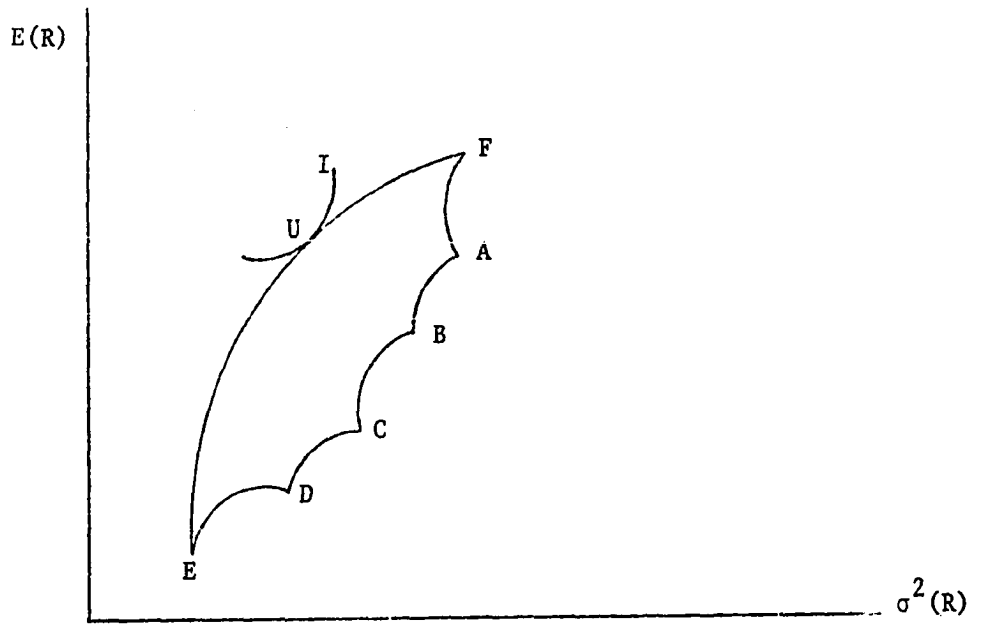

FIGURE 2-3. The Efficient Frontier in Risk-Return Space

The structure of a basic portfolio problem was given by the expressions (2-10) through (2-12). Combining the three expressions, the Lagrangian objective function of the risk-minimization problem with a desired return constraint $E(R)^*$ is given by

$$Z = \sum_{i=1}^{n}\sum_{j=1}^{n} X_i X_j \rho(R_{ij})\sigma(R_i)\sigma(R_j) + \lambda_1\left[\sum_{i=1}^{n} X_i E(R_i) - E(R)^*\right] + \lambda_2\left[\sum_{i=1}^{n} X_i - 1\right] \quad (2\text{-}16)$$

The minimum-risk portfolio for successively predetermined return-classes is found by setting

$$\frac{\partial Z}{\partial X_i} = \frac{\partial Z}{\partial \lambda_j} = 0 \quad (2\text{-}17)$$

Fourth, portfolio theory specifies a decision rule for selecting one efficient portfolio from a wide range of choices. In essence, portfolio selection consists of reconciling one of the multitude of efficient portfolios with individual utility preference for risk.[28] With reference to Figure (2-4) portfolio selection amounts to isolating a unique location on the efficient frontier, such as U, where I_1 describes an inventor's indifference curve between risk and return. The point of tangency (U), between the efficient frontier and an investor's indifference curve, is the point of compatibility between a unique optimal portfolio and the investor's attitude towards risk.

In the preceding paragraphs, the essential elements of the portfolio approach to diversification were reviewed using securities as decision variables and a portfolio of securities as the frame of reference. In the following section, a portfolio approach to conglomerate diversification will be examined. Hence, a "conglomerate portfolio" will replace a portfolio of securities, and firms will be the relevant decision variables instead of securities.

Portfolio Analysis of Conglomerate Mergers

The original and widespread use of the portfolio approach was limited to the analysis, selection, revision, and evaluation of combinations of securities. Portfolio theory is such a fundamental guide to

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[28] The theory, in the form of the Separation Theorem, recommends that all investors should hold the market portfolio. Individual differences with regard to attitude towards risk should be adjusted by lending or borrowing at the risk free rate of interest. This portfolio selection rule is in sharpe contrast to the traditional "interior decorator" approach. See Sharpe, Portfolio Theory and Capital Markets, 70-73.

all decisions involving probabilistic and interrelated outcomes that its potentials transcend the narrow scope of analyzing combinations of capital assets only. As a tribute to the generality of portfolio theory, Sharpe observed: "If the Markowitz approach is useful in the context of security selection it must be useful in (almost all areas of finance and most areas of business administration)."[29] A portfolio framework has been suggested for the selection of capital projects and conglomerate merger decisions, as special cases of the general portfolio theory.[30]

A portfolio of securities can be considered as a merger of securities and a merger as a portfolio of firms. A different view of the firm would be to regard it as a portfolio of securities with identical expected returns, identical variances of returns, and perfect positive covariances of returns. Similarly, a conglomerate is a portfolio of firms with their respective expected returns, variances, and covariances. If all the assumptions of portfolio analysis were duplicated for the conglomerate case, the selection of firms for acquisition would be akin to the selection of a portfolio of securities and the following expressions would describe the formulation of the merger problem:

> Expected operating return of a conglomerate portfolio in the absence of synergistic effects:

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[29]William F. Sharpe, "Portfolio Analysis," Journal of Financial and Quantitative Analysis, II (June, 1967), 81.

[30]James C. Van Horne, "Capital Budgeting Decisions Involving Combinations of Risky Investments," Management Science, XIII (October, 1966), 84-92 and Keith V. Smith and John C. Schreiner, "A Portfolio Analysis of Conglomerate Diversification," Journal of Finance, XXIV (June, 1969), 413-427.

$$E(R_c^a) = \sum_{i=1}^{n} X_i E(R_i^a) \qquad (2\text{-}18)$$

Variance of a conglomerate portfolio:

$$\sigma^2(R_c^a) = \sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \rho(R_{ij}^a) \sigma(R_i^a) \sigma(R_j^a) \qquad (2\text{-}19)$$

Subject to:

$$\sum_{i=1}^{n} X_i = 1 \quad \text{and} \quad X_i > 0 \qquad (2\text{-}20)$$

This view of conglomerate diversification in which firms as decision variables are treated as if they were perfectly divisible is here designated as Case One.

As indicated earlier, the analysis of conglomerate diversification within a framework of portfolio theory is a special case of the "general theory." Pondering the implications of portfolio theory for conglomerate mergers offers useful insights into such decisions and broadens the applicability of the theory. But some of the assumptions underlying the general theory must be carefully screened in studying special cases such as merger decisions. The two sets of assumptions forming the basis of portfolio theory are those governing the behavior of investors and those referring to the nature of securities or decision variables. No objection is raised here to the former group of assumptions. But to replicate the second set of assumptions, in the analysis of conglomerate mergers using the portfolio approach, would amount to a total disregard

for real differences between the nature of firms and that of securities as decision variables of their respective portfolios.

A decision variable, whether a security or a firm, is a distinct entity. Its uniqueness is defined by its expected returns, variance of returns, and in relation to other decision variables, by its covariances. The three attributes of a decision variable, representing the parameters of portfolio inputs, are uncontrollable factors. Determining the level of participation of decision variables is the only controllable variable in portfolio analysis. The power of the decision maker consists of naming a tentative list of portfolio candidates and solving for optimal proportions of investment in each decision variable.

The dissimilarities between a portfolio analysis of securities and that of mergers can be delineated by focusing on constraints governing the two types of portfolios, both implicitly and explicitly. Whereas the securities of all publicly held corporations constitute the universe from which a portfolio of securities can be selected, the scope of prospective acquisitions by a conglomerate firm are generally limited. A portfolio of securities can include International Business Machines, American Telephone and Telegraph, General Motors, or any of the dominant firms in different industries. A conglomerate acquisition of these giants is very unlikely. In addition to the overwhelming size of many firms and the prohibitive funding necessary to acquire them, anti-trust restraints would exclude many firms from a list of potential acquisitions.

The capital market, where the decision variables of a portfolio of securities are traded, is the institution closest to the theoretical construct of perfect markets. Firms can be bought and sold in the open

market via public offering. But the market for firms is a far cry from organized stock exchange. An efficient capital market facilitates the selection and revision of portfolios. An inefficient "firms market" hampers the acquisition and disposition of firms.

One of the explicit assumptions of portfolio analysis is the perfect divisibility of securities as decision variables. Theoretically, any number of securities can be bought and sold, including fractional securities. Securities are in fact reasonably divisible, if not perfectly. The fact that securities are issued in small denominations gives a character of flexibility to securities as decision variables. Indivisibility is one of the limiting features of a portfolio approach to capital budgeting and merger decisions. In view of the lumpiness of capital projects, Weingartner has proposed an integer constraint which prevents a fractional solution to problems involving stochastic and interrelated projects.[31] Equivalently, if conglomerate acquisitions require total interest in potential subsidiaries, the structure of the portfolio problem described as Case One in Equations (2-18) through (2-20) may be modified in the following manner:

Expected operating return of conglomerate portfolio in the absence of synergistic effects

$$E(R_c^a) = \sum_{i=1}^{n} X_i \, E(R_i^a) \qquad (2\text{-}21)$$

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[31] Martin Weingartner, "Capital Budgeting of Interrelated Projects: Survey and Synthesis," Management Science, XII (March, 1966), 491-504.

variance of conglomerate portfolio

$$\sigma^2(R_c^a) = \sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \rho(R_{ij}^a) \sigma(R_i^a) \sigma(R_j^a) \qquad (2\text{-}22)$$

subject to

$$\sum_{i=1}^{n} X_i = 1 \quad \text{and} \quad 0 \leq X_i = \frac{K_i v_i}{V} \leq 1 \qquad (2\text{-}23)$$

$$\sum_{i=1}^{n} K_i v_i = V \leq W \qquad (2\text{-}24)$$

$$K_i = 0 \text{ or } 1 \qquad (2\text{-}25)$$

where

X_i = proportion of investment in the i^{th} subsidiary

K_i = the i^{th} subsidiary

v_i = market value of the i^{th} subsidiary

V = total amount invested in acquisitions

W = total funds available for acquisitions

The constraint in (2-25) precludes fractional firms from consideration in an optimal solution. An integer requirement transforms the structure of the portfolio problem and its solution procedure from quadratic programming to quadratic-integer programming. Hence, the efficient sets of portfolios take the form of optimal lists of firms, in contrast with optimal proportions of firms under Case One. However, optimal proportions of

investments are indirectly obtained as shown in Equations (2-23) and (2-24). A portfolio analysis of conglomerate diversification where complete control of prospective acquisitions is required by imposing an integer constraint on the objective function is here termed Case Two.

In the selection of statistically interdependent portfolio of capital projects, an integer constraint is inescapable. A portfolio framework for capital projects is further complicated by physical interdependence, such as contingency and mutual exclusion.[32] In view of antitrust considerations, the latter factor may influence merger decisions including conglomerate mergers. A case in point is an antitrust suit involving LTV acquisitions of Jones & Laughlin Steel, the Okonite Company, and Braniff. This case is cited in Chapter Four.

Assuming no antitrust guidelines are violated, potential candidates for a conglomerate portfolio may be treated as physically independent. If control rather than full ownership of a subsidiary is the requirement of acquisition policy, the integer condition in (2-25) may be relaxed. The fraction of controlling interest in a firm largely depends on how widely the shares of the company in question are distributed. However, a fifty-one percent ownership of outstanding common stock guarantees a definite control, irrespective of how widely or closely shares of a company are distributed. A portfolio analysis of merger decisions in which a minimum controlling interest of fifty-one percent is required of all potential acquisitions is here referred to as Case Three. The structure of the corresponding portfolio problem appears as follows:

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[32] Ibid.

Expected portfolio return in the absence of synergistic effects

$$E(R_c^a) = \sum_{i=1}^{n} X_i \, E(R_i^a) \tag{2-26}$$

variance of conglomerate portfolio

$$\sigma^2(R_c^a) = \sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \rho(R_{ij}^a) \sigma(R_i^a) \sigma(R_j^a) \tag{2-27}$$

subject to

$$\sum_{i=1}^{n} X_i = 1 \quad \text{and} \quad 0 \leq X_i = \frac{K_i V_i}{V} \leq 1 \tag{2-28}$$

$$\sum_{i=1}^{n} K_i V_i = V \leq W \tag{2-29}$$

$$1 \geq K_i \geq 0.51 \tag{2-30}$$

The stipulation in (2-30) should not be confused with lower limit requirements of participation levels in the conglomerate portfolio. As specified in (2-28), optimal participation levels (X_i) depend on optimal controlling interests (K_i), the market value of each firm (V_i), and the aggregate market value of an efficient portfolio (V). The condition in (2-30) insures that the twin objectives of diversification and control are simultaneously satisfied.

In preceding discussion three types of conglomerate diversification

problems were formulated within a framework of portfolio analysis. The three cases of divisibility considered were perfect divisibility (Case One), imperfect divisibility (Case Three), and perfect indivisibility (Case Two). The different degrees of divisibility were explicitly shown by attaching side conditions to the objective function of the conglomerate portfolio problem. Having presented the structure of the three problems, attention can now be diverted to an assessment of how the indivisibility of firms might affect the resulting efficiency of conglomerate diversification.

Sharpe has emphasized that portfolio problems differ only to the extent of side conditions imposed on the objective function.[33] An interpretation of this view would indicate that the efficiency of portfolio diversification depends on the degree of imperfection of the decision variables composing the portfolio. Decision variables are considered imperfect if they are less susceptible to manipulation by way of portfolio analysis. The three cases of divisibility were an indication of imperfection of firms as decision variables in merger analysis. Only by applying conditions to the objective pursued can the solution to a portfolio analysis of conglomerate mergers yield realistic economic meaning. Imperfect decision variables, such as firms and capital projects, have a tendency to limit the area of the feasible region and the height of the efficient frontier of their respective portfolios in a risk-return space.[34] In general, the more perfect or divisible the decision variables, the more

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[33]Sharpe, Portfolio Theory and Capital Markets, 59.

[34]Ibid., 65.

efficient the corresponding portfolios, and the larger the size of the feasible region.

Figure (2-4) portrays the efficiency of diversification under three degrees of divisibility:

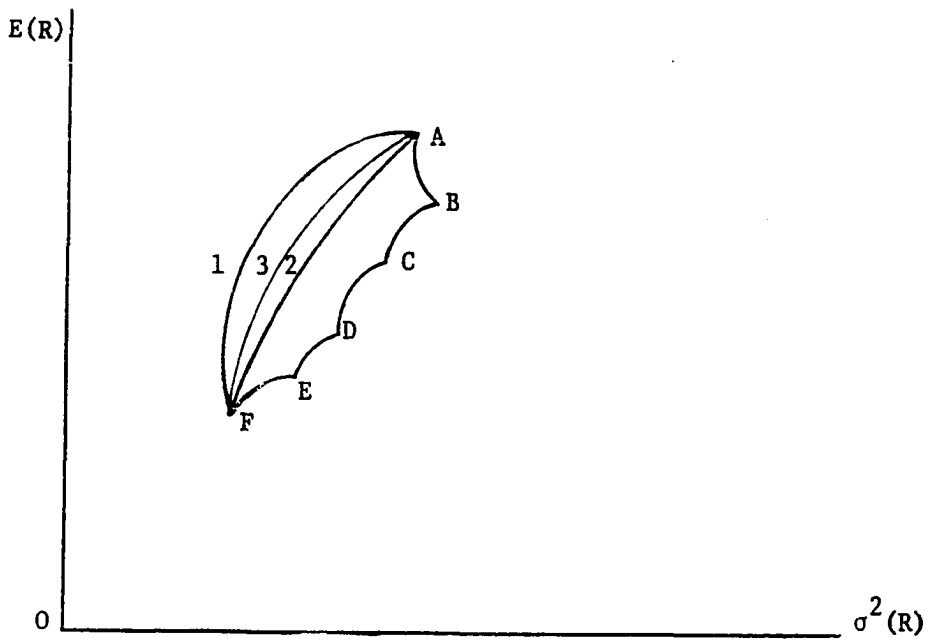

FIGURE 2-4. Efficiency of Diversification Under Three Degrees of Divisibility

More specifically, the figure refers to the three cases discussed earlier, and numerically designated as Case One, Case Two, and Case Three. The identifying number of each efficient frontier relates to the three cases, respectively. The right hand borders of the feasible region (ABCDEF) are commonly shared by the three cases, because the portfolio analysis uses the same inputs for each case of divisibility. The efficient frontier (1) envelopes the other two because Case One is unconstrained as to divisibility. The efficient frontier (2) is enveloped by the other two because

Case Two is constrained by integer requirements. The intermediate position of the efficient sets (3) is easily inferred from the preceding explanations. The three cases are superimposed in order to simplify the task of comparing the effect of different merger policies on conglomerate diversification.

The conglomerate portfolio problem under Case One was characterized by omitting restrictions on the proportion of investments in each firm. The decision variables (X_i) were allowed to assume any positive magnitude subject to the stipulation that the sum of the proportions could not exceed one hundred percent. Under Case One, the level of participation is independent of the market value of firms and availability of funds, because each firm entering the conglomerate portfolio is treated as if it were perfectly divisible. Although void of realism, the broad range of values that participation levels may assume enhances the efficiency of diversification under Case One, and the resulting efficient frontier (1) reflects the advantages of divisibility in a portfolio analysis of conglomerate diversification. The dominance of the efficient frontier (1) over (3) and (2) will be clear after the remaining two cases have been examined.

A portfolio analysis of conglomerate mergers under Case Two does not require the solution procedure to yield optimal proportions of investment in the portfolio. The objective function is conditioned by integer constraints, and the optimal solution to the portfolio problem appears in the form of an "efficient list" of firms. The level of participation in each firm (X_i) is merely a by-product. If n firms are involved in the merger analysis with integer constraints, the total number of attainable sets will be 2^n. Since some portfolios will dominate others, the number

of the efficient sets will be less--perhaps very considerably less--than the number of the feasible sets.

In Figure (2-4) the efficient frontier of Case Two composes part of the feasible sets of Case One, whose efficient frontier lies further to the left. The indicated hierarchy of the two efficient frontiers is possible because the quadratic programming solution under Case One can accomodate the efficient sets generated by integer-quadratic programming under Case Two. The structure of the portfolio problem under Case Two can be transformed into portfolio analysis under Case One by dropping the integer requirement. If the efficient list of firms obtained from Case Two, which yielded the efficient frontier (2), is used as the input under Case One, a new efficient frontier (1) will emerge. It can be generalized, therefore, that the efficient frontier under Case One dominates the efficient frontier under Case Two.[35]

The intermediate position of the efficient frontier (3) can be argued by following the preceding line of reasoning. Under Case Three, the proportion of investment in firms composing the conglomerate portfolio can assume any value provided that two requirements are satisfied. First, the sum of fractional investments in each firm cannot exceed unity. Second,

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[35]The three alternative approaches to a portfolio analysis of conglomerate diversification implicitly assume that parameters of the decision variables remain the same. The only difference among the three alternatives is the degree of divisibility of firms as decision variables. Indirectly, the three efficient frontiers rank the efficient sets of portfolios of securities, portfolios of firms, and portfolios of capital projects. As for the dominance of the efficient frontiers of securities portfolio over that of firms, the evidence is indicated in a comparative study of mutual funds and conglomerate firms. See Smith and Schreiner, "A Portfolio Analysis of Conglomerate Diversification," 420 and Randolph Westerfield, "A Note on the Measurement of Conglomerate Diversification," Journal of Finance, XXV (September, 1970), 912.

the proportion of investment in each firm must be more than fifty-one percent of its corresponding market value. Because of the emphasis of a minimal controlling interest, a portfolio analysis of mergers, under Case Three, is not independent of the market value of firms being considered for the conglomerate portfolio. Cases Two and Three are similar in one respect: their respective portfolios do not include less than fifty-one percent of candidate firms. But the similarity ends here. Whereas the portfolio under Case Three consists of fractional firms in excess of fifty-one percent of their respective market values, the portfolio under Case Three accepts only whole firms. Given differences in covariances between the operating returns of firms, it is very likely that the efficient frontier generated under Case Three will dominate the efficient frontier under Case Two, and will be dominated by portfolios under Case One, because the divisibility of Case Two is hindred by integer requirements. The dominance of the efficient sets under Case One over those under Case Three is brought about by the perfect divisibility of firms under the former case. Thus, there is a sound theoretical basis for the arrangement of the three efficient frontiers corresponding to three cases of divisibility, in Figure (2-4).

No portfolio, securities included, may achieve efficient diversification in a Markowitz sense because theoretical portfolio analysis does not allow for transaction costs and indivisibilities. Even securities, in spite of their small denominations, are not perfectly divisible. The highest efficient frontier in Figure (2-4) does not remotely approximate the diversification potentials and the acquisition policy of conglomerate firms. A practical usefulness of portfolio analysis of conglomerate

diversification designated as Case One is, therefore, precluded on both grounds of divisibility and control.

The lowest efficient frontier in Figure (2-4) is a result of an overemphasis placed on controlling potential subsidiaries. The order of priority of such policy is control first and diversification second. It is no wonder, therefore, that Case Two with its integer constraints should yield the lowest efficient sets of portfolios. Justifications for a merger policy that treat diversification as secondary can only be sought outside the realm of portfolio analysis.

A portfolio analysis of the merger problem, labelled as Case Three, strikes a tenable balance between corporate control and corporate diversification. The policy premise of the intermediate efficient frontier in Figure (2-4) is that a fifty-one percent interest is the minimal requirement to guarantee control in potential subsidiaries. An acquisition policy that requires wholly-owned subsidiaries is inefficient. It adds little to control, but it takes away from diversification. If diversification and control are of equal importance, a portfolio approach to merger decisions referred to as Case Three is both feasible and desirable.

Redundancy of Conglomerate Mergers

In an earlier discussion, one of the extreme views on conglomerate mergers referred to as the risk-independence hypothesis was briefly mentioned. This hypothesis challenges the necessity of conglomerate business consolidations as a means of achieving diversification. Ideally, a detailed account of this thesis best follows a general treatment of portfolio analysis as it relates to mergers. Having examined a portfolio analysis of

securities and firms in the preceding two sections, the risk-independence hypothesis can now be presented within a portfolio framework.

Given less than perfect positive covariances between expected returns, the concavity of the two lower efficient frontiers in Figure (2-5) suggests that there is a definite economic gain from conglomerate diversification. The risk-independence hypothesis is not in dispute with this possibility, but stresses that the same result can be achieved without mergers.[36] For the convenience of exposition, it will be assumed that the capital market consists of three risky assets and one riskless asset. Using one of the tools of portfolio analysis cited earlier, the efficient frontier can easily be generated. The capital asset pricing model is convenient in identifying the market portfolio (M), in Fig. (2-5). Under conditions of market equilibrium, the structure of the market portfolio must be proportional to the aggregate market value of the three firms issuing the risky securities.[37]

The claimed redundancy of conglomerate mergers hinges on whether or not a portfolio revision following a merger will alter the structure of the pre-merger optimal portfolio. To resolve this controversy, two of the firms will be allowed to merge and the reaction of the market to the merger event by adjusting its portfolio will be observed. The post-merger capital market will consist of two risky assets and one riskless asset.

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[36]This section draws heavily from Haim Levy and Marshall Sarnat, "Diversification, Portfolio Analysis and the Uneasy Case for Conglomerate Mergers," Journal of Finance, XXV (September, 1970), 795-802.

[37]For the capital market to be in equilibrium there must be a correspondence between the structure of the market portfolio and the relative value of firms issuing risky securities. See Eugene F. Fama, "Risk, Return and Equilibrium: Some Clarifying Comments," Journal of Finance, XXIII (March, 1968), 33.

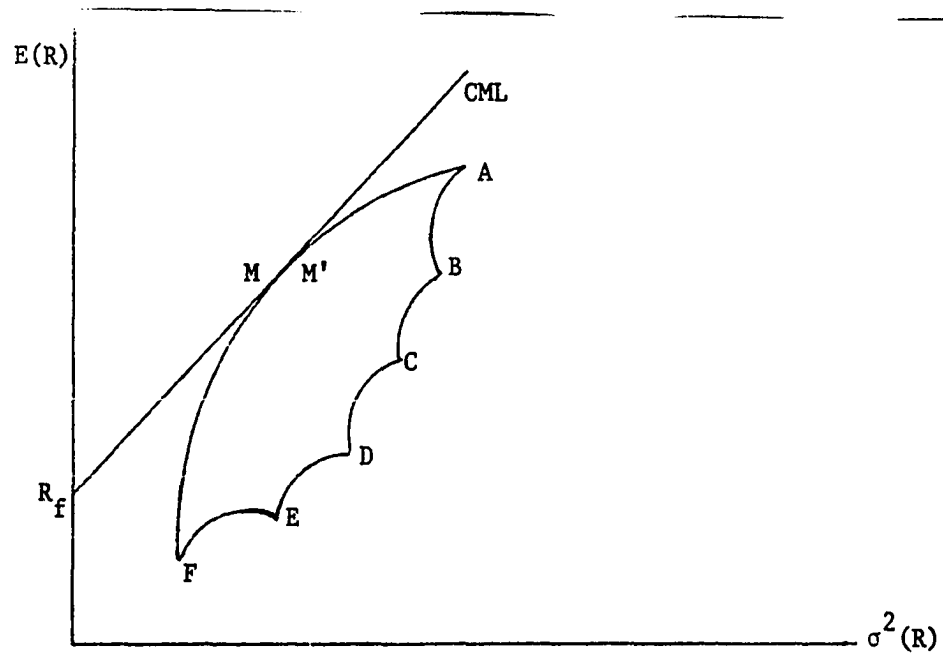

FIGURE 2-5. Equivalence of Conglomerate Diversification and Diversified Securities in a Perfect Capital Market.

After the merger, the revised and efficient portfolio is different in form but the same in content. In a risk-return space, the market portfolio (M) in Figure (2-5) does not alter its position. Under the stipulated conditions of market equilibrium, the "new" market portfolio (M') will be proportional to the relative market value of the two firms making up the market.[38] It can be demonstrated mathematically that the proportion invested in the securities of the conglomerate firm is equal to the sum of the proportions invested in the securities of its component firms prior to the merger.[39] By abstracting from synergistic effects of expected returns and under conditions of market equilibrium, Levy and

[38] Levy and Sarnat, "Diversification, Portfolio Analysis and the Uneasy Case for Conglomerate Mergers," 798.

[39] Ibid.

Sarnat concluded that a conglomerate firm cannot accomplish for its stockholders what the stockholders cannot do for themselves by diversifying their personal portfolios.

Mueller scorns the risk pooling role of conglomerate firms and assigns that specialty to a diversified portfolio of securities.[40] If the acquiring firm cannot improve its return dimension by means of synergistic effects and hidden profit opportunities in the acquired firms, the stockholders of the acquiring firm can accomplish for themselves what the management of the conglomerate firm professes to do for them with regard to risk reduction. For the small investor, Mueller recommends mutual funds as a more effective avenue to diversified investments.

Michaelson and Goshay contend that the wealth maximizing rule does not fully account for the portfolio selection practices of financial intermediaries.[41] From a direct analysis of financial intermediaries they draw implications for conglomerate firms. West counters the opinion of Michaelson and Goshay with respect to conglomerate firms.[42] The thrust of his argument hinges on the distinction between financial and non-financial corporations and whether or not corporate leverage and corporate diversification can be duplicated by homemade leverage and homemade portfolios. For both types of corporations. the substitutability between

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[40]Mueller, "The Theory of Conglomerate Mergers," 652.

[41]Jacob B. Michaelson and Robert C. Goshay, "Portfolio Selection in Financial Intermediaries: A New Approach," Journal of Financial and Quantitative Analysis, II (June, 1967), 195-196.

[42]Richard R. West, "Homemade" Diversification vs. Corporate Diversification," Journal of Financial and Quantitative Analysis, II (December, 1967), 417-421.

personal and corporate leverage is considered to be valid. Personal portfolio is judged to be an effective substitute for corporate diversification because the decision variables in question are securities. When the decision variables involve real assets, the substitutability between personal portfolios and conglomerate diversification is rendered dubious. West attempts to advance a transparently weak justification for conglomerate mergers not on the strength of what conglomerate firms can do, but on the seeming weakness of what investors cannot do.[43]

Myers' risk-independence thesis is just another variant of the famed leverage-independence argument.[44] The latter argument contends that in a perfect capital market the value of a pie is independent of the manner in which it is partitioned. The risk-independence view, the converse of the leverage-independence proposition, asserts that in an efficient capital market a combination of pies is equal to the sum of its separate pieces, no more, no less. Myers directly addresses the risk-independence thesis to internal diversification. He then extends his conclusions to conglomerate mergers as a corollary.[45] Either leverage or conglomerate mergers cannot generate disequilibrium in the capital market. The corrective mechanism for the leverage-independence thesis is

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[43]The expected return of a portfolio of securities is the weighted average of the expected returns of the component securities. But the expected return of a conglomerate portfolio is multiplicative due to a potential for synergism. Investors cannot diversify real assets due to problems of divisibility and, therefore, cannot realize synergistic effects. Ibid., 419-420.

[44]Stewart C. Myers, "Procedures for Capital Budgeting Under Uncertainty," Industrial Management Review, IX (Spring, 1968), 1-15.

[45]Ibid., 10-11.

the substitution of personal leverage for corporate leverage. The equilibrating force for the risk-independence proposition is the substitution of personal portfolios for conglomerate diversification.

The authorities sampled were nearly unanimous in their conclusions. In the absence of synergistic effects and in perfect capital markets, substituting a portfolio of firms for a portfolio of securities does not serve either a useful or a harmful purpose--it is merely redundant. The conclusion necessarily follows from a premise of capital markets and this is hardly surprising to anyone familiar with economic analysis. But when one moves closer to reality by dropping the setting of perfect markets, the portfolio effect of conglomerate mergers ceases to be indisputable. The portfolio effect brought about by merger decisions gives rise to a leverage response from the financing side. In the following section, the leverage implication of the portfolio effect will be examined as the exact antithesis of the risk-independence and the leverage-independence theses.

Leverage Implication of Portfolio Effect

One of the justifications appealed to in explaining the incidence of conglomerate mergers is a vague argument generally referred to as potential economies of finance accompanying such mergers. This ambiguity takes many forms. First, it is argued that securing and managing capital, like other factors of production, is subject to indivisibilities. The efficiency of a specialized financial function is warranted provided that the operating scale of the firm is large enough. The process of securing funds from external sources involves incurring a fixed cost of transactions.

On unit basis, the fixed cost of transactions is a declining function of the magnitude of financing required. The amount of funds needed in turn depends on the size of the firm. Therefore, growth in size by means of conglomerate mergers enables a firm to reduce the cost of obtaining external funds. This line of argument fails to distinguish between financial economies arising from an adjustment in capital structure and economies due to scale effects. The potential for reducing unit transactions cost by increasing the size of the firm exists not because of, but in spite of, conglomerate mergers. The economies of finance invoked in conjunction with conglomerate mergers is a mere restatement of the familiar economies of scale as a financial case.[46] Second, a related point of view suggests that a conglomerate firm has better access to cheaper sources of capital than its smaller parts. This argument could be persuasive if it were not for the fact that mergers more often take place between large firms for whom the capital market is already within reach.

The third interpretation of financial economies refers to the existence of suboptimal capital structure in prospective acquisitions.[47] If the opportunity for reducing financial cost has been overlooked by the candidate firms, the acquiring firm will take advantage of unused debt capacity. This line of argument would suggest that in instances where idle debt capacity is nonexistent, adjustment of leverage following diversified acquisitions would be unnecessary.

Assume that two firms A and B, with existing leverage ratios L_A

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[46]Gort, "Diversification, Mergers, and Profits," 34.

[47]Wilbur G. Lewellen, "A Pure Financial Rationale for Conglomerate Mergers," Journal of Finance, XXVI (May, 1971), 542.

and L_B, merge to form firm C. The optimal capital structure for the two firms is L_A^* and L_B^*. If $L_A^* = L_A$ and $L_B^* = L_B$, the optimal leverage of firm C would appear to be the weighted average of the pre-merger optimal capital structure:

$$L_C^* = WL_A^* + (1-W)\ L_B^* \qquad (2\text{-}31)$$

where, W is the relative size of firm A.

On the other hand, if suboptimal leverage is indicated in one or both firms, such that $L_A^* > L_A$ and $L_B^* > L_B$, firm C is presented with an opportunity to correct the unused debt capacity:

$$L_C^* > WL_A + (1-W)\ L_B \qquad (2\text{-}32)$$

Even if the pre-merger capital structure is optimal, it is maintained in this paper that the post-merger optimal leverage will be greater than the weighted average of the two optimal capital structures prior to the merger:

$$\hat{L}_C^* > WL_A^* + (1-W)\ L_B^* \qquad (2\text{-}33)$$

The situation in (2-28) is induced by a decision to combine two firms whose operating earnings are less than perfectly correlated. The inequality in (2-32) is merely an attempt to rectify financial mismanagement that existed before the merger. Steps to utilize idle debt capacity are not opportunities contingent upon events of conglomerate mergers.

But the financial synergy indicated in (2-33) is a direct consequence of diversification.

In the preceding discussion, the first two financial explanations of conglomerate mergers were mere extensions of the familiar economies of scale. The third view suggested that if suboptimal leverage decisions were reached by firms to be acquired, the conglomerate firm is offered the opportunity to achieve optimal leverage. Lewellen aptly dismisses these arguments as mere tautology.[48] The three types of financial economies are neither created by, nor peculiar to, conglomerate mergers.

A final ambiguity requiring some clarification is the distinction between leveraged portfolios with reference to capital market theory and the leverage implication of portfolio effect in the context of conglomerate diversification. Figure (2-6) depicts the Markowitz-Tobin-Sharpe capital asset pricing model and is based on a host of underlying assumptions.[49]

Capital market theory reduces the investment decision to three basic options: investment in a riskless asset, investment in the market portfolio of risky assets, and investment in some combination of the market portfolio and riskless assets. Points R_F, L_1, and L_2 along the capital market line (CML) portray the three investment choices. The capital market line depicts the financing decision. All points to the left of L_2 along CML are lending portfolios and involve negative leverage. Positively

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[48] Ibid., 525.

[49] For assumptions underlying capital market theory, refer to Jack Clarke Francis, Investment Analysis and Management (New York: McGraw-Hill Book Company, 1972), 444-445.

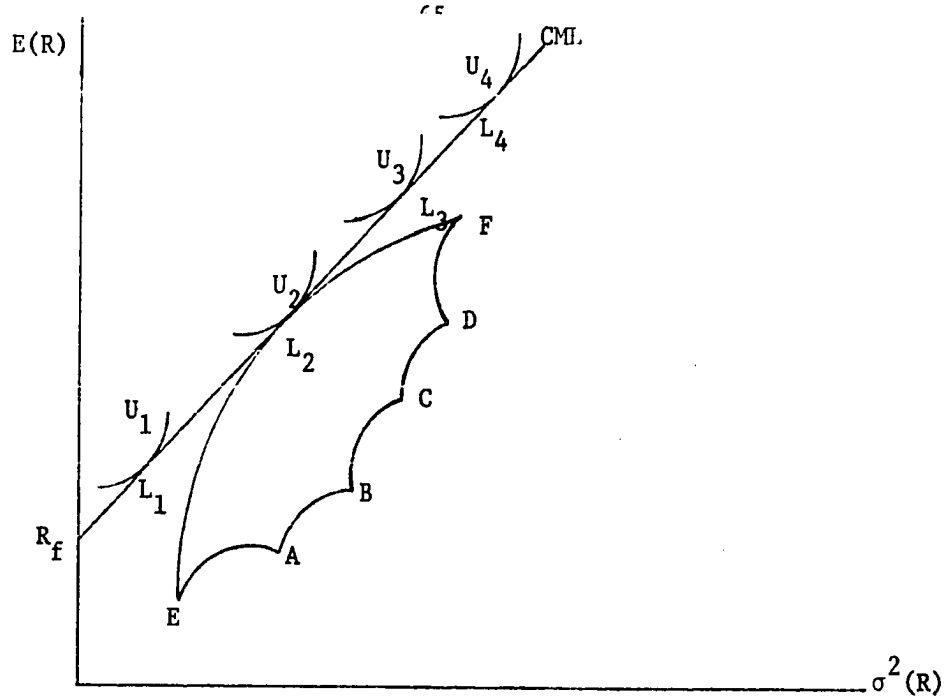

FIGURE 2-6. Choice of Leverage According to Risk-Return Indifference Curves in a Perfect Capital Market

leveraged portfolios, or borrowing portfolios, lie to the left of L_2, with leverage increasing in a north-easterly direction. The point at L_2 is an all-equity capital structure and the segment of CML to the left of it is the concern of this study.

Figure (2-6) shows a correspondence between the indifference curves U_1 through U_4 and different degrees of leverage L_1 through L_4. The significance of such portrayal is that leverage decisions are dictated by individual attitudes towards risk. The constant slope of the capital market line implies that different degrees of leverage, extreme or moderate, do not alter the rate of change between risk and return.

The notion of leveraged portfolios within a framework of market equilibrium is the equivalent of the first two propositions posed by

M & M. Hamada has reconciled the capital asset pricing model in Figure (2-6) and the leverage-independence hypothesis without requiring the homogeneous risk-class assumption and the arbitrage process.[50] He concludes, as M & M do and as the separation theorem indicates, that when investment and financing decisions are dichotomous leverage decisions have no effect on the value of the firm. Hamada concedes that when market imperfections are admitted the value of the firm is not independent of capital structure but he gives most prominence to the tax deductibility of interest as a form of government subsidy.[51] The implication of such qualification is that in a realistic setting of market disequilibrium, where all investment units do not hold the market portfolio, investment and leverage decisions are not independent. In the context of conglomerate diversification, this reservation would further suggest that a portfolio effect emanating from an inter-industry combination might have a leverage implication in terms of increased debt capacity.

The traditional theory of corporation finance is more explicit about predictions pertaining to changes in operating risk and financial leverage. Given the behavioral assumptions of the traditional school, subscribed to herein, an interrelationship between investment and financing decisions will manifest itself in the form of an inverse change between operating risk and leverage.

A few writers on conglomerate mergers give indications of financial leverage as a unique advantage of inter-industry union. Narver refers to

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[50] Hamada, "Portfolio Analysis, Market Equilibrium and Corporation Finance," 16-19.

[51] Ibid., 20.

five economic forces requiring a simultaneous optimization. He characterizes two of these factors as "financial forces making for an optimal financial unit" and "forces of risk and fluctuation making for a unit possessing the greatest power of survival in the face of industrial vicissitudes."[52] Muller hints, with a cryptic air, a conglomerate advantage in the form of an ability to realize hidden economic potentials.[53] These hidden economic potentials could be interpreted as reference to the subtlety of financial leverage and the diversification effect from which it derives. Levy and Sarnat deny the advantage of conglomerate diversification over personal portfolio of securities in a perfect capital market. But they acknowledge financial leverage potentials of an inter-industry union in an environment of imperfect markets.[54] Due to a reduced dispersion of operating income and the resulting decline of lenders' risk subsequent to mergers, a modest increase in leverage will not be expected to entail a rise in the rate of interest and a fall in the price-earnings ratio.

Lewellen is emphatically explicit about the leverage implication of conglomerate mergers.[55] After categorizing the sources of profitable external growth as operating and financial in character, he identifies

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[52]The other three forces are technological, managerial, and marketing. See Narver, Conglomerate Mergers and Market Competition, 62-63.

[53]Mueller's characterization of hidden economies does not make an explicit reference to financial leverage. But hidden economies could be interpreted to indicate the subtlety of financial synergy. Mueller, "A Theory of Conglomerate Mergers," 654.

[54]Levy and Sarnat, "Diversification, Portfolio Analysis and the Uneasy Case for Conglomerate Mergers," 801.

[55]Lewellen, "A Pure Financial Rationale for Conglomerate Mergers," 521-535.

operating synergy with intra-industry mergers. Other financial considerations such as financial economies of scale and suboptimal leverage prior to mergers are assigned secondary importance because they are not peculiar to conglomerate mergers. Lewellen singles out the leverage implication of portfolio effect as the most outstanding economic force inducing conglomeration:

> Its singular fascination lies in the fact that it is purely financial in character, is unique to the implementation of consolidations of enterprises, is available from virtually every merger, and is independent of the presence of any of the other possible benefits indicated above. That opportunity arises from the phenomenon that the juxtaposition within a single firm of the probabilistic income streams from two previously separate companies will necessarily yield a resulting joint income stream whose diminished relative variability will be such as to induce lenders to establish a new aggregate limit on lending which can only exceed the sum of the original limits established for the two merger partners individually. Therefore, as long as leverage has, in a world of taxes, a beneficial impact on residual equity market values, an expansion of the range of borrowing levels by corporations as an automatic byproduct of merger provides a convenient and reliable vehicle for the augmentation of shareholder wealth.[56]

Renshaw is equally direct in recognizing the effect of inter-industry diversification on post-merger capital structure.[57]

Conclusion

In this chapter, a broad spectrum of pertinent and controversial issues surrounding conglomerate mergers were examined. The theory of conglomerate mergers was surveyed, and the diversification motive was emphasized as the most important economic force inducing inter-industry combi-

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[56] Ibid., 525.

[57] Edward E. Renshaw, "The Theory of Financial Leverage and Conglomerate Mergers," California Management Review, XI (Fall, 1968), 79-85.

nation of firms. While the desirability of stabilizing operating earnings and conglomeration as a means of achieving that end was stressed the conventional measure of corporate diversification based on a linear summation of industries was criticized and a more sophisticated approach was proposed.

Throughout the discussion, recognition was given to conflicting points of view on corporate diversification and corporate leverage. Arguments that are inclined towards minimizing the diversification effects of conglomerate mergers were favorably recognized on the basis of the underlying assumptions. But the tendency to be comprehensive about multiple issues had its drawbacks, in the sense that an uninterrupted development of the main thesis was compromised. Finally, inquiry into the leverage implication of the portfolio effect for multi-industry firms could be brought into focus without the interference of lateral issues.

Taking the view point of the traditional school of corporate finance, it was argued that the investment and the financing decisions of the firm are interrelated in a world characterized by uncertainty, market imperfections, and taxes. More specifically, if uncertainty inherent in the investment decision is reflected in the variability of return on assets, the direction of change between operating risk and financial leverage was represented to be inverse. Hence, the major premise of the argument on leverage and diversification derives from the position of the traditional school on the interaction of the two variables. The proposition that there is a certain quantum of pure financial leverage which can be generated by corporate diversification is a mere extension of the theory of capital structure espoused by the traditional argument.

This study, as an inquiry into the dynamics of corporate diversification and corporate leverage, is characterized by three distinguishing features. First, diversification is considered to be the most compelling economic justification for the incidence of conglomerate mergers. Reduced reliance on one market, one product, or one technology enables the conglomerate firm to achieve a measure of stability in operating returns. The process of sustained diversification produces what was earlier termed a portfolio effect. Second, the increased stability of operating returns facilitates, or at least should, a leverage response from the financing side. Since the interaction of operating risk and financial leverage is theoretically specified to be an inverse process, some quantum of increased borrowing capacity is expected to be induced by a reduced dispersion of operating income. Third, the portfolio framework is proposed as a superior approach to the analysis of merger decisions. In spite of the problems of divisibility discussed earlier and the difficult task of generating statistical inputs, portfolio analysis is a significant advance over the commonly used naive approach to corporate diversification.

CHAPTER III

REVIEW OF SELECTED EMPIRICAL STUDIES

Introduction

Reference to any index of economic literature would show that empirical analysis of conglomerate firms from the viewpoint of the theory of corporation finance is very limited. Although portfolio analysis and the theory of capital structure have important implications for examining the interaction of corporate diversification and financial leverage, empirical analysis of diversification in these contexts has been neglected. The review of selected empirical studies sampled in this chapter consists of five papers covering different aspects of conglomerate performance and two articles on optimal capital structure.

In a comparative study of firms using different growth strategies, Reid reported that conglomerate firms tend to maximize size-related variables such as sales and assets more than profit-related variables.[1] Although conglomerate firms dominated organizations utilizing other types of mergers, Reid discounts the profit performance of conglomerate firms as merely surendipitous. In two recent papers, Weston-Mansinghka and Rush-Melicher reported that the performance of conglomerate firms was average

[1] Reid, Mergers, Managers, and the Economy, 181-194.

in relation to other companies in the economy.[2] Whereas Weston and Mansinghka emphasize performance at the operating level, Melicher and Rush employed multiple indices of performance within a framework of the capital-asset-pricing model. The two studies also noted higher use of financial leverage by conglomerate firms in comparison with undiversified companies for the periods covered in the respective studies. In contrast with the methodology of the following chapter in which diversification effects are developed and tested, both studies treat the influence of diversification on debt capacity qualitatively.

A portfolio analysis of conglomerate firms by Smith and Schreiner is the first effort of its kind in which the portfolio approach was used to examine corporate diversification.[3] In an attempt to evaluate the diversification potential of conglomerate portfolios, Smith and Schreiner compared the performance of mutual funds and conglomerate firms. Using a model which was claimed to be an exclusive measure of portfolio diversification, in contrast with portfolio management, Smith and Schreiner commended some of the conglomerates for their good diversification record. On the average, however, mutual funds proved to be better diversified than conglomerate firms. Disputing both the merit of the methodology and the validity of the empirical results presented by Smith and Schreiner, Westerfield compared mutual funds and conglomerate firms using an alterna-

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[2]J. Fred Weston and Surend K. Mansinghka, "Tests of the Efficiency Performance of Conglomerate Firms," Journal of Finance, XXVI (September, 1971), 919-936 and Ronald W. Melicher and David F. Rush, "The Performance of Conglomerate Firms: Recent Risk and Return Experience," Journal of Finance, XXVIII (May, 1973), 381-388.

[3]Smith and Schreiner, "A Portfolio Analysis of Conglomerate Diversification," 425-444.

tive approach that separated portfolio diversification and portfolio management.[4] Westerfield reported that the diversification performance of conglomerate firms was overrated by Smith and Schreiner because their index was an aggregate measure of performance and did not segregate its component elements.

Although the controversy over optimal capital structure remains unsettled, a number of empirical investigations have been performed to test the alternative hypotheses. A common shortcoming of these studies is that most of them use an industry class as the equivalent of homogeneous risk. The empirical studies by Scott and Wippern were singled out for review primarily because these two depart from the usual assumption of equivalent risk class by employing the variability of operating return as a surrogate for business risk in a manner similar to the approach of this dissertation.[5]

In the remainder of this chapter, each of the seven select articles are reviewed in some detail. In each case, the same pattern of review is followed. First, the purpose or the hypothesis of the study is stated. Second, the methodology of the study is discussed. Third, the empirical results are presented along with their interpretations. At each phase of the review, criticisms are interjected and comparisons are made including reference to other studies not cited here.

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[4]Westerfield, "A Note on the Measurement of Conglomerate Diversification," 909-914.

[5]Scott, "An Inquiry Into the Existence of Optimal Financial Structure," 95-100 and Wippern, "Financial Structure and the Value of the Firm," 615-633.

The Reid Study--Conglomerate Performance and Other Growth Strategies

According to conventional economic theory, the goal of the firm is defined as the maximization of owners' wealth. The profit maximization hypothesis implicitly assumes that the owner and the manager are two names for the same entity, or, if the two are dichotomous, their interests are compatible. With the progressive separation of ownership and management, resulting mainly from the corporate form of organization, the validity of the profit maximization hypothesis has been increasingly questioned. The underlying theory of Reid's empirical study is the possible incongruency of managers' and owners' interests.[6] Based on this, Reid hypothesized that the type of growth or merger would have differential effects upon indicators of managers' and stockholders' interests. More specifically, Reid expected conglomerate mergers to serve the interests of managers more than those of stockholders. In accordance with traditional theory of economies of scale, he considered inter-industry union of firms to be less amenable to the advantages of operating synergy.

Since the interests of stockholders and managers were supposed to be non-complementary, separate sets of measures were developed for each on the basis of profit-related and size-related variables, respectively.[7]

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[6]More than four decades ago, Adolph A. Berle and Gardner C. Means made these predictions about an emerging phase of the free enterprise system: increased concentration in industrial structure, progressive separation of ownership and control, and conflict of managerial and ownership interests. The third factor stems from the second and Reid sets out to test this as his underlying hypothesis. Reid, Mergers, Managers, and the Economy, 132 and Adolph A. Berle and Gardner C. Commons, The Modern Corporation and Private Property (New York: Harcourt, Brace and World, Inc., 1968), 293-309.

[7]Reid, Mergers, Managers, and the Economy, 181-182.

Size-related variables used to reflect the interest of managers were relative changes in assets, sales, and employment. Relative changes in stock prices, return on assets after taxes, and the net profit margin were associated with the interest of stockholders. From the Fortune list of 500 largest industrial corporations, 478 firms included in the study were divided into five groups: internal growth firms, firms engaged in horizontal, vertical, circular, and conglomerate mergers. For each category of firms, the mean growth rate of the six interest variables were computed over the period 1951-1961. The analysis of variance was used to determine if there were significant differences in growth rates among the five samples.

Conglomerate firms dominated the remaining four groups in all three categories of managers' interest indicators, followed by circular mergers.[8] Firms active in vertical mergers exhibited the lowest average growth rate in two size-related variables. According to the three measures of growth rate in size, significant differences were observed among firms using different growth strategies. The results of Reid's investigation could be interpreted to mean that conglomerate mergers serve the interest of managers the most, and vertical mergers the least. These findings are not surprising in view of the fact that the pattern of external growth during the period covered by this study is noted for the dominance of conglomerate and circular mergers.[9] However, Reid's inference about manager's interest and conglomerate growth does not necessarily follow. In terms of measures

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[8] Ibid., 185.

[9] Ibid., 74-75.

of stockholders' interests, the performance of conglomerate firms was only second to that of internal growth firms.[10] Vertically integrated firms showed the lowest profit performance indicating that these firms benefited their stockholders the least.

From the viewpoint of stockholders, two of Reid's rate of return measures are inappropriate for the purpose they were intended to serve. Net income as a percent of sales is influenced by such factors as asset turnover and the structure of operating cost, and has minimal significance in the context of Reid's study. The second approach for measuring stockholders interest equates return on assets to return on equity. Return on assets would be a valid measure of owners' interest and an acceptable basis of comparison among the five groups of firms only if all firms had an all-equity capital structure, or if their debt-equity ratios were identical. Reid's analysis makes no reference to differences in leverage of firms included in the study. In particular, the absence of allowance for capital structure differences harbors a measurement bias against the profit performance of the conglomerate group. Nevertheless, the performance record of these firms was impressive relative to other forms of mergers. But Reid dismisses the return performance of conglomerate firms as merely "serendipitous," and characterizes them as primarily size-maximizers.[11]

The fact that conglomerate firms were noted for high growth rates in size-related variables is not a valid ground for inferring that conglomerage firms cater primarily to the interest of managers. Since conglomer-

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[10] Ibid., 185.

[11] Reid, "Reply to the Weston Mansinghka Criticisms Dealing with Conglomerate Firms," Journal of Finance, XXVI (September, 1971), 945.

ate firms were also found to rate high on stockholders' interest variables, perhaps a more reasonable explanation would be that conglomerate firms serve the interests of both owners and managers well.

The Weston-Mansinghka Study--Efficiency Tests of Conglomerate Firms

The broad objective of the Weston-Mansinghka (hereafter W-M) paper was to follow up on Reid's evaluation of conglomerate firms and assess his results and conclusions in the light of the evidence derived from their own investigation.[12] The specific task of the W-M study was to examine the comparative efficiency performance of conglomerate and non-conglomerate firms during the period 1958-1968. The two scholars held that the lower growth rate of conglomerate earnings and share prices, as suggested in Reid's study, was perhaps due to the early terminal date of the period covered by the study, although conglomerate mergers peaked during the second half of the 1960's.

To test the hypothesis, W-M selected a total of 189 firms and divided them into three equal groups consisting of conglomerate firms, industrial firms, and a combined group of industrial and non-industrial firms. The last two were randomly selected and served as control groups. The conglomerate sample was chosen on the basis of a minimum growth rate of twenty percent by means of acquisitions during 1960-1968. In addition, these firms were required to be active in ten or more three-digit, or five or more two-digit, SIC categories in 1968. The analysis of variance was used

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[12]Weston and Mansinghka, "Tests of the Efficiency Performance of Conglomerate Firms," 920-921.

to compare the three groups of firms in terms of growth and earnings performance.

In the first part of the study, the average growth rate of several financial variables were computed and tested for statistical significance. These variables included total assets, sales, net income, earnings per share, and prices per share. In all instances, the mean growth rate of conglomerate firms was found to be significantly higher than that of the control groups.[13] Some of the results confirm Reid's findings with regard to managers' interest variables but not his interpretations. However, W-M do not attach much importance to the observed differential growth rates between conglomerate firms and the control samples. The explanation offered for their position is that the trend of the five financial variables is largely influenced by the degree of merger activity. This conclusion is slightly oversimplified. Granted, the trend of assets, sales, and net income is a function of the rate of expansion, both internal and external. But the generalization of W-M does not apply to earnings per share and the value of shares, because the trend of the two variables is dependent on factors other than the degree of merger activity. Subsequent to mergers, the earnings per share of the surviving firm would improve provided that the price/earnings ratio paid for the acquired firm is less than that of the acquiring firm. Moreover, the value of the acquiring firm would appreciate if investors evaluate the improved earnings per share at the existing or higher price/earnings ratio.[14] Without information con-

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[13] Ibid., 924-925.

[14] James C. Van Horne, Financial Management and Policy (Englewood Cliffs: Prentice-Hall, Inc., 1968), 473-480.

cerning exchange ratios between merging firms and the level of the discount rate subsequent to mergers, there is no factual basis for the W-M assertion that the trend of earnings per share and prices per share is a result of the degree of merger activity.

The second and more important aspect of the W-M effort involved evaluating the three groups of firms using multiple measures of performance. Several results of the investment and financing decisions were examined both separately and jointly. These included return on assets before interest and taxes, debt to net worth, debt and preferred stock to equity, return on net worth, return on equity, and the price earnings ratio. The sample means of these financial variables were computed in 1958 and 1968 and examined for significance of differences.

In terms of operating return and return on net worth, the record of conglomerate firms was significantly lower than that of the non-conglomerate sample in 1958. By 1968, the earnings performance of conglomerate firms had improved to such an extent that there were no significant differences among the means of the three samples. In addition to improving their operating return significantly, conglomerate firms achieved a moderately higher return on equity than their non-conglomerate counterparts. It is often alleged that higher growth rate in the earnings performance of conglomerate firms is due to differential price/earnings ratios during acquisitions. The evidence on price/earnings ratios does not lend credibility to that point of view.[15] Both in 1958 and 1968, there were no

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[15]Weston and Mansinghka, "Tests of the Efficiency Performance of Conglomerate Firms," 926-927.

significant differences between the price/earnings ratios of the three samples. An explanation of higher gorwth rate in earnings performance achieved by conglomerate firms lies in the results of their investment and financing decisions. In 1958, the mean leverage ratio of conglomerate firms was intermediate between those of industrial firms and the combined sample of industrial and non-industrial firms. A decade later, a measure of leverage including preferred stock placed conglomerate firms in a first position. Over the ten years, conglomerate firms achieved the highest growth rate in the use of leverage according to two measures in which preferred stock was both included and excluded from the numerator.

On the basis of their empirical analysis, W-M made the following conclusions about conglomerate firms.[16] The higher growth rate of conglomerate firms in terms of size-related variables such as assets, sales, and net income has no particular economic significance as it directly correlates with the degree of merger activity. Second, higher growth rates in equity return achieved by conglomerate firms is attributed to a combination of improvement in operating profitability and the increased use of leverage. Third, a significant improvement in operating return during a period of intense conglomerate mergers is a strong indication that conglomerate firms fulfill an important economic function of raising and maintaining the profitability of their diversified acquisitions. Therefore, conglomerate firms should not be viewed with disfavor for not achieving superior performance, but should be commended for defensive diversification and average performance comparable to that of other industries

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[16] Ibid., 933-934.

in the economy.

The effect of diversification on the capital structure of conglomerate firms is implied in the empirical results of the W-M study.[17] During the period covered in the study, the conglomerate sample was noted for using significantly more leverage than the control groups. But the increased utilization of leverage by conglomerate firms did not entail appreciable differences in the mean price/earnings ratios of the three samples. Ordinarily, more financial risk is associated with decline in the price/earnings ratio. In the case of conglomerate firms, the adverse effect of leverage on the equity capitalization rate could have been mitigated by the portfolio effect arising from conglomerate diversification. But the analysis of W-M did not include a measure of dispersion about mean operating returns. On the other hand, an explicit consideration of variance of operating return and its influence on the leverage capacity of conglomerate firms is the distinguishing feature of this dissertation.

The Melicher-Rush Study--Risk and Return Performance of Conglomerate Firms

The purpose of the study was to compare the risk-return performance of conglomerate and non-conglomerate firms during the period 1965-1971.[18] From each group, a sample of forty-five firms were selected from the 1971 Fortune list of 1000 largest industrial corporations according to two criteria. Each pair of firms across the two samples were required to belong to the same industry in 1960. Firms from the non-conglomerate

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[17] Ibid., 926-927.

[18] Melicher and Rush, "The Performance of Conglomerate Firms: Recent Risk and Return Experience," 381.

sample were further required to have remained in their respective industries in 1971.

The investigation of the ninety firms, equally divided between conglomerate and non-conglomerate corporations, consisted of two major parts. In the first part, each firm's return on assets before interest and taxes, return on equity, financial leverage, and price-earnings ratio were computed. The two samples were then compared to see if significant differences were in evidence with respect to these variables. On the basis of before tax and after tax operating return, the non-conglomerate sample was found to have achieved moderately higher performance, but these were not significantly different from their conglomerate counterparts. In terms of return on equity and financial leverage, significantly higher results were noted for the conglomerate sample. The price-earnings ratios of conglomerate firms were lower, but these were not significantly different from those of non-conglomerate firms.

Melicher and Rush interpret the higher returns on equity and the lower earning multipliers achieved by conglomerate firms as a reflection of the dual effect of leverage on equity return and financial risk.[19] Although they attribute the low level of price-earnings ratios to a correspondingly high business risk, no evidence is presented to support this assertion in terms of some index of operating risk. True, the magnitude of the price-earnings ratio is an index of the quality of earnings in terms of operating risk, financial risk, and growth prospects. The unsubstantiated arguement of Melicher and Rush runs counter to views held with regard to the effect of diversification on the stability of operating in-

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[19] Ibid., 384.

come. Moreover, diversification is expected to enable conglomerate firms to stretch their leverage capacity without entailing increase in financial risk. The results of the Melicher-Rush study is not disputed here. But their interpretation of the results is at odds with the leverage implication of corporate diversification, emphasized in the preceding chapter.

The second part of the Melicher-Rush study was concerned with the measurement of investment performance, for the most part, on the basis of the capital asset pricing model.[20] From the middle of 1966 to the end of 1971, monthly time series of each firm's equity yield were obtained from Standard and Poor's Compustat tapes. For each of the ninety firms, the following investment performance measures were computed: average monthly return over 66 months, standard deviation of returns or total risk, systematic risk, correlation coefficients between each firm's return and return on the market portfolio, Jensen's predictability index, Sharpe's reward-to-variability ratio, and Treynor's reward-to-volatility ratio.[21] On the basis of these variables, the two groups of firms were compared and tested for significance of differences. Although not statistically significant, slightly higher average return and higher total risk were observed for the conglomerate sample. Risk differences between the two samples, according to systematic risk and on the basis of correlation co-

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[20] Ibid., 384-387.

[21] The market portfolio and the risk free rate of interest were approximated by Standard and Poor's 500 Price Index and interest rate on sixty-day U. S. Treasury Bills as of the beginning of the month, respectively. Ibid., 384. For an excellent comparison of the Jensen, Sharpe, and Treynor Performance indicators refer to Keith V. Smith and Dennis A. Tito, "Risk-Return Measure of Ex-Post Portfolio Performance," Journal of Financial and Quantitative Analysis, IV (December, 1969), 449-471.

efficients between individual firms and the market portfolio, were inconsistent. With respect to the former, conglomerate firms demonstrated a significantly higher level of systematic risk. With respect to correlation measures, on the other hand, the conglomerate group was characterized by a significantly lower level of risk. This index of risk supports the view that conglomerate firms can achieve better diversification performance than their non-conglomerate counterparts. However, a significantly higher systematic risk coupled with non-significantly higher return appears to contradict the theory of capital asset pricing in which a significant and positive correlation is predicted between risk and return.[22] In two out of three composite measures of investment performance, conglomerate firms achieved moderately better trade-off between risk and return. But differences between the two samples, in terms of the three indexes, were not statistically significant.

Melicher and Rush conclude that on the basis of most evaluation tests used in the study, the performance of conglomerate firms was comparable to that of non-conglomerate firms. The only outstanding difference they found was the greater use of financial leverage by the conglomerate sample. However, the use of more debt in the capital structure of conglomerate firms is taken to be counter productive due to associated lower price/earnings ratios. Nevertheless, according to the theoretical framework of this paper, diversification by conglomerate firms is expected to

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[22]According to the theory of capital markets, the relationship between return and systematic risk is predicted to be both positive and significant. Sharpe, "Capital Asset Pricing: A Theory of Market Equilibrium Under Condition of Risk," 433-442 and John Lintner, "Security Prices, Risk, and Maximal Gains from Diversification," Journal of Finance, XX (December, 1965), 606.

increase their leverage capacity without entailing a deterioration in the quality of earnings.

The Smith-Schreiner Study--A Portfolio Analysis of Conglomerate Diversification

A unique feature about the Smith-Schreiner (hereafter S-S) paper is that it is the first attempt to examine conglomerate diversification within a framework of portfolio analysis.[23] The main objective of the S-S study was to develop and evaluate a model for the selection of diversified industrial categories by conglomerate firms using the portfolio approach. The secondary task of their effort was to compare the diversification performance of two samples comprising conglomerate firms and mutual funds.

While recognizing several limiting conditions associated with applying portfolio analysis to corporate diversification such as: indivisibility, uniqueness of each acquisition, and abandonment, S-S circumvent these problems by invoking a homogeneity assumption, which states that firms in the same industry are nearly the same with regard to business risk characteristics.[24] If some conglomerate firms were known for acquiring companies from the same industry, each acquisition was treated alike with respect to risk and return. The S-S approach, for example, would disregard the difference between the acquisition of Jones & Laughlin Steel by LTV and investment in another representative firm of the steel industry. The merit of this approach, apart from its obvious simplification, is that it provides a basis for making comparisons among the sample conglomerates.

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[23] Smith and Schreiner, "A Portfolio Analysis of Conglomerate Diversification," 413-427.

[24] Ibid., 417.

Having assumed away distinctions between a portfolio of securities and a portfolio of firms, S-S chose the Standard and Poor's 88 industrial categories as the spectrum of investments open to conglomerate acquisitions. By excluding certain industries in which conglomerate firms were not historically known to invest, 67 industrial categories were finally selected to represent the conglomerate market portfolio. The risk-return attributes of these industries were computed from the Standard and Poor's market indices of fourteen (1953-1967) price relatives. From a past performance of fifteen years, expectations for the following year were approximated by means of a simple extrapolation on the basis of which efficient sets were generated. The conglomerate market portfolio was identified by assuming a risk-free return of five percent. The S-S model of conglomerate portfolio analysis showed that, if the past is a reliable guide to future expectations, investment in seven industrial categories would yield an optimal portfolio of conglomerate investments.[25]

The second phase of the S-S analysis involved comparing the diversification performance of conglomerate firms with that of mutual funds. Two non-random samples consisting of nineteen conglomerate firms and eight mutual funds were selected for this purpose. Whereas analysis of mutual

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[25]These industries included soft drinks, cosmetics, drugs, electronics, publishing, radio and T.V. networks, and telephone and telegraph. Although the market portfolio for conglomerate firms consisted of 67 industries investment, seven select industries yield the same diversification result as that of the market portfolio. This result indirectly lends support to an earlier study by Evans and Archer in which they demonstrated that diversification is governed by diminishing returns. Out of a possible portfolio of 470 NYSE securities, 10 to 15 securities were found sufficient to reduce portfolio risk to its systematic level. Portfolio larger than these produced redundant results--counter productive considering transactions costs. For more detail, refer to J. Evans and S. H. Archer, "Diversification and the Reduction of Dispersion: An Empirical Analysis," Journal of Finance, XXIII (December, 1968), 761-767.

funds was based on actual data, a simulation technique was employed in the case of conglomerate firms. After computing average returns and standard deviations for individual conglomerate and investment company, Sharpe's reward-to-variability composite measure was used to rank the diversification performance of each firm.[26] The results showed that, on the average, mutual funds achieved better diversification performance than conglomerate firms.[27] However, a few conglomerate firms performed better than some mutual funds. When the combined sample of mutual funds were ranked according to the Sharpe portfolio performance index, four conglomerate firms appeared on the top ten list. Although S-S did not perform a test of significance, the comparative advantage of mutual funds comes as little surprise since investment companies are organized to pursue portfolio diversification. With due allowance for certain shortcomings in their methodology, equating the firm and the industry in particular, S-S concluded that some conglomerate firms have succeeded reasonably well in their diversification performance in relation to some mutual funds.[28] The S-S model is claimed to make no allowance for managerial

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[26]Sharpe's portfolio performance ratio measures risk premium induced by total risk:

$$\theta = \frac{r_i - r_f}{\sigma_i}$$

where: θ = reward-to-variability ratio
r_i = average return on the i^{th} portfolio
r_f = riskless rate of interest
σ_i = total risk of the i^{th} portfolio.

The higher the value of θ, the better the diversification performance. Sharpe, "Mutual Fund Performance," 119-138.

[27]Smith and Schreiner, "Portfolio Analysis of Conglomerate Diversification," 423.

[28]Ibid., 427.

consideration. An examination of this point is held over to the review of the next article.

Aside from obvious differences in the objective of the S-S study and an investigation dealing with the leverage implication of the portfolio effect, one outstanding difference between the two approaches is to be noted. S-S assume away the distinction between an industry and a firm by employing a convenient homogeneity assumption. In the methodology of the following chapter, however, the uniqueness of each acquisition and disposition is maintained despite the rigors of obtaining requisite financial data.

In the preceding chapter, with particular reference to a portfolio analysis of conglomerate mergers, the effect of indivisibility on the efficiency of diversification was discussed. One aspect of the S-S empirical analysis provides interesting insights into this issue and may merit closer examination. In the case of two conglomerate firms for which proportion of investment in their respective industrial categories were unavailable, equal weights were assumed. To examine the sensitivity of the empirical results to such assumption, S-S calculated another set of the Sharpe performance index for each mutual fund and conglomerate firm. For example, if a conglomerate firm or a mutual fund were considered to hold a portfolio of ten industries, each industrial category was assigned a participation level of ten percent. The results of a sensitivity analysis showed negative changes in the performance index for all mutual funds. But a degradation of diversification was the case for only a few of the conglomerate firms.[29] Given the risk and return attributes of different

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[29] Ibid., 426.

industrial categories in which the sample conglomerate firms and mutual funds held investments, similar conditions of divisibility improved the diversification performance of the former, while affecting the latter adversely.

The Westerfield Study--Measurement of Conglomerate Diversification

In a study concerning the performance of mutual funds, Jensen has proposed a dichotomy of portfolio performance in terms of efficiency in diversification and efficiency in forecasting security prices.[30] Smith and Schreiner referred to the latter component of performance as a "management variable" and contended that their model of conglomerate portfolio analysis measures exclusively the diversification prospects of conglomerate firms.[31] Westerfield, on the other hand, disputes the validity of the S-S model for its intended purpose, contending that their approach is remiss in that it does not separate the two components of performance: portfolio management and portfolio diversification.[32]

Westerfield's alternate approach to the measurement of conglomerate diversification is developed along the lines of the model for pricing capital assets which states that the expected return on a portfolio ($E(R_i)$) is related to return on a riskless investment (R_f), return on the market

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[30]Michael C. Jensen, "Problems in Selection of Security Portfolios: The Performance of Mutual Funds in the Period 1945-1964," Journal of Finance, XXIII (May, 1968), 389.

[31]Smith and Schreiner, "Portfolio Analysis of Conglomerate Diversification," 427.

[32]Westerfield, "A Note on the Measurement of Conglomerate Diversification," Journal of Finance, XXV (September, 1970), 908.

portfolio ($E(R_m)$), and the beta coefficient (β_i) which is an index of systematic risk:

$$E(R_i) = R_f + \beta_i \quad E(R_m) - R_f \tag{3-1}$$

Implicit in this equation is a condition of market equilibrium. But if there is disequilibrium in the capital market due to the existence of over-priced or under-priced securities, the asset pricing model can be modified to allow for ability in identifying such investments by adding an alpha term (α_i):

$$E(R_i) = \alpha_i + R_f + \beta_i \quad E(R_m) - R_f \tag{3-2}$$

The first term in (3-2) may assume a negative or positive value depending on whether or not the portfolio in question contains under-valued or over-valued securities, respectively. The above expression can be reconciled with the performance index used by Smith and Schreiner by substituting the definition of systematic risk $\beta_i = \rho(R_i, R_m)\sigma(R_i)\sigma(R_m)/\sigma^2(R_m)$ into (3-2) and dividing both sides by the total risk $\sigma(R_i)$ of the portfolio:

$$\frac{E(R_i) - R_f}{\sigma(R_i)} = \frac{\alpha_i}{\sigma(R_i)} + \frac{\rho(R_i, R_m) \quad E(R_m) - R_f}{\sigma(R_m)} \tag{3-3}$$

The principal difference between the S-S analysis of conglomerate diversification and Westerfield's proposed approach is set forth in Equa-

tion (3-3).[33] The left hand side of the equation represents Sharpe's reward-to-variability ratio which is the index claimed by S-S to measure portfolio diversification separately from portfolio management. The right hand side of (3-3) shows Westerfield's index of performance, segregated into its two elements. The second term depends on correlations between any portfolio and the market portfolio. The higher the correlation coefficient between return on a conglomerate portfolio and return on a market portfolio, the better the diversification performance of the former. In the limiting case, if correlations between the two are perfectly positive, it means a conglomerate firm has eliminated all diversifiable risk by reducing total portfolio risk to its systematic level.

Having separated the effects of portfolio management and portfolio diversification on performance, Westerfield proposed as a measure of the latter the correlation coefficient between returns on a conglomerate portfolio and returns on those of the market portfolio. When inefficient portfolios are involved, this correlation is influenced by the value of the beta coefficient which is noted for its instability due to the existence of diversifiable risk. To allow for such differences among conglomerate firms, the proposed index of diversification was converted to a relative measure by dividing $\rho(R_i, R_m)$ into the corresponding systematic risk. Westerfield's measure of diversification or "total relative risk" is the same as the ratio of risk on the market portfolio to total risk on a conglomerate portfolio.[34]

To compare his proposed model with that of Smith and Schreiner,

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[33] Ibid., 910.

[34] Ibid., 912.

Westerfield calculated the diversification performance of ten conglomerate firms for two sub-periods during 1954-1968. The same performance index was also calculated for four mutual funds and 890 common stocks listed on the New York Stock Exchange. Several differences in the results of the two empirical studies can be observed. Within conglomerate firms, the two measures of performance showed inconsistent results. For example, International Telephone and Telegraph ranked first in terms of the S-S performance index, but was rated eighth according to Westerfield's criterion. Contrary to the S-S conclusion about the remarkable diversification performance of conglomerate firms in comparison with mutual funds, Westerfield's findings showed that conglomerate firms were outperformed by mutual funds during both sub-periods. However, Westerfield's study showed a marked improvement in the diversification performance of conglomerates during the second sub-period. During the period 1961-1968, conglomerate firms achieved better diversification than the average of NYSE stocks.

Differences in portfolio performance, conglomerate firms as well as others, may arise from portfolio diversification, portfolio management, or both. Since the methodology of Smith and Schreiner does not separate the two effects, their observation about the diversification performance of conglomerate firms seems untenable.[35] Westerfield's dichotomy of portfolio performance, with particular reference to conglomerate firms, is a useful contribution to the growing interest in portfolio analysis of conglomerate diversification.

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[35] Ibid., 914.

The Scott Study--Inquiry Into Optimal Financial Structure

The primary purpose of Scott's study was to investigate empirically whether or not optimal capital structure exists.[36] The secondary objective of the study--and the more important one with reference to the present dissertation--involved determining if leverage differences among firms could be explained more meaningfully by the variability of operating income instead of industry classes.

The one-way analysis of variance was employed to compare the capital structure pattern of 77 firms from 12 industries during the period 1958-1968 using two different approaches: on the basis of industry class of firms and according to a parameter of operating risk.[37] Utilities and railroads were excluded from the sample of industries to eliminate the influence of regulatory agencies on the capital structure decision of the firm. On the basis of book value, the debt/assets ratio was computed for each firm annually. The mean leverage ratio of each industry was then tested for statistical significance. The F-test produced evidence supporting the traditional position on inter-industry differences in capital structure at the five percent level of significance.[38] The rejection of the null hypothesis was followed up with the pairwise test using the results of the analysis of variance. This test confirmed that inter-industry differences in capital structure were pervasive.

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[36] Scott, "An Inquiry Into the Existence of Optimal Financial Structure," 2.

[37] Ibid., 90-100.

[38] Ibid., 130-132.

In the second approach for examining optimality of capital structure, a parameter of operating risk was used as a criterion for classifying firms instead of industrial class. The variability of operating income was measured by the antilog of the standard error of estimate about the log rend line and was used as the business risk surrogate. This was computed on the basis of two income streams: per share earnings before interest and taxes (EBIT) and per share earnings before depreciation, interest, and taxes (EBDIT). For each firm, three time periods consisting of 1959-1968, 1959-1963, and 1964-1968 were analyzed.

Having determined the operating risk characteristics of each firm six different ways, the 77 firms were assigned to one of the arbitrarily formed four or five business risk classes ranging from high to low. The one-way analysis of variance was then performed to determine if there were significant differences among the mean leverage ratios of firms in different variability classes. Four F-ratios for the periods 1964-1968 and 1959-1968 showed no significant differences in the mean leverage ratio of firms in separate variability classes.[39] For the period 1959-1963, however, a weak evidence of differences in capital structure was indicated at the twenty-five percent level of significance. These results may cast doubt on the traditional theory of finance concerning interrelationships between operating risk and capital structure.

Most empirical analyses about capital structure assume that firms in the same industry belong to a homogeneous risk class.[40] Scott sets out

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[39] Ibid., 162.

[40] The classical article by M-M is based on the same homogeneity assumption. Modigliani and Miller, "The Cost of Capital Corporation Finance and the Theory of Investment," 266.

to test the validity of the equivalent risk class proposition as a second minor hypothesis. Accordingly, the analysis of variance was performed on variability of operating income by industry. The F-test showed that inter-industry differences in variability were statistically significant at a confidence level ranging from 95 to 75 percent.[41] The pairwise test substantiated the same conclusion. On the basis of these tests, Scott observed that the industrial grouping of firms is a reasonable approximation of homogeneous risk class.

In his inquiry into the existence of optimal capital structure, Scott tested three separate hypotheses, the major one being inter-industry differences in financial leverage. By using a larger sample of industries and a more refined methodology, in comparison with a related study by Schwartz and Aronson, Scott provides further evidence in support of the traditional theory of finance on corporate leverage.[42] His first minor hypothesis concerning the variability of operating return and capital structure is of particular interest from the perspective of a dissertation which attempts to show a relationship between corporate diversification and financial leverage. While no dispute is raised here over the merit of Scott's methodology, an apparent inconsistency in the interpretation of his results cannot be overlooked. The same sample of 77 firms from 12 industries were used to test inter-industry differences in capital structure, inter-industry differences in the variability of operating income, and inter-variability

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[41]Scott, "An Inquiry Into the Existence of Optimal Financial Structure," 155-156.

[42]Eli Schwartz and J. Richard Arnson, "Some Surrogate Evidence in Support of the Concept of Optimal Financial Structure," Journal of Finance, XXII (March, 1967), 10-19.

differences in capital structure. Scott interprets the results of the first two analyses to mean that leverage differences among firms are significantly related to their industrial classification and that firms in the same industry are characterized by equivalence of operating risk.[43] On the basis of separate evidence regarding the non-significance of differences in mean leverage ratio among firms in different variability classes, he argues that financial leverage is independent of stability in operating income. However, when the results of the two minor hypotheses are interpreted together a double meaning is inevitable. On one hand, appreciable differences among industries with respect to variability in operating income could mean that the industrial category of firms is a good approximation of homogeneous risk class. On the other hand, the same result could also be interpreted to suggest that the evidence concerning independence of operating risk and financial leverage is spurious. The first interpretation implies the second. However, Scott opts for one interpretation and ignores the other without any allowance for the ambiguity of his results.

The Wippern Study--Financial Structure and the Value of the Firm

Both proponents and opponents of the concept of optimal capital structure share a common ground regarding the direction of change between equity yield and financial leverage.[44] Both sides agree that the cost of

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[43]Scott, "An Inquiry Into the Existence of Optimal Financial Structure," 178.

[44]There is a widespread consensus both in theoretical analysis and empirical evidence. For representative views from each school, refer to Modigliani and Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," 284-288 and Fred J. Weston, "A Test of Cost of Capital Propositions," Southern Economic Journal, XXX (October, 1963), 105-112.

equity is an increasing function of leverage. Values predicted for the slope of the leverage-yield function is the substance of the dispute about leverage effects. Wippern's study addresses itself to this crucial issue. Specifically, the purpose of the study was to examine the effect of leverage on the equity capitalization rate by means of multiple regression and interpret the results of the analysis in the light of the two opposing views.[45]

From the perspective of this dissertation, the most interesting feature of Wippern's investigation is his recognition of the inadequacies of an industrial category as a proxy for a homogeneous risk class. In lieu of a homogeneity assumption, relied upon by other investigators of optimal capital structure, Wippern used the variability of pre-tax and pre-depreciation operating profit as a business risk surrogate.[46] Although the variability of EBIT is associated with debt capacity, Wippern adds depreciation to this income stream to obtain quasi-cash flow before financial charge and taxes. The standard error of estimate around a logarithmic trend line of the indicated income stream over the previous ten years was used as an index of business risk.

Another novel aspect of Wippern's work is his specification of a more appropriate standard of leverage. In contrast with leverage ratios which are based on stock figures, Wippern employs a flow measure for the leverage variable (L), and directly incorporates in the ratio the level of earnings ($\bar{E}$), the variability of earnings (s), and interest charges (i),

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[45] Wippern, "Financial Structure and the Value of the Firm," 617.

[46] Ibid., 618-619.

as shown below:[47]

$$L = \frac{i}{\overline{E} - 2s} \qquad (3\text{-}4)$$

The right hand side of (3-4) is a modified reciprocal of the familiar times-interest-earned ratio. The numerator (i) consists of interest and preferred dividends. The denominator $(\overline{E} - 2s)$ is a ninety-five percent certainty-equivalent of average earnings. In other words, EBIT before depreciation was adjusted for business risk within a confidence interval of ninety-five percent by subtracting two standard errors (2s) from the average level of income. The explicit consideration of the risk factor in the leverage ratio made it unnecessary to rely on the equivalent risk assumption for firms in the same industry.

In addition to leverage, three independent variables comprising growth, dividend payout, and size were included in the multiple regressions analysis to serve as a control group. Six dummy industry variables were also introduced to detect any systematic influence of the industry factor which may remain unexplained by the four independent variables. The dependent variable, equity cost, was estimated two ways: as earning yield and as dividend yield plus growth rate.[48]

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[47]Leverage measures based on stock figures, whether based on market value or book value, have been criticized for lacking conceptual merits. See J.K.S. Ghandi, "On the Measurement of Leverage," Journal of Finance, XXI (December, 1966), 715-726.

[48]The empirical analysis was based on sample data of 50 firms from 7 industries. Regression coefficients were computed for four non-consecutive years (1956, 1958, 1961, 1963) in order to observe the stability of the coefficients over time both in sign and magnitude. Wippern, "Financial Structure and the Value of the Firm," 620-621.

Multiple regression coefficients were computed for a cross section of 50 firms from 7 industries, and these were tested for statistical significance. Empirical results showed that equity yield was directly related to leverage and retention and inversely to growth and firm size.[49] On the average, each of these coefficients was significant at the five percent level. In the theory of finance, general agreement exists as to the effects of growth and firm size on the equity capitalization rate. Wippern's empirical results are further evidence to the broad consensus that the two variables are inversely related to the cost of equity. However, some ambivalence is still prevalent, on both theoretical and empirical grounds, about the interdependence between equity cost and the payout ratio.[50] The negative payout coefficient in this study supports the view that investors have preference for dividends to capital gains.

In the preceding regression analysis, a strong, positive functional relationship between the cost of equity and financial leverage was demonstrated. The sign of the leverage coefficient, however, is neutral to the stance of the two conflicting theories on capital-structure effects, and merely reaffirms their point of accord that equity yield and financial leverage move in the same direction. The dispute can only be settled by comparing the magnitude of the observed leverage coefficients

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[49] Ibid., 622-623.

[50] For opposing views on dividend policy and equity cost, refer to Modigliani and Miller, "Dividend Policy, Growth, and the Valuation of Shares," 411-434 and Eugene F. Brigham and Myron J. Gordon, "Leverage, Dividend Policy, and the Cost of Capital," Journal of Finance, XXIII (March, 1968), 85-105.

with corresponding values predicted by M-M's proposition II and the traditional model. The former states that the cost of equity (K_e) is a function of the cost of equity for unlevered firms in the same industry (K_o), the rate of interest (r), and the debt-to-equity ratio ($\frac{D}{E}$), in a manner expressed below:[51]

$$K_e = K_o + (K_o - r)\frac{D}{E} \qquad (3\text{-}5)$$

The model in (3-5) predicts that in the absence of corporate taxes the leverage coefficient (b) is equal to the difference between the required rate of return on a leverage-free capital structure and the rate of interest:

$$K_o - r = b > 0 \qquad (3\text{-}6)$$

Provided that the rate of interest does not rise with the progressive use of leverage, the advantage of debt financing is counterbalanced by the rise of equity cost to render the over all cost of capital independent of leverage. The traditional view, on the other hand, maintains that with or without corporate taxes the leverage coefficient is lower than that predicted by the M-M model:

$$K_o - r > b > 0 \qquad (3\text{-}7)$$

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[51] Modigliani and Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," 271.

Wippern tested the two versions of capital structure effects on equity yield in which the cost of equity for leverage-free firms was estimated from the intercept of the regression function and the rate of interest was approximated by Moody's Industrial Bond Yields.[52] Given the predictions of Proposition II and the leverage dependence hypothesis set forth in equations (3-6) and (3-7), respectively, the empirical results showed strong evidence that the observed leverage coefficients for all the seven industries during each of the periods were significantly lower than the forecast of the M-M model. Based on these findings, Wippern concludes that, contrary to the M-M position, the cost of equity does not respond to financial leverage to the extent of completely offsetting the advantage of debt on earnings.[53] However, the study does not directly establish the existence of optimal capital structure except by implication. If the assumption in the empirical analysis concerning the constant rate of interest were relaxed, a range of "diminishing returns" to excessive leverage could be demonstrated.

In addition to presenting indirect empirical support in favor of optimal capital structure, Wippern used an explicit measure of operating risk without having to rely the equivalent risk proposition. The latter approach should prove particularly useful in the analysis of conglomerate firms where a definition of the industry is not always operational. By directly incorporating a measure of business risk in the leverage ratio,

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[52]For the sake of direct comparison between the traditional and M-M models of leverage effect, leverage coefficients based on income statement data were transformed to one based on the balance sheet. Wippern, "Financial Structure and the Value of the Firm," 626.

[53]Ibid., 631.

the pattern of equity yield and financial leverage was demonstrated to be consistent with the traditional theory. Scott's empirical analysis, cited in the preceding section, had asserted that the industrial classification of firms is a better frame of reference for explaining capital structure differences rather than a parameter of operating risk. Even if indirectly, Wippern's multiple regression analysis in which the influence of the industry factor was recognized by means of dummy variables does not support Scott's view about the relationship between operating risk and financial leverage. As pointed out in the preceding section, Scott's empirical results and their interpretation were logically inconsistent. Due to differences in the approach of the two studies, a direct comparison of their results would be perhaps inappropriate. But one thing may be said in favor of Wippern's investigation: the results and their interpretation appear consistent.

Conclusion

Return on equity and its related risk reflect the compound effect of the investment and financing decisions on common stock. The earning power of assets and its accompanying risk, on the other hand, are independent of financing decisions such as capital structure. The distinction between the two levels of risk and return defines the principal difference between portfolio analysis of conglomerate diversification with reference to the three studies by Melicher-Rush, Smith-Schreiner, and Westerfield; and portfolio analysis of conglomerate diversification in the context of this dissertation. With due allowance for their dissimilarities, the three papers essentially classify samples of common stocks

by type (conglomerate firms, mutual funds, undiversified companies) and compare the risk and return performance of conglomerate securities with those of the other two groups. Since the three studies are primarily concerned with the measurement and evaluation of efficiency of diversification, in the sense of residual performance, they do not deem necessary considering the effects of operating risk and financial leverage separately.

The relevant return variable in the studies by Scott and Wippern is operating return before financial charges. The two papers are partially related to the general approach of this dissertation in the sense that they develop a measure of variability in operating return and examine its effects on capital structure. The samples of companies analyzed by Scott and Wippern are treated as independent entities because the purposes of the studies were to test inter-variability differences in capital structure and to determine the effect of leverage on the cost of equity. With respect to business risk, the operating return of subsidiary companies are interdependent from the view point of the parent company. Subsidiary companies making up a conglomerate portfolio are analogous to securities composing a portfolio of risky assets. In a study addressed to the effect of conglomerate diversification on capital structure, interrelationships between the operating return of subsidiaries and their joint influence on the stability of the parent company's operating income cannot be overlooked. Since one of the merits of portfolio analysis is its explicit recognition of interrelationships between returns of portfolio components, the model for portfolio variance is a useful tool for monitoring the effect of diversified acquisition on the stability of operating return. An examination of this approach and the results of the attendant empirical

analysis are presented in the following chapter.

CHAPTER IV

METHODOLOGY AND RESULTS OF EMPIRICAL INVESTIGATION

Introduction

In Chapter Two, a theoretical framework for the leverage implication of the portfolio effect was developed. The theory of corporate finance concerning inverse relationships between the variability of operating profit and financial leverage was discussed and the implications were extended to the effect of diversification on the capital structure of multi-industry firms. On the ground that an inverse relationship between the two variables is theoretically sound and empirically supported, for a cross section of industries, a case was made to explain the financial advantages of conglomerate diversification in terms of increased leverage capacity.

In the theoretical aspect of this paper, the broad principles of diversification were extensively covered, with particular reference to conglomerate mergers. The popular but naive approach to the measurement of corporate diversification, often based on a simple frequency count of industries in which a firm operated plants, was criticized. An alternative and a more sophisticated method of analyzing diversification was proposed in a form of the portfolio technique. Hence, the secondary purpose of this chapter is to measure corporate diversification within a

portfolio framework. The primary objective is to test empirically, by means of a case study, the proposition that some quantum of financial leverage can be generated by corporate diversification. The subject of the study is the LTV Corporation during the period 1962-1971.[1]

According to the Fortune Directory of 500 in 1962, the LTV Corporation was ranked as the 158th largest industrial corporation. Over a decade, by combined means of diversified acquisitions, internal growth, and frequent reorganizations, its position moved in 1971 to that of the 20th largest industrial corporation and the second largest conglomerate firm.

The difficult task of applying multi-period portfolio analysis to such a complex organization cannot be fully appreciated without a historical perspective about the organizational changes and the acquisition activities of the subject company during the period covered in the study.[2] Hence, a historical account of major developments between 1962 and 1971 is briefly reviewed in the following section.

Organization and Acquisition History of LTV (1962-1971)

Ling-Temco-Vought, Inc., a name adopted in 1961, is the company that survived a series of mergers and acquisitions which began in 1959.

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[1]Several considerations prompted the choice of the LTV Corporations as the subject of the empirical study. According to the 1971 Fortune Directory of largest corporations, LTV was one of the 50 largest diversified industrial firms. The corporate head office located in Dallas, which is less than 200 miles from Norman made it easily accessible for needed consultation. In addition to the large size of the company and its proximity to the home base of this researcher, enthusiastic support and cooperation was received from the office of the Chief Financial Officer.

[2]Another important consideration was the "high visibility" of LTV subsidiaries which made them conducive to the method of portfolio analysis adopted in this study.

The original company, Ling Electronics, Inc., was formed in California in 1953. Following the acquisition of Altec Companies, Inc., in 1959, the company came to be known as Ling Altec Electronics, Inc. After the acquisition of Temco Aircraft Corporation in 1960, the name, Ling Electronics, Inc. was changed to Ling-Temco Electronics, Inc. The present name, Ling-Temco-Vought, Inc. (LTV), was adopted after the acquisition of Chance Vought Corporation in late 1961. Hence, 1962 marks the first full year of the company's operation as LTV.[3]

In 1962, LTV consisted of twenty-four divisions and subsidiaries. During the next three years, the company implemented its decision to pursue continued growth within the aerospace and the electronics industries and seek operating economies by combining related operating units. Certain subsidiaries and product lines that were not complementary to LTV's primary fields of activity were relinquished. The elimination of such units was accompanied by steps to streamline and strengthen the company's organization. These steps included changing subsidiary companies to divisional status, assigning new names to most divisions to identify them more clearly as LTV operating units, and consolidating similar units more closely together under fewer divisions. By 1964, through a combination of dispositions, acquisitions, and reorganizations, LTV had collected its corporate effort into eleven operating units.

In late 1964 and early 1965, the eleven operating divisions of LTV were restructured under a reorganization plan entitled "Project

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[3]This fact was the primary consideration in choosing 1962 as the initial period for analyzing LTV's diversification and financing program during 1962-1971.

Redeployment." Under the redeployment plan, LTV was reorganized into four independent units: a parent operating company and three wholly-owned subsidiaries with specialized product lines and technical capabilities. Eight of the eleven operating divisions were transferred to the three subsidiaries. LTV Aerospace Corporation, LTV Electrosystems, Inc., and LTV Ling Altec, Inc. were formed to concentrate on aerospace, electronics, and sound systems, respectively. The three remaining divisions were retained by the parent company with plans towards eventual redeployment.

Assets of the eight divisions were transferred to the three subsidiaries at book value. In exchange for assets received, the subsidiaries assumed the liabilities of the parent company valued at $31.7 million. In addition, the parent company received from each of the three subsidiaries 1,200,000 shares of common stock and 65,000 shares of 4% convertible preferred stock. Subsequently, LTV stockholders were offered the option of exchanging their holdings in the parent company for the common stock of subsidiary companies. For each LTV common share tendered, one-half of each subsidiary's common share and nine dollars in cash were paid. Owners of LTV common were allowed to exchange their holdings up to one-third of the outstanding common shares of each of the three subsidiaries. The public offering to LTV common stockholders was instrumental to the establishment of definite market values for LTV's investments in the three subsidiaries as one of the objectives of Project Redeployment. By the end of 1965, the creation of minority interests had reduced LTV ownership in each subsidiary to ninety percent.

Under Project Redeployment, several factors led to the formation

of three subsidiaries and a parent operating company. Managerially, the centralization of control was matched by the decentralization of authority as an effective means of motivating each subsidiary's personnel. Economically, the competitive position of the subsidiaries in their respective industries was enhanced through greater specialization by freeing subsidiaries to do what they knew best. Functions which the specialized units could not provide for themselves economically without costly duplication were provided by the parent company. These functions included financial planning, legal matters, public and industrial relations, long-range product planning, basic research and computer services, expertise in the area of merger and acquisitions, and general management guidance. Project Redeployment, as a unique management philosophy of operating through largely autonomous subsidiaries, was partly intended to prevent an adverse development in one unit from affecting other units. Should a subsidiary experience trouble, its impact would not be felt by other subsidiaries, and only minimally by the parent company. In a sense, therefore, the concept of Project Redeployment can be regarded as one form of diversification that could be achieved by effectively separating different operating units. Forming autonomous operating units was partly a result of LTV's previous experience in the sudden cancellation of defense contracts.

Project Redeployment attempts to combine the advantages of decentralization with the plus factors of centralization. As a result, it has been aptly termed as a concept of "optimum decentralization." In addition to achieving a large measure of autonomy and management motivation, LTV subsidiaries were enabled to establish definite market value

as separate entities. As a management philosophy with broader scope, Project Redeployment was designed to encompass LTV's subsequent acquisitions. The creation of minority interests and the disclosure of its operating units to public scrutiny by publishing subsidiary financial statements, both consequences of Project Redeployment, have earned for LTV a recognition as being, perhaps, the most visible corporation among the 500 largest industrials according to the June 15, 1968, issue of Fortune.

Project Redeployment was partly designed as a limited measure of protection against operating risk arising in one segment of LTV from affecting other subsidiaries. In implementing Project Redeployment, LTV management was well aware that the formation of independent subsidiaries was no substitute for diversifying into non-defense sectors. In spite of the company's major reorganization during the redeployment program, LTV remained largely a defense-oriented corporation. Between the incorporation of LTV in 1961 and the first-phase completion of Project Redeployment, government sales made up nearly 90 percent of total LTV revenue, as shown in Figure 4-1. During the same period about 75 percent of total sales came from defense contracts.

A number of factors, all related to the company's heavy reliance on the defense business, prompted LTV's pressing need for diversifying into commercial sectors. By the end of 1964, LTV had not fully recovered from the cancellation of defense contracts in 1958 and 1960.[4] In 1964,

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[4]According to company records, the 1958 contract cancellation resulted in the termination of 5900 employees. Over the next two years, sales dropped by 35 percent. The cancellation of the Corvus Missile program involved total expenditure estimated at $400 million.

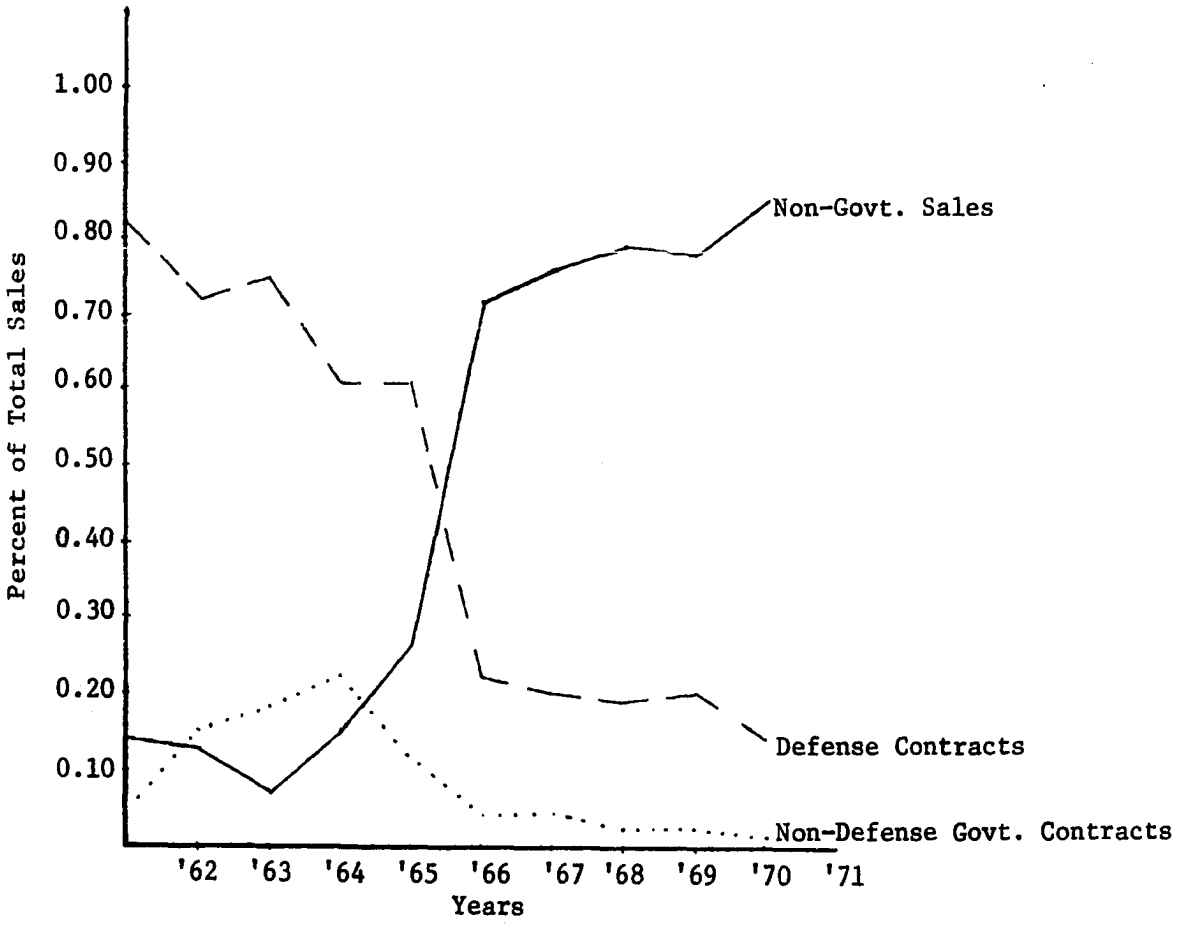

FIGURE 4-1. Relative Trend of LTV Sales by Principal Market Sectors: 1962-1971

the Johnson Administration warned of an impending cutback in the defense budget. Through numerous officials of his administration, public statements were made urging defense-oriented companies to diversify their products and markets. The management of LTV recognized the fact that the Company's prospects for growth were constrained by appropriations for defense and the space program.

In the face of economic uncertainties resulting from great reliance on the defense industry, the decision to seek diversification was rather compelling by mid 1960's. After recalling the experience of LTV up to 1963, Mr. James J. Ling, then Chairman of the Board and Chief Executive Officer, summed up the company's pattern of growth, beginning with the redeployment program:

> I made a vow that never again would any company for which I was responsible be dependent upon one market, any one product, or any one technology. Our concept would be that we would continually and on a sustained basis seek diversification.[5]

Two methods of diversification were open to LTV: internal diversification through research and development and external diversification by means of acquisitions. Research and development has always been a first-priority activity at LTV. This is evidenced by the fact that most of the products marketed by the company were internally developed. In addition to three divisions of the LTV Research Center located in Dallas, Anaheim, and Hawaii, each operating unit of LTV maintains its own separate research function. Research and development at the parent company level was enlarged and strengthened as part of the redeployment program. Between 1962 and 1968, LTV made expenditures in research and development at annual rate of $15 million.[6] Prior to 1965, most of these expenditures were directly tied to defense-related research. The company was well aware that redirecting its R&D effort as a means of achieving a pressing

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[5]Remarks to the National Electrical Contractors' Association, October 17, 1968.

[6]The figure for research and development was obtained from LTV annual reports 1962-1968. Research and development expenditures for years 1969-1971 were not included in the annual reports.

need for diversification would be a slow process. The long lead time required to diversify by internal means, coupled with the risk inherent in internal diversification, prompted LTV to pursue acquisitions as a primary method of achieving immediate diversification.

LTV made acquisitions both directly through the parent company and indirectly through its subsidiaries. In October of 1965, LTV acquired the Okonite Company from Kennecott Copper Corporation for a total consideration of $31 million, after the latter was forced by the courts to divest itself of a wholly-owned subsidiary. The Okonite specialized in the production and marketing of insulated electrical power and communication cable. Two years later, the Okonite diversified into carpeting and other floor covering businesses through the acquisition of General Felt Industries for a sum of $53.6 million.

LTV made its first major move towards diversification into the consumer and commercial markets with the acquisition of a 53 percent interest in Wilson and Co. for a total sum of $81.5 million.[7] At the time of its acquisition in January 1967, Wilson was the nation's largest in meat packing and food processing and the world's largest in the manufacture of sporting goods and athletic equipment. Wilson was also involved in the chemical and pharmaceutical industry. Following its merger into LTV in June 1967, Wilson became the beneficiary of the redeployment concept. Wilson was redeployed along the lines of meat and foods, sporting goods, and chemical and pharmaceutical products which resulted in the formation of three separate companies. At the end of 1967, LTV's equity

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[7]The Wilson acquisition including subsequent additional purchase of 18 percent of the outstanding common stock involved a sum of $225.4 million paid in cash and securities to Wilson stockholders.

interest in Wilson and Co., Inc., Wilson Sporting Goods Co., and Wilson Pharmaceutical and Chemical Corporation was 82 percent, 75 percent, and 78 percent, respectively. The acquisitions of Wilson and that of the Okonite, the latter two years earlier, were responsible for drastically changing the composition of LTV sales. Commercial sales as a percent of total sales increased from 27 percent in 1966 to 72 percent in 1967 representing the most substantial change in the composition of LTV revenues in one year.

In September 1969, the number of Wilson companies increased from three to seven. The redeployment of Wilson & Co., Inc., resulted in the formation of four independent subsidiaries with each company concentrating on different lines of the meat and food industry. Wilson & Co., Inc., with an 89 percent LTV interest, became a parent holding company with controlling ownership in excess of 80 percent in each of the four new subsidiaries: Wilson Beef & Lamb, Wilson Certified, Wilson Laurel Farms, and Wilson Sinclair. In 1970, LTV's 75 percent equity interest in Wilson Sporting Goods Co. and Wilson Pharmaceutical & Chemical Corporation was sold to Pepsi Co. and American Can, respectively, for an aggregate sum of $79 million.

With the acquisition of the original Wilson, LTV diversified into three unrelated industries simultaneously. Withdrawal from the chemical-pharmaceutical and sporting goods industries was accomplished with the disposition of these two Wilson subsidiaries. Wilson's food lines were strengthened by using the redeployment strategy. The net result of the Wilson acquisition, subsequent redeployment, and partial disposition culminated in establishing LTV as a leading company in the food industry.

In 1968, with the acquisition of Braniff Airways, LTV extended its diversification activities into air transportation. Braniff joined the rank of LTV subsidiaries as part of the acquisition of Greatamerica Corporation, a holding company with diversified interests in banking, insurance, and air and ground transportation.[8] During the liquidation of Greatamerica which immediately followed its acquisition, LTV ownership in the four subsidiaries engaged in banking and insurance was eliminated. Shortly after, National Car Rental System was sold, resulting in the retention of only Braniff out of the Greatamerica acquisition.

With the acquisition of a 63 percent ownership in Jones & Laughlin Steel Corporation, through a tender offer at $85 per share, LTV extended its aggressive diversification program into the steel industry. At the time of the acquisition in June 1968, Jones & Laughlin Steel was the sixth largest manufacturer of steel and steel products with sales in excess of $1.15 billion and assets of more than $1.13 billion.[9] At the beginning of 1969, Jones & Laughlin Industries was formed as a wholly-owned subsidiary for dual purposes of making an exchange offer for additional shares of Jones & Laughlin Steel and pursuing further diversification. By the end of 1969, through an exchange offer of Jones & Laughlin Industries shares for those of Jones & Laughlin Steel, LTV's indirect controlling interest in the latter company increased to 81 percent. In the sense that

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[8]Greatamerica was acquired for a total consideration of $440.7 million paid in subbordinated debentures and warrants. The six subsidiaries of Greatamerica were Braniff Airways, National Car Rental System, First Western Bank and Trust, Stonewall Insurance, American-Amicable Life Insurance, and Gulf Life Insurance.

[9]Including subsequent increase of LTV ownership to 81 percent of outstanding common stock, Jones & Laughlin Steel was acquired for a total value of $534.6 million.

the purchase of Jones & Laughlin Steel was directly responsible for the subsequent divestiture of two subsidiaries, the acquisition of the steel company produced mixed effects on LTV's overall diversification program.

In April, 1969, the Department of Justice filed an antitrust suit against LTV challenging the acquisition of Jones & Laughlin Steel as a violation of Section 7 of the Clayton Act. The suit alleged that the transaction would be anticompetitive on grounds of substantial concentration of assets and the potential for reciprocal buying. In March 1970, the suit was settled with the provisions that LTV complete the divestiture of Braniff and Okonite or Jones & Laughlin Steel within three years, that LTV and its subsidiaries refrain from acquiring companies with assets exceeding $100 million without the prior knowledge of the Justice Department, and that LTV and/or its subsidiaries not engage in reciprocal trading.[10]

Pursuant to the court ruling, LTV opted to retain Jones & Laughlin Steel. In a series of transactions initiated and consummated in 1971, the divestiture of the Okonite and Braniff was completed.[11] Thus, the entry of LTV into air transportation, electrical cable, carpets, and other floor covering products, terminated with the disposition of the two subsidiaries.

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[10]The terms of the settlement are binding for ten years. However, should LTV sell Jones & Laughlin Steel, the restrictions automatically terminate.

[11]The Okonite was sold to Omega-Alpha, a Dallas company formed by James J. Ling, who was the Board Chairman and the Chief Executive Officer of LTV at the time the Okonite was acquired in 1965. Mr. Ling was not associated with LTV as of 1970.

The preceding account of LTV's diversification program presented highlights of the parent company's acquisitions and dispositions during 1962-1971. As pointed out earlier, one of the objectives of the redeployment concept was to enable LTV to make acquisitions through its subsidiaries. Accordingly, LTV pursued external diversification on two fronts: directly through the parent company and indirectly through its subsidiaries. To mention a few highlights of major acquisitions by LTV subsidiaries, LTV Electrosystems purchased Memcor, Inc. for a total sum of $7.8 million in January, 1967. LTV Ling Altec acquired Allied Radio Corporation and Escon, Inc. for an aggregate sum of $50.9 million in October, 1967 and March 1968, respectively. General Felt Industries was acquired by the Okonite in January, 1969. LTV Aerospace, through its subsidiary LTV Educational System, has acquired beginning in 1969 more than 40 business and technical schools throughout the Southern half of the United States. The examples cited here are only a few instances of LTV acquisitions through its subsidiaries.[12]

Prior to Project Redeployment, LTV had evolved into a monolithic multi-divisional enterprise specializing in aerospace and electronics, having nearly 85 percent of its sales committed to the military and space agencies. Realizing the risk of depending on a single market, LTV took determined steps in the direction of a broad diversification program. The result of its diversification effort, largely external, is reflected in changes in the composition of company sales. During the period 1962-1965, sales to the private and consumer sectors made up nearly 15 percent

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[12]For a detailed account of subsidiary acquisitions and dispositions during the period 1962-1971 refer to Moody's Industrial Manual.

of aggregate revenue. In the next five years sales to diverse commercial markets soared to about 80 percent of total company sales. In the following sections, the diversification pattern of LTV during ten years (1962-1971) is measured by employing the portfolio approach. The stability of operating profit resulting from diversification is then compared with the trend of capital structure on a yearly basis.

General Approach

The diversification activities of LTV after the first half of the 1960's resulted in a substantial shift of emphasis from government contracts to commercial markets, the effect of which is depicted in the trend of the company's revenue structure in Figure (4-1). But a view of diversification based on the trend of relative sales in two highly aggregated sectors is probably more simplistic than the popular measure of corporate diversification criticized earlier. The unique feature of the approach taken in this study is the use of portfolio analysis, in the ex post sense, for examining conglomerate diversification.[13] Individual subsidiaries were treated as if they were securities. Similarly, the parent company (LTV) was considered as a standard portfolio.[14]

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[13] To the best knowledge of this researcher, no approach similar to the one used in this study is in evidence with regard to empirical investigations of other scholars on the subject of conglomerate diversification.

[14] Standard portfolio in this context means the elements of the portfolio are securities, in contrast with a portfolio of subsidiaries, or a conglomerate portfolio. Sharpe draws a distinction between a basic portfolio and a standard portfolio in terms of the number of constraints imposed on the objective function. The only constraints governing a basic portfolio problem are nonnegatively ($X_i > 0$) and the aggregate sum of weights adding to one ($\sum_{i=1}^{n} X_i = 1$). In addition to these, a standard portfolio problem includes upper bounds, lower bounds, and other requirements. See Sharpe, Portfolio Theory and Capital Markets, 59-66.

The preliminary step in portfolio analysis consists of examining the characteristics of individual securities with respect to expected returns, variance of returns and covariances among returns. In the same manner, the attributes of individual subsidiaries were measured in terms of the three parameters. Because of the presumed relationship between operating risk and leverage capacity, the relevant return variable was returned on subsidiary assets before interest and taxes, in contrast with security yield which is used as a return variable in standard portfolio analysis.

In the next phase of the investigation, the various subsidiaries were jointly brought together into a portfolio framework. Periodic changes in the composition and structure of subsidiaries constituting the conglomerate portfolio required the use of ex-post dynamic portfolio analysis: ex-post portfolio revision. Since an aspect of this study is concerned with examining the effect of corporate diversification on the stability of operating return, portfolio variance was measured at the end of each year over ten years. The pattern of variability in operating return was then compared with the trend of financial leverage to test the claimed validity of opposite direction of change between the two variables. Befor specifying procedures followed in the three distinct phases (analysis of subsidiaries, ex-post portfolio analysis, and leverage analysis) of the empirical work, the choice of financial variables and the adjustment of their time series is described in the next section.

Selection of Variables and Adjustment of Time Series

The choice of financial variables in any empirical investigation

depends on the objective of the study. The purpose of this study is to examine the hypothesized opposite direction of change between the variability of operating profit and financial leverage over time due to conglomerate diversification. Five financial variables were selected: the stream of earnings before interest and taxes (EBIT), total assets, total equity, percent of controlling interest in subsidiaries, and financial leverage. Data for the first four variables were taken from the consolidated operating and position statements of individual subsidiaries at the end of each year for ten years.[15] Information for leverage ratios was obtained from the consolidated balance sheets and income statements of the parent company over the same period.

Earnings before interest and taxes were chosen because they are considered to be the major determinant of a firm's leverage capacity. The theoretical justification for the dependence of financial leverage on the stability of operating profit was discussed in Chapter II. To eliminate scale effects on the variability of operating profit over time, EBIT was converted to a relative measure by expressing it as a percent of total assets. The book value of total equity and the corresponding fraction of the parent company's interest were used to determine the relative weight of each subsidiary in the parent company portfolio.

The processing of information (subsidiary analysis, portfolio analysis, and leverage analysis) was preceded by the adjustment of some time series. Ideally, all units of the parent company and its subsidiaries

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[15]Data for this study were mostly compiled from Moody's Industrial Manual, and Moody's Transportation Manual in the case of Braniff. When unavailable in Moody's, the required information was obtained from the annual reports of individual subsidiaries and priviledged company files.

should be directly included in the portfolio analysis. This treatment would have required separate computation of the critical portfolio inputs for units purchased or sold by LTV and its subsidiaries during the period covered in this study. Unfortunately, such a direct and comprehensive approach could not be adopted because continuous and parallel time series covering the full ten years were impossible to obtain. The difficulty arose from the high level of aggregation in financial reporting practiced both before and subsequent to acquisitions by selling and buying parties. For example, if an acquisition were made in 1966 for which there were no prior financial statements, observing the co-movement of the acquired company's operating profit in relation to existing subsidiaries and prospective acquisitions was not possible. The same problem was faced with regard to dispositions made by LTV subsidiaries in which the records of units relinquished were subsequently consolidated into those of the new parent. However, if not separately treated, all units of LTV and its subsidiaries were indirectly included in the portfolio analysis because the time series were compiled from the consolidated financial statements of individual subsidiaries. The preparation of consolidated statements at the subsidiary level would support the position taken in this study, that is, each of these companies is a portfolio consisting of second level subsidiaries. For example, Wilson & Co. is a parent holding company of four Wilson subsidiaries. LTV in turn acts as parent to Wilson & Co. In a sense, therefore, LTV is a portfolio of portfolios in this study.

In consideration of the above problems, LTV was treated as a portfolio consisting of the operating divisions of the parent, as one unit,

and seven autonomous subsidiaries: LTV Aerospace Corporation, LTV Electrosystems, Inc., LTV Ling Altec, Inc., The Okonite Company, Wilson & Co., Inc., Braniff International, and Jones & Laughlin Steel Corporation. After reducing LTV to eight manageable subsets on the basis of availability of data, each unit was separately examined to determine whether adjustment of time series was necessary. In certain cases, adjustment of financial variables was unavoidable due to the frequent redeployments after 1965.

As discussed under the historical background of the LTV Corporation, LTV Aerospace, LTV Electrosystems, and LTV Ling Altec were organized in 1964 as a result of Project Redeployment. Since these subsidiaries did not exist as separate entities before the reorganization, their individual financial statements were publicly unavailable for 1962 and 1963. On the basis of divisions transferred to the three subsidiary companies pursuant to Project Redeployment, estimates of the required financial variables were extracted from company files. Until 1968, the LTV Corporation did not follow the practice of separate financial disclosure with regard to the operating divisions of the parent company. For the period 1962-1967, unconsolidated financial statements pertaining to the operating divisions of the parent company were compiled from priviledged company documents.

Before the Okonite was acquired in 1966, the company had been a subsidiary of Kennecott Copper with its financial history during the preceding four years submerged in the consolidated statements of the parent company. For the period 1962-65, estimates of operating profit were obtained from LTV files. But these estimates were not accompanied by related balance sheet figures. To complete the partial reporting of assets for ten years, the average annual growth rate of assets during six years (1966-1971) was assumed to hold for the preceding four years. On that premise,

the value of assets at the end of each year between 1962 and 1965 was determined by discounting the balance of assets at the end of 1966 at the estimated annual growth rate. The same approach was used in generating equity figures. However, the extent of realism in obtaining equity figures was of minimal consequence because the participation level of the Okonite in the LTV portfolio of subsidiaries before the acquisition was zero.

As reported earlier, the acquisition of Wilson was followed by the organization of three Wilson subsidiaries in 1967. In 1969, four additional Wilson subsidiaries were incorporated. These developments were recognized in compiling time series for one representative company of Wilson subsidiaires. For the period 1967-1971, EBIT, equity, and assets of Wilson & Co., Wilson Sporting Goods, and Wilson Chemical and Pharmaceutical Corporation were aggregated to make these figures comparable to those of the preceding five years.[16]

The organization of Jones & Laughlin Industries as a parent holding company of Jones & Laughlin Steel Corporation did not require adjustment of financial data because the former did not control separate operating divisions. Braniff International was not redeployed after acquisition. The data for this subsidiary was directly taken from Moody's Transportation Manual without requiring any change. Having compiled adjusted yearly time series covering ten years and encompassing four financial variables and eight subsidiaries, the stage was set for performing subsidiary

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[16]Since Wilson & Co. was a parent holding company of the remaining Wilson subsidiaries, the financial records of these units were included in the consolidated statements of the parent Wilson.

analysis.[17]

Analysis of Subsidiaries

The portfolio technique of the original Markowitz type requires security analysis to be performed as a preliminary step towards ex-ante portfolio analysis. As discussed in Chapter II, the task of security analysis consists of making predictions about expected returns and variances of returns for individual securities, in addition to determining covariances among security returns. The three parameters make up the statistical information necessary for portfolio analysis. Correspondingly, an ex-post portfolio analysis of LTV was preceded by the analysis of its individual subsidiaries to determine their respective attributes in terms of average operating returns, variance of operating returns, and covariances among operating returns. In ex-post portfolio analysis, a method of evaluating diversification performance, risk and return achieved by the portfolio provide sufficient information for rating performance because covariances among the elements are implicitly reflected. The reasons for explicitly considering interrelationships in retrospective portfolio analysis are explained later in conjunction with the computation of covariances.

The first step in preparation for subsidiary analysis was to determine the yearly rate of operating return on assets:

$$r_{i,t} = \frac{2E_{i,t}}{A_{i,t-1}+A_{i,t}} \qquad (4\text{-}1)$$

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[17]These time series are reported in Appendices A-D.

where

$$i = 1, 2, \ldots, 8$$

$$t = 1, 2, \ldots, 10$$

As shown in Equation (4-1), this step was accomplished by expressing EBIT ($E_{i,t}$) during a year as a percent of the average of beginning and ending asset balances ($(A_{i,t-1}+A_{i,t})/2$) during the same period. The averaging of the two asset balances was required by possibilities of contributions and withdrawals of assets during the interim period. The annual rate of operating return ($r_{i,t}$) was computed for individual subsidiaries over ten years.

The next step consisted of calculating the average yearly rate of operating return on assets.

$$\bar{r}_i = \frac{1}{T} \sum_{t=1}^{T=10} r_{i,t} \qquad (4\text{-}2)$$

The average yearly rate of operating return ($\bar{r}_i$) was computed by taking the arithmetic mean of ten annual observations. Eight arithmetic means were generated for the eight units which made up the LTV portfolio of subsidiaries. Each subsidiary's annual rate of operating return and the mean rate of operating return over ten years are shown in Table 4-1.

The risk surrogate used in this study was the intertemporal variability of operating return. Accordingly, the variance of each subsidiary's operating return was computed in a manner shown in Equation (4-3).[18]

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[18]In this paper, the variance was preferred to the standard deviation as a risk surrogate of a subsidiary's operating return because the portfolio phase of the analysis could be simplified by regarding the

TABLE 4-1

ANNUAL AND MEAN RATE OF OPERATING RETURN[a]

BY SUBSIDIARY,[b] 1962-1971

	LTA	LTE	LTP	LTL	LTO	LTW	LTB	LTJ
1962	0.14926	0.19768	0.15698	0.10520	0.03304	0.11282	0.05869	0.05610
1963	0.13250	0.20104	0.01928	0.23326	-0.00119	0.11029	0.04303	0.10359
1964	0.19362	0.22154	0.11936	0.12637	0.06704	0.17007	0.12443	0.11607
1965	0.14715	0.16169	-0.00682	0.09630	0.13860	0.10762	0.13178	0.09694
1966	0.14516	0.12232	0.00397	0.10704	0.31697	0.14829	0.12053	0.11449
1967	0.13673	0.14398	0.05614	0.11880	0.18757	0.13389	0.04960	0.03599
1968	0.13212	0.09604	0.00310	0.10189	0.10957	0.14970	0.07157	0.04100
1969	0.10950	-0.01891	0.01202	0.04173	0.00251	0.12194	0.05649	0.03261
1970	0.08118	0.09733	0.01680	0.02816	0.05573	0.14483	0.04467	0.00392
1971	0.03944	0.07676	0.02354	0.07584	0.00000	0.13253	0.06781	0.03336
MEAN	0.12667	0.12995	0.04044	0.10346	0.09099	0.13320	0.07686	0.06341

[a]The figures in the table were computed from Appendices A and B.

[b]The column initials stand for LTA = LTV Aerospace Corporation; LTE = LTV Electrosystems, Inc.; LTP = Operating divisions of parent company; LTL = LTV Ling Altec, Inc.; LTO = The Okonite Company; LTW = Wilson & Co., Inc.; LTB = Braniff International; LTJ = Jones & Laughlin Steel Corporation.

variance of a subsidiary's return as the covariance between the same subsidiary's return--which in fact is true:

$$\tilde{\sigma}_i^2 = \frac{1}{T} \sum_{t=1}^{T} (r_{i,t} - \bar{r}_i)^2$$

$$\tilde{\sigma}_{i,j} = \frac{1}{T} \sum_{t=1}^{T} (r_{i,t} - \bar{r}_i)(r_{j,t} - \bar{r}_j)$$

If i=j, then, $\tilde{\sigma}_i^2 = \tilde{\sigma}_{ij}^2$.

$$\sigma_i^2 = \frac{1}{T} \sum_{t=1}^{T=10} (r_{i,t} - \bar{r}_i)^2 \qquad (4\text{-}3)$$

As a last step of subsidiary analysis, covariances among the operating returns of the eight companies were computed to determine the co-movement of each paired combinations of subsidiaries composing the LTV portfolio. Before specifying the computation of covariances, the explicit role of interrelationships in ex post portfolio analysis, and in this study in particular, must be noted. Ordinarily, an evaluation of portfolio performance is based on risk and return achieved by the portfolio in question. Interrelationships or covariances among the elements of the portfolio are implicitly reflected in the two parameters of the portfolio over time. The implicitness of covariances among the elements of a portfolio are evident in the three widely known approaches for measuring ex-post portfolio performance: Shapre's Variability, Treynor's Volatility, and Jenesen's Predictability, all of which rank investment portfolios on the basis of risk and return.[19] The explicit consideration of covariances is pertinent in ex ante portfolio analysis where interrelationships among the elements of the portfolio are crucial to the selection and subsequent performance of the portfolio.

Portfolio analysis in the context of this study is retrospective. An explicit consideration of covariances among the operating returns of LTV subsidiaries would not have been necessary if the aim of this study

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[19]For a comparative study of the three approaches, refer to Smith and Trito, "Risk-Return Measures of Ex Post Portfolio Performance," 449-471.

were not to simultaneously compare the pattern of stability in LTV's operating return and its effect on financial leverage on a yearly basis. The dynamic nature of the study, although ex post, both in terms of portfolio analysis and leverage analysis, prompted the direct inclusion of subsidiary covariances. Therefore, covariances (σ_{ij}) among the eight subsidiaries which comprised LTV portfolio were computed, as shown in the following equation:

$$\sigma_{ij} = \frac{1}{T} \sum_{t=1}^{T=10} (r_{i,t} - \bar{r}_i)(r_{j,t} - \bar{r}_j) \qquad (4\text{-}4)$$

The variance-covariance matrix of the eight LTV subsidiaries is shown in Table 4-2. After performing subsidiary analysis, as indicated in Equations (2-1) through (2-4) and Tables 1 and 2, in which the attributes of subsidiaries were measured in terms of average returns, variances of returns, and covariances among returns, the next major step consisted of a portfolio analysis of these subsidiaries.

Ex Post Portfolio Analysis

The purpose of portfolio analysis in an ex ante sense is to identify the efficient sets from which an optimal portfolio is selected. In the process, optimal proportions of investment in each decision variable are obtained as a solution. Portfolio analysis in the context of this study is not intended to identify an optimal portfolio of subsidiaries, nor show optimal proportions according to which the LTV Corporation should have invested in its subsidiaries. Since this investigation is concerned with portfolio analysis in an ex post sense, the relative magnitudes of

TABLE 4-2

VARIANCE-COVARIANCE MATRIX OF SUBSIDIARY OPERATING RETURNS,[a] 1962-1971

	LTA	LTE	LTP	LTL	LTO	LTW	LTB	LTJ
LTA	0.00159	0.00172	0.00091	0.00093	0.00138	0.00015	0.00068	0.00107
LTE	0.00172	0.00465	0.00198	0.00246	0.00070	0.00002	0.00065	0.00164
LTP	0.00091	0.00198	0.00271	0.00038	-0.00115	0.00011	-0.00006	0.00022
LTL	0.00093	0.00246	0.00038	0.00279	-0.00001	-0.00021	-0.00000	-0.00132
LTO	0.00138	0.00070	-0.00115	-0.00001	0.00928	0.00056	0.00165	0.00131
LTW	0.00015	0.00002	0.00011	-0.00021	0.00056	0.00037	0.00019	0.00004
LTB	0.00068	0.00065	-0.00006	-0.00000	0.00165	0.00019	0.00110	0.00090
LTJ	0.00107	0.00164	0.00022	0.00132	0.00131	0.00004	0.00090	0.00148

[a]The figures in the table were computed on the basis of Appendices A and B.

each subsidiary in the parent company portfolio were given.

The preliminary task in this section consisted of transforming the investments of the parent in each of its subsidiaries to a form suitable, as weighting factors, for portfolio analysis. This task was accomplished in three distinct steps. First, the annual book value of LTV equity in each subsidiary ($c_{i,t}$) was computed by multiplying yearly total equity of each subsidiary ($S_{i,t}$) and the corresponding fraction of controlling interest ($w_{i,t}$) held by the parent company:

$$c_{i,t} = w_{i,t} S_{i,t} \qquad (4-5)$$

The following table presents the book value of equity held by LTV in individual subsidiaries at the end of each of the ten years. The zero values between 1962 and 1967 corresponding to the Okonite, Wilson, Braniff, and Jones & Laughlin show that these subsidiaries had not been acquired and, therefore, were not part of the conglomerate portfolio. Similarly, the zero values in 1971 relating to the Okonite and Braniff show the divestiture of the two subsidiaries which resulted from the antitrust ruling cited earlier. Second, the book values of LTV equity in each subsidiary were then aggregated to provide a basis for conversion to percentages:

$$C_t = \sum_{i=1}^{n=8} c_{i,t} \qquad (4\text{-}6)$$

As a final step, the equities of the parent in each subsidiary were converted to relative values ($X_{i,t}$) by expressing them as percentages of the aggregate parent company equities in all the subsidiaries:

$$X_{i,t} = \frac{c_{i,t}}{C_t} \qquad (4\text{-}6)$$

Obviously, the sum of these fractions adds to unity:

$$\sum_{i=1}^{N=8} X_{i,t} = 1 \qquad (4\text{-}7)$$

The last column of Table 4.4 satisfies this constraint. Due to the multi-period approach of portfolio analysis in this study, to be specified shortly, a total of 80 participation levels were computed as shown in

TABLE 4-3

LTV EQUITY[a] IN EACH SUBSIDIARY, 1962-1971

(In Thousands of Dollars)

	LTA	LTE	LTP	LTL	LTO	LTW	LTB	LTJ	TOTAL
1962	66089.0	7955.0	21381.0	6659.0	0.0	0.0	0.0	0.0	102084.0
1963	31513.0	5873.0	27616.0	6083.0	0.0	0.0	0.0	0.0	71085.0
1964	6047.0	1984.0	25468.0	3301.0	0.0	0.0	0.0	0.0	36800.0
1965	8687.7	3746.7	30534.0	3465.0	0.0	0.0	0.0	0.0	46433.4
1966	19309.5	9168.6	58906.0	4131.6	20485.2	0.0	0.0	0.0	112000.9
1967	28574.5	18423.1	245409.0	13219.2	29766.2	82054.1	0.0	0.0	417446.0
1968	45246.6	21378.0	288567.0	16800.2	34930.6	93690.8	55265.8	447509.8	1003388.0
1969	70514.6	17875.8	268174.0	17040.4	38654.4	112036.7	49043.7	567100.7	1140440.0
1970	76582.8	21356.9	181490.0	10496.7	47316.0	76358.4	46557.6	542506.3	1002664.0
1971	73726.0	22202.1	207851.0	8726.7	0.0	66208.8	0.0	548988.8	927703.3

[a]The figures in the table were computed from Appendices C and D.

TABLE 4-4

PROPORTION[a] OF LTV INVESTMENT IN EACH SUBSIDIARY, 1962-1971

	LTA	LTE	LTP	LTL	LTO	LTW	LTB	LTJ	TOTAL
1962	0.64740	0.07793	0.20945	0.06523	0.00000	0.00000	0.00000	0.00000	1.00000
1963	0.44331	0.08262	0.38849	0.08557	0.00000	0.00000	0.00000	0.00000	1.00000
1964	0.16432	0.05391	0.69207	0.08970	0.00000	0.00000	0.00000	0.00000	1.00000
1965	0.18710	0.08069	0.65759	0.07462	0.00000	0.00000	0.00000	0.00000	1.00000
1966	0.17240	0.08186	0.52594	0.03689	0.18290	0.00000	0.00000	0.00000	1.00000
1967	0.06845	0.04413	0.58788	0.03167	0.07131	0.19656	0.00000	0.00000	1.00000
1968	0.04509	0.02131	0.28759	0.01674	0.03481	0.09337	0.05508	0.44600	1.00000
1969	0.06183	0.01567	0.23515	0.01494	0.03389	0.09824	0.04300	0.49726	1.00000
1970	0.07638	0.02130	0.18101	0.01047	0.04719	0.07616	0.04643	0.54106	1.00000
1971	0.07947	0.02393	0.22405	0.00941	0.00000	0.07137	0.00000	0.59177	1.00000

[a]Computed on the basis of Appendices C and D.

Table 4-4. These included 8 subsidiaries over ten years on yearly basis. The Okonite, Braniff, Wilson, and Jones & Laughlin Steel were acquired at different times after 1965. The first two were sold in 1970. Before acquisition and after disposition, these subsidiaries were assigned participation levels of zero in the LTV portfolio. Before undertaking an intense diversification program in 1966, more than seventy five percent of LTV portfolio was invested in the operating divisions of the parent company and LTV Aerospace. After 1967, Wilson and Jones & Laughlin Steel made up nearly sixty percent of their parent company's portfolio.

After generating the four sets of parameters consisting of average operating returns, variances of operating returns, covariances among operating returns, and subsidiary participation levels, the variability of the parent company's operating return was measured on a yearly basis over ten years by using a model of portfolio revision in an ex post sense. Before specifying the computation of portfolio variance, important differences between portfolio analysis and portfolio revision require some clarification. Portfolio analysis is a static optimization technique based on single-period expectations. But expectations are seldom stable. As history unfolds, predictions made earlier about decision variables such as securities become obsolete in the light of new developments, and the existing portfolio is rendered suboptimal. As part of an ongoing search for optimality, expectations require periodic review, and portfolios frequent adjustment. Thus, portfolio revision is an inter-temporal approach to portfolio selection.[20]

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[20]The most outstanding distinction between portfolio selection

In addition to change in economic expectations as the cause of portfolio revision, multi-period portfolio decision can also be described in terms of its effect on the composition and structure of portfolios. As decision variables like securities and subsidiaries leave and enter the portfolio, in part or as a whole, the effect is reflected in changes in participation levels. For example, the divestiture of the Okonite and Braniff in 1971 reduced the participation level of the two companies to zero, in addition to altering the relative weight of the remaining subsidiaries in the parent company portfolio. Portfolio revision from the view point of its effect on the structure of the portfolio was especially useful in the context of this study in which revision was taken in the after-the-fact sense. In that respect, the ex post portfolio revision framework was employed as a sequential application of the one-period portfolio model. This allowed the model for portfolio standard deviation to be used for determining the variability of the parent company's operating return, as shown in the following equation:

$$\tilde{\sigma}(R_{p,t}) = \left[\sum_{i=1}^{n=8} \sum_{j=1}^{n=8} X_{i,t} X_{j,t} \tilde{\sigma}_{i,j} \right]^{\frac{1}{2}} \qquad (4\text{-}8)$$

where

$\tilde{\sigma}(R_{p,t})$ = conglomerate portfolio standard deviation at the end of

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and portfolio revision lies in the static nature of the former and the dynamic nature of the latter. Because portfolio revision is multi-period compared to single-period portfolio selection, Smith considers portfolio selection as a subset of the more general portfolio revision model. For more detail, see K. V. Smith, Portfolio Management: Theoretical and Empirical Studies of Portfolio Decision Making (New York: Holt, Rinehart and Winston, Inc., 1971), 199-231.

period t.

$X_{i,t}$; $X_{j,t}$ = participation levels of the i^{th} and j^{th} subsidiaries at the end of period t.

$\tilde{\sigma}_{ij}$ = covariances between subsidiaries i and j.

Parameters for participation levels ($X_{i,t}$;$X_{j,t}$) and variance-covariance ($\tilde{\sigma}_{ij}$) are based on Tables 4-4 and 4-2, respectively. The time subscript (t) in Equation (4-8) denotes the changing structure in the composition of subsidiaries over time and the corresponding effect on portfolio dispersion at the end of each period over ten years. The diversification performance of the LTV Corporation was computed annually over ten years in terms of the variability of operating returns.[21] Table 4-5 shows the variability of the parent company's operating return and was generated by employing Equation (4-8). Changes in the variability of operating return, designated as portfolio effect, reflect the influence of diversification on the stability of operating return. The portfolio effect was obtained by finding differences between consecutive levels of the standard deviation of operating returns. Noteworthy are the negative signs of the portfolio effect between 1965 and 1968. The steady decline in the variability of operating return during four years coincides with the period of diversified major acquisitions such as the Okonite, Wilson, Braniff, and Jones & Laughlin Steel. The moderate rise in the standard deviation of portfolio

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[21] In the context of this study, diversification performance refers to the operating risk dimension of joint LTV subsidiaries as measured by portfolio variance. In its usual sense, diversification performance means a trade-off between risk and return achieved by portfolios such as mutual funds. The common approaches for rating portfolio performance are according to the dominance principle, comparison with some market index, and in relation to randomly selected portfolios. Ibid., 235-261.

TABLE 4-5

PORTFOLIO EFFECT OF CONGLOMERATE DIVERSIFICATION

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Variability of Operating Return	0.03775	0.03837	0.04315	0.04305	0.03816	0.03456	0.02904	0.02911	0.03038	0.03102
Portfolio Effect[d]		0.00062	0.00478	-0.00175	-0.00324	-0.00359	-0.00552	0.00007	0.00127	0.00064

[d]Differences between consecutive levels of portfolio standard deviation.

operating returns may be attributed to the divestiture of Wilson Sporting Goods, Wilson Pharmaceutical & Chemical, the Okonite, and Braniff. Increases in the variability of operating return during the first three years correspond to the period heavy reliance on the defense industry and other government contracts which was the primary reason for seeking diversification into the commercial sector.

Leverage Implication of Portfolio Effect

After completing the sequences of subsidiary analysis and portfolio analysis, which were essential steps for generating the independent variable, effort was focused on the primary task of this paper: examining the effect of conglomerate diversification on capital structure. Thus, the final phase of the empirical analysis involved assessing the leverage implication of the portfolio effect. To determine whether the hypothesized inverse relationship between portfolio standard deviation and some measure of financial leverage was empirically valid, regression analysis was performed. Data used in the regression analysis are shown in Table 4-6.

In Table 4-6, alternative measures of financial leverage are presented. The use of these multiple standards merits some clarification. As pointed out in earlier discussions, the concept of financial leverage stems from the use of fixed charge securities and common stock in the capitalization of a company. Whereas this broad classification of capital sources underlies the capital structure problem in general, there appears to be no general consensus regarding a specific measure of financial leverage.[22] Standards of financial leverage have been defined in terms

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[22]Ghandi, "On the Measurement of Leverage," 715-721.

TABLE 4-6

VALUES[a] OF DEPENDENT AND INDEPENDENT VARIABLES

USED IN REGRESSION ANALYSIS

Year	$\delta(R_p)$	L_1=TD/TE	L_2=TD/TA	L_3=LD/TA	L_4=I/EBIT
1962	0.03775	3.00000	0.82034	0.39099	0.39189
1963	0.03837	1.30000	0.73314	0.24556	0.20530
1964	0.04315	9.60000	0.74488	0.29134	0.37398
1965	0.04305	5.00000	0.81670	0.19911	0.24675
1966	0.03816	3.70000	0.74430	0.32105	0.15278
1967	0.03456	1.50000	0.64620	0.23973	0.18870
1968	0.02904	10.00000	0.77872	0.46700	0.58813
1969	0.02911	7.00000	0.79316	0.50973	1.01702
1970	0.03038	11.40000	0.80702	0.54104	1.42667
1971	0.03102	6.90000	0.76666	0.50548	0.98972

[a]Calculation of leverage ratios is based on data in Appendix E. The notations represent L_i = different leverage ratios, TA = total assets, TD = total debt, TE = total equity, LD = long-term debt, I = interest, EBIT = earning before interest and taxes, and $\delta(Rp)$ = standard deviation of portfolio operating return.

of the structure of the balance sheet and the income statement--stock vs. flow measures. The exclusion of short-term debt from some leverage ratios has resulted in a subtle distinction between capital structure and financial structure.[23] The former refers to the composition and relative mag-

[23]J. Fred Weston and Eugene F. Brigham, Managerial Finance (New York: Holt Rinehart and Winston, 1972), 249.

nitude of long-term capital. Further diversity has been added due to procedures of valuation--book value vs. market value.

In this study alternative measures of leverage were used to observe whether or not the various formulations would have differential effects upon the degree of association between operating risk and financial leverage. The four leverage ratios employed in the present analysis consist of total debt-to-total equity, total debt-to-total assets, long-term debt-to-total assets, and interest-to-earnings before interest and taxes. The first two measures and the third refer to a distinction between financial structure and capital structure, respectively. The last ratio is a flow measure of leverage and is similar to the leverage standard used by Wippern.[24]

The four leverage ratios were computed at the end of each year over the period 1962-1971 on the basis of information obtained from the consolidated balance sheets and income statements of the parent company. The scatter diagrams shown in Figures 4-2 - 4-5 were examined prior to specifying the form of functional relationship between the variability of operating return and financial leverage. Inspection of the scatters indicated that a linear model would be appropriate for explaining an interdependence of the bivariate sample. Simple regression analysis was performed by treating the standard deviation of portfolio operating return as the independent variable, and the different measures of financial leverage as the dependent variable:

$$L_i = a_i + b_i \sigma(R_p) \qquad (4\text{-}9)$$

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[24] Wippern, "Financial Structure and the Value of the Firm," 616-619.

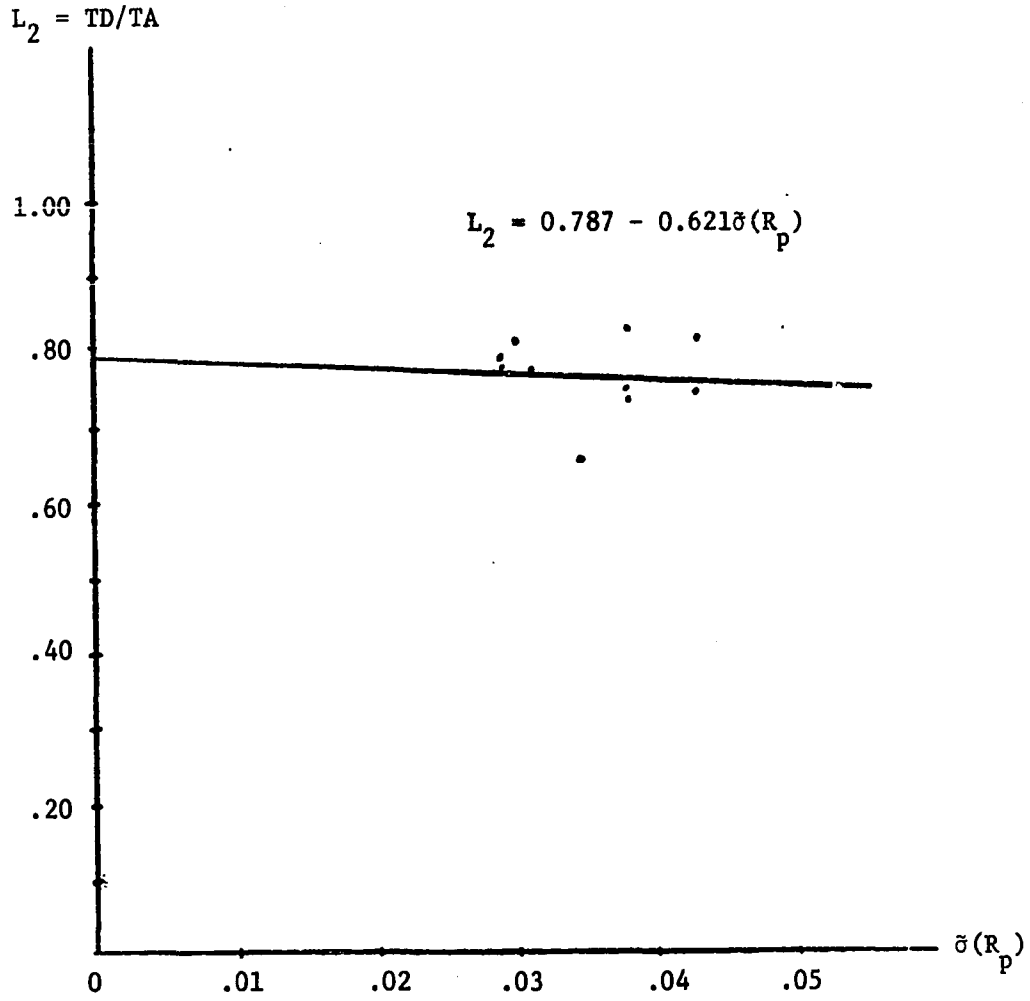

FIGURE 4-2. Inverse Relationship between Variability of Operating Return and Financial Leverage (Total Debt-To-Total Assets)

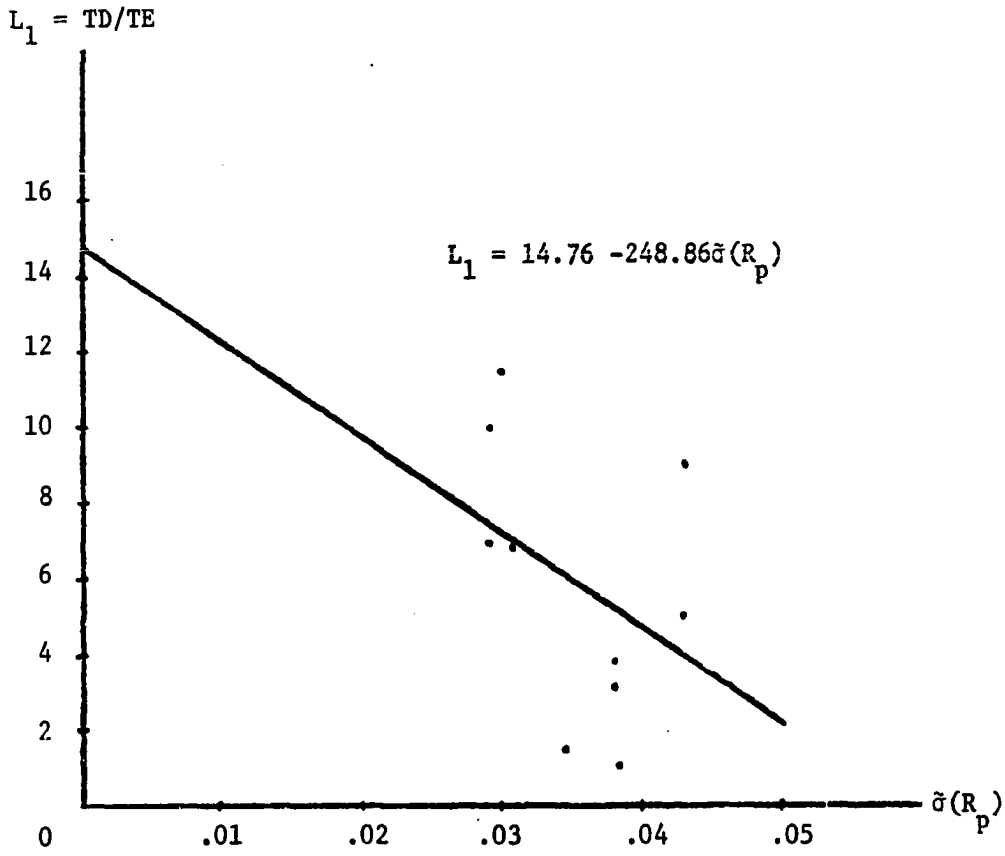

FIGURE 4-3. Inverse Relationship between Variability of Operating Return and Financial Leverage (Total Debt-To-Total Equity)

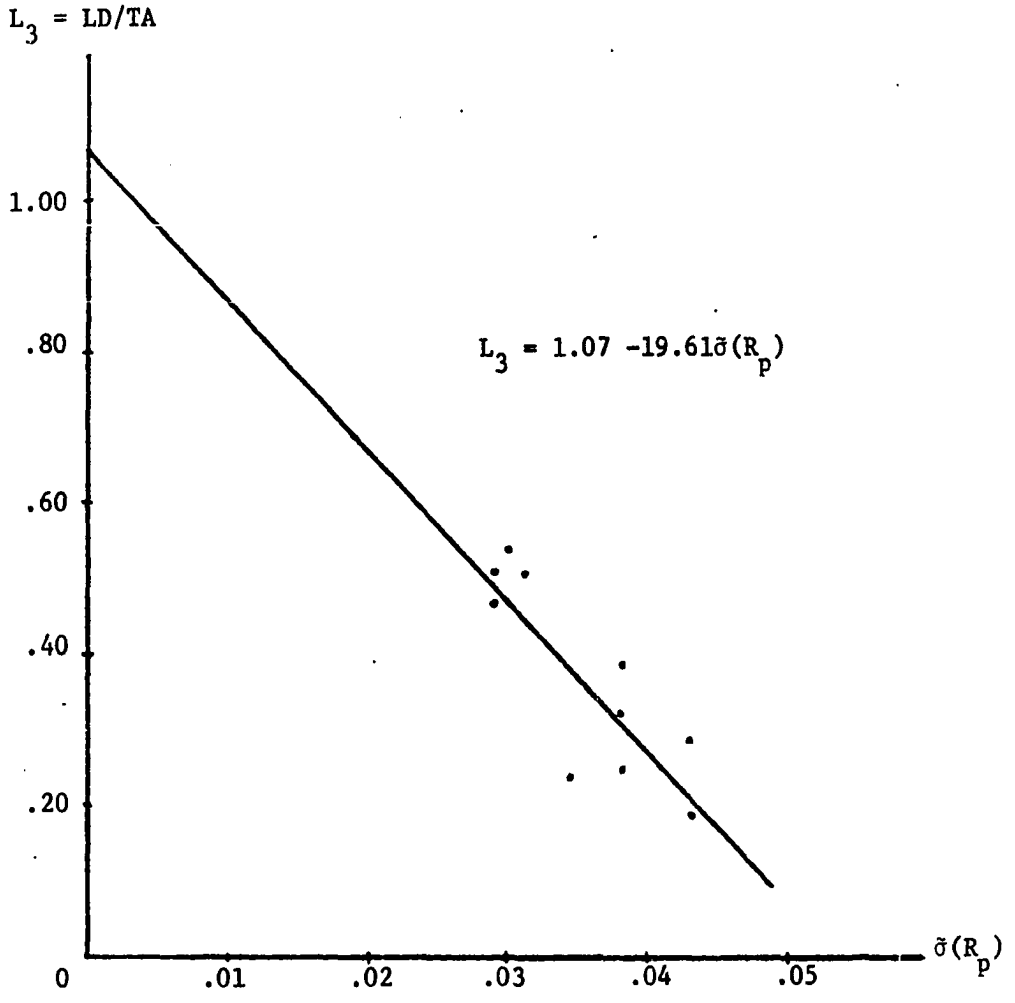

FIGURE 4-4. Inverse Relationship between Variability of Operating Return and Financial Leverage (Long-Term Debt-To-Total Assets)

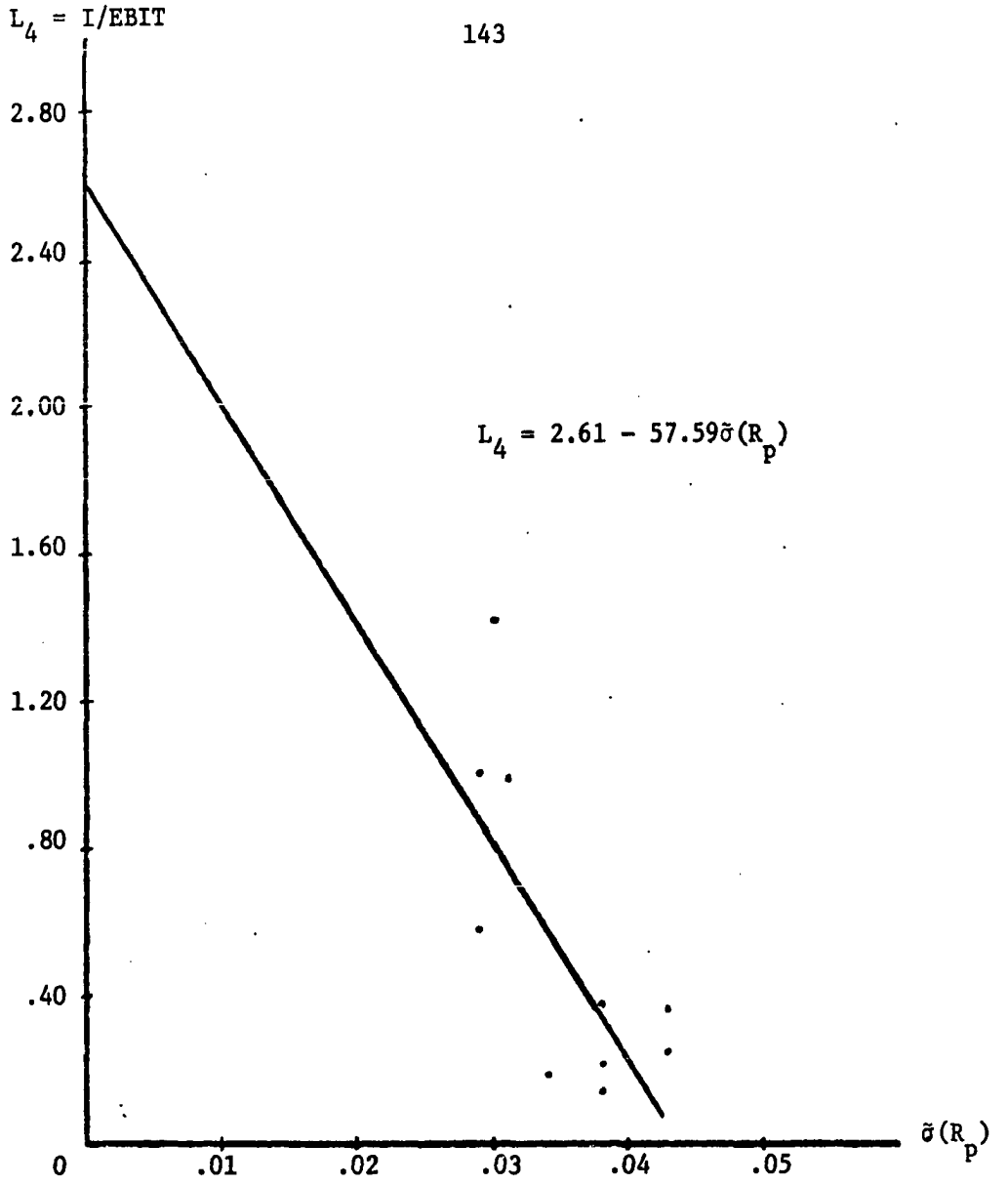

FIGURE 4-5. Inverse Relationship between Variability of Operating Return and Financial Leverage (Interest-To-Earnings before Interest and Taxes)

where

L_i = a measure of leverage ratio

a_i = an intercept of regression equation

b_i = a regression coefficient

$\sigma(R_p)$ = standard deviation of portfolio operating return

i = i . . 4, denoting different leverage ratios

The four leverage ratios were individually regressed on the standard deviation of portfolio operating return. Since financial leverage was measured four different ways, a total of four regression equations were derived. The coefficients of these equations were estimated by the method of least squares, the results of which are reported in the following table.

TABLE 4-7

RESULTS[a] OF REGRESSION ANALYSIS

Parameters \ Leverage ratios	L_1=TD/TE	L_2=TD/TA	L_3=LD/TA	L_4=I/EBIT
Leverage Intercept (a_i)	14.76	0.79	1.07	2.61
Regression Coefficient (b_i)	-248.75	-0.62	-19.62	-57.77
Standard Error of Estimate (e_i)	3.55	0.05	0.07	0.31
Correlation Coefficient (p_i)	-0.37	-0.07	-0.83	-0.72
Standard Error Regression Coefficient ($\sigma(b_i)$)	218.11	3.38	4.60	19.93
t value	(-1.14)[d]	(-0.18)[e]	(-4.27)[b]	(-2.90)[c]

[a]All figures are rounded to two decimal places; [b]significant at the .005 level; [c]significant at the .01 level; [d]significant at the .15 level; [e]not significant.

The statistical summary in the table consists of intercepts of the independent variable (a_i), regression coefficients (b_i), standard errors of estimates (e_i), correlation coefficients (ρ_i), standard errors of regression coefficients ($\sigma(b_i)$), and t values. As noted by appropriate column captions, the five sets of parameters correspond to different leverage ratios.

According to an aspect of the theory of capital structure, greater variability in operating returns is associated with lower debt capacity. The leverage implication of the portfolio effect for diversified firms is a special case of the inverse relationship between operating risk and financial leverage. Hence, the slopes of the regression equations describing an interdependence between the two variables were predicted to negative. As reported in Table 4-7, the signs of these regression coefficients attest to the position taken in this study that the standard deviation of portfolio operating return and financial leverage are inversely related. However, these negative signs do not reveal more than merely describing a simultaneous but opposite movement in direction between the bivariate sample.

As a preliminary step towards examining the degree of relationship between the variability of operating return and financial leverage, the standard error of estimate was computed. The smaller the value of this statistic, the greater the degree of relationship between two variables. In the limiting case, when two variables are perfectly correlated, the standard error of estimate assumes a value of zero. In addition to the degree of interdependence between two variables, the magnitude of the standard error of estimate is influenced by the unit of measurement used.

For example, although debt-to-equity is more correlated with the standard deviation of portfolio operating returns than the ratio of total debt-to-total assets, the standard error of estimate related to the former measure of leverage is larger than that of the latter.

To eliminate the influence of differences in leverage standards, further evaluation of the regression analysis was required by computing the coefficient of correlation. This statistic has the merit of independence of measurement units. Correlation coefficients identified with two leverage ratios (long-term debt-to-total assets and interest-to-earnings before interest and taxes) showed a high degree of relationship between the standard deviation of portfolio operating returns and financial leverage. Total debt-to-total equity was found to be moderately correlated with portfolio standard deviation. Although the sign of the regression coefficient corresponding to the ratio of total debt-to-total assets was negative, the related correlation coefficient was barely different from zero.

As a final step, the levels of significance of the four correlation coefficients were measured by performing the t test. Whereas the coefficient of correlation and the t value are directly related, the latter is used for stating the level of significance of the former. The task of performing the t test was preceded by computation of standard errors of regression coefficients because the t value is a ratio of the regression coefficient divided by the standard error of regression coefficient.[25] The degree of association between the independent variable and

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[25]This is one of the several approaches for determining the t value. For a different approach refer to Ya-lun Chou, Probability and Statistics for Decision Making (New York: Holt, Rinehart and Winston, 1972), 471.

the ratio of total debt and total assets was found to be not significantly different from zero. The correlation coefficient in which the dependent variable was measured by total debt-to-total equity was moderately significant at the 0.15 level. In the remaining two cases, the extent of relationship between the variability of operating return and financial leverage was significant. Correlation coefficients identified with long-term debt-to-total assets and interest-to-earnings before interest and taxes were significant at the 0.005 level and the 0.01 level, respectively.

CHAPTER V

SUMMARY AND CONCLUSION

The objective of this dissertation is to examine, theoretically and empirically, the leverage implication of the portfolio effect for diversified firms. As a main thesis, corporate diversification is predicted to induce increased debt capacity of conglomerate firms. To pursue this line of inquiry, in addition to the introductory and concluding chapters, the study is divided into three main parts: theoretical framework, review of selected empirical studies on conglomerate mergers and capital structure, and empirical analysis regarding the leverage effects of corporate diversification.

Chapter II is concerned with a theoretical and comprehensive discussion of multiple issues related to the stated hypothesis. The financial advantage of conglomerate mergers, in terms of augmented leverage capacity, is predicated on the theoretical and empirical merit of the net income hypothesis. Similarly, a general inverse relationship between operating risk and financial leverage, advanced by the traditional view of corporate finance, is the basis for predicting the effect of diversification on the capital structure of multi-industry firms. Having underscored these premises, an explanation of the dynamics of corporate diversification and capital structure followed. Sustained acquisitions from diverse industries enables a conglomerate firm to achieve progressive measures of stability

in operating return. The resulting portfolio effect or, what is the same, decline in the variability of operating returns, in turn induces the use of more leverage in the financing mix.

Other empirical studies concerning conglomerate performance have, either relied on a naive view of diversification, or have diligently avoided the complexity of conglomerate portfolio analysis at the operating level. The latter group consists of those studies that classify samples of common stocks by type (conglomerate firms, mutual funds, undiversified companies) and compare the risk-return performance of conglomerate securities with those of other groups and the market index.[1] To the former group belong those studies that measure corporate diversification by a linear summation of industries in which a conglomerate firm held subsidiaries.[2] Such a simplistic approach to diversification is criticized on the following grounds. First, the operating risk characteristics of individual subsidiaries are not defined. Second, identical participation levels are implied for each subsidiary composing the parent company. Third, the movement of each subsidiary's operating return is not specified in relation to those of other subsidiaries. Fourth, variance of subsidiary operating returns, covariances among subsidiary operating returns, and the relative weight of each subsidiary are not explicitly treated as a whole in measuring the operating risk of the parent company.

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[1]Smith and Schreiner, "A Portfolio Analysis of Conglomerate Diversification," 423-27, Westerfield, "A Note on the Measurement of Conglomerate Diversification," 912-14, and Melicher and Rush, "The Performance of Conglomerate Firms: Recent Risk and Return Experience," 384-87.

[2]Weston and Mansinghka, "Tests of the Efficiency Performance of Conglomerate Firms," 921-22, and Melicher and Rush, "The Performance of Conglomerate Firms: Recent Risk and Return Experience," 382-84.

Two empirical studies, cited in Chapter III, have shown that conglomerate firms attained the highest mean growth rate of leverage ratios in relation to control samples of undiversified firms.[3] In both studies, the effect of diversification on capital structure was reflected by a simple trend analysis of leverage ratios. Consequently, the treatment of diversification was both naive and implicit. The distinguishing feature of the present study is the application of the portfolio model for measuring the operating risk of a conglomerate firm. Although the scope of the empirical investigation is limited to a sample of one conglomerate firm, the analysis consisted of three principal and successive steps: analysis of subsidiaries, conglomerate portfolio analysis, and regression analysis. As a preliminary step, parameters of individual subsidiaries are computed in terms of variance of operating returns, covariances among operating returns, and participation levels for eight subsidiaries of the LTV Corporation. A model of portfolio standard deviation is employed to determine the variability of the parent company's operating return, at the end of each year during the period 1962-1971. Finally, the proposition pertaining to the leverage implication of the portfolio effect is tested by separately regressing four different standards of leverage on the parameter of portfolio operating risk. The regression coefficients are tested further for direction of change of the bivariate sample and their degree of correlation. In terms of the former, the hypothesized inverse relationship between the variability of operating return

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[3]Weston and Mansinghka, "Tests of the Efficiency Performance of Conglomerate Firms," 927, and Melicher and Rush, "The Performance of Conglomerate Firms: Recent Risk and Return Experience," 382-84.

and financial leverage is supported. With reference to the latter, the tests show mixed results. While one correlation test shows that the degree of association between operating risk and financial structure is not markedly different from zero, the remaining three correlation analyses produced degrees of interdependence between the two variables ranging from moderate to strong. In the aggregate, therefore, hypothesis of this paper is supported: diversification increases the leverage capacity of conglomerate firms. However, one swallow does not make a summer; nor does evidence derived from a case study warrant generalizations about the effect of corporate diversification on capital structure.

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APPENDIX A

EARNINGS BEFORE INTEREST AND TAXES BY SUBSIDIARY: 1962 - 1971

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
LTA	11868.	8840.	9622.	8311.	12453.	20695.	33885.	43240.	36811.	15693.
LTE	2403.	2104.	2021.	4736.	7119.	12033.	10332.	-2109.	9767.	6882.
LTP	8737.	1136.	10777.	-714.	455.	12652.	2480.	15151.	18773.	19774.
LTL	816.	1728.	1179.	1577.	2427.	5588.	9308.	4466.	2037.	3151.
LTO	573.	-24.	1780.	4858.	14665.	17666.	16424.	433.	9916.	0.
LTW	16735.	16402.	26369.	17994.	27405.	27799.	37842.	38052.	48135.	44479.
LTB	5628.	4098.	12032.	15098.	27240.	17352.	26855.	21145.	16600.	24211.
LTJ	46326.	87752.	103660.	89749.	117019.	39646.	46059.	37121.	4525.	39620.

APPENDIX B

TOTAL ASSETS BY SUBSIDIARY: 1962 - 1971

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
LTA	79513.	53917.	45473.	67490.	104085.	198628.	314323.	475478.	431380.	364377.
LTE	12156.	8775.	9470.	49113.	67284.	99865.	115292.	107754.	92941.	86363.
LTP	55657.	62191.	118393.	90907.	138322.	312404.	1288214.	1233555.	1001632.	678389.
LTL	7757.	7059.	11600.	21153.	24193.	69884.	112815.	101247.	43437.	39664.
LTO	17340.	22890.	30215.	39884.	52647.	135716.	164077.	180981.	174864.	181577.
LTW	148331.	149093.	160998.	173393.	196210.	219051.	286531.	337576.	327147.	344103.
LTB	95896.	94596.	98805.	130336.	321678.	378016.	372458.	376155.	367021.	347013.
LTJ	825794.	868402.	917767.	933869.	1110266.	1092800.	1154207.	1122629.	1188068.	1187492.

APPENDIX C

TOTAL EQUITY BY SUBSIDIARY: 1962 - 1971

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
LTA	66089.	31513.	6047.	9653.	25746.	34847.	64638.	111928.	121560.	118913.
LTE	7955.	5873.	1984.	4163.	12064.	25948.	30540.	25907.	30952.	32177.
LTP	21381.	27616.	25468.	30534.	58906.	245409.	288567.	268174.	181490.	207851.
LTL	6659.	6083.	3301.	3850.	4695.	18360.	22703.	23343.	14379.	15046.
LTO	15876.	17781.	19915.	22305.	24982.	34214.	40617.	44947.	47316.	47018.
LTW	98426.	99953.	108780.	112968.	121983.	103866.	118596.	134984.	85796.	78820.
LTB	39330.	40046.	45722.	54877.	83218.	74446.	83736.	87578.	81680.	90820.
LTJ	553129.	576876.	616256.	648839.	691062.	703884.	710333.	696684.	669761.	677764.

APPENDIX D

FRACTION OF LTV CONTROLLING INTEREST BY SUBSIDIARY: 1962 - 1971

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
LTA	100.	100.	100.	90.	75.	82.	70.	63.	63.	62.
LTE	100.	100.	100.	90.	76.	71.	70.	69.	69.	69.
LTP	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
LTL	100.	100.	100.	90.	88.	72.	74.	73.	73.	58.
LTO	0.	0.	0.	0.	82.	87.	86.	86.	100.	0.
LTW	0.	0.	0.	0.	0.	79.	79.	83.	89.	84.
LTB	0.	0.	0.	0.	0.	0.	66.	56.	57.	0.
LTJ	0.	0.	0.	0.	0.	0.	63.	81.	81.	81.

APPENDIX E

SELECTED FINANCIAL VARIABLES OF THE LTV CORPORATION: 1962 - 1971

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
DEBT-EQUITY RATIO	3.0	1.3	9.6	5.0	3.7	1.5	10.0	7.0	11.4	6.9
TOTAL ASSETS	164.2	140.9	127.0	202.4	298.4	845.1	2648.2	2944.3	2582.1	1961.5
CURRENT LIABILITIES	70.5	68.7	57.6	125.0	126.3	343.5	825.5	834.5	689.1	512.3
LONG-TERM DEBT	64.2	34.6	37.0	40.3	95.8	202.6	1236.7	1500.8	1394.7	991.5
INTEREST	5.8	3.1	4.6	3.8	5.5	17.7	67.4	122.6	128.4	96.3
EBIT	14.8	15.1	12.3	15.4	36.0	93.8	114.6	121.3	90.0	97.3