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THE EFFECT OF ACCOUNTING FOR THE COST OF INTEREST ON THE PREDICTIVE ABILITY OF FINANCIAL RATIOS

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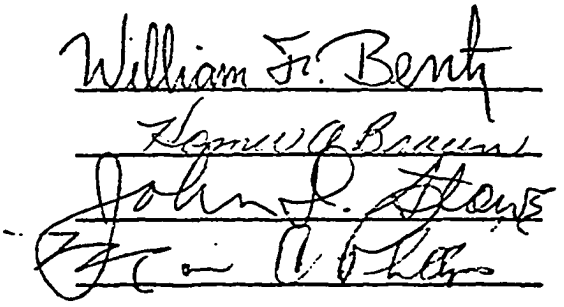

DISSERTATION COMMITTEE

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CHAPTER I

OVERVIEW

The purpose of this study is to empirically test the proposition that incorporating selected cost of capital adjustments will improve the predictive power of published financial statements. The test involves the use of a discriminant function to predict bankruptcy, using published financial statements, a portion of which have been adjusted for the cost of capital.

Hypotheses

The proposition of interest is that "incorporating the cost of capital within the accounting records and reporting the effects of such cost in the financial statements of the firm will increase the power of financial ratios in predicting firm bankruptcy."

The research hypothesis is that the relative frequency of correctly classifying both bankrupt and nonbankrupt firms is increased by incorporating cost of capital adjust-

ments in the published financial statements. The null hypothesis is that the relative frequency with which bankrupt and nonbankrupt firms are classified correctly is not increased by selected cost of capital adjustments.

Importance of the Study

Historically, there has been a great deal of interest in the problem of accounting for the cost of capital. This topic was debated actively during the last part of the nineteenth century and well into the twentieth century. In 1918, for example, the American Association of the University Instructors in Accounting (now the American Accounting Association) devoted a session to this subject during its annual meeting. During the same year the American Institute of Accountants (now the American Institute of Certified Public Accountants) established a special committee to study the subject. In 1924, Scovell devoted an entire book to the subject, Interest as Cost.[1] Moreover, The Accountant's Index lists no fewer than 240 references to this issue for the period 1920-1926.

In recent years there has been a renewed interest in the problem of accounting for the cost of capital. Evidence of this renewed interest can be found in the pronouncements of authoritative accounting bodies as well as the writings of individual scholars. Relevant pronouncements include Accounting Series Release Number 163 (June 21, 1974) by the Securities and Exchange Commission, Standard Number

414 (June 2, 1976) by the Cost Accounting Standards Board, Statement Number 4 (October 20, 1972) by the National Association of Accountants, and Internal Revenue Code Sections 163 and 266. These pronouncements deal with a variety of issues concerning the recording of interest costs or the cost of capital for various accounting purposes. These pronouncements have been necessary because, at the present time, generally accepted accounting principles are not consistent in accounting for the cost of capital.

This need has been articulated by a leading educator (Robert Anthony, 1973 and 1975)[2] and a leading professional accountant (Phillip Defliese, 1975).[3] The emphasis of both Anthony and Defliese has been on the practical problems associated with accounting for the cost of capital. The conceptual issues were discussed at length in the 1920's.

The Financial Accounting Standards Board (FASB) has decided to consider the problem of accounting for the cost of capital. A discussion memorandum was distributed in December 1977 and a public hearing was held in April 1978. To date, the Board has not taken an authoritative position on this subject.

The purpose of this study is to develop some empirical evidence about the predictive power of financial statements which have been adjusted to reflect the cost of capital. To date, relatively little empirical evidence has been developed to evaluate the consequences and usefulness

of developing financial statements which reflect cost of capital adjustments. The results of such empirical studies should provide some basis upon which accounting policy makers such as FASB could base their future decisions.

Summary of the Research Methodology

The primary steps of the empirical investigation of this study are as follows:

1. A list of forty-eight firms filed under Chapter X or Chapter XI of the National Bankruptcy Act over a period of five years from 1973 to 1977 was developed. The Wall Street Journal Index, Moody's Industrial Manual and Moody's OTC Manual were used to derive such a list.

2. A matching list of nonbankrupt firms was also derived. A pair sampling technique was used in order to make certain that for every bankrupt firm, a twin nonbankrupt firm was included. Three factors were considered for the matching procedures: (1) industrial class, (2) size of total assets, and (3) fiscal year.

3. Financial statements of bankrupt and nonbankrupt firms for five years prior to bankruptcy were located in Moody's Industrial Manual, Moody's OTC Manual, Standard and Poors Corporation Records or Compustat Tapes.

4. Thirty-five financial ratios were selected to play the role of independent variables in forming the discriminant functions. These ratios incorporate most of the financial ratios which were used by financial analysts,

textbooks and previous studies dealing with prediction of corporate bankruptcy.

5. The total cost of capital was computed. This cost consisted of: (1) the actual interest costs paid during the year; (2) preferred dividends computed according to the rates which were stated in the preferred stock certificates; (3) the cost of equity capital computed according to Standard and Poors Earnings/Price Ratio of each year included in the study; (4) the cost of other financing items such as customer deposits or deferred taxes, computed according to the weighted average of cost of debt and equity capital. The total cost of capital was accumulated in a pool of interest costs and allocated to cost of goods sold, inventories and total selling, general and administrative expense according to the ratio of the figures of these three items as reported in financial statments. Financial statements were adjusted to reflect the incorporation of the cost of capital on each statement.

6. Three predictive models were used as prediction instruments: (1) a year by year predictive model, (2) multiyear predictive model, and the (3) Altman corporate bankruptcy predictive model. Multivariate discriminant analysis, stepwise selection procedures and chi-square tests were applied as statistical techniques for this study. The "Subprogram DISCRIminant Computer Program" which was designed and programmed by James Tuccy and Willaim Klecka,

and custom made computer programs, as well as the University of Oklahoma computing facilities, were used to facilitate the computing phase of this study.

Summary of Major Findings

The major results of the predictive tests are summarized as follows:

1. The results of the year by year predictive model indicate that the overall predictive results of the conventional model are more accurate than the overall predictive results of the adjusted-for-cost-of capital model for each year included in the study for the sample of firms studied.

2. Multiyear predictive model results indicate that the conventional model produced slightly more accurate overall predictive results than the adjusted-for-cost-of capital model did when the selected ratios of two consecutive years and three immediate consecutive years prior to bankruptcy were combined. But the difference between the overall predictive results of the two models in these combinations is not statistically significant. In the remaining combinations, the conventional model gave the same overall predictive results as did the adjusted-for-cost-of capital model.

3. The comparative overall predictive results of the Altman model show that the conventional model led to more accurate overall predictive results than the adjusted-for-cost-of capital model did in the first year, the second

year and the fifth year prior to bankruptcy, while the adjusted-for-cost-of-capital model led to slightly more accurate prediction results in the third and the fourth year, prior to bankruptcy.

Conclusion

The empirical investigation of this study leads to the conclusion that the evidence which was gathered from a sample of 96 firms does not support the major hypothesis of this study. Instead, it supports the null hypothesis, which states that the probability of correct classification into bankrupt or nonbankrupt classes with financial statements including cost of capital is no different than the probability of correct classification without adjustments for the cost of capital.

In addition, evidence gathered from the study corroborates the findings of previous studies that (1) financial ratios are valid or useful as an instrument for predictions of business bankruptcy; (2) the use of more than one financial ratio to predict business bankruptcy leads to more accurate predictive results than the use of only one ratio; and (3) combining the financial ratios of more than one year lead to more accurate predictive results than using those of only one year.

CHAPTER I FOOTNOTES

[1]Clinton H. Scovell, Interest as a Cost (New York: The Ronald Press Company, 1924).

[2]Robert N. Anthony, "Accounting for the Cost of Equity," Harvard Business Review, 51 (November-December 1973), pp. 88-102; and Robert N. Anthony, Accounting for the Cost of Interest (Lexington, Massachusetts: Heath and Company, 1975).

[3]The call of Philip L. Defliese for accounting for cost of equity capital was cited by M. Leopold Schaner, "Accounting for Cost of Equity Capital," C.P.A. Journal, 45 (December 1975), p. 13.

CHAPTER II

ACCOUNTING FOR CAPITAL COSTS

The purpose of this chapter is to discuss some of the accounting as well as economic concepts relating to the treatment of "interest." This discussion serves only as a general basis for a study of the accounting treatment of "interest" or cost of capital; it is not an in-depth discussion of either accounting or economic theory. A brief review of the historical development of the subject is given, with emphasis on some of the basic points of controversy among economists, businessmen, and accountants. Specific references are made to accounting theories, such as the equity, proprietorship and entity concepts, and to implications of these concepts with respect to capital cost accounting and income measurement. In addition, the positions of major accounting authoritative bodies as well as the opinions of some accounting scholars regarding accounting for cost of capital are presented.

The Economic Perspective

Economic theory provides that production processes require production inputs or factors of production. These

factors are, mainly, raw materials, labor and capital. In order for a business enterprise to be profitable, its generated sales revenues should exceed the total cost of the factors of production. Total factor cost is the sum of wages and salaries that were paid for labor, the cost of raw materials and depreciation, as well as interest paid to capital suppliers in the form of either explicit interest for borrowed capital or imputed interest for equity capital.

The component theories of economic theory, such as production, cost and price theories, consider cost from a perspective not restricted, as is accounting theory, by a legal point of view. In economic theory, opportunity cost is the customary concept of cost.[1] For this reason economists associate the same production cost with two identical units of production if they both have the same production inputs, regardless of their source of supply. Both the cost of labor and the cost of capital provided are included in the cost of production. Bye and Hewett, for instance, in their discussion of costs of production, stated that economists include in the term "costs" certain elements not always recognized by the businessman.

> First, costs in the economic sense of that term include not only interest on borrowed savings, but also interest on investments owned by enterprisers themselves. Second, costs include a remuneration to business enterprisers for the time and energy expended in directing and managing a business. This we may call the wages of management.[2]

A common classification of costs is into explicit and

implicit costs: i.e., explicit cost is that cost which is provided by outsiders, while the imputed cost is the proportion of cost provided by owners of a business enterprise. The legal nature of a self-provided source of production does not determine whether or not such production factor is free of cost. Hibdon (1969) in listing some examples of implicit cost, including funds provided by owners, did not hide the fact that accountants ignore such cost. He stated:

> Each of these resources has an opportunity cost, although, because they are not sold to the firm, they are not listed by the accountant in the expenses of the firm as money costs. They are ignored by the accountant in his profit and loss statement because of the legal requirements. . . . Nevertheless they are resources that are used and they do have costs.[3]

Economists agree that the confusion about what is cost and what is not is mainly created by the difficulty of distinction between profit and interest on equity capital. In fact there are two schools of thought on the issue of interest and profit. One of them which is represented by Professor Frank H. Knight of the University of Chicago maintains that interest cost should not reflect risk level and should not include compensation for risk.[4] For this school risk is compensated by profit, while interest is the cost of provided funds. The other school of thought, which is represented by Professor Ezra Solomon, for instance, provides that interest cost should reflect the level of risk and should include a compensation for such level of risk.[5]

The point is that most economists consider profit as the difference between the revenue generated from production and the total cost of production, including the cost of capital. The conventional arguments are reflected in the following quotation:

> The cost of a product means all the expenses necessary to induce producers to bring it to market. Over the long-run this must include a normal rate of profit to the owners of the enterprise. Normal profit is in fact not profit at all. It is a necessary interest return on the owner's investment required to induce them to devote their funds to this line of production instead of doing something else. Profit is the difference between the actual return and the normal rate.[6]

Business Practice

In part, business practice reflects economic theory in that interest on borrowed capital is capitalized as a part of work-in-process during the construction stage. Some high-cost assets, such as huge buildings, aircraft, ships and motion picture sets, are built by a contractor or by the business enterprise itself. In the first case, the contractor requires that the larger portion of the purchase price be paid in installments prior to the delivery of the asset. Businessmen justify capitalization of cost of installment funds by the fact that the asset price would be higher in the absence of such advance payments because the contractor would then have to finance the project with his own funds.[7] In the second case, when the fixed asset is built internally, businesses capitalize the amount of interest on funds tied up in such assets during the construc-

tion stage.

Anthony reported that in the 1971 financial statements of 21 companies analyzed in Accounting Trends and Techniques included interest in cost of their capital assets, mostly construction projects.[8] In a 1974 investigation of the current business practice regarding accounting for cost of capital by the Financial Accounting Standards Board, all regulated companies and 120 out of 198 nonregulated companies, or 61% of those investigated, were found to capitalize interest as a cost element of the work-in-process during the construction stage.[9]

Some real estate investors capitalize the cost of funds invested in undeveloped land and add such interest costs of land inventory. This practice was accepted by the American Institute of Certified Public Accountants in its pronouncement of 1973.[10]

The Accounting Model

Accountants generally have views that differ from those of economists and businessmen concerning the treatment of the cost of capital which is, in part, because financial accounting must adhere to current professional standards. Generally accepted accounting principles ignore accounting for the cost of equity capital, the cost of borrowed capital being recorded as an expense item, not as a part of the cost of production.

In contrast to the economic position in this issue,

accounting treatment is inconstant and has no specific logical or theoretical base. Ironically, financial accountants capitalize the cost of borrowed capital as an element of cost in certain long-term construction projects such as motion picture and television films among others. There is no theoretical reason for accounting to ignore cost of capital in computing cost of production. Moreover, there is no valid theoretical reason to distinguish between the cost of borrowed capital and the cost of equity capital, since accountants recognize the entity concept as a basic postulate of accounting, the subject of a following section.

Proprietary Concept

The concept of proprietorship or ownership originated in the early stages of the development of accounting thought as an attempt to make the accounting equation logical. According to this theory, the proprietor or the owner of a business enterprise is the center of interest. The assets of the firm are owned by the proprietor, and at the same time he is responsible for the liabilities of the firm. The difference between assets and liabilities represents the net wealth of the proprietor and is described as the proprietorship. Also, this concept implies that revenues are considered as an increase in proprietorship and expenses as a decrease. The net income which results from operations accrues directly to the owner and represents the net increase in proprietorship.[11]

Proprietory theory classifies creditors as a distinct class, not included among the proprietor group. This distinction is described by Sprauge in terms of three points:

> 1) The rights of the proprietor involve dominion over the assets and power to use them as he pleases even to alienating them, while the creditor cannot interfere with him or them except in extraordinary circumstances. 2) The right of the creditor is limited to a definite sum which does not shrink, while that of the proprietor is an elastic value. 3) Losses, expenses and shrinkage fall upon the proprietor alone and profits revenue and increase of value benefit him alone, not his creditors.[12]

Accordingly, contractual interest is considered an expense and should be deducted from the net income of the proprietor.[13]

The proprietorship theory is readily adapted to the sole proprietorship form of organization. It is also a logical framework for the partnership form of organization. Hendriksen has stated:

> In accounting for both the single proprietorship and the partnership forms, the proprietary theory appears to dominate, particularly because net income is added each period to the personal capital accounts of the owners.[14]

While this theory is not readily applicable to the corporate form of organization because of the legal distinction between the corporation and the stockholders, it could possibly be applied to this form of business organization by looking through the corporate veil and viewing the business entity of a corporation as an association of stockholders who own the business.[15]

Extending the umbrella of the proprietary theory to the corporate form raises the issue of identifying the owners or the proprietors of the corporation. Some accounting writers, such as Husband, limit ownership to the common stockholders only since they are the true entrepreneurs of the corporation.[16] Other accounting writers, such as Lorig, widen the owernship concept to include preferred stockholders. The argument proceeds as follows:

> Just who constitute the proprietors in a business corporation is not entirely clear. Certainly the common stockholders are included. The preferred stockholders also are generally considered in that category though normally they have no voice in operating the business. In practice, the financial return to them is always considered a distribution and is chargeable only to net profits, current or accumulated, and payable only when declared in the form of a dividend. Both classes of stockholders therefore are distinctly different from the creditor group; and this distinction is basic in the proprietary concept.[17]

With the increase of large corporations and an increase in the complexity of accounting practices, proprietary theory faces a number of challenges. The search for a solution led accounting writers to introduce the entity theory of corporate accounting.[18]

The Entity Concept

It is generally agreed that accounting entity is one of the basic postulates underlying modern financial accounting. An accounting entity, as it is defined by practicing accountants, is the economic unit which has control over resources, accepts responsibilities for making and carrying

out commitments and conducts economic activities.

In the early 1930's this concept emerged to support the needs of corporate accounting that were developing as a result of the dominance of the corporation as the more important form of business enterprise. For some time, the question of the proper accounting entity was a topic of active discussion.

The entity theory view is that assets belong to the entity and that the liabilities are the responsibility of the entity itself, not of stockholders or proprietors; whereas the proprietary theory implies that the assets of the business enterprise are owned by the stockholders and that the liabilities are the liabilities of the stockholders. The legal form of both sole proprietorships and partnerships is in agreement with proprietary theory, while the legal form of a corporation is an implementation of the entity theory.

In a corporation the assets belong to the business entity, not to the stockholders. At the same time the liabilities of the corporation are not the liabilities of stockholders. A shareholder is not responsible for the debts of the corporation. Shareholders cannot withdraw assets from a corporation, even dividends, without approval of the corporation. On the other hand, the declaration of dividends gives the shareholders a legal right to collect such dividends like any regular creditor.

The emergence of the entity concept as a means of distinguishing between a corporation and its owners has contributed to the development of accounting thought. It has allowed for the extension of double entry accounting technique to cover transactions between the corporation and its owners.[19]

Entity theory implies that the revenue generated by a business enterprise and the expenses acquired by that enterprise are the revenue and expenses of the business enterprise itself. Application of the entity theory to corporations is clearly explained by Hendriksen:

> Since corporate net income is not considered to be directly the net income of the stockholder, revenues and expenses are not increases and decreases in the stockholder's equity. Revenue is the product of the enterprise, and the expenses are the good, and services consumed in obtaining the revenue. Therefore, expenses are deductions from revenues and the difference represents the corporate income.[20]

The entity concept implies that all expenses or costs paid to outsiders who provide services to the entity should be recognized. The cost of capital provided by shareholders of a business enterprise is not an exception to this general principle. Equity capital is a resource provided by an outsider for the business enterprise to be used in order to generate profit. It is similar to funds provided by creditors of the same entity.

Anthony supports this viewpoint:

> Under the entity concept, the corporation is viewed as an entity separated from its proprietor. The entity obtains its capital from two principal sources: it

> obtains debt capital from creditors and equity capital from shareholders. Management decides on the best mix between debt capital and equity capital. Equity capital therefore becomes just another source of funds. Both creditor and equity investors are viewed as outsiders. The decision on whether to raise additional capital from creditors or from shareholders (either from the sale of shares or by retaining earnings) turns, essentially, on the balance between the risk and cost characteristics of these sources of capital. Under these circumstances, it would seem appropriate to measure the cost of using equity capital, which is supplied to outside shareholders, just as it is appropriate to measure the cost of using debt capital which is also furnished by outside parties. From the standpoint of entity, each type of capital is a resource furnished by an outside party.[21]

Childs agress with this opinion inasmuch as he considers that capital provided by both creditors and stockholders represents long-term financing for the company.[22] Welsch and Davidson stated that "under the entity concept shareholders and debtholders are viewed equally as providers of enterprise capital."[23] Staubus in 1952 pointed out that entity theory implies that there is a cost for services received for all funds provided to the enterprise.[24] Thus, the cost of a resource is measured in terms of the cost to the entity of interest, not its owners.

Cost Concept

Extending the umbrella of cost concept to include cost of capital can be partially clarified by a discussion of acquisition cost, holding cost and explicit cost as opposed to implicit cost.

Acquistion cost of production assets. Asset acquisition activities are those activities which are aimed primarily at acquiring commodities and services

from other entities for use in achieving the objectives of the organization. A productive asset may be acquired through purchase or production. In either case, the acquisition cost of the asset is the total value of goods and services given up in order to acquire the asset.

Interest on capital, both borrowed and equity, represents the service value of funds invested in the acquisition of the asset prior to the availability of the asset for use. Price theory as well as business practice indicates that the price of a purchased productive asset includes the amount of return on capital that is received by the seller. The way in which an asset is acquired, whether it is by purchase or production, is not relevant.

The relevant cost is the economic sacrifice required to acquire the asset. This argument had been presented by Professor Anthony when he said:

> Except in public utilities a building that is constructed by a company's own personnel appears in the financial accounts at a lower cost than an identical building constructed by an outside contractor: When a building is constructed by an outside contractor, he almost surely includes interest on his total capital in calculating his selling price; that is, he includes interest on his debt capital as a specific cost element, and he includes an allowance for profit which approximates the interest cost of his equity capital. The contractor's selling price becomes the buyer's cost. Interest is therefore a part of the cost of such a building. There is no logical reason why a building should cost less, by the omission of interest, if it is constructed by the company's own force. Furthermore, it makes no sense that a building constructed by a public utility should be recorded at a higher cost than an identical building constructed by an industrial company.[25]

To exclude the cost of capital just because the productive asset was constructed or manufactured internally is not consistent. Such exclusion is theoretically inconsistent with both the value added or cost attachment propositions that are necessary to the concept of production or construction cost.[26]

Holding costs of assets. Holding activities are another class of business activities besides acquisition and production activities. The reasons for holding activities are "primarily aimed at providing a supply of output when needed and for permitting efficiency of acquisition."[27] Time lag between inputs and outputs is the only reason for a distinction of holding activities from both acquisition and production activities.

Two major classes of assets are subject to holding activities. These are 1) inventories including merchandise, raw materials, work in process and finished goods, and 2) plant assets. There is an amount of capital funds tied up in these assets during the period of their existance. Such capital has a cost. Neglecting such cost makes accounting information misleading, especially if the time lag between inflow and outflow of such assets as long as it is in the case of real estate and timber inventories.[28]

There are two items of cost or expenses which are associated with plant assets which should be covered by selling price of manufactured products or rendered services

of such plant assets. These items as pointed out by Professor John F. Childs are return of capital and return on capital. Return of capital is accounted for as a depreciation expense, while return on capital is not. It is a foregone conclusion that a business enterprise cannot continue in business if it does not recover the cost of its productive assets during the period of production. For a project to be described as economically successful, it should generate revenue sufficient to cover three elements of expenses.[29] These elements are operating expenses such as material and labor, return of capital or depreciation expense and return on capital or cost of capital which is actually a holding cost.

Explicit as opposed to implicit costs. Accounting practice shows that the explicit cost of capital or the contractual interest is more likely to be accepted as a part of cost of production than the implicit cost of capital, the cost of equity capital. However, it appears that most of the arguments for interest on borrowed capital could be claimed also for the cost of equity capital, especially if we accept the accounting entity as a basic postulate. The logical similarity between borrowed capital and equity capital is based on the fungible nature of money. A dollar of equity capital is identical to a dollar of debt capital for disbursement purposes.

Philip L. Defliese, in his address to the Economic Club of Detroit in March 1975 called for an adequate accounting for the cost of equity capital. In that speech he raised the same question that is usually raised when this matter comes to discussion:

> Does the source of capital have anything to do with the productive nature of capital? Instruments by which funds are raised differ sharply. Some are clearly classifiable as either debt or equity, while others are of a rather uncertain category. These include all possible types of debt with conversion features and other hybrids. The time has come to recognize that the cost of capital whatever its source--debt, equity, retained earnings--should enter into the determination of income.[30]

Welsch and Davidson in their study came to the conclusion that timing and legal aspects are the only differences between contractual interest--cost of debt--and theoretical interest cost of equity capital. They pointed out that the only major difference between explicit interest and implicit interest is the explicit interest and the principal "amount of the related debt must be paid at specified points in time. In contrast, the return on equity capital and the principal of equity capital carries no specified points in time."[31]

Scovell at the beginning of this century argued for inclusion of the cost of equity capital to the cost of production as is the case of borrowed capital (in his opinion), and he found no reason for such distinction. In his argument Scovell pointed out that accountants who include only the cost of borrowed capital in production costs base

their practices upon a real misunderstanding of the concept of cost. This misunderstanding is caused by the distinction between services provided by outsiders and services provided by owners. One dollar of capital fund is no more serviceable because it is supplied by owners or by creditors. Such a dollar gives rise to a cost factor only because of its use in production. The source of capital is immaterial and should not be allowed to influence its cost in any way.[32]

Although the accounting profession has not recognized explicity the cost of equity capital in computing either income or cost, some accounting writers have not found it difficult to realize that equity capital has cost, and that neglecting such cost by the accounting profession is unjustified. Soule wrote in 1953:

> To the accountant, borrowed capital is the only type of capital which has cost and this cost is measured of course by the interest charges paid. Preferred stock capital, on the other hand, is raised by the sale of certificates of ownership. Hence, in the eyes of the accountant, preferred dividends do not measure cost of any kind but merely constitute a distribution of profits. The same thing applies to common equity capital with the added twist that this type of capital includes not only new common stock but retained earnings as well. . . . All forms of capital may be conceived to have "cost" however when viewed through the eyes not of the accountant but of the common stockholder.[33]

Recently John F. Childs in his answer to "Does common have a cost?" criticized the accounting position by stating that it does not have an accounting cost. But it does have a cost in the economic sense. Common stockholders have to be satisfied in order to secure the flow of their capital.[34]

Authoritative Positions

Individual Scholars

Although exclusion of interest of equity capital from cost of production is the generally accepted accounting principle at the present time, some accountants are in favor of its inclusion. This opinion was formed as early as 1913 when William Morse Cole defended it in an article which he wrote for the Journal of Accountancy. He concluded that "businessmen are likely to be misled in the future as they have been in the past by statements of profit which assume that no cost is involved in the use of capital."[35] Kester, in Accounting Theory and Practice (1918), expressed a similar opinion concerning the inclusion of interest in cost. For the inclusion of interest he stated that full cost of a building, for instance, should include not only material, labor and a part of overhead, but all related expenses such as architect's fee, supervision, and interest on borrowed money.[36]

C. H. Scovell, a well-known accounting writer during the first decade of this century and a founder of the prominent public accounting firm of Scovell, Wellington & Company Accountants, defended recording interest in his book Interest as a Cost. In his concluding chapter he pointed out that "sound economic theory supports good business practice" in the treatment of interest as a cost factor rather than a profit element.[37]

With the introduction of accounting for leases, Defliese, managing partner of Coopers and Lybrand, supported the recognition of interest cost, on both borrowed and equity capital, in order to make the accounting for purchased assets comparable with that for leased assets.[38]

Courts

The issue of accounting for the cost of capital was brought to the United States Supreme Court as early as 1869 in the case of Rubber Company vs. Good Year in which the Court opposed the inclusion of cost of capital in manufacturing cost. But the United States Supreme Court came to support inclusion of interest on invested capital little by little in the case of Manufacturing Company vs. Cowing in 1881, and Am Ende vs. Seabury, et al., in 1894. Clear support for inclusion of interest of the invested capital in manufacturing cost was given by the United States Court of Appeals for the Seventh Circuit when the foregoing cases were brought to this court. The court allowed the defendant to include in its costs $11,047 of interest for the use of its entire plant during the period of infringement.[39]

In the case of Hill vs. Antigo Water Co. the court supported the inclusion of cost of capital. In its justification of such inclusion, the court looked at capital as a major factor of production. Without paying the cost of capital that production factor cannot be had for industrial and commercial purposes.[40]

Legislative and Regulatory

Pronouncements of APB & FASB. Accounting for interest costs did not get much attention from the Accounting Principles Board during its existence. Interest was mentioned in some of the PAB pronouncements such as APB Opinions 14 and 26. But the only pronouncement that was devoted entirely to interest was Opinion 21, "Interest on Receivables and Payables." In this opinion, APB recognized clearly the necessity of accounting for the cost of implicit interest. It

> sets forth the Board's views regarding the appropriate accounting when the face amount of a note does not reasonably represent the present value of the consideration given or received in the exchange. This circumstance may arise if the note is non-interest bearing or has a stated interest rate which is different from the rate of interest appropriate for the debt at the date of transaction.

The Board states clearly the reason for recognition of such implicit cost when it says:

> Unless the note is recorded at its present value in this circumstance the sales price and profit to a seller in the year of the transaction and the Purchase Price and cost to the buyer are misstates, and interest income and interest expense in subsequent periods are also misstated.[41]

The AICPA in the Industry Audit Guide recommended capitalization of interest cost in some circumstances such as land held for sale or a project under construction. The Guide states:

> Costs directly related to inventories of unimproved land or to construction required to brnkg land and improvement to a saleable condition are properly capitalizable

> until a saleable condition is reached. Those costs would include interest, real estate taxes and other direct costs incurred during the inventory and improvement periods. Interest is properly capitalized if it results from (a) loan for which unimproved land or construction in progress is pledged as collateral or (b) other loans if the proceeds are used for improvements or for acquiring unimproved land. The carrying amount of capitalized costs should not exceed net realizable value. Interest not meeting the above criteria . . . should be treated as expenses of the period in which incurred.[42]

The AICPA takes the same position with repsect to the "Audits of Saving and Loan Associations." It says "direct holding costs and amounts representing the cost of money invested in the property should be capitalized subject to the lower of cost or market principle when the current sale of REO (Real Estate Owned) is unlikely or when management intends to hold or develop property over an extended period.[43]

In some other circumstances, such as the case of motion picture films, the Guide has concluded that "it's not appropriate to capitalize interest as a production cost. Interest costs are properly treated as a period expense."[44]

In July 1977 the AICPA stated that a position has not been taken on the appropriateness of capitalizing amounts representing cost of money applied to real estate owned which have not been included in an allowance for loss charged to income because accounting for interests costs is currently under study by the FASB, but in an Exposure Draft of a proposed revision to the Audit Guide, the AICPA proposes capitalization of direct holding costs to the extent that the amount has been included in the allowance for losses, subject to a

net realizable value limitation.[45] The AICPA limited its treatment of interest to the interest on borrowed capital but not the implicit interest on equity capital.

To date, the FASB has not issued any pronouncement dealing with accounting for cost of interest, but as was stated above, the issue is under consideration by FASB at the present time. In December 1977 FASB distributed a discussion memorandum on accounting for interest costs, and a public hearing on the Subject was held in April 1978.[46]

The Securities and Exchange Commission. Due to the increasing number of non-utility companies which adopted a policy of capitalizing interest cost, in 1974 the SEC issued the Securities Act of 1933 Release No. 5505, which proposed a moratorium on adoption or extension of a policy of capitalizing interest by companies other than public utilities, where it is an established practice; and at a later date the moratorium was imposed by Accounting Series Release No. 163, in which the Commission expressed the opinion "that it does not seem desirable to have an alternative practice grow up through selective adaption by individual companies without careful consideration of such a change by Financial Accounting Standards Board including the development of systematic criteria as to when if ever capitalization of interest is desirable."[47] SEC Accounting Series Release No. 163 stated clearly that the return on equity invested should not be capitalized by companies other than public utilities. But

the release stated also that at such time as the Financial Accounting Standards develops standards for accounting for interest costs the commission expects to reconsider this conclusion.[48]

Cost Accounting Standards Board. Interest has been included as an element of cost in some government contracts but without official pronouncements. This treatment has been confirmed by the Cost Accounting Standards Board in its Standard No. 414 entitled "Cost of Money as an Element of the Cost of Facilities Capital," in which the Board has stated that the cost of contractor's capital committed to facilities employed in negotiated contracts with the government shall be recognized as an element of contract cost. This standard clearly recognized the imputed cost of capital tied to fixed assets, both tangible and intangible, when it gives definitions as follows:

> Cost of capital committed to facilities: An imputed cost determined by applying a cost of money rate to facilities capital.
>
> Facilities capital: The net book value of tangible capital assets and of those intangible capital assets that are subject to amortization.[49]

The Board did not include the cost of working capital because at that time it was not prepared to make determinations on all the issues related to working capital, although the Board staff distributed research papers dealing with this issue in June 1974, April 1975, and December 1975.

Federal Income Tax. For federal income tax purposes

the only deductible interest is the amount of interest "paid or accrued." An imputed interest cost of other capital is not deductible. This position is contained in the Internal Revenue Code, Sec. 163. In regard to the treatment of paid or incurred interest, the code takes a moderate position and allows capitalization of interest in some circumstances. Such cases were pointed out in Section 266 of the Internal Revenue Code as

1. Mortgage interest and other carrying charges on unimproved or unproductive real estate.

2. Interest on a loan to develop real property.

3. Interest on a loan to purchase personal property or to pay for its transportaion or installation.

4. Any other carrying charges, otherwise deductible which in the opinion of the commissioner, are, under sound accounting principles, chargeable to the capital account.[50]

Professional Organizations

American Accounting Association. The American Accounting Association has not dealt with accounting for interest costs as a separate issue, but the subject was touched upon in a discussion of the realization concept by AAA.

> The realized net income of an enterprise measures its effectiveness as an operating unit and is the change in its net assets arising out of (a) the excess or deficiency or revenue compared with related expired

> cost and (b) other gains or losses to the enterprise from sales, exchanges, or other conversions of assets. Interest charges, income taxes, and true profit-sharing distributions are not determinants of enterprise net income.
>
> In determining net income to shareholders, however, interest charges income taxes, profit-sharing distributions, and credits or charges arising from such events as forgiveness of indebtedness and contributions are properly included. In financial reports and discussions alike, care should be exercised to indicate whether enterprise net income or net income to the shareholders is at issue.[51]

National Association of Accountants. In cost and managerial accounting the concept of cost of capital has received more attention. It has been adopted in capital investment decisions, pricing and the measurement of divisional performance. The Management Accounting Practice Committee of the National Association of Accountants in its Statement No. 4, entitled "Fixed Assets Accounting: the Capitalization of Costs" (October 20, 1972), recognized imputed interest on equity capital and recommended capitalization of such interest as well as the contractual interest in some cases. The Committee stated that:

> Interest during the period of construction should not be capitalized except in the utility and real estate industries where the current acceptance of this practice and the economics of these industries permit such capitalization. . . . Interest during construction . . . the net cost of borrowed funds used for construction purposes and a reasonable rate upon the firm's own funds when so used.
>
> When interest incurred during the period of construction is capitalized it's reasonable for identifiable imputed interest on fixed assets constructed to be capitalized in order to provide comparability.[52]

Table 2-1 summarizes the positions of the major accounting authoritative bodies concerning accounting for

TABLE 2-1

A Summary of Positions of Major Accounting Authoritative Parties Concerning Accounting for Cost of Interest

Accounting Authoritative Party	Recognizes Explicit Interest	Recognized Imputed Interest on Equity Capital	Agrees on Capitalization by Reg'd Co.	Agrees on Capitalization by Non-Reg'd Companies	Reference
American Inst. of Certified Public Acc'ts	yes	no	yes	no	APB opinions 14, 21 and 26 and Industry Audit Guide
Financial Accounting Stand. Board	yes	no	yes	no	Discussion memorandum dated December 1977
Securities & Exchange Commission	yes	no	yes	yes	SEC Act Release No. 5505, Accounting Series Release No. 163
Cost Acc'ting Stand. Board	yes	yes			Cost Acc'ting Standard Board Standard No. 414
Federal Income Taxes	yes	no	yes	yes	Internal Revenue Code Sec. 163, 189 and 266
American Accounting Association	yes	no position	no position	no position	Statement of American Acc'ting Assoc. Committee on Acc'ting Concepts and Standards 1957
National Accounting Association	yes	yes	yes	yes	Management Accounting Practice Statement No. 4

cost of interest. These positions are somewhat inconsistent with regard to the capitalization of the cost of equity capital.

A Summary of the Pros and Cons

A brief summary of the principal points in arguments for and against including cost of capital is given in Table 2-2. Since these are the arguments customarily made by a variety of individuals and authoritative bodies, they are not necessarily consistent.

Three topics relating to the accounting for cost of capital were discussed in this chapter. These three topics were relevant economic theory, business practice and the accounting treatment of capital costs. The accounting model was extended to include the major equity concepts, i.e., proprietary concept and entity concept, as well as the cost concept. In addition, the positions of some individual scholars, legislative and professional parties were reviewed.

The review of these topics was limited to the extent that it serves two purposes. The first is to shed some light on the present status of accounting for the costs of capital. The second purpose is to form with the bankruptcy prediction related topics which will be presented in the third chapter a background for this study.

TABLE 2-2

Summary of the Major Arguments for and Against Accounting for Cost of Interest

Arguments for Accounting for Imputed Interest Cost	Arguments against Accounting for Imputed Interest Cost
Recognizing imputed interest is in agreement with value, cost entity and relevance concepts.	Economic cost cannot be reconciled with business cost.
Interest is a true economic cost irrespective of the source of funds.	Capital has nothing to do with production cost.
An asset is no more valuable just because it is financed by debt other than equity.	There is an actual outgo for labor but not for capital.
Manipulation of income and asset values is possible if imputed interest is rejected.	Much "futile clerical calculation" is needed to account for imputed interest
Assets are financed from a pool of funds with no recognition of source of funds.	Interest rate is chosen arbitrarily.
Money has time utility value which should be recognized in the accounts.	Accounting for cost of capital implies that capital shall be granted a definite return.
It helps to measure relative economy of machines or methods.	Inclusion of interest leads to inflation of inventories.
It helps to compare inventory policies, make or buy and buy or lease.	Objectives of inclusion of interest in costs can be secured by interest calculations in supplementary records.
	Imputed interest is subjectively determined, hence subject to manipulation.
	The function of accounting is reporting of costs actually incurred, not all information which influences market price.

CHAPTER II FOOTNOTES

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[30]Cited by M. Leopold Schamer in "Accounting for Cost of Equity Capital," C.P.A. Journal, 45 (December 1975), p. 13.

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[34]Childs, p. 475.

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[48]Ibid.

[49]Cost Accounting Standards Board, Standard No. 414, June 2, 1976.

[50]Internal Revenue Code, sec. 163, 189, and 266. Reported in FASB Discussion Memorandum, p. 84.

[51]American Accounting Association Committee on Accounting Concepts and Standards. Accounting and Reporting Standards for Corporate Financial Statements. American Accounting Association, 1957, p. 5.

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CHAPTER III

BANKRUPTCY PREDICTION

The overall purpose of this study is to examine the usefulness of financial statements that have been modified to reflect the cost of capital for the prediction of bankruptcy. More specifically, the predictive power of ratios that are developed from cost-of-capital adjusted financial statements is examined in the bankruptcy context using discriminant analysis.

This chapter begins with a discussion of predictive validity as a criterion to evaluate usefulness. Next, a definition of bankruptcy is provided. Previous studies involving the use of financial ratios to predict firm bankruptcy are reviewed as background for this study. Next, the ratios selected for use in this study are reviewed. The final section is a description of the use of linear discriminant functions to predict firm failure.

The Predictive Validity Criterion

Validation of financial ratios as predictive means of failure is explained by Blum when he says

> Selection of these variables is based on a theory of various ways impending failure might be symptomized by

> accounting data. A theory of symptoms of failure focuses on how the behavior of fundamental economic variables would be epxected to be portrayed in financial statements.[1]

This implies that the multidimensioned complexity of the economic world must be reduced to scales. These, however, could be viewed as describing factors in the business environment by means of certain unifying denominators: liquidity, profitability and variability.

The predictability criterion is well established in the social and natural sciences as a method for choosing among competing hypotheses, and this criterion is pertinent to the evaluation of the usefulness of competing accounting methods even though usefulness is a broader concept. Beaver, Kennelly and Voss state the merit of usefulness in a decision making context:

> The use of predictive ability as a purposive criterion is more than merely consistent with accounting decision making orientation. It can provide a body of research that will bring accounting closer to its goal of evaluation in decision making criterion.[2]

They explained the common features of competing hypotheses and alternative accounting measures. They stated that "the predictive ability approach provides a method for drawing operational implications from the a priori arguments such that the measurement controversies become empirically testable according to a purposive criterion."[3] The predictive power of financial ratios was established as an effective tool not only to predict business failure but also to evaluate accounting alternatives. The relevant predictive studies in the bankruptcy context are reviewed next.

Bankruptcy

A business enterprise that faces some financial difficulties is described as a failing, insolvent or bankrupt business. Most writers use these three adjectives interchangeably although they can have different meanings. A failing business is a business enterprise which has failed to achieve success as defined by Dun & Bradstreet (D&B), a leading supplier of relevant statistics on enterprises. Dun and Bradstreet lists as a failing business any business enterprise which ceased operations following assignment or bankruptcy, which ceased doing business with a loss to creditors, or which was involved in court action such as reorganization or arrangement.

But it is worth mentioning that business failure represents a very small fraction of business enterprises which cease operation every year, e.g., only three to four percent of the total enterprises discontinued during the period 1940 - 1962 were business failures. Failure sometimes is preceded by a legal failure when a business enterprise becomes a subject of a court case because of its disability to meet debt obligations. Sometimes a failure is preceded, also, by an economic failure. Such a failure represents the situation wherein the realized rate of return on invested capital, with allowances for risk consideration, is significantly and continually lower than prevailing rates on similar investments.[4]

In the finance literature, solvency or insolvency is usually preceded by the adjective technical. Walter (1957) describes technical solvency as the ability of a given business unit to meet its currently maturing obligations. He studied technical solvency and advanced the theory that the ratio of net cash flows to current liabilities should be the primary criterion used to evaluate technical solvency.[5]

Altman, when he speaks about insolvency in a bankruptcy sense, says

> It's a more critical condition and indicates a chronic rather than temporary illness. A firm finds itself in this situation when its total liabilities exceed a fair valuation of its total assets. The real net worth of the firm is, therefore, negative.[6]

Bankruptcy is a formal declaration that a business enterprise is in financial trouble. Usually, it follows a petition to the court seeking either liquidation of a business enterprise or the implementation of a recovery program in which the business enterprise starts a reorganization process; such procedures are detailed in Chapter X and XI of the National Bankruptcy Act.

In order for the bankruptcy event to be well determined, only those companies which filed for reorganization under Chapter X or Chapter XI of the Chandler Act, e.g., which reached an agreement with creditors to reduce the firm's liabilities at a loss to the creditors or which liquidated due to financial difficulties, are included in this study. It is worth mentioning that bankruptcy was

chosen as a dependent variable for this study because it is a definite event that decision makers, including creditors, investors and management, want to avoid; thus their desire to detect its signs as early as possible and as accurately as possible indicates the usefulness of accounting data which would help to do the detecting.

Financial Ratios and Prediction of Failure

The main issue of this study is to determine if incorporating the cost of capital other than outside capital in the financial statements will allow the adjusted for cost-of-capital model to predict more accurately firm bankruptcy than the present reporting practice. Empirical evidence is needed to help in solving this issue. This section describes previous studies of the use of financial ratios to predict future events, explains how this tool fits the study, designates the criteria to be considered in choosing financial ratios for this particular study, and lists the ratios to be included.

Previous Research

Financial ratios have been used widely as a tool to predict business failure. The initial studies of this type were conducted in the early 1930's by Smith and Wimaker, who studied a sample of 183 firms which had experienced financial difficulties during the period 1923-31 and had failed by 1931.[7] They analyzed the prior 10-year trends by the means of 21

ratios and found that the ratio of net working capital to total assets was the most accurate and steady indicator of failure. Also, they found that the long-term solvency ratios were equally good indicators.

Fitzpatrick in 1931 conducted another study in which he analyzed the prior three to five-year trends of 13 ratios for 20 firms that had failed during the period 1920-29. He also matched his sample of failing companies with a sample of successful firms. He concluded that all his ratios predicted failure to some extent, through declining trends, but his best predictors were the net profit to net worth ratio and the net worth to total debt ratio.[8]

In 1942 Merwin conducted a study of 939 firms of both continuing and discontinuing firms in the period 1926-36. He came to a conclusion that three ratios were very sensitive predictors of discontinuance, up to as early as four to five years in some instances. These ratios were net working capital to total assets, net worth to total debt, and the current ratio.[9]

Beaver published a study in 1966 in which he introduced the paired sample technique. In his study a sample of 79 fialed firms was matched on the basis of industry class and asset size with a selection of other firms that continued in operation. For all firms in the sample financial statements data for five years prior to failure were examined. Thirty different financial ratios were selected including

liquidity ratios, profitability ratios, leverage ratios, activity ratios and cash flow ratios. He came to a conclusion supporting the ability of financial ratios to predict the comparative solvency of the paired firms.[10] He did another study of the same sample using a dichotomous classification test. In this study he demonstrated the power of financial ratios to predict failure of individual firms. He found out that cash to total debt, net-income to total assets, total debt to total assets, working capital to total assets, and the current ratios are the most power-predictive ratios.[11]

Altman, in his famous paper which was published in 1968, used financial statements of 33 pairs of manufacturing firms--bankrupt and continuing firms. From these financial statements he selected the ratios of 1) working capital to total assets, 2) retained earnings to total assets, 3) earnings before interest and taxes to total assets, 4) market value or equity to book value of total debt, and 5) sales to total assets for inclusion in his discriminant function. Using a discriminant analysis technique, he concluded that financial ratios are a very accurate tool for prediction of firm's failure. Specifically, he found that failure could be detected with up to 95% assurance in the first year before bankruptcy and that this assurance declines to 36% by the fifth year before the actual failure.[12]

In his doctoral dissertation completed in 1968,

Troy Daniel used simple correlation, factor analysis and stepwise regression to select financial ratios which best correlated with failure and nonfailure as the dependent variable. Using discriminant analysis technique he came to a conclusion that financial ratios have considerable power in identifying failing firms, as is shown in Table 3-1.

TABLE 3-1

Predicted and Actual Outcomes of Daniel's Discriminant Analysis

	Predicted Outcome			
	Failed	Borderline	Non-failed	Total
Failed	45	20	0	65
Non-failed	4	9	22	35
Total	49	29	22	100

Table 3-1 summarizes the accuracy of Daniel's predictions for the fifth year prior to failure. He misclassified only four of the 49 bankrupt firms and none of the continuing firms.[13]

Beaver (1966) and Beaver, Kennelly and Voss (1968) suggested using predictive power of financial ratios to find out the effect of capitalization of leases.[14] This suggestion was carried out by Elam in 1973 as a Ph.D. dissertation. He conducted a study using a sample of 48 bankrupt companies and a matching sample of 48 continuing companies. For each company he chose 28 financial ratios,

classified as short term liquidity ratios, cash flow ratios, long term solvency ratios, short term capital productivity ratios, profit margin ratios, long term capital productivity ratios and return on investment ratios. He computed and analyzed these ratios with and without lease capitalization for five-year periods using discriminant analysis to classify sample observations either as bankrupt or non-bankrupt firms. He came to the conclusion that capitalization of lease does not have a remarkable effect on predictability power of financial ratios.[15]

Blum in an article published in 1974 entitled "Failing Company Discriminant Analysis," assembled a sample of 115 industrial firms which failed during the period 1954-1968 and a paired sample of 115 nonbankrupt firms similar with respect to industry, sales, number of employees and fiscal year. He collected data for up to eight years when available; however, he found that data of five years before bankruptcy were optimal. He performed a discriminant analysis and, based upon validation sample tests, he concluded that his model had an accuracy of 93-95% prediction of failure within one year, 80% within two years and 70% within three years.[16]

In 1972 Edmister published an article entitled "An Empirical Test of Financial Ratio Analysis for Small Business Failure Prediction," describing a study based on 19 financial ratios which were derived from 282 annual observa-

tions and 42 tri-annual observations.[17] He performed a multi-discriminant function, demonstrating the ability of such functions as those developed by Altman and Beaver to predict bankruptcy not only for large sized firms but also for small business, defined as an enterprise listed with the Small Business Administration and Robert Morris Associates. However, he found that the function for a small business fails to discriminate when only one statement is available and concluded that at least three consecutive financial statements should be available for analysis of a small business.

Harold H. Simeon Diamond, Jr., for his Ph.D. dissertation, conducted a study in 1976 using data collected from financial statements of 150 manufacturing firms for three consecutive fiscal years in the period 1968-74. For his analysis he used discriminant plane technique, and Bayesian Predictive Classifier. His conclusions support the use of financial ratios in predicting firm failure. His results are presented in Table 3-2. Table 3-2 shows that the Diamond

TABLE 3-2

Diamond's Percentage of Firms in Each Group That Were Correctly Identified

Year	Failed	Continuing
1	97.3	90.7
2	78.7	85.3
3	80.0	80.0

model has a high recognition rate even as far as 3 years before failure.[18]

Norton (1976) performed a study where he tried to test the usefulness of general price level financial statements. His major question was "Do financial ratios computed from general price level adjusted financial statements predict bankruptcy more accurately than financial ratios computed from historical cost financial statements?" With 32 financial ratios of 30 bankrupt firms and matching 30 non-bankrupt firms and through the linear discriminant function and linear multiple regression analysis for all four years ratios to select variables, he came to a conclusion that "GPL data are different from historical cost data, but are neither more nor less useful for predicting bankruptcy."[19]

In 1977 John Ketz conducted a study for the purpose of finding out whether general price level financial statements improve the decision-making process of creditors in relation to the use of historical cost statements. His criterion was the predictability of business failure by use of financial ratios. His conclusion, based on discriminant analysis error rates of misclassifying failed firms and the expected cost of misclassification, was that the general price level model provided a slight improvement in the decision-making process concerning the predictability of bankruptcy.[20]

A summary of the previous use of financial ratios in bankruptcy investigation is presented in Table 3-3.

TABLE 3-3

A Summary of the Previous Use of Financial Ratios and Discriminant Analysis in Prediction of Bankruptcy

Study	Sample Size	Number of Ratios	Variable Selection	Paired Sampling	Dispersion Matrices	A Priori Probabilities	Cost of Misclassifying	Tests Performed: Group Means	Tests Performed: Discrimination
Smith & Wimaker (1930's)	183	21	full*	no	no	no	no	yes	no
Fitzpatrick (1931)	20	13	full	no	no	no	no	yes	no
Merwin (1942)	939		full	no	no	no	no	yes	no
Horrigan	24	17	correlation	no	no	no	no	yes	no
Beaver (1966)	158	30	full		no	no	no	yes	dichotomous classif.
Altman (1968)	66	5	t-test correlation and	yes	no	no	no	yes	original and hold-out disc
Daniel (1968)	100	33	simple correlation factor analysis step-wise	yes	yes	no	no	no	original
Deaken (1972)	34	14	full	yes	no	no	no	yes	original hold-out
Edmister (1972)	282	19	stepwise	no	no	no	no	no	synthetic scrambler
Elam (1973 & 1975)	96	28	stepwise	yes	no	no	no	no	original
Blum (1974)	230	12	full	yes	no	no	no	yes	holdout
Diamond (1976)	150	23	stepwise	yes	no	yes	yes	no	optimal Bayesian
Norton (1976)	60	32	stepwise full	yes	no	no	no	no	original
Ketz (1977)	672	16	factor	no	yes	yes	yes	yes	original quadratic

*All the variables have been used.

Financial Ratios for this Study

Although the effectiveness of financial ratios to predict business failure has been demonstrated in earlier studies, there has been no significant agreement about the predictive ability of a particular set of ratios (Table 3-4). For this study 35 ratios were selected, representing a consensus of the selections used in earlier studies and including most of the ratios which have been demonstrated to be good predictors of failure. Individual ratios used in earlier studies are listed in Table 3-5. In the selection of ratios, a special attention was given to those ratios which would be affected either in the nominator or denominator by accounting for cost of capital.[21]

Linear Discriminant Function: Its Nature And Illustration of its Use

In order to find out whether incorporating the cost of capital other than outside capital within the financial statements has any effect on the ability of financial ratios derived from financial statements to predict corporate failure, some classification tests must be performed. To do that, the linear discriminant function was chosen as classification instrument. This section explains the nature of the linear discriminant function, illustrates its use and describes the classification procedures.

TABLE 3-4

Summary of Ratios Found to be Significant Predictors
Of Business Failure in Previous Studies

Ratio	Altman (1968)	Beaver (1966)	Blum (1974)	Fitzpatrick (1931)	Horrigan (1965)	Merwin (1942)	Smith & Winaker ('30s)	Walter (1957)
Net working capital to total assets	x		x		x	x	x	
Current assets to current liabilities		x			x	x		
Net worth to total debt				x	x			
Debt to total assets	x	x						
Cash to total debt		x						
Net profit to net worth				x				
Earning after tax to total assets		x						
Cash flow to total debt		x	x					
Retained earnings to total assets	x							x
Sales to total assets	x							
Market value of equity to book value of debt	x							
Net quick assets to inventory			x					
Rate of return to common stock			x					

TABLE 3-5

The Ratios to be Used in this Study

Ratio	Abbreviation
Liquidity ratios	
Current assets less inventory to current liabilities	CAM/CL
Current assets to current liabilities	CA/CL
Inventory to current liabilities	INV/CL
Current assets to total debt	CA/TD
Working capital to total debt	WC/TD
Solvency and leverage ratios	
Net worth to total liabilities	NW/TD
Net worth to long term debt	NW/LTD
Total assets to total debt	TA/TD
Net worth to current liabilities	NW/CL
Total assets to long term debt	TA/LTD
Profitability ratios	
Retained earnings to total assets	RE/TA
Income before taxes to sales	IBT/S
Income before taxes to total assets	IBT/TA
Income before taxes to equity	IBT/EQ
Income before taxes to interest	IBT/INT
Income before interest and taxes to sales	IBIT/S
Income before interest and taxes to total assets	IBIT/TA
Income before interest and taxes to equity	IBIT/EQ
Income before interest and taxes to interest	IBIT/INT
Productivity ratios	
Sales to inventories	S/INV
Sales to current assets less inventories	S/CAM
Sales to current assets	S/CA
Sales to working capital	S/WC
Sales to total assets	S/TA
Sales to equity	S/EQ
Asset structure ratios	
Inventories to receivables	INV/REC
Working capital to cash and marketable securities	WC/CMS
Fixed assets to net worth	FA/NW
Inventories to total assets	INV/TA
Inventories to net worth	INV/NW
Inventories to working capital	INV/WC
Inventories to current assets	INV/CA
Net worth to total assets	NW/TA
Working capital to total assets	WC/TA
Market value equity to book value of debt	MVE/BVD

The Nature of Linear Discriminant Function

Due to the power of Multiple Discriminant Analysis as a statistical technique to discriminate between observations using more than one variable taken jointly, it was used by most of the previous researchers who did perform bankruptcy investigation. These studies are summarized in Table 3-3.

The discriminant analysis technique was developed in the 1930's by Ronald Aylmer Fisher as a response to classification problems in anthropology, biology, education, medicine and psychology. When many individuals are very similar in a number of characteristics so that they cannot be separated into different classes on the basis of one character only, it is desirable to have a method of combining characteristics so as to differentiate between classes of individuals.[22] A discriminant function provides the means by which the classification can be made. So, the purpose of discriminant analysis as stated by Eisenbeis and Avery is 1) to test for mean group differences and to describe the overlaps among groups, and 2) to construct classification schemes based upon the set of M variables in order to assign previously unclassified observations to the appropriate groups. Or, in other words, the mathematical objective of discriminant analysis is to weight and linearly combine the discriminating variables in some fashion so that the groups are forced to be as statistically distinct as possible.[23]

Discriminant analysis has some underlying assumptions: 1) the groups being investigated are discrete and identifiable; 2) each observation in each group can be described by a set of measurements on M characteristics or variables, and 3) these M variables are assumed to have a multivariate normal distribution in each population.[24]

There is much similarity between the linear regression function and the linear discriminant function, but among the differences are the following: 1) the linear regression function usually has a constant term. It is presented as $y = b_o + b_1x_1 + b_2x_2 + \ldots + b_nx_n$ while the linear discriminant function does not have such a constant term. It is presented as

$$Z = \lambda_1x_1 + \lambda_2x_2 + \ldots + \lambda_nx_n$$

where Z is the score on discriminant function i, the λ_i's are coefficients, and the x_i's are the discriminant variables.

The linear discriminant function enables the researcher to develop a scoring system in which a score "Z" is assigned to each individual observation. This score is a weighted average of the individual numerical values of independent variables. On the basis of this score the individual observation is assigned to the most likely group. To make it more clear let us describe the individual linear function as

$$Z_i = b_1x_{1i} + b_2x_{2i} + \ldots + b_nx_{ni}$$

where

x_{ji} represents the individual value of the jth independent variable for the ith individual (j = 1, 2, . . ., n_{ji} = 1, 2, . . ., 96),

b_j represents the discriminant coefficient for the ith variable (j = 1, 2, . . ., n), and

Z_i represents the ith individual's discriminant score

From all individuals' scores a critical value of Z' is computed and the clasification procedures are performed where any $Z_i < Z'$ is classified as belonging to group 1 and any observation for which $Z_i > Z'$ is classified as belonging to group 2. The following illustrative example will explain the application of the linear discriminant function.[25]

Illustrative Example

For the illustration of the use of the linear discriminant function, consider a classification problem in which insects are to be classified either with race A or within race B on the bases of mean number of teeth in proximal (x_1) combs and mean numbers of teeth in distal (x_2) combs. The individual mean number of these variables for each group are presented in Table 3-6.[26]

The equations to be solved are

1) $S_{11}\lambda_1 + S_{12}\lambda_2 = d_1$

TABLE 3-6

Data for Illustrative Problem

Race A		Race B	
x_1	x_2	x_1	x_2
6.36	5.24	6.00	4.88
5.92	5.12	5.60	4.64
5.92	5.36	5.64	4.96
6.44	5.64	5.76	4.80
6.40	5.15	5.96	5.08
6.56	5.56	5.72	5.04
6.64	5.36	5.64	4.96
6.68	4.96	5.44	4.88
6.72	5.48	5.04	4.44
6.76	5.60	4.56	4.04
6.72	5.08	5.48	4.20
		5.76	4.80

Source: Paul G. Hoel, Introduction to Mathematical Statistics (John Wiley & Sons, Inc., 1947).

$$2) \quad S_{21}\lambda_1 + S_{22}\lambda_2 = d_2$$

Computation given

$$\bar{x}_{11} = 6.466 \qquad \bar{x}_{21} = 5.55$$

$$\bar{x}_{12} = 5.324 \qquad \bar{x}_{22} = 4.727$$

$$d_1 = \bar{x}_{11} - \bar{x}_{21} = 6.465 - 5.5500 = .915$$

$$d_2 = \bar{x}_{12} - \bar{x}_{22} = 5.324 - 4.727 = .597$$

$$S_{11} = \sum_{i=1}^{2} \sum_{j=1}^{n_i} (x_{1ij} - \bar{x}_{1i})^2 = 2.677$$

$$S_{12} = S_{21} = \sum_{i=1}^{2} \sum_{j=1}^{n_i} (x_{1ij} - \bar{x}_{ij})\ (x_{2ij} - \bar{x}_{2i}) = 1.294$$

$$S_{22} = \sum_{i=1}^{2} \sum_{j=1}^{n_i} (x_{2ij} - \bar{x}_{2i})^2 = 1.755$$

Substitute in equations 1-2

$$2.677\ \lambda_1 + 1.294\ \lambda_2 = .916$$

$$1.294\ \lambda_1 + 1.755\ \lambda_2 = .597$$

and the solution is $\lambda_1 = .276$ and $\lambda_2 = .137$. The linear discriminant function for these two variable examples is then

$$Z = 0.276x_1 + 0.137x_2$$

The values of Z corresponding to the individual members of the two roles are given in Table 3-7. Observations are segregated by means of Z as it is illustrated in Graph 3-1.

The graph shows that observations with a Z value greater than Z' (cut off value) will be classified in the

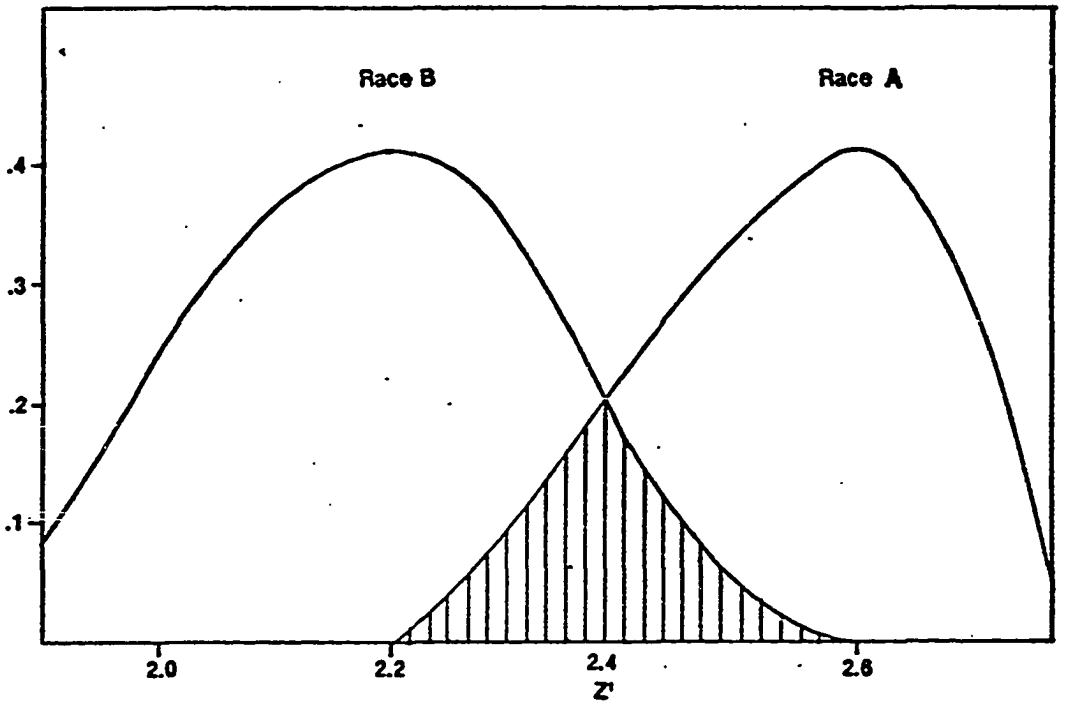
TABLE 3-7

Discriminant Values for Illustrative Problem

Race A	Race B
2.63	2.34
2.60	2.32
2.57	2.27
2.57	2.25
2.55	2.35
2.54	2.23
2.52	2.23
2.47	2.18
2.47	2.17
2.37	2.09
2.33	2.00
	1.81

Figure 3-1

Distribution of Discriminant Values for Illustrative Problem



group represented by the righthand distribution (Race A) and those with Z values less than Z' will be classified in the other group (Race B). The shaded area represents the possible misclassification area.[27]

For some classification approaches a Bayesian adjustment is made for a priori estimates of group membership. To explain this approach let

$P(I)$ represents the unconditional (prior) probability that an individual belongs to Group I

$P(I/x_i)$ represents the conditional (posterior) probability that an individual belongs to Group I

$L(x_i/I)$ represents the likelihood that an individual has the vector of values x_i, given that he belongs to Group I.

Similar definitions hold for Group 2. From Bayes Theorem we have

$$\frac{P(1/x_i)}{P(2/x_i)} = \frac{L(x_i/1)}{L(x_i/2)} \cdot \frac{P(1)}{P(2)}$$

or Posterior Odds = Likelihood Ratio x Prior Odds.

The odds are used to classify observations where an individual observation is classified as belonging to Group 1 or Group 2 if the odds strongly support either way.

In some cases the logarithm of odds is used as a criterion. In this case the last equation becomes

$$\text{Log (Posterior Odds)} = \text{Log (Likelihood Ratio)} + \text{Log (Prior Odds)}$$ [28]

The review of the predictive validity criterion of financial ratios, bankruptcy and linear discriminant function which were discussed in this chapter was not in depth. Such discussion was limited to the extent that it serves only as a background for the research method which is described in the next chapter.

CHAPTER III FOOTNOTES

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[3]Ibid., p. 678.

[4]Edward I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," Journal of Finance, 23 (September 1968): 594.

[5]James E. Walter, "Determination of Technical Solvency," Journal of Business, 30: 30-43.

[6]Edward I. Altman, Corporate Bankruptcy in America, (Lexington, Massachusetts: Heath Lexington Books, 1971), p. 3.

[7]Raymond F. Smith and Arthur H. Wimaker, "Changes in Financial Structure of Unsuccessful Industrial Corporations," (Bulletin No. 51, University of Illinois, Bureau of Business Research, 1935). Reported by William H. Beaver, see Footnote #10, p. 81.

[8]Paul J. Fitzpatrick, A Comparison of the Ratios of Successful Industrial Enterprises with those of Failed Firms. Reported by William H. Beaver, see Footnote #10, p. 81.

[9]Charles L. Merwin, Financing Small Corporations in Five Manufacturing Industries 1926-36 (New York: National Bureau of Economics Research, 1942). Reported by William H. Beaver, see Footnote #10, p. 83.

[10]William H. Beaver, "Financial Ratios as Predictors of Failure," Empirical Research in Accounting. Selected Studies 1966, Supplement to Vol. 4, Journal of Accounting Research, pp. 71-127.

[11]Ibid., p. 85.

[12]Edward I. Altman, "Financial Ratios," p. 594.

[13]Troy E. Daniel, "Discriminant Analysis for the Prediction of Small Business Failure," unpublished Ph.D. dissertation, University of Alabama, 1968, pp. 133, 137.

[14]William H. Beaver, et al., "Predictive Ability as a Criterion for the Evaluation of Accounting Data," pp. 675-676.

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[18]Harold Simeon Diamond, Jr., "Pattern Recognition and the Detection of Corporate Failure," unpublished Ph.D. dissertation, New York University, 1976.

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[22]R. A. Fisher, Contributions to Mathematical Statistics (New York: John Wiley & Sons, Inc., 1950), pp. 32.178a - 36.249.

[23]William R. Klecka, "Discriminant Analysis," in Norman H. Nie, C. Hull, Jean Jenkins, Karim Steinbrenner and Dale Bent, Statistical Package for the Social Sciences, 2nd ed. (New York: McGraw-Hill, 1975), p. 435.

[24]Robert A. Eisenbeis and Robert B. Avery, Discriminant Analysis and Classification Procedures. Theory and Application (Lexington, Massachusetts: Lexington Books, 1972), p. 1.

[25]Derivation of the linear discriminant function is presented in most of multivariate statistics texts such as Hoel (1947, pp. 121-125), Cooley and Lohmes (1971, pp. 243-250) and Tatsuoka (1971, pp. 157-164).

[26]Data were taken from P. G. Hoel, Introduction to Mathematical Statistics (John Wiley & Sons, Inc., 1947), p. 125.

[27]Similar computations had been done by T. Daniel, "Discriminant Analysis for the Prediction of Business Failures," p. 22-24.

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CHAPTER IV

RESEARCH METHODOLOGY

The purpose of this chapter is to summarize the research methodology used in this study. This chapter deals with data collection, the way in which the cost of capital was measured, the method used to charge interest to accounts and the method by which the prediction model was implemented.

Data Collection

A list of 48 bankrupt firms was developed from a variety of public sources of financial information. Three factors were considered in collecting the primary sample of bankrupt firms: 1) an operational definition of a bankrupt firm, 2) the industrial classification from which the sample was drawn, and 3) the number of annual time periods to be included in the study.

For this study a bankrupt firm is a firm which has filed for bankruptcy under either Chapter X or Chapter XI of the National Bankruptcy Act. Although this definition is a narrow definition of bankruptcy, it provides an unambiguous way of identifying a bankrupt firm for prediction purposes. The terms "nonbankrupt" and "continuing" are thus defined

as those firms which have not filed for bankruptcy under Chapter X or Chapter XI of the National Bankruptcy Act during the period 1973 to 1977.

Only manufacturing firms were included in this study. Companies engaged in wholesale and retail trades were excluded because these firms need relatively little long term financing and they turn over funds more rapidly than do manufacturing companies. Firms engaged in transportation, construction, financing and mining were excluded because they are subject to special laws and regulations.

Financial statements for five years before the fiscal year of bankruptcy were collected for each company. The selection of a five-year period was based on previous studies which indicate that the financial ratios of a firm can be used to predict whether or not that firm is a potential bankrupt firm as early as six years before the fact.[1]

Sample of Bankrupt Firms

The development of a sample of bankrupt companies started with the identification of those firms that filed under either Chapter X or Chapter XI of the National Bankruptcy Act over a period of five years, from 1973 to 1977. A preliminary list of such firms was obtained mainly from the Wall Street Journal Index,[2] Moody's Industrial Manual,[3] and Moody's OTC Manual.[4] This list was only a preliminary guide, because the Wall Street Journal Index discloses only the name of the firm and the date on which it applied for

protection under either Chapter X or Chapter XI of the National Bankruptcy Act. The annual issues of Moody's Industrial Manual and Moody's OTC Manual include a list of all firms that were included in last year's issue but were excluded from the current issue for reasons such as bankruptcy, merger or change of name. Every company included in the primary list was checked with Moody's Industrial Manual and Moody's OTC Manual in order to identify the industrial classification of the firm and to be certain of the bankruptcy status of that company.

The main source of financial statements for most of the firms included in the study were Moody's Industrial Manual and Moody's OTC Manual. However, Standard and Poors Corporation Records was used as a secondary source of financial statements for those firms for which the financial statements for 1977 were not included in either Moody's Industrial Manual or Moody's OTC Manual. Standard and Poor's compustat tapes were useful for continuing firms but not for bankrupt firms because they are updated regularly and include information about continuing firms only.

The list of bankrupt firms that was compiled in accordance with the above procedures appears in Table 4-1. The next step was to develop a matching list of continuing firms.

Sample of Continuing Firms

After the list of bankrupt firms was developed, a

TABLE 4-1

List of Bankrupt Firms

Firm	Name	Year of Bankruptcy
1.	Alan Wood Steel Co.	1977
2.	American Beef Packers, Inc.	1975
3.	American Book Stratford	1973
4.	American Girls Fashions, Inc.	1975
5.	Armac Enterprises, Inc.	1976
6.	Bevis Industries, Inc.	1974
7.	Botany Industries, Inc.	1973
8.	Bowmar Instrument Corp.	1975
9.	Commodore Corporation	1974
10.	Computer Communication, Inc.	1973
11.	Curits Electro Corp.	1974
12.	DAC Development Corp.	1973
13.	Detro Scales, Inc.	1973
14.	Drew National Corporation	1975
15.	Duplan Corporation	1976
16.	Eagle Clothes, Inc.	1977
17.	Electro Data, Inc.	1973
18.	Electro Space Corporation	1974
19.	Fields Plastic & Chemicals, Inc.	1977
20.	Furntee Industries, Inc.	1974
21.	Goodway, Inc.	1973
22.	Gray Manufacturing Co.	1977
23.	Gruen Industries, Inc.	1974
24.	Hers Apparel, Inc.	1974
25.	House of Knitting	1975
26.	Hydroculture, Inc.	1975
27.	Kirby Industries, Inc.	1975
28.	Leader International	1973
29.	Maule Industries, Inc.	1976
30.	Metro Meat Packing, Inc.	1974
31.	Old Town Corporation	1973
32.	Optel Corporation	1977
33.	Optics Technology, Inc.	1974
34.	Pavelle Corporation	1973
35.	Permaneer Corporation	1976
36.	Potter Instrument Co., Inc.	1975
37.	Republic Aluminum Co.	1974
38.	Sequoyah Industries, Inc.	1974
39.	Stebler Industries, Inc.	1976
40.	Stellar Industries, Inc.	1975
41.	Trio Laboratories, Inc.	1974
42.	United Merchants & Manufactures, Inc.	1977
43.	Vacco Industries	1973
44.	Vogue Instrument Corporation	1973
45.	Walter Read Organization	1977
46.	Washington Group, Inc.	1977
47.	Western Digital Corporation	1976
48.	Willcox & Gibbs, Inc.	1976

list of continuing firms was developed using a matched-pair sampling technique. The proportion of firms that fail during any year varies from industry to industry and from year to year. Because the evidence in support of a particular *a priori* ratio of failed to continuing firms is inconclusive, a matched-pair sample was used.[5]

The criteria used to match firms were: 1) industrial classification, 2) asset size, and 3) fiscal year. Failed firms were matched with firms in the same industry to minimize the effects of the institutional factors that differ across industries. Similarly, consistent reporting periods were used to reduce the differential effects of general economic conditions on the firms in the sample.

In order to assure that the nonbankrupt firm had the same industrial classification as its twin bankrupt firm, an identification was made of the major business activities of the bankrupt firm. The standard industrial classification manual was consulted for this purpose. *Moody's Industrial Manual* or *Moody's OTC Manual* business classification lists were checked in order to identify the group of firms listed in the same classification as the bankrupt firm.

From the resulting group of firms, the one which was closest in total asset size to the bankrupt firm was chosen as the twin bankrupt firm. The major business activities were again reviewed in order to assure similarity with the bankrupt company. These procedures resulted in choosing the 48 nonbankrupt companies listed in Table 4-2.

TABLE 4-2

Matching List of Nonbankrupt Firms

	Firm Name
1.	Bliss & Laughlin Industries, Inc.
2.	Hormel and Company
3.	Stecher-Traung-Schmidt
4.	Wellco Enterprises, Inc.
5.	Gabriel Industries, Inc.
6.	Arts & Leisure Corporation
7.	Wayne Gossard Corporation
8.	Wang Laboratories, Inc.
9.	Coachman Industries, Inc.
10.	Comten, Inc.
11.	SIM-KAR Lighting Fixture Co., Inc.
12.	Sixes Corporation
13.	Rockway Corporation
14.	Campbell Industries
15.	Farah Manufacturing Co.
16.	Spencer Companies, Inc.
17.	Physio-Control Corporation
18.	Tracor, Inc.
19.	Crest-foam Corporation
20.	Vanguard Studies, Inc.
21.	Lehigh Press, Inc.
22.	International Aluminum Corporation
23.	Cohen Hatfield Industries, Inc.
24.	Walls Industries, Inc.
25.	Sue Ann, Inc.
26.	King Juices, Inc.
27.	Michigan General Corporation
28.	Tenna Corporation
29.	Gifford-Hill & Co.
30.	Zemco Industries, Inc.
31.	Speed-O-Print Business Machines Corporation
32.	Rodale Electronics, Inc.
33.	Finning Corporation
34.	Aic Photo, Inc.
35.	GAF Corporation
36.	Data General Corporation
37.	Ohio Valley Aluminum Co.
38.	Shaw Industries, Inc.
39.	Ideal Toy Corporation
40.	Schenuit Industries, Inc.
41.	Keithley Instruments, Inc.
42.	Rapid-American Corporation
43.	Circle Seal Corporation
44.	Astrosystems, Inc.
45.	Downe Communications, Inc.
46.	Champion Products, Inc.
47.	Spectromics, Inc.
48.	Keller Industries, Inc.

Measuring the Cost of Capital

Accounting for the cost of capital necessitates the selection of a method for estimating that cost. The problem is to estimate the cost of capital for accounting purposes, which is not to be confused with the problem of estimating capital costs for investment decisions purposes. In accounting, the problem is to estimate the capital costs for a particular firm given information about the economic conditions that were actually experienced during the period of interest. In capital budgeting, the problem is to forecast capital costs over an extended, future time period.

The sources of funds were divided into three major classes: borrowed capital, preferred stock, and stockholders' equity in terms of book values. The methods used to estimate the costs of each of these sources are described in the next three sections.

Cost of Borrowed Capital

The actual interest expense of short-term borrowing and long-term borrowing as reported in financial statements by conventional financial accounting principles was selected to measure the cost of borrowed capital for this study. This cost was charged to a pool of interest cost as will be described in a later section.

This means that the approximate effective interest rate, not the nominal or contract interest rate, was used to compute the cost of borrowed capital. Bond discount and bond

premiums were considered in computing interest expense. This treatment is in agreement with the economic concept of cost and an application of Accounting Principle Board (APB) Opinion No. 21, which suggested such treatment of computing interest expenses for financial reporting.

Convertible bonds were treated in the same manner because such bondholders maintained a lender's position over the past twelve months, regardless of the position they might take in the future.

Cost of Preferred Stock

Cost of preferred stock for this study was computed by multiplying the rate of dividend which appears in the preferred stock certificate by the book value of preferred stock for each firm. Normally, the cost of preferred stock should be computed by dividing dividends of the period by the share price at the beginning of the period. However, this approach is not applicable in the case of bankrupt firms because their financial difficulties often preclude the payment of preferred dividends. The implication that this capital is without cost is inconsistent with the economic concept of the cost of interest. Therefore, the book yield was used to approximate the cost of preferred stock.

Cost of Equity Capital

The measurement of cost of total equity capital was based on an E/P ratio method similar to that suggested by

Ezra Solomon. But in order to avoid a bias against bankrupt firms and to avoid having a negative cost of interest, a unified rate was chosen for all firms included in the study. The reciprocal of Standard and Poor's Common Stock Price/Earnings ratio was used as a cost rate for stockholder equity capital which included common stock, capital surplus and retained earnings. Common stock price/earnings and earnings/price ratios for the ten-year period of this study are presented in Table 4-3.

A variety of methods have been proposed for the measurement of the cost of capital. A summary of the methods that have been proposed is contained in Table 4-4. All of these methods reflect Fisher's theory of interest in that they relate a series of future purchasing power flows to measures of current investment. Each method requires very severe assumptions and none of them is designed to deal with the problem of liquidating firms. As a result, none of the proposed measures is entirely adequate for the problem at hand.

Charging Interest to Cost Objectives

The cost of interest for different sources of financing was computed using the cost rate determination methods described in the previous section. The total interest cost was accumulated in an interest cost pool. This interest cost pool included the interest cost of short-term borrowed

TABLE 4-3

Standard and Poor's Common Stock Price/Earnings And Earning/Price Ratios

Year	P/E	E/P
1977	9.59	.1043
1976	11.68	.0856
1975	11.46	.0872
1974	9.19	.1088
1973	14.79	.0676
1972	19.18	.0521
1971	19.35	.0516
1970	16.19	.0618
1969	17.00	.0588
1968	17.98	.0566

Source: Standard and Poor's Industrial Surveys (New York: Standard and Poor Corporation, 1977).

TABLE 4-4

Brief Summary of the Major Approaches of Computing The Cost of Equity Capital

Model	Definition	Formula
Gordon and Shaprio	The cost of capital is that rate of discount that equates the asset's expected payments with its price[6]	Cost of equity = dividend/price + dividend growth rate
Durand	Rate of return that the businessman must receive in order to maximize his wealth[7]	Cost of equity = $\frac{\text{return on investment}}{\text{stock market value}}$
Modigliani and Miller	Rate of return that equates the market value of a share of common stock with the expected future stream of income to the investor[8]	Cost of equity = $\frac{\text{average of future income}}{\text{current stock market value}}$
Childs	Cost of equity capital is the overall composite net cost rate[9]	Cost of equity = $\frac{\text{expected return from future dividends + market price apr}}{\text{market price adjusted for financing costs}}$
Staubus	The cost of using the capital is the cost of acquiring it (opportunity cost)[10]	Cost of equity = $\frac{\text{yield on bonds + difference between average yield on common stock and bonds}}{\text{one - tax rate}}$
Ezra Solomon	Rate of return is required to justify the active investment of these available funds[11]	Cost of equity = $\frac{\text{future earnings per share}}{\text{market price}}$

TABLE 4-4 (Continued)

Model	Definition	Formula
Sharpe and Lintner	The cost of equity capital is the rate of return that incorporates time and risk factors.[12]	Cost of equity = risk free rate + risk premium*

*The risk premium is computed as follows:

$$\left(\frac{\bar{R}_m - i}{\sigma_m^2}\right)(r_{jm}\sigma_j\sigma_m)$$

where

$\bar{R}_m$ represents the expected value of the market return

i represents the risk free rate of return

σ_m^2 represents the variance of the probability distributions of the market return

$(r_{jm}\sigma_j\sigma_m)$ represents the covariance of returns of security j with the market return.

funds, long-term borrowed funds and equity capital.

For example, the total interest cost of firm X is accumulated in its interest cost pool in the following manner:

1. The actual interest expense of short-term borrowing and long-term borrowing was computed in accordance with generally accepted accounting principles and reported in the financial statements of firm X.

2. The interest cost of preferred stock was computed by multiplying the book value of preferred stock by the rate of preferred dividends which appears in the preferred stock certificates of firm X.

3. The interest cost of stockholders equity capital was computed by multiplying the book value of stockholders' equity capital of firm X by Standard and Poors Earning/Price Ratio, which is the reciprocal of the Price/Earning Ratio.

The total interest cost that was accumulated in the interest cost pool was then charged to the accounts, cost of goods sold, inventories and selling, administrative and general expenses. This allocation of interest cost was made in proportion to the ratio of these account balances as reported in financial statements (Figures 4-1 and 4-2).

For example, the total interest cost of firm X, which is accumulated in the manner described above, is allocated among 1) the cost of goods sold, 2) inventory, and

3) selling, administrative and general expenses. The allocation was computed by multiplying each one of these three balances by a factor, which was obtained by dividing the total cost of interest of firm X as such total appears in the interest cost pool of firm X into the sum of 1) the cost of goods sold, 2) inventory and 3) selling, administrative and general expenses.

The totals of these three amounts as originally given in the financial statements were by this method recomputed to include the total interest cost. Consequently, most other amounts in the financial statement also had to be recomputed. However, the after-tax net income was left unchanged because the implicit cost of interest is not a deductible expense for tax purposes.

Charging the cost of interest to cost objectives by this method is consistent with the allocation theory which provides that production facilities or fixed assets used in the manufacturing process are depreciated according to a predetermined depreciation rate. Depreciation expense becomes part of the cost of manufactured products. Therefore, the part of depreciation expense that is absorbed by products sold is reported as a part of the cost of goods sold in the income statement at the end of the accounting period. The remainder of the depreciation expense is absorbed by products in stock, and is reported as a part of the related inventory cost. Depreciation expenses on fixed assets used for marketing or administrative purposes are reported in the income

statement as a part of periodical expenses.[13]

Although the approach proposed in this paper agrees in principle with that which Anthony suggested (1973), some details of the procedure are different. Anthony does not suggest how the cost of each different source of financing is to be computed, but once such cost rates are determined, the cost of different sources is computed and charged to the interest cost pool. The total interest cost is divided by the total capital employed to obtain a weighted interest rate. This rate is used by Anthony to compute the interest cost of using a single asset or a group of assets. The resulting cost is charged to cost objectives, such as individual job orders or cost centers, according to an appropriate allocation criterion. The cost of goods sold, the cost of inventory, and general and administrative expenses absorb a portion of interest cost via these allocation procedures. According to Anthony, any interest cost which remains, i.e., is not charged to cost objectives or cost centers, is added to the general expenses in order to clear off the balance of the interest cost pool.[14]

Illustrative Example

In order to illustrate the adjustments which are needed for incorporating cost of interest within financial statement, a specific example is provided in Figure 4-1. The illustrative example shows that a total interest cost of $65.50 was computed by multiplying balance sheet figures, of short-term borrowed capital, long-term borrowed capital and stockholders equity capital by interest rates which were

assumed to be 7%, 8% and 12% respectively. This cost was accumulated in an interest cost "pool."

The total interest cost should be charged to cost objectives or cost centers in accordance with an acceptable allocation criterion. It is agreed that amounts which are charged to cost objectives or cost centers end up in one or more of three end-of-account period balances; these accounts are cost of goods sold, inventory, and selling, general and administrative expenses. In this study each one of these accounts was charged a fair share of interest cost. This share was computed by dividing the total interest cost by the sum of the cost of goods sold, inventory and selling, general and administrative expenses and then multiplying by the balance of the account which was to be charged. The cost of interest that was charged to the cost of goods sold, for instance, was computed as follows:

$$\frac{\text{Total Cost of Interest}}{\text{Cost of Goods Sold + Inventory + Adjusted S.G.\&A. Exp.}} \times \text{Cost of Goods Sold}$$

In the illustrative example total cost was allocated as follows:

Interest cost charged to cost of goods sold =

$$\frac{65.50}{680 + 150 + (220 - 23.5)} \times 680 = \$43.50$$

Interest cost charged to inventory =

$$\frac{65.60}{1026.50} \times 150 = \$9.50$$

FIGURE 4-1

Financial Statements with and without Cost of Capital

Balance Sheet		Without Cost of Capital		With Cost of Capital
Assets				
Current Assets (less inventory)		$ 100.00		$ 100.00
Inventory		150.00		159.57
Fixed Assets		500.00		500.00
TOTAL		$ 750.00		$ 759.57
Liabilities & Equity				
Current liabilities (less short-term loan)		$ 100.00		$ 100.00
Short-term loan at 7%		50.00		50.00
Long-term debt at 8%		250.00		250.00
Common stock } at 12%[1]		100.00		100.00
Retained Earnings } at 12%[1]		250.00		259.57
TOTAL		$ 750.00		$ 759.57
Income Statement				
Sales Revenue		$1000.00		$1000.00
Cost of Goods sold	$680		$723.39	
Selling, General and Administrative Exp.	220	900.00	209.04	932.43
Income before taxes		100.00		67.57
Income Taxes[2]		50.00		50.00
Net Income		$ 50.00		$ 17.57

[1] A hypothetical E/P ratio.

[2] Assuming corporate income tax rate of 50%.

FIGURE 4-2

Interest Pool

Cost of short-term loan	$ 3.50
Cost of long-term debt	20.00
Cost of equity capital	42.00
TOTAL	$65.50
To cost of goods sold	43.50
To inventory	9.50
To selling, general and administrative expenses	12.50
TOTAL	$65.50

Interest cost charged to S.G.&A. exp. =

$$\frac{65.50}{1026.50} \times 195.50 = \$12.50$$

It is worth mentioning that the interest cost that was charged to income for the conventional accounting model is subtracted from the balance of selling, general and administrative expenses in order to avoid double counting.

Due to the fact that the only information available for this study was that which was reported in financial statements, the proposed allocation approach is to be used for study purposes only; it should not be used for price decisions, for instance, or for any managerial accounting decisions. Such decisions need more detailed financial information.

Predictive Models

The thesis of this study is that adjusting the published financial statements to incorporate the cost of capital to the entity will increase the power of financial ratios for predicting firms' bankruptcy. This hypothesis is restated into a more clearly testable form as follows:

H_o: The probability of correct classification of firms into bankrupt or nonbankrupt classes with financial statements partially adjusted to reflect the cost of capital is equal to or less than the probability of correct classi-

fication with unadjusted financial statements.

H_1: The probability of correct classification of firms into bankrupt or nonbankrupt classes is greater with financial statements partially adjusted to reflect the cost of capital.

In order to find empirical evidence in support of one of the two competing hypotheses, 35 financial ratios were derived from the conventional financial statements of the selected firms. These ratios were used as independent variables to predict a well defined event, "business bankruptcy." The financial statements were adjusted to include cost of capital, and the financial ratios were recomputed from the new set of financial statements. Predictive tests were performed for the new set of financial ratios. Comparison of prediction results for the conventional model and the cost-of-capital model was made to find the change in prediction ability of financial ratios if they were derived from adjusted-for-cost-of-interest financial statements.

Chi-square tests of predictive results were performed to find whether the change was statistically significant and thus whether to accept or reject the stated hypotheses. Three predictive models were used as prediction instruments. These are the following:

Year by Year Predictive Model

Multiyear Predictive Model

Altman Bankruptcy Predictive Model

A brief description of these models will be included in the following sections, which explain the procedures of this study.

Year by Year Predictive Model

In accordance with the procedure of this instrument of prediction, year by year financial statements both with and without cost of capital were analyzed. Prediction tests were conducted for financial statements of each year, and no more than one-year's financial statements were combined and analyzed together. All selected financial ratios (Table 3-4) were introduced as independent variables to predict business bankruptcy.

Prediction was achieved by forming a multivariable discriminant function for each individual firm included in this study. Every selected financial ratio participated in this function. The multivariate discriminant function was in this form:

$$Z_i = b_o + b_1x_{1i} + b_2x_{2i} + b_3x_{3i} + \ldots + b_nx_{ni}$$

where

Z_i represents an overall discriminant score,

$b_1, b_2, \ldots b_n$ represent discriminant coefficients of variables 1 through n, and

$x_{1i}, x_{2i}, \ldots x_{ni}$ represent the n independent variables for the ith firm.

Once discriminant functions were formed and the discriminant scores (Z) of each firm were computed, classification

procedures were followed.

According to an individual firm's discriminant function score (Z_i), the firm was classified into a bankrupt or nonbankrupt group with patterns most similar to its own. This was accomplished through the aid of classification equations for each group. Each classification equation yielded a probability of group membership, and the individual firm was classified into the group for which it had the highest probability of being a member.

Variables Reduction. It was not possible to use all 35 financial ratios all together for discriminant functions of 35 independent variables, because some of these variables caused singularity in the within-groups' covariance matrix and had to be dropped; the remaining variables then led to biased results. For this reason, reduction of the original 35 financial ratios into a manageable number of variables was found necessary. The stepwise selection procedures were adapted to choose the financial ratios which provide the greatest power to discriminate between the two groups.

The stepwise selection procedure is a method to compute the linear discriminant function by which variables are selected according to their discriminant power while the remaining variables are omitted. Different computer programs are available to perform the selection procedures. For this study, the "Subprogram DISCRIMINANT"[15] which was

designed and programed by James Tuccy and William Klecka was used. In accordance with this program, the procedures started with the selection of the variable which maximizes F ratio and Rao's V and minimizes Wilk's Lambda as selection criteria.

This selected variable was then paired with each of the remaining variables, one at a time, and the selection criteria were computed. The new variable which in conjunction with the initial variable produced the best criterion values was selected as the second variable to "enter the equation." These two were then combined with each of the remaining variables, one at a time, to form triplets which were evaluated on the criterion. The triplet with the best criterion value determined the third variable to be selected. This procedure of locating the next variable that would yield the best criterion score, given the variables already selected, continued until all variables were selected or no additional variables provided a minimum level of improvement.

A "tolerance" test was performed before a variable was actually selected. This test is an instrument to detect situations in which rounding error during the inversion of the pooled within-groups' covariance matrix would have a serious effect upon the results.

This program was written not only to add a new variable but also to discard some variables which were previously selected if the selection criterion proves that they lose

their discriminating power due to the inclusion of a new variable.

The Wilk's Lambda Statistic for all the variables under consideration was computed as a selection criterion. This statistic measures the discriminating power gained or lost by adding or removing a variable. The variable which minimizes Wilk's Lambda maximizes the overall multivariate F ratio which indicates the differences among the group centroids.

Rao's V, another selection criterion, measures the generalized distance. Increase in Rao's V which is caused by adding new variables means increase in separation of variables, which implies that the added variable has more discriminating power. Rao's V was also used as a criterion in this study.

Multiyear Predictive Model

In accordance with the procedure of the multiyear predictive model, data of more than one year were combined and analyzed together. Prediction tests were also performed to determine what kind of change in prediction accuracy would occur if more than one year's data were combined.

Stepwise selection procedures were applied to select the most powerful combination of financial ratios in discriminating between the two groups.

The set of variables selected by the year-by-year predictive model was used as raw data for the multiyear

predictive model. Multiyear predictive discriminant analysis was performed by combining the two or three sets of financial ratios. Accordingly, in order to perform the discriminant analysis for the first and the second year prior to bankruptcy jointly, the selected set of financial ratios to form the discriminant function of the first year prior to bankruptcy and the set of ratios that was selected to form the discriminant function of the second year prior to bankruptcy were combined. The selected sets of ratios that were used to compute the discriminant function of the first, the second and the third year prior to bankruptcy were combined for the purpose of performing the multivariate predictive discriminant analysis of the first three consecutive years prior to bankruptcy.

The same method was applied for the four-year and the five-year combinations. Four different combinations were tested:

1. Financial ratios of the first year and the second year prior to bankruptcy

2. Financial ratios of the first, the second and the third year prior to bankruptcy

3. Financial ratios of the first, the second, the third and the fourth year prior to bankruptcy

4. Financial ratios of the first, the second, the third, the fourth and the fifth year prior to bankruptcy.

A multivariate discriminate function was formed for each firm included in this study. Financial ratios derived from the financial statements of each year were included in the combination. For instance, if the ratios of the first year and the second year before bankruptcy were combined, a discriminant coefficient had ratios derived from the financial statements of both years:

$$Z_i = b_1x_{1it} + b_2x_{2it} + b_3x_{3it} + \cdots b_nx_{nit}$$

where

$b_1, b_2, \cdots b_n$ represent discriminant coefficients

$x_{1it}, x_{2it}, \cdots x_{nit}$ represent the financial ratios, and

Z_i represents an overall index.

Selected financial ratios were combined for the first year and the second year before bankruptcy, each ratio of each year being considered as an observation of an independent variable. The third year financial ratios were added to the combination, and the fourth year as well as the fifth year. Predictive results of these combinations were compared with each other and at the same time with one year predictive results. The effects of including cost-of-capital predictive results for each combination were compared with those which excluded cost-of-capital results. Statistical significance tests were then performed in order to reach an objective conclusion.

Altman Predictive Model

The model which Altman (1968) developed for predicting business bankruptcy is as follows:

$$Z = .012x_1 + .014x_2 + .033x_3 + .006x_4 + .999x_5$$

where

x_1 = the ratio of working capital to total assets

x_2 = the ratio of retained earnings to total assets

x_3 = the ratio of earnings before interest and taxes to total assets

x_4 = the ratio of market value of equity to book value of debt

x_5 = the ratio of sales to total assets, and

Z = overall index.

The five variables (financial ratios) were selected by Altman according to the following selection criteria: 1) observation of the statistical significance of various alternative functions including determination of the relative contributions of each independent variable, 2) evaluation of intercorrelations between the relevant variables, 3) observation of the predictive accuracy of the various profiles, and 4) judgement of the analyst.[16]

For classification purposes, Z score cutoff points were determined by Altman to be 1.81 and 2.67. Accordingly, in this study a firm was classified as bankrupt with a Z

score of 1.81 or less, and as nonbankrupt with a Z score of 2.67 or more, with a nonclassified area located between the two cutoff points.

An empirical analysis involving these three predictive models has been performed. Such empirical tests involved a comparison of the predictive results of these models using data derived from conventional financial statements and data derived from adjusted for cost of capital financial statements. A discussion of these results will be presented in Chapter V.

CHAPTER IV FOOTNOTES

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[12]See James C. Van Horn, Financial Management and Policy, 3rd Ed. (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1974), pp. 118-119.

[13]Robert N. Anthony, Accounting for Cost of Interest (Lexington, Massachusetts: Heath and Company, 1975), p. 84.

[14]Ibid., pp. 85-92.

[15]Norman H. Nie, C. Hadlai Hull, Jean G. Jenkins, Karin Steinbrenner and Dale H. Bent, Statistical Package for the Social Sciences, 2nd Ed. (New York: McGraw-Hill, 1975), pp. 434-67.

[16]Edward I. Altman, Corporate Bankruptcy in America (Lexington, Massachusetts: Heath and Company, 1971), p. 62.

CHAPTER V

THE EMPIRICAL RESULTS

Three models were used to evaluate the predictive value of cost of capital adjustments. The three models utilized were: 1) year-by-year multivariable discriminant analysis, 2) multiyear, multivariable discriminant analysis, and 3) Altman's discriminant model. Statistical tests were conducted to determine the significance levels of any differences between predictive performance using both adjusted and unadjusted ratios. Results of the prediction tests and the related significance levels are presented in this chapter.

Year by Year Multivariate Discriminant Analysis

As indicated previously, 35 financial ratios were chosen as independent variables to perform the multivariate discriminant analyses for this study. It was not possible to include all 35 variables since some were omitted because they caused singularity in the within-groups covariance matrix and the remaining variables led to relatively biased results. For this reason, instead of using all selected variables to participate directly in creation of the

discriminant function, reduction procedures were used to choose the most powerful variables to form the discriminant function.

A stepwise selection method was adopted to select the most powerful financial ratios in discriminating between the two groups of this study. The stepwise selection procedures are incorporated into the Computer Program Discriminant which was used in this study. According to the selection criteria described in Chapter IV, different sets of variables were selected to form the discriminant function of each year. The selected variables as well as values of selection criterion are presented in Tables A-1 to A-10, Appendix A.

Although the theoretical or financial reason behind the variation in the ratios that are included in the analysis each year is beyond the scope of this study, the technical or the statistical reason for such variation is presented in these tables. Table A-1, for instance, lists all first year's financial ratios which were found to be better able to discriminate between the two groups when costs of interest were not included within financial statements. This table demonstrates that every selected variable contributed to minimize Wilks' Lambda and maximize Rao's V. Selection procedures started with Wilk's Lambda of 0.66610 and a Rao's V of 38.59900 and ended with Wilks' Lambda of 0.39217 and Rao's V of 119.36688. Only 19 financial ratios were selected for

the first year before bankruptcy because the remaining financial ratios were no longer able to contribute to further discrimination.

A multivariate discriminant test was performed for each year using the selected financial ratios to form the discriminant functions and to classify individual observations into groups according to the value of the discriminant function of each firm without cost of capital. Classification into groups takes place where every individual firm is classified into the group with the pattern most similar to its own. This is accomplished statistically through the aid of classification equations, one for each group. The classification equation is derived from the pooled within-groups covariance matrix and the centroids for the discriminant variables. The computed classification coefficients are then multiplied by the raw variable values, summed together and added onto a constant. Each classification equation yields a probability of group membership, and the individual firm is classified into the group for which it has the highest probability of being a member. Similar multivariate discriminant tests have been performed for financial ratios derived from financial statements which were adjusted for costs of interest and for every year up to five years prior to bankruptcy. The comparative predictive results of these tests are presented in Table 5-1, as well as in Figure 5-1.

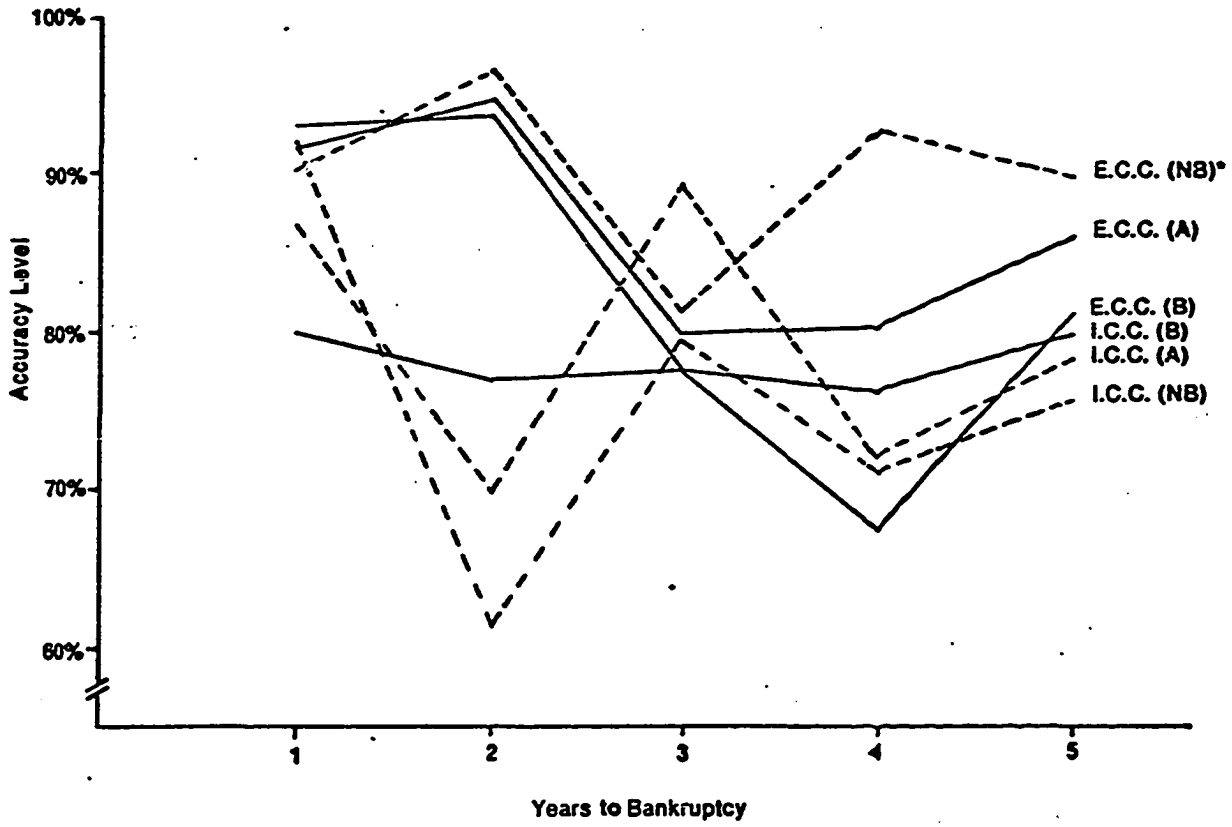
The overall, year by year comparative results of

TABLE 5-1

Comparative Predictive Accuracy Using Year by Year Predictive Model

Years to Bankruptcy	Classes	Excluding Cost of Interest			Including Cost of Interest			χ^2
		Bankrupt	Continuing	Overall	Bankrupt	Continuing	Overall	
1	Actual	34	45	79	34	45	79	
	Correctly classified	32	41	73	27	42	69	1.112
	Incorrectly classified	2	4	6	7	3	10	
	Percentages of correctly classified	94.1	91.1	92.41	79.4	93.3	87.34	
2	Actual	44	48	92	47	48	95	
	Correctly classified	42	47	89	36	30	66	1.633
	Incorrectly classified	2	1	3	11	18	29	
	Percentages of correctly classified	95.5	97.9	96.7	76.6	62.5	69.47	
3	Actual	48	47	95	48	47	95	
	Correctly classified	37	38	75	37	37	74	0.031
	Incorrectly classified	11	9	20	11	10	21	
	Percentages of correctly classified	77.1	80.9	78.95	77.1	78.7	77.89	
4	Actual	48	45	93	48	45	93	
	Correctly classified	32	42	74	36	32	68	1.406
	Incorrectly classified	16	3	19	12	13	26	
	Percentages of correctly classified	66.7	43.3	79.57	75	71.1	73.12	
5	Actual	46	39	85	46	39	85	
	Correctly classified	37	35	72	37	29	66	1.385
	Incorrectly classified	9	4	13	9	10	19	
	Percentages of correctly classified	80.4	89.7	84.71	80.4	74.4	77.65	

Figure 5-1
Comparative Predictive Accuracy using year by year predicictive model



*ECC (NB) = Excluding cost of capital nonbankrupt firms
ECC (B) = Excluding cost of capital bankrupt firms
ECC (A) = Excluding cost of capital overall
ICC (NB) = including cost of capital nonbankrupt firms
ICC (B) = including cost of capital bankrupt firms
ICC (A) = including cost of capital overall

prediction of business bankruptcy do not show that inclusion of costs of capital within financial statements improves the ability of financial ratios which are derived from those financial statements to predict business bankruptcy. Table 5-1 shows that financial ratios that were derived from a set of conventional financial statements led to prediction of business bankruptcy with 92.14% overall accurate results one year prior to bankruptcy. When the same set of financial statements was adjusted to include costs of interest, prediction accuracy level dropped slightly to 87.34%. Or in absolute numbers, 73 firms out of 79 were correctly classified without cost of interest, and 69 out of 79 firms were correctly classified with cost of interest. That is, ten firms were incorrectly classified with costs of interest while only six firms were misclassified without costs of interest. The difference between the overall predictive results of the two models was not statistically significant. It scored only 1.112 of χ^2 scores, which is less than the critical value of the chi square table of 3.85 under .05 level of significance.

Two years prior to bankruptcy, the conventional model led to more accurate bankruptcy prediction results than did the adjusted-for-cost-of-capital model. Of all firms, 96.7% or 89 out of 92 were correctly classified without inclusion of costs of interest. On the contrary, 69.47% or 66 firms out of 95 were correctly classified with costs of interest.

But the difference is still not statistically significnat. The χ^2 score of the second year prior to bankruptcy is 1.633 which is less than the above mentioned critical value of the chi square statistic. The predictive results of the third, fourth and the fifth years prior to bankruptcy show the same trend. The difference between the overall predictive results of the two models was not statistically significant in any of the last three years. Table 5-1 shows that the third year, the fourth year and the fifth year prior to bankruptcy resulted in χ^2 scores of .0313, 1.406 and 1.398, respectively. Each one of these scores is less than the critical value of the chi-square table which was mentioned above.

A glance at Table 5-1 and Figure 5-1 leads to a conclusion supporting the null hypothesis of this study, that the probability of correct classification into bankrupt or nonbankrupt classes with financial statements including costs of capital is equal to or less than the probability of correct classification without cost of capital. This means that the null hypothesis cannot be rejected according to the evidence which is derived from the empirical results. But the effect of the inclusion of costs of interest or ability of financial ratios as an instrument of prediction of business failure becomes clearer with two more points to be mentioned later.

Closer examination of Table 5-1 and Figure 5-1 shows that inclusion of cost-of-interest within financial state-

ments has more effect on bankrupt firms than on nonbankrupt firms during the first year prior to bankruptcy. For the first year prior to bankruptcy only two firms out of thirty-four were misclassified without cost of capital, while seven firms out of thirty-four were misclassified with cost-of-capital model. Or in terms of percentages, 94.1% of bankrupt firms were correctly classified without cost-of-capital at the first year in contrast with 79.4% of bankrupt firms which were correctly classified at the same year with cost of capital. The impact cost of capital adjustments on bankrupt firms was even more desparate at the second year prior to bankruptcy. In this year 95.5% of bankrupt firms were correctly classified without cost of capital in contrast with 76.6% correctly classified with cost of capital. Or, in more specific terms, forty-two firms out of forty-four were correctly classified without cost of capital at the second year prior to bankruptcy, while thirty-six firms out of forty-seven were correctly classified with cost-of-capital at the same year.

Results of the third year and fifth year predictions prior to bankruptcy show no impact at all on bankrupt firms. For the third and fifth years prior to bankruptcy respectively, 77.1% and 80.4% of bankrupt firms were correctly classified with and without cost-of-capital.

Comparing the results of classification of bankrupt firms with the classification results of nonbankrupt firms

shows that inclusion of cost of interest has less effect, but a continuing effect, on the nonbankrupt firms. For the second year through the fifth year prior to bankruptcy, the conventional model led to more accurate results than the adjusted for cost-of-capital model. The second year prior to bankruptcy shows that 97.9% of nonbankrupt firms were correctly classified without cost of capital included in financial statements. The results for the same year of the adjusted for cost-of-capital model show that only 69.47% of nonbankrupt firms were correctly classified. The empirical results of the third, fourth and fifth years of the conventional model are 80.9%, 93.3% and 89.7% of nonbankrupt firms were correctly classified. These results are compared with 78.7%, 71.1% and 74.4% of nonbankrupt firms were correctly classified with adjustments for cost-of-capital for the same years. Only the first year prior to bankruptcy showed that the adjusted for cost-of-capital model led to more accurate results than did the conventional model for nonbankrupt firms. Of nonbankrupt firms 93.3% or 42 out of 45 firms were correctly classified with adjusted for cost-of-capital model in contrast with 91.1% or 41 out of 45 firms correctly classified with the conventional model.

Tables A-1 through A-10 show that for each year two sets of financial ratios were selected, one set for the conventional model and the other for the cost-of-capital model. Examination of these tables shows that a limited

number of financial ratios participated in forming the discriminant functions of each, that a larger number of financial ratios participated in the creation of discriminant functions for four years out of five, and that another set of financial ratios contributed to form discriminant functions for three years out of five. The financial ratios that participated in creation of discriminant functions of only one year or two years out of five are less than the financial ratios which contributed to form the discriminant functions of three or four years.

Using the conventional model, some financial ratios were eliminated during the selection procedures and were not included in the discriminant function of any year. Tables 5-2 and 5-3 regroup financial ratios according to their involvement in the creation of discriminant functions of each year. Table 5-2, which regroups financial ratios of the traditional model, shows that only three ratios--total assets to long-term debt, retained earnings to total assets and market value of equity to total debt--played some role to form the discriminant functions in all five years. Six ratios--namely, total assets to total debt and income before taxes to total assets, income before interest and taxes to sales, inventories to receivables, inventories to net worth and inventories to total assets--were eliminated during the selection procedures of every year and did not participate in forming discriminant functions of any year.

TABLE 5-2

Financial Ratios that Contributed to Form the Discriminant Function for the Conventional Model

All 5 Years	Four Years Only	Three Years Only	Two Years Only	One Year Only	0 Years
TA/LTD	NW/TD	CA/TD	CA/CL	CAM/CL	TA/TD
RE/TA	NW/LTD	WC/TD	IBIT/INT	INV/CL	IBT/TA
MVE/TD	IBT/EQ	IBIT/TA	INV/WC	NW/CL	IBIT/S
	IBT/INT	IBIT/EQ	INV/CA	IBT/S	INV/REC
	IBIT/EQ	S/WC		S/CA	INV/NW
	S/INV	S/TA		S/CAM	INV/TA
	WC/CMS	WC/TA			
	FA/NW				
	NW/TA				

TABLE 5-3

Financial Ratios that Contributed to Form the Discriminant Function for the With-Cost-Of-Interest Model

All 5 Years	Four Years Only	Three Years Only	Two Years Only	One Year Only	No Contribution
RE/TA	S/CAM	TA/LTD	CAM/CL	CA/TD	CA/CL
IBT/TA	INV/REC	IBIT/S	INV/CL	WC/TD	NW/TD
S/INV	WC/CMS	S/CA	NW/LTD	IBIT/EQ	TA/TD
S/WC	FA/NW	S/TA	IBIT/INT	INV/CA	IBT/S
WC/TA	INV/WC	S/EQ	NW/CL	INV/TA	INV/NW
		MVE/TD	IBT/INT		
			IBIT/TA		
			IBIT/EQ		
			NW/TA		

Nine financial ratios took a role in forming the discriminant functions in four years out of five and seven ratios, four ratios and six ratios participated in forming the discriminant functions in three years, two years and one year out of five, respectively.

Table 5-3 regroups financial ratios according to the number of years in which a ratio participated in the creation of discriminant functions with cost of interest. This table shows that five financial ratios took a role in all five years. These ratios were retained earnings to total assets, income before taxes to total assets, sales to inventories, sales to working capital and working capital to total assets. On the other hand, five financial ratios did not participate in the forming of discriminant functions in any year of the period of the study. These ratios are current assets to current liabilities, net worth to total debt, total assets to total debt, income before interest and taxes to sales, and inventories to net worth. Five ratios only participated in the creation of discriminant functions of four years out of five, and six ratios, nine ratios and five ratios took a part in forming discriminant functions of three years, two years, and one year, respectively.

It is important to point out that it is not a true statement to say that an individual ratio which participated in forming discriminant function in all fives years has more discriminant power over a ratio which participated in only

four years or less, either with or without costs of capital, because the power of each ratio is measured by its Wilks' Lambda and Rao's V relative to other ratios every year.

Selection of two sets of financial ratios each year, one set for the conventional model and the other for the cost of capital model, indicates another form of the impact of inclusion of cost of capital within financial statements. However, analyzing and measuring this impact requires studying the behavior of the individual financial ratios which is beyond the scope of this study. Such behavioral impact is suggested as a topic of future research.

Multiyear Predictive Model

Most of the previous studies that dealt with the prediction of corporate bankruptcy analyzed every-year financial statements independently and came up with prediction results which show how far financial ratios are able to detect financial difficulties. The year-by-year analysis reported in the previous section led to a similar conclusion--that the ability of financial ratios to predict business bankruptcy decreases with increasing length of time from the year of bankruptcy.

This section explains a method of testing the accuracy of the predictions of bankruptcy when financial ratios of more than one year were pooled to form discriminant functions. Financial ratios of each year were considered as independent observations. Values of one ratio for more

than one year were not added or averaged in this method.

In the year-by-year analysis, different sets of financial ratios were selected to form discriminant functions of each year. In other words, a set of ratios was selected for the first year prior to bankruptcy, another set of ratios was selected for the second year prior to bankruptcy, etc. Table 5-4 presents the different sets of financial ratios which were selected every year for both models. It is true that some ratios participated in forming discriminant functions of more years than some other ratios. But there was no indication that total assets to long-term debt or retained earnings to total assets which were selected for all five years have more discriminating power than income before taxes to total assets which was selected for one year only.

Table 5-4 shows that even if a ratio participated in more than one year's discriminant function, such participation did not take a continuing course. Current assets to total debt, for instance, was selected for the first year, the third year and the fifth year before bankruptcy, but not for the second year or the fourth year where the conventional model was concerned. And sales to equity was selected for the first year, the third year and the fifth year prior to bankruptcy for the adjusted for cost-of-capital model. For those reasons, it was not easy to determine what ratio or ratios the researcher should choose for the combined model.

TABLE 5-4

Sets of Comparative and Financial Ratios that Formed The Discriminant Functions of Each Year

	Excluding Costs Of Interest					Including Costs Of Interest				
	Years To Bankruptcy					Years To Bankruptcy				
Financial Ratios	1	2	3	4	5	1	2	3	4	5
CAM/CL			X						X	X
CA/CL	X			X						
INV/CL		X					X	X		
CA/TD	X		X		X				X	
WC/TD	X	X		X		X				
NW/TD	X	X	X	X						
NW/LTD		X	X	X	X		X		X	
TA/TD										
NW/CL					X	X			X	
TA/LTD	X	X	X	X	X	X	X		X	
RE/TA	X	X	X	X	X	X	X	X	X	X
IBT/S					X					
IBT/TA						X	X	X	X	X
IBT/EQ	X	X		X	X		X			
IBT/INT	X	X		X	X	X	X			
IBIT/S								X	X	X
IBIT/TA		X		X	X		X			X
IBIT/EQ		X	X		X	X	X			
IBIT/INT				X	X	X		X		
S/INV	X		X	X	X	X	X	X	X	X
S/CAM						X		X	X	X
S/CA			X			X				X
S/WC	X	X			X	X	X	X	X	X
S/TA	X		X	X		X		X		X
S/EQ	X			X		X		X		X
INV/REC						X	X	X	X	
WC/CMS		X	X	X	X		X	X	X	X
FA/NW	X	X		X	X	X	X	X	X	
INV/TA						X				
INV/NW										
INV/WC						X		X	X	X
INV/CA	X				X			X		
NW/TA	X	X		X	X			X	X	
WC/TA	X			X	X	X	X	X	X	X
MVE/BVD	X	X	X	X	X	X			X	X

But in order to facilitate selection decisions, combining the whole two or three sets of financial ratios was, for this reason, found appropriate. Or in other words, the set of ratios selected by the year-by-year predictive model was used as raw data for the multiyear predictive model.

Accordingly, the selected set of financial ratios to form the discriminant function of the first year and the set of ratios that was selected to perform the discriminant function of the second year prior to bankruptcy were combined in order to create a discriminant function with ratios of the first year and second year as independent variables. To form the discriminant function of the first three years prior to bankruptcy, the selected set of financial ratios of the third year was combined with the selected ratios of the two previous years, and so on for the fourth and the fifth year.

These procedures produced four different combinations. These combinations are as follows:

1. Financial ratios of the first year and the second year prior to bankruptcy

2. Financial ratios of the first, the second and the third years prior to bankruptcy

3. Financial ratios of the first, the second, the third and the fourth years prior to bankruptcy

4. Financial ratios of the first, the second, the third, the fourth and the fifth years prior to bankruptcy. Two sets of financial ratios for each combination were pre-

sented in Tables A-11 to A-18, Appendix A, and a summary of these ratios is presented in Tables 5-5 and 5-6. Comparative predictive results of these combinations for both the conventional model and with cost-of-capital model were presented in Table 5-7. The same results were plotted on Figure 5-2. Examination of Table 5-7 and Figure 5-2 shows that the conventional model led to more accurate overall predictive results than did the adjusted for cost-of-capital model in two out of the five combinations presented in the table and the figure. Seventy-three firms out of seventy-nine firms or 94.1% of all firms were correctly classified using only the first year prior to bankruptcy financial ratios without cost of capital. The financial ratios of the same year led to 87.34% or sixty-nine firms out of seventy-nine correctly classified with cost of capital.

Combining the selected variables of the first year and the second year prior to bankruptcy led to seventy-three firms out of seventy-nine or 92.2% of firms correctly classified without cost of capital, and seventy firms out of seventy-nine or 88.6% of all firms correctly classified with cost-of-capital model. More combined years led to more accurate overall predictive results for both models. Combination of the three immediate consecutive years prior to bankruptcy resulted in seventy-seven firms out of seventy-eight firms or 98.72% of all studied firms correctly classified without cost-of-capital. Seventy-two firms out of

TABLE 5-5

Summary of Financial Ratios that were Selected For the Multiyear Predictive Model Without Cost of Capital

Financial Ratios	Years		Years			Years				Years				
	1	2	1	2	3	1	2	3	4	1	2	3	4	5
1. CAM/CL														
2. CA/CL					X				X					
3. INV/CL														
4. CA/TD	X		X		X	X				X				X
5. WC/TD		X	X	X		X								
6. NW/TD	X			X	X		X							
7. NW/LTD		X		X										
8. TA/TD														X
9. NW/CL														
10. TA/LTD														
11. RE/TA	X	X	X	X	X	X				X				X
12. IBT/S	X	X	X	X	X	X	X	X		X		X		
13. IBT/TA														X
14. IBT/EQ														
15. IBT/INT	X	X	X	X										X
16. IBIT/S	X	X	X	X		X				X				X
17. IBIT/TA														
18. IBIT/EQ				X			X		X		X			
19. IBIT/INT	X	X	X	X	X	X								
20. S/INV	X		X		X	X		X	X	X			X	
21. S/CAM	X			X				X						
22. S/CA					X									
23. S/WC	X		X	X		X								
24. S/TA	X		X		X	X				X				
25. S/EQ	X		X		X									
26. INV/REC														
27. WC/CMS				X	X			X						
28. FA/NW		X	X	X		X	X			X	X			X
29. INV/TA														
30. INV/NW	X													X
31. INV/WC					X									
32. INV/CA														
33. NW/TA	X			X			X							X
34. WC/TA	X		X			X			X				X	
35. MVE/BVD	X	X	X	X	X				X				X	X

TABLE 5-6

Summary of Financial Ratios that were Selected For the Multiyear Predictive Model With Cost of Capital

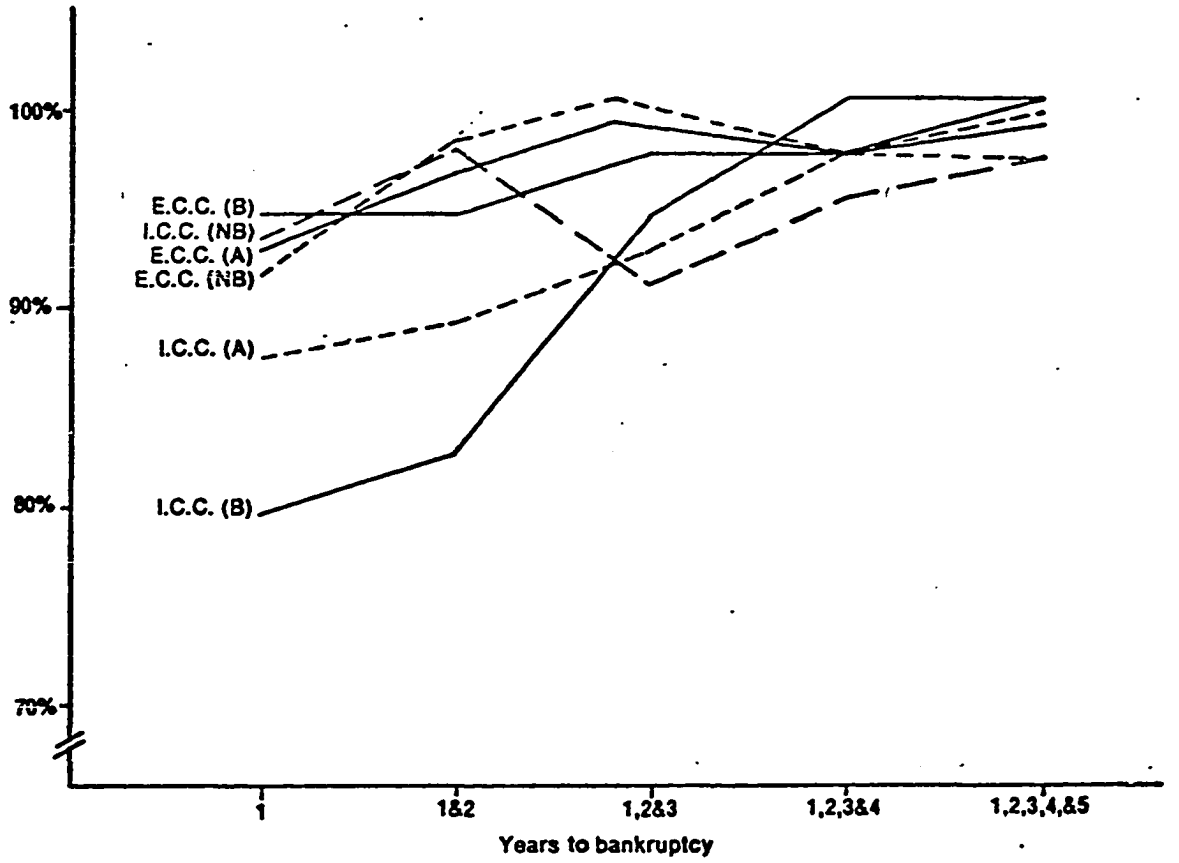
Financial Ratios	Years		Years			Years				Years				
	1	2	1	2	3	1	2	3	4	1	2	3	4	5
1. CAM/CL														
2. CA/CL														
3. INV/CL		X		X			X				X			
4. CA/TD									X				X	
5. WC/TD	X		X			X				X				
6. NW/TD														
7. NW/LTD		X		X					X				X	
8. TA/TD	X		X		X	X		X		X		X		
9. NW/CL														
10. TA/LTD									X				X	
11. RE/TA		X		X										X
12. IBT/S	X	X	X		X	X		X		X		X		X
13. IBT/TA														
14. IBT/EQ	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15. IBT/INT		X												
16. IBIT/S		X		X			X				X			
17. IBIT/TA					X			X				X		
18. IBIT/EQ		X												
19. IBIT/INT	X	X												
20. S/INV	X				X									
21. S/CAM	X		X		X	X		X	X	X			X	X
22. S/CA														X
23. S/WC		X							X					X
24. S/TA	X													
25. S/EQ					X									
26. INV/REC	X		X	X	X	X	X	X		X	X	X		
27. WC/CMS		X		X	X		X	X				X		
28. FA/NW	X		X			X			X	X			X	
29. INV/TA														
30. INV/NW	X		X			X				X				X
31. INV/WC														
32. INV/CA	X													
33. NW/TA				X				X						
34. WC/TA		X		X	X		X	X	X		X	X	X	X
35. MVE/BVD	X		X						X				X	X

TABLE 5-7

Comparative Predictive Accuracy Using Multiyear Predictive Model

Years to Bankruptcy	Classes	Excluding Cost of Interest			Including Cost of Interest			χ^2
		Bankrupt	Continuing	Overall	Bankrupt	Continuing	Overall	
1	Actual	34	45	79	34	45	79	
	Correctly classified	32	41	73	27	42	69	1.112
	Incorrectly classified	2	4	6	7	3	10	
	Percentages of correctly classified	94.1	91.1	92.41	79.4	93.3	87.34	
1 & 2	Actual	34	45	79	34	45	79	
	Correctly classified	32	44	73	28	42	70	.644
	Incorrectly classified	2	1	6	6	3	9	
	Percentages of correctly classified	94.1	97.8	92.2	82.4	97.7	88.6	
1, 2 & 3	Actual	34	44	78	34	44	78	
	Correctly classified	33	44	77	32	40	72	3.739
	Incorrectly classified	1	0	1	2	4	6	
	Percentages of correctly classified	97.1	100	98.72	94.1	90.4	92.3	
1, 2, 3 & 4	Actual	34	42	76	34	42	76	
	Correctly classified	33	41	74	34	40	74	0
	Incorrectly classified	1	1	2	0	2	2	
	Percentages of correctly classified	97.1	97.6	97.37	100	95.2	97.37	
1, 2, 3, 4 & 5	Actual	32	37	69	32	37	69	
	Correctly classified	32	36	68	32	36	68	0
	Incorrectly classified	0	1	1	0	1	1	
	Percentages of correctly classified	100	97.3	98.55	100	97.3	98.55	

Figure 5-2
Comparative Predictive Accuracy using Multiyear Predictive model



*ECC (NB) = Excluding cost of capital nonbankrupt firms
ECC (B) = Excluding cost of capital bankrupt firms
ECC (A) = Excluding cost of capital overall
ICC (NB) = Including cost of capital nonbankrupt firms
ICC (B) = Including cost of capital bankrupt firms
ICC (A) = Including cost of capital overall

seventy-eight firms or 92.3% of all firms were correctly classified with cost-of-capital model. Combination of the selected financial ratios of the four immediate consecutive years prior to bankruptcy resulted in seventy-four firms out of seventy-six or 97.37% of all firms correctly classified with the conventional model. At the same time, seventy-four firms out of seventy-six or 97.31% of all firms were correctly classified with the adjusted for cost-of-capital model. Combination of selected financial ratios for all five years prior to bankruptcy produced very accurate predictive results for both models. Sixty-eight firms out of sixty-nine or 98.55% of all firms were correctly classified without cost of capital. The same combination of years led to sixty-eight firms out of sixty-nine, or 98.55% of all firms included in the study, correctly classified with adjusted for cost-of-capital model.

Some concluding points were derived from the overall predictive results of the multiyear predictive model. These results support a conclusion which was reached in the previous section, i.e., that incorporating cost of capital within financial statements does not improve the ability of financial ratios derived from these statements to predict business bankruptcy. It is true that the overall predictive results of the conventional model for the first combination and the second combination are more accurate than the overall predictive results of the adjusted for cost-of-capital model.

But the difference in accuracy between results of the two models in the combinations mentioned is not statistically significant as is shown by the X^2 scores of these two combinations, where the combination of the first year financial ratios with the second year financial ratios is .644. Combination of the three immediate consecutive years prior to bankruptcy resulted in X^2 scores of 3.74. Each one of the two X^2 scores is less than the critical value of the chi-square table of 3.85 under .05 level of significance. In the light of the overall results the null hypothesis of this study cannot be rejected.

Another point is that combining financial ratios of more years prior to bankruptcy improves the ability of financial ratios to predict business bankruptcy for both the conventional model and the adjusted for cost-of-capital model. Examination of Table 5-7 indicates that combining financial ratios of more than one year improves the ability of financial ratios to correctly classify each group's members. This table shows that 94.1% of all bankrupt firms or thirty-two firms out of thirty-four were bankrupt firms correctly classified when the selected ratios of the first year and the second year prior to bankruptcy were combined without cost of capital. The same combination produced 82.4% or twenty-eight out of thirty-four bankrupt firms which were correctly classified with the adjusted for cost-of-capital model.

Comparing the predictive results for the first two years prior to bankruptcy with the predictive results for the first year prior to bankruptcy shows that combined predictive results are more accurate than the one year predictive results for both models. The first year prior to bankruptcy predictive results of bankrupt firms are thirty-two out of thirty-four or 94.1% and twenty-seven out of thirty-four, or 79.4% of all bankrupt firms correctly classified for the conventional model and the adjusted for cost-of-capital model, respectively. The predictive results were improved remarkably for both models when the selected financial ratios of the three immediate consecutive years prior to bankruptcy were combined.

Only one firm out of thirty-three, and two firms out of thirty-four bankrupt firms, were misclassified for the conventional and the cost-of-capital models, respectively. Adding the set of financial ratios of year four to the combination of the first three years prior to bankruptcy led to 97.1% of bankrupt firms correctly classified. A combination of all selected ratios of all five years prior to bankruptcy generated the highest level of predictive accuracy of any combination of consecutive years prior to bankruptcy. The predictive results were 100% and 100% of bankrupt firms correctly classified for the conventional model and cost-of-capital model, respectively.

Classification results of nonbankrupt firms show

that using the conventional model led to more accurate predictive results with more years added to the analysis up to the third year prior to bankruptcy where 100%, 97.8% and 100% of nonbankrupt firms were correctly classified with more years added to the combination.

Combining selected financial ratios of more than one year improved the predictive results of cost-of-capital model as well. In this case predictive results of nonbankrupt firms improved from 93.3%, with only selected ratios of the first year prior to bankruptcy studied, to 97.7% and 97.3% of correct classification when selected ratios of the second year and the fifth year prior to bankruptcy were added to the combination.

The evidence supports the conclusion that combining financial ratios of more than one year make the multiyear predictive model more powerful in detecting systems of financial difficulties which sometimes appear as early as five years prior to bankruptcy.

Altman Predictive of Bankruptcy Model

Altman (1968) came to the conclusion that five financial ratios are valid instruments for prediction of failure. These ratios are:

1. Working capital to total assets
2. Retained earnings to total assets
3. Earnings before interest, and taxes to total assets

4. Market value of equity to book value of debt

5. Sales to total assets.

He formed what has become known as the Altman Model for Prediction of Bankruptcy.

The Altman model was used as a control model for the prediction of business failure for the 96 firms included in this study, with and without cost of capital data. The comparative prediction results of both models, the conventional and cost-of-capital model, are presented in Table 5-8 and Figure 5-3.

Examination of Table 5-8 and Figure 5-3 shows that the overall prediction results of the conventional model are more accurate than the overall prediction results of the adjusted model in three out of five years, although the adjusted for cost-of-interest model led to slightly more accurate prediction results in two years out of the studied five years. Starting with the first year prior to bankruptcy, the conventional model led to 79.48% or sixty-two out of seventy-eight firms correctly classified. For the same year, 77.2% or sixty-one cases out of seventy-nine firms were correctly classified by the adjusted-for-cost-of-interest model.

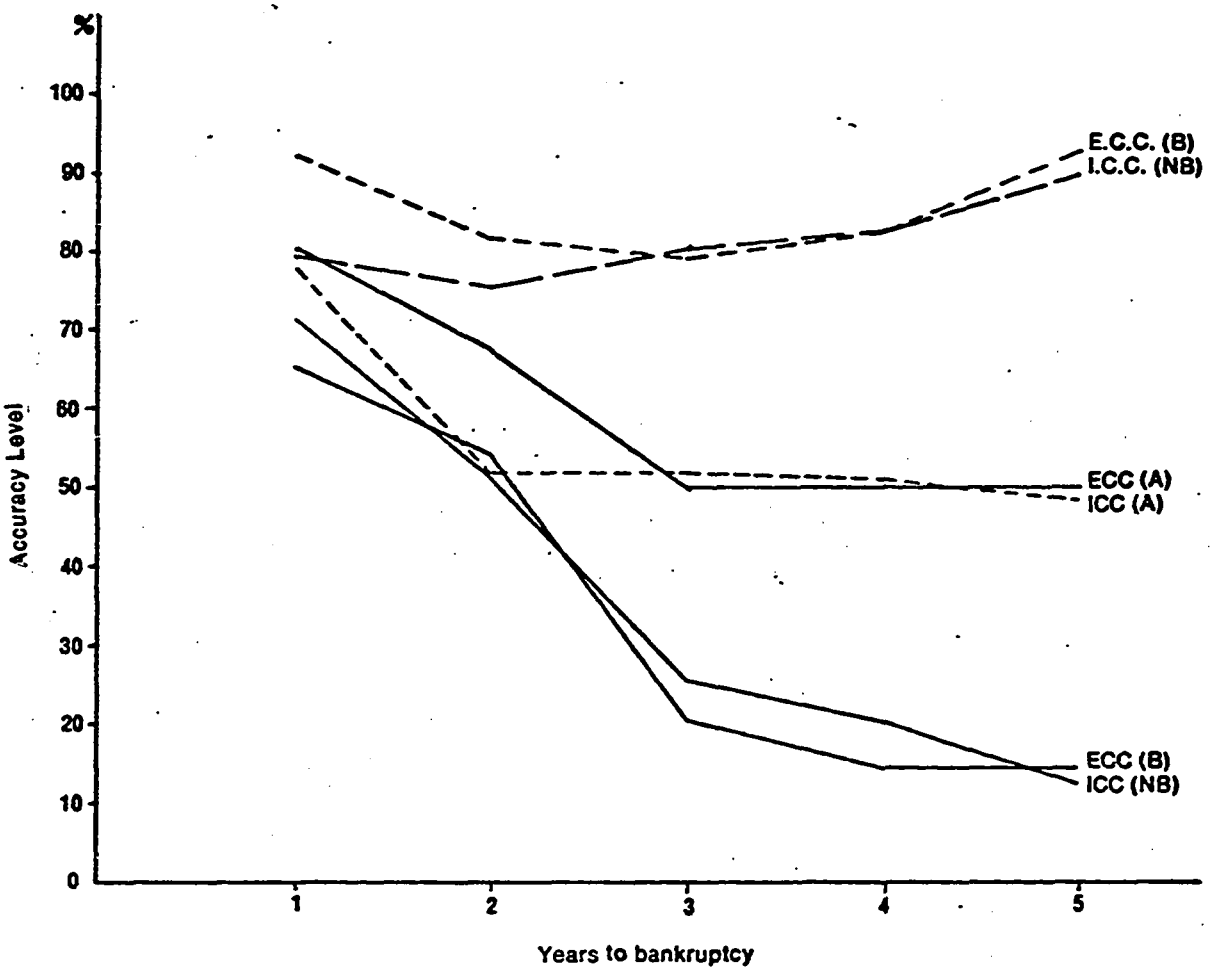
Moving to the second year prior to bankruptcy, the conventional model led to a correct classification of 66.7% or sixty-two firms out of ninety-three firms, and 52.6% or fifty firms out of ninety-five correctly classified with the cost of interest included. At the third year prior to

TABLE 5-8

Comparative Predictive Accuracy Using Altman Predictive Model

Years to Bankruptcy	Classes	Excluding Cost of Interest			Including Cost of Interest			χ^2
		Bankrupt	Continuing	Overall	Bankrupt	Continuing	Overall	
1	Actual	34	44	78	34	45	79	
	Correctly classified	22	40	62	24	37	61	
	Incorrectly classified	6	0	6	5	3	8	
	Unclassified	6	4	10	5	5	10	
	Percentages of cor. clas.	64.7	90.9	79.48	70.5	78.7	77.2	
2	Actual	47	46	93	47	48	95	
	Correctly classified	25	37	62	24	36	50	
	Incorrectly classified	10	2	12	11	4	15	
	Unclassified	12	7	19	12	8	20	
	Percentages of cor. clas.	53.2	80.4	66.7	51	75	52.6	
3	Actual	48	47	95	48	47	95	
	Correctly classified	10	37	47	12	37	49	.056
	Incorrectly classified	21	3	24	20	3	23	
	Unclassified	17	7	24	16	7	23	
	Percentages of cor. clas.	20.1	78.7	49.4	25	78.7	51.5	
4	Actual	48	43	91	48	45	93	
	Correctly classified	7	37	44	10	37	47	.163
	Incorrectly classified	28	1	29	24	3	27	
	Unclassified	13	5	18	14	5	19	
	Percentages of cor. clas.	14.5	86	48.35	20	82.2	50.5	
5	Actual	48	39	87	46	39	85	
	Correctly classified	7	36	43	6	34	40	
	Incorrectly classified	29	0	29	26	1	27	
	Unclassified	10	3	13	14	4	18	
	Percentages of cor. clas.	14.5	92.3	49.4	13	87.1	47	

Figure 5-3
Comparative Predictive Accuracy using Altman Predictive model



*ECC (NB) = Excluding cost of capital nonbankrupt firms
ECC (B) = Excluding cost of capital bankrupt firms
ECC (A) = Excluding cost of capital overall
ICC (NB) = Including cost of capital nonbankrupt firms
ICC (B) = Including cost of capital bankrupt firms
ICC (A) = Including cost of capital overall

bankruptcy, where the adjusted for cost-of-interest model led to more accurate results, forty-seven firms out of ninety-five firms or 49.4% were correctly classified with the conventional model in comparison with forty-nine out of ninety-five firms or 51.5% of firms correctly classified with cost of capital at the same year. But the difference between the predictive results of the two models is not statistically significant. The χ^2 score resulting from that difference is .056 which is less than the critical value at the 95% confidence level. The fourth year results showed the same trend where the correctly classified firms with the conventional model were 48.35% compared to 50.5% of correct classification for the adjusted for cost-of-interest model. In this year, too, the difference is not statistically significant. It resulted in a χ^2 score of .163, which is not significant at the 95% level. The fifth year results showed that the conventional model led to more accurate prediction results than the adjusted for cost of interest model. Table 5-8 shows that these two models reported 49.4% and 47% of correct classification of both models, respectively.

The overall predictive results that were reached by applying the Altman model support the null hypothesis of this study--that the probability of correct classification into bankrupt or nonbankrupt classes with cost of capital is equal to or less than the probability of correct classifica-

tion without cost of capital.

Further examination of Table 5-8 and Figure 5-3 shows that incorporating cost of capital within financial statements led to more accurate classification of bankrupt firms than did a method using financial ratios from the conventional financial statements. Twenty-two bankrupt firms out of thirty-four or 64.7% were correctly classified using the conventional model, while for the same year, twenty-four firms out of thirty-four bankrupt companies or 70.5% were correctly classified with the adjusted for cost-of-capital model. Analyzing financial statements of the second year prior to bankruptcy shows that twenty-five bankrupt firms out of forty-seven or 53.2% were correctly classified for the conventional model, compared with twenty-four bankrupt firms out of forty-seven or 51% correctly classified with adjusted for cost-of-interest model. Third year data show that ten firms out of forty-eight of 20.1% of bankrupt firms were correctly classified with the conventional model, in contrast with twelve firms out of forty-eight or 25% of bankrupt firms correctly classified with the adjusted for cost-of-interest model.

Although the predictability of the Altman model was reduced in the fourth year prior to bankruptcy for the conventional model and the adjusted for cost-of-capital model as well, the latter model leads to a more accurate classification of bankrupt firms in this year also. Seven firms out

of forty-eight or 14.5% of bankrupt firms were correctly classified with the conventional model. But ten firms out of forty-eight or 20% of bankrupt firms were correctly classified for the adjusted for cost-of-capital model.

The fifth year results show that the conventional model led to slightly more accurate classification. In this year, 14.5% of bankrupt firms were correctly classified in comparison with 13% of bankrupt firms correctly classified with the adjusted for cost-of-interest model. Table 5-8 and Figure 5-3 show the predictive classification results of nonbankrupt firms also.

For all five years the conventional model produced more accurate classification results than the adjusted-for-cost-of-capital model; 90.9% of the nonbankrupt firms were correctly classified with the conventional model compared to 78.7% of nonbankrupt firms correctly classified at the first year prior to bankruptcy using the adjusted model; 80.4%, 78.7%, 86.1% and 92.3% of nonbankrupt firms were correctly classified with the conventional model at the second year to the fifth year prior to bankruptcy, respectively. The adjusted for cost-of-capital model led to correct classification rates of 75%, 78.7%, 82.2% and 87.1% nonbankrupt companies during the same years.

The a priori expectation is that the predictive results for nonbankrupt firms would take a nearly horizontal path over the five years for both models, while the correctly

TABLE 5-9

Bankrupt Firms Which Were Reclassified Using Altman Model: Comparison of Classification Derived from Conventional Model with Classification Derived from Cost-of-Interest Model

Firms	Excluding Cost of Interest					Including Cost of Interest				
	1	2	3	4	5	1	2	3	4	5
Alan Wood Steel Co.	B	B	?	?	B	B	B	?	B	B
Detro Scales Inc.	?	?	?	N	N	?	?	?	?	N
Drew National Corporation		B	?	?	B		B	?	?	?
Duplan Corporation	B	B	?	?	N	B	B	?	?	?
Eagle Clothes Inc.	?	B	?	?	N	?	?	?	?	?
Furntee Industries, Inc.	B	B	?	?	?	B	B	?	B	?
Gray Manufacturing Co.	B	?	?	N	?	B	?	?	?	?
Gruen Industries, Inc.	B	B	?	N	N	B	B	?	?	N
Optel Corporation		B	B	B	B		?	B	B	B
Pavell Corporation	B	B	?	N		B	B	B	N	
Permaneer Corporation		?	N	N	N		N	N	N	N
Republic Aluminum Co.	?	B	N	B	B	B	B	N	B	B
Sequoyah Industries, Inc.	B	?	B	B	N	B	B	B	B	N
Stebler Industries, Inc.		B	?	?	N		B	B	?	?
Trio Laboratores, Inc.	B	?	B	N	N	B	B	B	N	N
United Merchants & Manufactures, Inc.	B	B	?	?	?	B	B	B	?	?
Vogue Instrument Corporation	B	B	?	?	?	B	B	B	?	?
Western Digital Corporation	B	N	N	B	B	B	N	N	B	?

B = Bankrupt N = Nonbankrupt ? = Unclassified = No data

classified bankrupt firms would take a downward path over the five years. Our findings agree with previous findings using the Altman model that prediction of bankruptcy becomes more accurate the closer the researched financial statements are to the year of bankruptcy when the systems of financial as well as operational difficulties appear more clearly. The nonbankrupt classification does not show remarkable fluctuation from year to year because these are healthy firms.

The effect of incorporating cost of capital on prediction of business bankruptcy could be detected better by analyzing the behavior of Z scores of individual observations over the five year period and comparing the individual Z scores that were reached by the two models. According to Altman, cutoff points of 1.81 Z score are required for a bankrupt company and 2.67 Z score for a company to be classifed as nonbankrupt. Nineteen bankrupt firms showed a sufficient change in their Z scores to have them moved from one class to another, in at least one of the five year periods.

Table 5-9 presents these firms and the method by which they were classified according to the conventional model and the with-cost-of-capital model. At the same time, nonbankrupt firms showed a change of Z score sufficient to be classified differently according to the accounting model which is in use. Table 5-10 presents those firms and their

TABLE 5-10

Nonbankrupt Firms Which Were Reclassified Using Altman Model: Comparison of Classification Derived from Conventional Model with Classification Derived from Cost-of-Interest Model

	Excluding Cost of Interest					Including Cost of Interest				
Firms	1	2	3	4	5	1	2	3	4	5
Wellco Enterprises, Inc.	N	N	N	N	N	N	N	N	N	?
Gabriel Industries, Inc.	N	N	N	N	N	?	?	?	N	?
Sixes Corporation		B	B	?	N		B	B	B	?
Tracor, Inc.	?	?	B	?	N	?	?	B	B	N
Cohen Hatfield Industries, Inc.	N	?	?	?	?	?	?	?	?	?
Michigan General Corporation	?	?	?	?	?	B	?	?	?	B

B = Bankrupt N = Nonbankrupt ? = Unclassified = No data

classification behavior over the five years for both models. Table 5-9 shows that a bankrupt firm is likely to be classified as bankrupt with cost of capital more often than without cost of capital. Examination of Table 5-8 shows that twelve firms were not classified as either bankrupt or nonbankrupt at the third year prior to bankruptcy with financial statements not having cost-of-interest. These firms produced Z scores less than 2.67 and greater than 1.81, which are the Altman Cutoff Points for a firm to be classified as a nonbankrupt or bankrupt, respectively.

With cost of interest incorporated within financial statements, five firms produced Z scores of less than 1.81 and they were classified as bankrupt firms. Pavell Co., for instance, scored 2.469 without cost of interest at the third year prior to bankruptcy, but it gave a 1.315 Z score when cost of interest was included within its financial statements. Similarly, Republic Aluminum gave a 1.999 Z score without cost of interest at the first year prior to bankruptcy. It was, accordingly, not classified as either bankrupt or nonbankrupt. However, this same firm gave a 1.776 Z score at the same year when cost of interest was included within its financial statements.

Examination of Table 5-10 shows also that incorporating cost of capital within financial statements has an effect on the classification of nonbankrupt firms as well. Sixes Corporation, for instance, had Z scores of 2.016 and

3.217 for the fourth and the fifth year prior to bankruptcy when cost of interest was not included with the financial statement. For this reason, Sixes Corporation was classified as nonbankrupt as of the fifth year, but it was classified as neither bankrupt nor nonbankrupt as of the fourth year. When cost of interest was included within the financial statements, Sixes Corporation gave scores of 1.683 and 2.492 for the fourth and fifth years prior to bankruptcy, respectively. Because the first Z score is less than the Altman lower cutoff point of 1.81, the firm was classified as bankrupt at the fourth year; and because the second Z score is less than 2.67 and greater than 1.81, Altman cutoff points, the firm could not be classified as either bankrupt or nonbankrupt as of the fifth year.

Conclusions

The principal finding of this study is that the empirical evidence that was gathered for 96 firms with total assets between $50,000 and $190,000,000 does not support the major hypothesis of this study: incorporating the cost of capital within the accounting books and reporting such cost in firms' financial statements will increase the power of financial ratios to predict firms' bankruptcy.

Some minor concluding points reached by this study are also of some significance. E.g., this study presented more empirical evidence about the validity or usefulness of

financial ratios as an instrument for prediction of business bankruptcy. Using more financial ratios to predict business bankruptcy leads to more accurate predictive results, especially for years not close to the year of bankruptcy. Combining more than one year's financial ratios leads to more accurate predictive results. Improvement of classification accuracy can be reached by combining financial ratios of additional years up to the fifth year prior to bankruptcy.

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APPENDIX

TABLE A-1

Year by Year Predictive Model
Ratios Selected for the First Year Prior to Bankruptcy
Excluding Costs of Interest

Variable		F to Enter	Wilks'	
Entered*	Removed	Or Remove	Lambda	Rao's V
R12Y1		38.59904	0.66610	38.59900
R04Y1		6.83532	0.61113	48.99573
R21Y1		5.95288	0.56619	58.99615
R16Y1		4.71954	0.53225	67.66974
R06Y1		2.91825	0.51179	73.45305
R19Y1		2.60889	0.49389	78.90453
R35Y1		2.26120	0.47865	83.86952
R23Y1		2.02384	0.46520	88.52023
R33Y1		1,79011	0.45343	92.81438
R02Y1		1.31515	0.44483	96.11575
R11Y1		1.11654	0.43754	99.00044
R20Y1		1.25205	0.42939	102.33965
R24Y1		2.45685	0.41375	109.11715
R25Y1		0.95996	0.40764	111.90921
R30Y1		0.41655	0.40496	113.15761
R28Y1		0.35430	0.40266	114.24397
R15Y1		0.31740	0.40058	115.24167
R05Y1		0.27010	0.39878	116.10771
R34Y1		0.99426	0.39217	119.36688

*For Tables A-1 to A-18, R represents ratios in the same order as in Table 3-5 and Y represents years prior to bankruptcy.

TABLE A-2

Year by Year Predictive Model
Ratios Selected for the Second Year Prior to Bankruptcy
Excluding Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R05Y2		14.75417	0.86308	14.75402
R27Y2		2.82141	0.83739	18.05858
R11Y2		2.49934	0.81501	21.10884
R16Y2		2.14963	0.79600	23.83424
R12Y2		1.75859	0.78057	26.14276
R07Y2		1.31883	0.75822	29.65619
R06Y2		1.24249	0.75822	31.06390
R23Y2		0.98705	0.74962	31.06390
R28Y2		0.70107	0.74348	32.08710
R33Y2		0.68731	0.73745	33.11058
R03Y2		0.69380	0.73134	34.16461
R10Y2		0.57714	0.72622	35.05951
R18Y2		0.73188	0.71972	36.21660
R15Y2		0.81878	0.71243	37.53073
R35Y2		0.30835	0.70966	38.04012

TABLE A-3

Year by Year Predictive Model
Ratios Selected for the Third Year Prior to Bankruptcy
Excluding Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R27Y3		16.09930	0.85243	16.09924
R24Y3		6.56657	0.79564	23.87993
R25Y3		10.28339	0.71486	37.08772
R22Y3		3.92036	0.68502	42.75345
R06Y3		3.41239	0.65973	47.95798
R04Y3		2.17820	0.64379	51.44678
R11Y3		1.87021	0.63024	54.55170
R07Y3		4.18361	0.60101	61.72969
R19Y3		1,61189	0.58982	64.66397
R35Y3		1.33850	0.58057	67.17708
R31Y3		1,07984	0.57311	69.26088
R20Y3		0.69401	0.56830	70.63388
R12Y3		0.72693	0.56325	72.10280
R02Y3		0.20837	0.56179	72.41121

TABLE A-4

Year by Year Predictive Model
Ratios Selected for the Fourth Year Prior to Bankruptcy
Excluding Costs of Interest

Variable Entered	Variable Removed	F to Enter Or Remove	Wilks' Lambda	Rao's V
R34Y4		17.36252	0.83977	17.36235
R35Y4		2.85166	0.81398	20.79582
R28Y4		1,60287	0.79958	22.80908
R20Y4		1.47249	0.78642	24.71336
R24Y4		1.73307	0.77106	26.89165
R02Y4		1.48627	0.75796	28.93279
R12Y4		1.25601	0.74693	30.69717
R06Y4		1.13655	0.73695	32.33904
R15Y4		1.03805	0.72785	33.87601
R18Y4		1.41110	0.71873	35.47139
R31Y4		0.85240	0.71124	36.79005
R33Y4		0.80333	0.70417	38.06483
R11Y4		0.71619	0.69784	39.24512
R07Y4		3.12457	0.67097	44.45796
R16Y4		0.34728	0.66795	45.05183
R08Y4		9.31839	0.59500	61.74760
R05Y4		0.50752	0.59100	62.77594
R27Y4		0.40942	0.58775	62.82756

TABLE A-5

Year by Year Predictive Model
Ratios Selected for the Fifth Year Prior to Bankruptcy
Excluding Costs of Interest

Variable Entered	Variable Removed	F to Enter Or Remove	Wilks' Lambda	Rao's V
R21Y5		24.29152	0.77359	24.29132
R34Y5		6.12379	0.71984	32.30351
R13Y5		4.49559	0.68198	38.70288
R16Y5		6.94685	0.62750	49.27090
R08Y5		6.86126	0.57735	60.60022
R28Y5		2.79578	0.55737	67.74724
R10Y5		1.93645	0.54370	69.48737
R04Y5		1.92081	0.53030	73.34016
R23Y5		1.75376	0.51818	76.99561
R18Y5		1.84156	0.50560	80.97594
R30Y5		1.79331	0.49347	85.00342
R35Y5		1.55733	0.48303	88.63531
R27Y5		1.20788	0.47495	91.55518
R11Y5		0.74530	0.46994	93.41277
R19Y5		2.28290	0.45489	99.06516
R33Y5		0.36655	0.45245	100.04488
R15Y5		0.34781	0.45012	100.97679
R07Y5		0.36859	0.44762	101.79446
R20Y5		0.29230	0.44561	101.82066

TABLE A-6

Year by Year Predictive Model
Ratios Selected for the First Year Prior to Bankruptcy
Including Costs of Interest

Variable Entered	Variable Removed	F to Enter Or Remove	Wilks' Lambda	Rao's V
R20Y1		8.37252	0.90193	8.37248
R30Y1		4.68816	0.84953	13.63870
R24Y1		5.52545	0.79123	20.31630
R34Y1		2.79950	0.76239	23.99577
R23Y1		3.22327	0.73015	28.45348
	R30Y1	0.00576	0.73021	28.44734
R08Y1		2.73962	0.70380	32.40457
R17Y1		2.76458	0.67777	36.60036
R11Y1		3.98786	0.64173	42.97964
R28Y1		2.14556	0.62264	45.65695
R21Y1		1.45633	0.60977	49.26675
R12Y1		1.29396	0.59839	51.66939
R10Y1		1.19280	0.58792	53.95992
R05Y1		3.02140	0.56218	59.93243
R32Y1		0.79510	0.55569	61.53159
R26Y1		2.02278	0.53867	65.74568
R16Y1		2.59583	0.51735	70.41995
R22Y1		0.57450	0.51260	71.74480
R35Y1		0.57070	0.50785	73.13182
R25Y1		0.20177	0.50615	73.62718
R19Y1		0.72552	0.50000	73.76466
	R17Y1	0.10351	0.50088	73.51207
R14Y1		4.90377	0.46244	76.80847
R30Y1		0.40284	0.45925	77.20909

TABLE A-7

Year by Year Predictive Model
Ratios Selected for the Second Year Prior to Bankruptcy
Including Cost of Interest

Variable Entered	Variable Removed	F to Enter Or Remove	Wilks' Lambda	Rao's V
R03Y2		1.63158	0.98276	1.63154
R18Y2		1.57190	0.96625	3.24836
R14Y2		3.68121	0.92868	7.14201
R16Y2		2.28413	0.90569	9.68364
R34Y2		2.27781	0.88309	12.31174
R19Y2		1.37914	0.86947	13.96181
R15Y2		2.04923	0.84946	16.47987
R12Y2		0.92411	0.84043	17.65565
R28Y2		0.68497	0.83371	18.54756
R23Y2		0.65261	0.82728	19.41400
R10Y2		0.47004	0.82258	20.05585
R35Y2		0.32948	0.81929	20.50958
R27Y2		0.72002	0.81207	21.63091
R26Y2		1.79543	0.79425	23.86972
	R10Y2	0.09136	0.79334	23.82550
	R35Y2	0.44090	0.79377	23.80325
R11Y2		0.28266	0.79101	24.20972
R07Y2		1.65098	0.77502	26.61983
R20Y2		0.24010	0.77267	26.98138

TABLE A-8

Year by Year Predictive Model
Ratios Selected for the Third Year Prior to Bankruptcy
Including Costs of Interest

Variable Entered	Variable Removed	F to Enter Or Remove	Wilks' Lambda	Rao's V
R12Y3		15.53885	0.85684	15.53861
R25Y3		5.15837	0.81134	21.62418
R23Y3		2.29496	0.79139	24.51482
R03Y3		2.27467	0.77188	27.48492
R28Y3		1.87860	0.75592	30.02823
R34Y3		2.40587	0.73580	33.39081
R24Y3		3.09493	0.71053	37.88458
R17Y3		1.74527	0.69639	40.54063
R27Y3		2.46121	0.67680	44.40730
R26Y3		1.36050	0.66601	46.86888
R20Y3		1.08604	0.65741	48.70200
R33Y3		0.57384	0.65284	49.69498
R14Y3		0.46957	0.64908	50.58226
R21Y3		0.36739	0.64611	51.24373
R08Y3		0.31887	0.64351	51.87224
R31Y3		0.48518	0.63953	52.86362
R30Y3		1.71490	0.62560	52.95554

TABLE A-9

Year by Year Predictive Model
Ratios Selected for the Fourth Year Prior to Bankruptcy
Including Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R34Y4		8.08654	0.91839	8.08498
R25Y4		3.43276	0.88465	11.86366
R28Y4		2.22959	0.86303	14.44046
R30Y4		2.13038	0.84263	16.99297
R01Y4		2.01428	0.82356	19.49321
R14Y4		1.80498	0.80663	21.81219
R17Y4		1.84779	0.78947	24.26518
R35Y4		1.25147	0.77788	25.98230
R33Y4		1.28401	0.76603	27.79198
R07Y4		0.85848	0.75809	29.03558
R10Y4		0.68506	0.75173	30.05275
R04Y4		2.90787	0.72537	34.72751
R27Y4		0.38866	0.72182	35.41699
R23Y4		0.31317	0.71893	35.92499
R12Y4		3.15322	0.69065	41.68489
	R25Y4	0.02769	0.69040	41.56697
R20Y4		0.82606	0.68307	43.15747
R21Y4		0.47818	0.67880	43.62637
R26Y4		0.51226	0.67419	43.89291

TABLE A-10

Year by Year Predictive Model
Ratios Selected for the Fifth Year Prior to Bankruptcy
Including Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y5		12.50854	0.86903	12.50803
R34Y5		2.39552	0.84436	15.29710
R01Y5		2.80196	0.81613	18.69737
R14Y5		2.09941	0.79526	21.36615
R17Y5		1.52040	0.78025	23.37468
R27Y5		2.60822	0.75500	26.93140
R11Y5		1.26621	0.74279	28.73846
R18Y5		1.66315	0.72688	31.17915
	R34Y5	0.04154	0.72728	31.12209
R24Y5		1.18215	0.71614	32.89709
R25Y5		1.78735	0.69947	35.75198
R30Y5		1.53592	0.68524	38.22374
R20Y5		1.56668	0.67085	40.80884
R34Y5		1.32356	0.65874	43.08397
R22Y5		1.54909	0.64467	45.44821
R23Y5		1.13318	0.63440	47.47913
R35Y5		0.76469	0.62745	48.94482
R21Y5		1.23197	0.61628	49.68250

TABLE A-11

Multiyear Predictive Model
Ratios Selected for the First and the Second Year Prior to Bankruptcy Excluding Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y1		38.59904	0.66610	38.59900
R04Y1		6.83532	0.61113	48.99573
R21Y1		5.95288	0.56619	58.99615
R16Y1		4.71954	0.53225	67.66974
R06Y2		4.87313	0.49894	77.32707
R19Y1		2.75595	0.48055	83.23413
R35Y1		2.36569	0.46505	88.57289
R33Y1		2.01679	0.45203	93.34320
R23Y1		1.87455	0.44007	97.97057
R16Y2		1.85330	0.42839	102.73909
R27Y2		1.78602	0.41727	107.52998
R11Y1		1.27429	0.40937	111.09245
R11Y2		1.06412	0.40277	114.17990
R20Y1		0.77503	0.39795	116.49368
R24Y1		1.92589	0.38615	122.40558
R12Y2		3.43253	0.36589	133.44289
R19Y2		1.21086	0.35877	137.62061
	R33Y1	0.14013	0.35959	137.13086
R15Y2		8.67625	0.31482	167.55370
R05Y1		2.22199	0.30357	176.60698
	R27Y2	0.03965	0.30378	176.44040
R07Y2		1.80043	0.29493	183.96577
R15Y1		2.36456	0.28356	194.37271
R05Y2		1.31229	0.27729	200.41335
R30Y1		0.59482	0.27442	203.30724
R33Y1		0.50457	0.27197	205.82892
R34Y1		0.54741	0.26929	208.42287
	R05Y1	0.03734	0.26948	208.37329
R35Y2		0.49100	0.26709	210.92226
R24Y2		0.40729	0.26509	213.09364
R25Y1		0.33587	0.26342	214.92644

TABLE A-12

Multiyear Predictive Model
Ratios Selected for the First, the Second and the Third Year Prior to Bankruptcy Excluding Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y1		43.22073	0.63747	43.22069
R04Y1		6.95529	0.58337	54.27689
R21Y1		5.78758	0.54106	64.46579
R16Y1		5.41390	0.50629	74.11188
R06Y2		5.44365	0.47070	85.46109
R24Y3		4.31747	0.44372	95.27458
R23Y1		3.20023	0.42432	103.10481
R20Y1		3.24500	0.46526	111.52878
R10Y1		2.81843	0.34913	119.30119
R16Y2		1.83466	0.37876	124.64879
R04Y3		1.54943	0.37907	129.35768
R02Y3		1.82280	0.35998	135.22057
R11Y3		1.56962	0.35136	140.40167
R07Y3		1.73485	0.34194	146.36177
R11Y2		2.15605	0.33045	154.10718
R25Y1		1.36047	0.32321	159.26563
R06Y3		1.47580	0.31545	164.99110
R36Y2		6.52264	0.28405	169.93327
R25Y3		1.41946	0.27727	175.45319
R20Y3		2.90807	0.26381	188.06352
R15Y1		1.33400	0.25767	194.46072
R24Y1		1.32956	0.25159	201.02512
R24Y1		2.18922	0.24178	211.39111
R22Y3		1.18065	0.23651	216.36737
R07Y2		1.15657	0.23137	220.34164
R19Y2		4.67053	0.22837	223.83740
R15Y2		5.53268	0.20561	253.93098
R05Y1		1.53332	0.19938	263.26465
R12Y2		1.43255	0.19360	273.04199
R11Y1		1.10304	0.18916	281.79932
	R11Y2	0.10818	0.18872	282.34351
	R02Y3	0.12797	0.18923	281.70996
RG5Y2		3.18614	0.17745	294.22461
R28Y2		1.26338	0.17280	308.56250
R23Y2		1.18527	0.16846	317.97412
R33Y2		1.68865	0.16205	328.98877

TABLE A-12 (Continued)

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R11Y2		1.51688	0.15723	338.51782
R35Y1		1.12249	0.15323	348.31030
R27Y3		0.83042	0.15026	354.92856
R02Y3		0.98767	0.14672	363.25293
R34Y1		0.70385	0.14419	372.44214
	R07Y3	0.20705	0.14344	372.23633
R14Y2		2.26175	0.13576	395.68890
R35Y3		15.92191	0.09640	400.87549
R31Y3		26.68855	0.95663	323.97510
R27Y2		0.95271	0.05521	309.08594
R19Y3		1.75368	0.05204	293.43579
R12Y3		4.69400	0.5162	300.57031

TABLE A-13

Multiyear Predictive Model
Ratios Selected for the First, the Second, the Third and the Fourth Years Prior to Bankruptcy
Excluding Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y1		41.39847	0.64126	41.39832
R04Y1		7.10649	0.58437	52.63219
R06Y2		5.22852	0.54481	61.82796
R06Y1		5.39913	0.50630	72.15680
R24Y3		5.22781	0.47112	83.06865
R21Y1		4.32047	0.44336	92.90340
R35Y4		3.96464	0.41893	102.63423
R19Y1		3.64859	0.39730	112.25299
R18Y4		3.70727	0.37617	122.71486
R23Y1		2.56058	0.36191	130.46420
R20Y1		2.51233	0.34824	138.49138
R28Y1		3.13108	0.33175	149.05196
R15Y2		0.83341	0.32735	152.04991
R24Y1		0.76486	0.32330	154.86446
R35Y1		0.81296	0.31898	157.98489
R20Y3		0.73418	0.31505	160.87100
R25Y3		0.84582	0.31053	164.29533
R20Y4		0.82680	0.30609	167.76035
R11Y1		0.62286	0.30272	170.44730
R12Y2		0.63731	0.29925	173.27789
R08Y4		0.54307	0.29627	175.76529
	R15Y2	0.09789	0.29681	175.31471
	R35Y1	0.14449	0.29759	174.66640
R12Y3		0.55295	0.29463	177.16507
R02Y4		1.59746	0.28616	184.60402
	R24Y3	0.03356	0.28634	184.44063
R11Y2		0.59789	0.28320	187.25415
	R08Y4	0.11555	0.28381	186.69667
R31Y4		0.45153	0.28140	188.87505
R15Y1		0.33296	0.27970	190.52583
R33Y2		0.31355	0.27802	192.12117
R18Y2		0.35042	0.27612	193.94884
R05Y2		0.26258	0.27468	195.35265
R34Y1		0.29262	0.27305	196.94920
R05Y1		0.61409	0.26960	200.39197
	R11Y2	0.09649	0.27014	199.91805
	R15Y1	0.11665	0.27079	199.26488
	R05Y2	0.14388	0.27157	198.48628
R27Y3		0.63360	0.26817	209.33447
R34Y4		1.32402	0.26111	209.33507
	R25Y3	0.03909	0.26132	209.11707
R28Y2		0.35336	0.25945	211.15953

TABLE A-14

Multiyear Predictive Model
Ratios Selected for the First, the Second, the Third, the Fourth and the Fifth Year Prior to Bankruptcy
Excluding Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y1		37.95753	0.63835	37.95743
R04Y1		5.50474	0.58921	46.71140
R06Y2		5.19275	0.54562	55.79953
R16Y1		9.45149	0.50280	66.25429
R21Y1		5.16685	0.46469	77.18288
R12Y3		4.43083	0.43369	87.48701
R04Y5		4.88648	0.40153	99.86197
R19Y1		4.07512	0.37599	111.19482
R33Y5		3.59643	0.35439	122.05667
R28Y1		2.95452	0.33721	131.68719
R13Y5		2.69685	0.32198	141.08755
R16Y5		3.89207	0.30105	155.54996
R28Y5		2.31076	0.28891	164.90005
R10Y5		0.81732	0.28461	168.40793
R08Y5		0.64429	0.28119	171.79492
R27Y3		1.16652	0.27502	177.19498
R24Y1		0.72337	0.27117	180.67486
R20Y1		0.99714	0.26587	185.59755
R12Y2		0.68898	0.26218	189.14116
R11Y5		0.71412	0.25834	192.95155
R15Y5		0.48900	0.25568	195.64146
R39Y5		0.33151	0.25385	197.53679
R35Y4		0.26484	0.25237	199.09280
P35Y5		0.37856	0.25021	201.36382
	R06Y2	0.02073	0.25033	201.29248
R18Y2		0.28123	0.24874	202.99230
R20Y4		0.32298	0.24689	204.99612
	R1262	0.00016	0.24689	205.03322
R28Y2		0.24332	0.24550	206.53438
R34Y4		0.24278	0.24409	208.15309
	R27Y3	0.05644	0.24441	207.77724

TABLE A-15

Multiyear Predictive Model
Ratios Selected for the First and the Second Year Prior to Bankrupcy Including Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R20Y1		8.37252	0.90193	8.38248
$30Y1		4.68816	0.84953	13.63870
R24Y1		5.52545	0.79123	20.31630
R34Y1		2.79950	0.76239	23.99577
R12Y2		3.52155	0.72730	28.86766
R26Y2		3.03572	0.69788	33.33130
R28Y1		2.65930	0.67272	37.45734
R23Y2		2.03070	0.64835	41.75868
R21Y1		2.13821	0.62887	45.43867
R19Y2		1.93490	0.61147	48.92273
R14Y1		1.82321	0.59527	52.34894
R08Y1		1.85628	0.57898	55.98676
R35Y1		1.34404	0.56726	58.73639
R05Y1		1.09337	0.55773	61.05498
R11Y2		0.85346	0.55027	62.92509
R07Y2		1.76879	0.53501	66.92493
R19Y1		1.80060	0.51967	68.12750
R03Y2		2.22561	0.50108	71.05341
R27Y2		2.55664	0.48027	75.93622
R16Y2		1.75922	0.46613	80.35352
R32Y1		0.50431	0.46204	81.56860
	R26Y2	0.12547	0.46306	81.44067
R26Y1		3.76228	0.43439	91.60181
R12Y1		2.70641	0.41394	100.12622
R26Y2		1.63774	0.40197	106.67578
R18Y2		9.52843	0.34168	110.13281
R14Y2		0.70536	0.33719	111.64453
R15Y2		0.66411	0.33294	113.20313
	R34Y1	0.11016	0.33224	112.25781
R34Y2		0.77329	0.32737	112.24545

TABLE A-16

Multiyear Predictive Model
Ratios Selected for the First, the Second and the Third Year Prior to Bankruptcy Including Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y3		11.26300	0.87093	11.26279
R30Y1		5.99307	0.80649	18.23558
R21Y1		4.03456	0.76479	23.37338
R16Y2		2.65173	0.73798	26.98309
R12Y1		4.82366	0.69164	33.91150
R25Y3		2.70815	0.66623	38.10367
R08Y1		2.62543	0.64215	42.38258
R05Y1		2.96359	0.61570	47.46642
R35Y1		2.27155	0.59580	55.89572
R14Y1		2.29317	0.57608	55.95552
R23Y3		2.16302	0.55780	60.28113
R14Y3		1.87681	0.54215	64.21667
R34Y3		4.21682	0.50863	73.45091
R24Y3		1.90747	0.49369	77.97516
R08Y3		1.45224	0.48239	81.51169
R11Y2		3.10193	0.45904	89.50519
R28Y1		1.24052	0.44975	92.92465
R03Y2		1.01058	0.44217	95.81089
R26Y3		0.87553	0.43560	98.41698
R26Y1		1.93773	0.42128	104.40541
R18Y2		1.79430	0.40820	110.18872
R27Y3		1.67946	0.39631	116.01921
R34Y2		1.18894	0.38777	120.24585
R14Y2		6.35221	0.34627	143.75990
R27Y2		0.33572	0.34405	145.46863
R17Y3		0.84865	0.33842	148.96637
	R08Y3	0.11083	0.33915	148.81151
R26Y2		0.76190	0.33416	155.25241
	R23Y3	0.09535	0.33478	154.73633
R33Y3		0.79948	0.32962	158.47890
R08Y3		0.70162	0.32506	162.39732
	R18Y2	0.09798	0.32569	160.43060
R20Y3		1.08731	0.31876	165.67966
	R24Y3	0.11912	0.31952	165.04085
R07Y2		0.94600	0.31359	169.36537
R21Y3		0.34060	0.31142	171.15240

TABLE A-17

Multiyear Predictive Model
Ratios Selected for the First, the Second, the Third and the Fourth Years Prior to Bankruptcy
Including Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y3		11.52852	0.86521	11.52810
R30Y1		6.10528	0.79843	18.68095
R28Y4		5.45136	0.74223	25.69818
R21Y1		3.56289	0.70677	30.70113
R16Y2		2.84326	0.67918	34.95380
R12Y1		4.11091	0.64099	41.41801
R34Y4		3.15741	0.61255	46.77370
R14Y2		4.50947	0.57392	54.90176
R34Y2		9.92296	0.49891	74.28197
R08Y1		4.03613	0.46974	83.48798
R14Y1		3.18680	0.44746	91.32985
R05Y1		2.57000	0.42992	98.07368
R26Y2		2.18325	0.41530	104.13100
R11Y2		2.21242	0.40076	110.59076
R17Y3		4.01326	0.37564	122.80550
R23Y4		2.21436	0.36205	130.19217
R21Y4		2.33760	0.34802	138.41844
R21Y4		2.33760	0.34802	138.41840
R35Y4		2.40206	0.33395	147.37064
R04Y4		1.49738	0.32525	153.29570
R10Y4		13.14746	0.26250	207.52867
R14Y4		1.66825	0.25464	216.22679
R07Y2		1.45714	0.24782	223.95241
R28Y1		1.12859	0.24256	230.41805
R33Y4		1.11046	0.23739	237.04422
R21Y3		0.58273	0.23465	240.66608
R14Y3		0.65893	0.23154	244.89468
R27Y2		0.65875	0.22841	248.89330
R26Y3		2.89419	0.21516	262.20361
R26Y1		3.96793	0.19807	289.77100
R08Y3		1.38465	0.19216	309.52783
R03Y2		0.81012	0.18868	316.51489
R27Y3		0.44436	0.18675	320.61816
R07Y4		0.30096	0.18543	323.48682
	R07Y2	0.09819	0.18586	322.11841
	R11Y2	0.14711	0.18649	317.73340
R34Y3		0.27005	0.18533	320.15063

TABLE A-18

Multiyear Predictive Model
Ratios Selected for the First, the Second, the Third, the Fourth and the Fifth Year Prior to Bankruptcy
Including Costs of Interest

Variable		F to Enter	Wilks'	
Entered	Removed	Or Remove	Lambda	Rao's V
R12Y3		16.49834	0.80241	16.49783
R30Y1		5.78172	0.73778	23.81224
R21Y3		5.56632	0.67958	31.58893
R14Y4		3.76399	0.64184	37.38701
R34Y4		3.17029	0.61108	42.63815
R16Y2		4.06150	0.57351	49.82030
R28Y4		4.10012	0.53739	57.67224
R08Y1		3.89447	0.50464	65.76436
R12Y1		4.47061	0.46909	75.83711
R14Y1		3.97392	0.43901	85.62262
R26Y1		4.28643	0.40831	97.10022
R35Y5		3.12646	0.38672	106.26115
R01Y5		3.44941	0.36390	117.17848
R34Y3		2.57055	0.34736	125.94582
R21Y1		3.60513	0.32524	139.06885
	R21Y3	0.00268	0.32525	139.06061
R07Y4		1.65650	0.31540	145.50490
R17Y3		5.51550	0.28515	168.11229
R21Y4		2.17780	0.27347	178.15204
R27Y2		1.13232	0.26742	184.98456
R26Y3		0.92917	0.26244	190.09286
R10Y4		0.25046	0.26108	199.01988
	R01Y5	0.44975	0.25863	193.90440
R04Y4		11.47873	0.20872	253.59062
R26Y2		1.59770	0.20186	267.09253
R21Y3		1.91880	0.19377	281.08521
R08Y3		1.61608	0.18706	293.27954
R28Y1		0.88263	0.18338	300.48975
R05Y1		0.54166	0.18110	306.31958
R27Y5		0.67174	0.17824	313.98608
R14Y5		1.78080	0.17083	331.01836
R03Y2		2.35839	0.16131	353.48584
R34Y5		1.13357	0.15676	366.23779
	R27Y2	0.63285	0.15421	360.00659
R30Y5		1.01645	0.15030	370.93164
R27Y3		0.78545	0.14725	381.31470
R12Y5		1.04226	0.14322	393.88013
R11Y5		0.66807	0.14061	402.30888

TABLE A-18 (Continued)

Variable Entered	Variable Removed	F to Enter Or Remove	Wilks' Lambda	Rao's V
R14Y2		0.63583	0.13810	410.79004
R34Y2		1.62604	0.13180	433.64233
	R34Y3	0.02149	0.13188	433.39624
R21Y5		1.54723	0.12614	456.15723
R23Y5		4.88334	0.10988	533.43823
R14Y3		1.77841	0.10409	566.78442
R22Y5		0.90513	0.00114	585.25146
R35Y4		0.90462	0.09818	604.11499
	R34Y5	0.13032	0.09861	602.60718
R18Y5		0.26999	0.09773	609.02075
	R14Y5	0.12566	0.09814	605.56860
R34Y3		0.20243	0.09748	609.81006
R34Y4		0.21024	0.09678	613.11670
R14Y5		0.22075	0.09602	618.76782
	R18Y5	0.11401	0.09641	616.32227