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Bankruptcy as business strategy : a multivariate analysis of the financial characteristics of firms which have succeeded in Chapter XI compared to those which have failed.

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BANKRUPTCY AS BUSINESS STRATEGY: A MULTIVARIATE ANALYSIS OF THE FINANCIAL CHARACTERISTICS OF FIRMS WHICH HAVE SUCCEEDED IN CHAPTER XI COMPARED TO THOSE WHICH HAVE FAILED

A Dissertation Presented

by

Robert Andrew Comerford

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To My Wife, Chris, and
Our Children, Bob, Josh, and Kristin

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BANKRUPTCY AS BUSINESS STRATEGY: A MULTIVARIATE ANALYSIS OF THE FINANCIAL CHARACTERISTICS OF FIRMS WHICH HAVE SUCCEEDED IN CHAPTER XI COMPARED TO THOSE WHICH HAVE FAILED

(March 1976)

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ABSTRACT

Although ailing firms are supposed to be rehabilitated by only one-half of them continue operating after their plans of arrangment are confirmed. Those which are adjudicated bankrupt or simply close their doors after Chapter XI proceedings, generate costs to the court, their creditors, and society which would have been avoided had their entry into Chapter XI disallowed. A critical question in the decision to file a petition, and later in the decision to confirm an arrangement, is whether the debtor firm shows potential for continued operation.

This research analyzed a sample of 52 Chapter XI firms to determine whether the successes and failures differed financially at the time their petitions were filed. They were evenly divided between Chapter XI successes and failures. All firms were taken from the 1963 through 1973 Moody's Industrial and Over the Counter Manuals. The two groups were similar in terms of distributions of industry classifications, elapsed years since petition, number of employees, total assets, and total liabilities.

Eighteen financial ratios computed on each firm in the sample were analyzed to test three hypotheses. The first hypothesis was tested to determine the nature of financial dimensions present in the data. The following dimensions were identified by factor analysis for Factors 1 through 6: Cash Balance, Equity Contribution, Liquidity, Total Asset Balance, Activity, and Current Asset Balance, respectively. These factors explained 72 percent of the variance in the data and were selected by the scree test; the 1.0 minimum eigenvalue rule produced the same results.

The second Hypothesis was tested to determine whether either of two multiple discriminant analysis models significantly discriminated between the two groups of firms.

Model A consisted of selecting ratios with the highest loadings on each significant factor for evaluation by discriminant analysis. This model did not significantly differentiate between the two groups at the .99 level. The Model A component of the second hypothesis was rejected and Model A was not analyzed further.

Model B selected ratios which maximized group centroid separation by a stepwise procedure. It was significant at the .99 level. Consequently the Model B part of the second hypothesis was accepted.

The third hypothesis was tested by constructing three synthetic validation samples to determine the predictive power of Model B. Each one was made up of different random orders of the analysis sample. New discriminant functions constructed on each validation sample produced an average of 57 percent correct classifications. Based upon this result, Model B's 85 percent correct classifications were found to be significantly free of bias at the .95 level. Thus the Model B part of Hypothesis 3 was accepted.

The substantive result of the study was the finding that Chapter XI successes could be distinguished from failures when petitions were filed, solely on the basis of financial ratios. Further, only six ratios were required to generate 85 percent correct classifications.

Methodologically the process of selecting ratios for discriminant analysis by factor analysis (Model A) could generate an insignificant discriminant function where stepwise discriminant analysis (Model B) would produce a significant function. If predictive ability of the function is important and if interdependencies among independent variables can reasonably be expected to exist in the population, then the former method could reject a potentially useful discriminant function which the latter method would accept. This highlights the need for checking insignificant Model A functions with Model B.

A peripheral result of the study was the realization of a need for more complete bankruptcy data for purposes of research. If recent reports of problems within the bankruptcy system reflect reality, then surely research on those problems could help correct them. It is anomolous that so little research has been conducted to analyze the impact of Chapter XI on the business community when it is such a valuable strategic alternative for ailing firms. Business

practitioners, who may be affected most by the Bankruptcy Law, and Business Policy academicians who could instruct their students and conduct research in bankruptcy, seem to understand it the least.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS v

LIST OF TABLES xi

LIST OF FIGURES . . . . . .

CHAPTER I - BACKGROUND INFORMATION 1
Introduction 1
Description of Chapter XI 2
Meaning of Arrangement 5
Social Purpose of Chapter XI and Bankruptcy in General 6
Statistics of Chapter XI 8
Description of the Problem Investigated 12
Objectives of the Study 16
Purposes of the Study 18
Significance of the Study 19
Business Policy 19
Business Practitioners: Debtors and Creditors 21
Business Debtors 22
Business Creditors 22
Judges, Referees and Attorneys in Bankruptcy 24
Public Policy 25
Summary 29

CHAPTER II - LITERATURE SEARCH 30
Introduction 30
Empirical Investigations of Bankrupt Firms . . 30
The Brookings Report 36
The Commission Report 39
Legal Studies in Bankruptcy 41
Category 1: Liquidation versus Rehabilitation 43
Category 2: Municipal Bankruptcy 45
Category 3: Non-Bankruptcy Act Proceedings 46
Category 4: Straight Bankruptcy 47
Category 5: Chapter X versus Chapter XI 49
Category 6: Chapter X 52
Category 7: Chapter XI 54
Category 8: Sources of Bankruptcy Information 55

Page

Statistical Analyses of Ratios to Predict Firm Behavior 57
Univariate Analysis of Ratios 58
Multivariate Analysis of Ratios 66
MDA Success-Failure Studies 67
Financial Analysis by MDA 84
Summary 91

CHAPTER III - METHODOLOGY 93
Introduction 93
Chapter XI Successes and Failures 93
"Successes and Failures" 96
Definition and Selection of Chapter XI Failures 97
Definition and Selection of Chapter XI Successes 100
Hypotheses 102
Data Reduction 103
Discrimination between Successes and Failures 106
Predictive Ability of Models A and B 115
Constructing Ratio Profiles 119
Model A 119
Model B 120
Summary 122

CHAPTER IV - RESULTS OF THE STUDY 124
Introduction 124
Description of the Sample 124
Data Reduction 130
Discrimination between Successes and Failures--Two Models 139
Model A 139
Significance of Discriminant Function 140
Model B 144
Significance of Discriminant Function 146
Classification of Analysis Data . . . 147
Validation of Model B 150
Tests of Major Assumptions of MDA 152
Relative Importance of Ratios -Model B 154
Summary 159

Page

CHAPTER V - IMPLICATIONS, LIMITATIONS, AND CONCLUSIONS 161
Introduction 161
The Research Objectives Revised 161
Methodology 162
Results 165
Implications of the Results 167
Business Policy 167
Debtors and Creditors 168
Bankruptcy Judges and Attorneys 170
Public Policy 170
Limitations of the Study 171
Suggestions for Future Research 172
Business Failure 172
Bankruptcy 172

BIBLIOGRAPHY 174

APPENDIX A 189

APPENDIX B 197

APPENDIX C 204

APPENDIX D 209

APPENDIX E 210

APPENDIX F 211

APPENDIX G 212

APPENDIX H 224

LIST OF TABLES

TABLE		Page
2-1	Comparison of Mean Values of Failed and Nonfailed Firms	64
2-2	Predictive Accuracy of the MDA Model for Data from Each of the Five Years Before Bankruptcy	73
4-1	Major Industry Classifications of Chapter XI Successes and Failures in the United States Between 1963 and 1973	126
4-2	Year of Chapter XI Petition for Firms in Failure and Success Samples in the United States	128
4-3	Elapsed Number of Years in 1975 Since Filing Chapter XI Petition for United States Sample of Successes and Failures	128
4-4	Means and Ranges (in Millions of Dollars) of Total Assets, Liabilities, and Sales of Chapter XI Successes and Failures, 1963 to 1973	129
4-5	Factors Produced by Principal Factors Analysis of Eighteen Original Ratios Taken On Sample of United States Chapter XI Successes and Failures from 1963 to 1973	133
4-6	VARIMAX Rotated Factor Matrix for Ratios Measured on United States Chapter XI Successes and Failures Between 1963 and 1973	134
4-7	Summary of Highest Loading Ratios on Each Significant Factor and Their Assigned Labels for United States Sample of Chapter XI Successes and Failures Between 1963 and 1973	138

TABLE		Page
4-8	Summary of Stepwise Selection of Ratios (Model B) For Analysis Data from United States Sample of Chapter XI Successes and Failures Data from 1963 to 1973.....	145
4-9	Statistics for Evaluation of Model A and B Discriminant Functions Computed on Analysis Sample of United States Chapter XI Successes and Failures from 1963 to 1973.....	146
4-10	Example of Format for Classification of Chapter XI Successes and Failures.....	148
4-12	Percentage of Model B Correct and Incorrect Classifications of Analysis Sample of United States Chapter XI Successes and Failures from 1963 to 1973.....	149
4-13	Percent of Correct Classifications for Three Validation Runs and Test of Significance Using Model B Ratios from United States Chapter XI Successes and Failures from 1963 to 1973.....	151
4-14	Coefficients and Rankings of Ratios in the Model B Discriminant Function of Chapter XI Failures and Successes from 1963 to 1973.....	156
4-15	Within-Groups Correlation Coefficients for Ratios in Model B Discriminant Function for United States Chapter XI Failures and Successes from 1963 to 1973.....	156

LIST OF FIGURES

FIGURE		Page
1	Number of Business Bankruptcy Filings by Chapter of the Federal Bankruptcy Act and Their Percentage of the Total Business Filings for the Fiscal Year Which Ended June 30, 1974.....	10
2	Relationships among Categories of Bankruptcy Legal Studies and Brief Descriptions of Each Category.....	44
3	Scree Line of Eigenvalues Against Their Original Numbers for United States Chapter X Successes and Failures, 1963 to 1973.....	132
4	Distributions of Model A Discriminant Scores for Chapter XI Failures and Successes, 1963 to 1973, in United States.....	153
5	Plot of Standard Discriminant Scores for United States Chapter XI Failures and Successes from 1963 to 1973.....	169

C H A P T E R I

BACKGROUND INFORMATION

Introduction

Although Chapter XI was designed to rehabilitate ailing firms, only about half of them continue operating after their plans of arrangement are confirmed. Those which are adjudicated bankrupt or simply close their doors after Chapter XI proceedings, generate costs to the court, their creditors, and society at large which would have been avoided had their entry into Chapter XI been disallowed. A critical question (for the debtor and its attorney) in the decision to file a petition, and later (for the court and creditors) in the decision to confirm an arrangement, is whether the debtor firm shows potential for continued operation. This is particularly important in deferred payment plans, where the terms of the arrangement are to be met on an installment basis.

By analyzing a sample of Chapter XI firms, this study will attempt to determine whether the successes and failures differed financially at the time their petitions were filed. Multivariate statistical analysis of ratios will be employed to derive a model of Chapter XI successes.

The model would assist debtors and their attorneys in deciding whether a troubled firm is more similar to successful or failed Chapter XI's. It would provide a guide for the appropriateness of pursuing Chapter XI as a strategy. Creditors and bankruptcy judges must decide upon the liklihood of a petitioner's success in Chapter XI. The model would similarly serve as a guide in this decision.

Description of Chapter XI

Chapter XI is a proceeding specified in the Federal Bankruptcy Act[1] (the Act) which is available to managers of troubled firms. It is one of a subset of the fourteen chapters[2] into which the Act is divided. Three of the bankruptcy proceedings included in that subset (Chapters X, XI,

---

[1]Bankruptcy Act, Secs. 301-99, 11 U.S.C. Secs. 701-99 (1938). References to the Bankruptcy Act will be accompanied by the reference to U.S.C, the abbreviation for United States Code. Title 11 of the United States Code includes the Bankruptcy Act and the numbering of sections in the Code differs from that in the Act. Corresponding section numbers of the Act and the Code are presented in a table in the first few pages of volumes of Title 11 of the U.S.C.

[2]The following will briefly explain the nature of each proceeding under the Act except Chapter XI which is described in detail in Appendix A:

Chapters I to VII cover straight bankruptcy which concerns liquidation (sale of assets) and distribution of proceeds to creditors of business or individual bankrupts and discharge of obligations of the bankrupt.

and XII) provide for the rehabilitation[3] of ailing

---

[2]Chapter VIII deals with relief for farmers through composition (agreement with creditors for discharge of their claims by partial payment) or extension (agreement for deferred payment of creditors' claims). Section 77 of this chapter concerns the reorganization (major modification of financial structure) of railroads engaged in interstate commerce.

Chapter IX provides for the readjustment (usually a change in financial structure on a smaller scale than is typically involved in reorganization) of the debts of taxing districts and agencies (public organizations).

Chapter X enables reorganization (major restructuring of debt as before, but also usually involves a material change in stockholders' interests in Chapter X) when it can be shown that Chapter XI relief was not possible (See, for example, W. R. Montgomery, "Defects in Law Review, Vol. XXV (June 1939), pp. 882-885).

Chapter XII provides for restructuring debt secured by real property, but only where debtor is an individual or a partnership, not a corporation.

Chapter XIII concerns wage earners' plans and provides relief from garnishment of wages. According to the plan adopted, sequestered future earnings of the wage earner are distributed among creditors.

Chapter XIV covers Maritime Commission liens.

(This series of explanations was adapted from George J. Hirsch, "Bankruptcy," pp. 1-76 in George H. Hirsch and Sydney Krause, Bankruptcy and Arrangements Under Chapter XI (N.Y.: Practicing Law Institute, 1968), pp. 4-5; except where otherwise noted.

[3]That Chapters X, XI, and XII are rehabilitative in nature is stated in U.S. Congress, House, Report of the Commission On the Bankruptcy Laws of the United States. Part I, 93d Cong., 1st Sess., July 1973 (Washington: Government Printing Office, 1973), p. 23, (hereafter referred to as the Commission Report) as well as in many other sources. Of particular importance to the present study is whether Chapter XI was intended to be rehabilitative. That intent is established in many articles and books among which are the following: Edward I. Altman, Corporate Bankruptcy in America (Lexington, Mass.: Heath-Lexington, 1971), p. 3; John Gerdes, "General Principles of Plans of Corporate Reorganization," University of Pennsylvania Law Review and American Law Register, Vol. 89.

business debtors.[4] Chapter XI affects rehabilitation, when it is applied to firms which are not extensively degenerated financially, by providing for settlements (arrangements) between business debtors and creditors which are binding upon even an unwilling minority of creditors[5] (where the arrangement is approved by a majority in number and amount of filed claims[6]).

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[3]No. 1, p. 41; H.G. Guthmann, "Absolute Priority in Reorganizations," Columbia Law Review, Vol. 45 (September 1945), p. 739; Sydney Krause, "Insolvent Debtor Adjustments Under Relevant State Court Statutes as against Proceedings under the Bankruptcy Act," The Business Lawyer, Vol. 12 (January 1957), p. 184; John E. Mulder, "Ambiguities in the Chandler Act," University of Pennsylvania Law Review and American Law Register, Vol. 89, No. 1, p. 16; Paul B. Rodden and James C. Carpenter, "Corporate Insolvency--Liquidation or Rehabilitation," University of Colorado Law Review, Vol. 36 (Fall 1963), p. 136; Joseph J. Rifkind, "Discharge of Debts in Bankruptcy and Some Problems Related Thereto," New York Law Forum, Vol. 7, No. 4, p. 354; and Paul M. Van Arsdell, Corporation Finance: Policy, Planning Administration (New York: The Ronald Press Company, 1968) p. 1505.

[4]See Bankruptcy Act, Secs. 106(5), 306(3), and 406(6), 11 U.S.C. Secs. 506(5), 706(3), and 806(6) for definitions of debtors to whom Chapters X, XI, and XII, respectively, apply. Within the scope of this study is that Chapter XI is available to any debtor who could become a bankrupt under the Act. Thus, any individual, partnership, and business corporation may file a petition except wage earners, farmers, building and loan associations, and municipal, railroad, insurance, and banking corporations. (Van Arsdell, pp. 1542-1543).

[5]Bankruptcy Act, Sec. 371, 11 U.S.C. Sec. 771 (1938).

[6]Bankruptcy Act, Sec. 362(1), 11 U.S.C. Sec. 762(1) (1938).

Meaning of Arrangement

An arrangement in Chapter XI proceedings refers to "provisions modifying or altering the rights of unsecured creditors generally or of some class of them upon any terms or for any consideration."[7] Section 357 of the Act spells out the specific content of an arrangement as follows:

> (1) Provisions for treatment of unsecured debts on a parity one with the other, or for the division of such debts into classes and the treatment thereof in different ways or upon different terms;
>
> (2) Provisions for the rejection of any executory contract;[8]
>
> (3) Provisions for specific undertakings of the debtor during any period of extension provided for by the arrangement, including provisions for payment on account;
>
> (4) Provisions for the termination, under specified conditions, of any period of extension provided by the arrangement;
>
> (5) Provisions for continuation of the debtor's business with or without supervision or control by a receiver or by a committee of creditors or otherwise;
>
> (6) Provisions for payment of debts incurred after the filing of the petition and during the pendency of the arrangement, in priority over the debts affected by such arrangement;

---

[7]Bankruptcy Act Sec. 356, 11 U.S.C. Sec. 756.

[8]"Executory contract" is defined as an unexpired lease of property.

> (7) Provisions for retention of jurisdiction by the court until provisions of the arrangement, after its confirmation, have been performed; and
>
> (8) Any other appropriate provisions not inconsistent with this Chapter.[9]

In fewer words, an arrangement may include an extension (where the debtor is granted a longer period of time in which to pay his obligations), a composition (where the balance of obligations is reduced), or some combination of both extension and composition. Such arrangement may affect only unsecured debt.

Social Purpose of Chapter XI and Bankruptcy in General

The bankruptcy system was designed (Appendix B contains a brief history of the evolution of the Bankruptcy Law) to relieve pressures in the open credit economy.[10] (The relationships between the economy and the Bankruptcy Law are discussed in Appendix C). The term "open credit economy" refers to the role of both private and commercial credit in the country's economy. The open credit economy contrasts with "command" credit economies of communistic and socialistic countries. In these, availability of credit is controlled (commanded) by state permit, license, and other authorization. Credit allocation is based upon the state's policy preferences for the use of credit. Compared with command credit systems, credit

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[9] Bankruptcy Act, Sec. 357, 11 U.S.C. Sec. 757.

[10] Commission Report, p. 68.

availability in an open credit system is ultimately determined by the credit policies of individual economic units.[11]

The bankruptcy system primarily affects the social values of orderliness, morality, and skill and knowledge upon which the functioning of the open credit economy depends. Orderliness refers to the authority-power relationships between debtors and creditors by which the legal consequence of future conduct can be anticipated. Morality provides reliability in the performance of debtor and creditor commitments. Skill and knowledge enable participation by the parties as informed, able contractors.[12]

The functions performed by the bankruptcy process are essential to the success of the open credit economy. The first function of the bankruptcy system is

> ... to continue the law-based orderliness of the open credit economy in the event of a debtor's inability or unwillingness generally to pay its debts. Especially from creditor's perspectives, it is important to have rules that determine rights generally in the debtor's wealth, whenever suited, and thus guide conduct in the open credit economy, as well as collective processes which effect such rules and protect creditors to realize on their claims. From debtors' prespectives it is important to have a sanctuary from the jungle of creditors' pursuit of their individualistic collection efforts....[13]

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[11] Commission Report, pp. 68-70.

[12] Commission Report, pp. 69-71.

[13] Commission Report, p. 71.

The second function is

> ... to rehabilitate debtors for continued and more value-productive participation, i.e., to provide a meaningful "fresh start."[14]

These two functions serve two purposes. The orderliness function provides for the systematic "death" of victims experiencing acute undebtedness by liquidation, partial (or no) satisfaction of creditors' interests, and discharge or corporate dissolution.[15] In the case of business debtors, the straight bankruptcy or liquidation chapters serve this purpose.

The rehabilitative function (encompassed by Chapters X, XI, and XII for business debtors) provides for the continuation of indebted units with regular incomes (albeit easier to distinguish among consumer than business debtors). It also keeps alive larger, publicly-owned corporations, with the potential to provide a multitude of social and economic services.[16]

Statistics of Chapter XI

Under the Bankruptcy Act, rehabilitation is an alternative to liquidation which is covered by Chapters I through VII and is called straight bankruptcy.[17]

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[14] Commission Report, p. 71.

[15] Commission Report, p. 72.

[16] Commission Report, pp. 79-81.

[17] Bankruptcy Act, Chapters I through VII, Secs. 1-72, 11 U.S.C. Secs. 1-112 (1958).

Contrasted with the rehabilitative chapters (frequently called "chapter proceedings"), straight bankruptcy is concerned with the termination of a business.[18]

With the exception of straight bankruptcy, Chapter XI is the Bankruptcy Act relief most frequently sought by managers of troubled businesses. As shown in Figure 1, the 2,171 Chapter XI cases filed in the Fiscal Year (FY) 1974 represented approximately eleven percent of the 19,786 voluntary[19] business cases filed under the Act. All the other proceedings amounted to less than two percent of the total voluntary business cases. The recent popularity of rehabilitative chapters relative to liquidation as a strategy for confronting adverse economic conditions is demonstrated by the fact that Chapter X and XI filings increased by factors of 61.4 percent and 48.9 percent, respectively, for FY 1974 over FY 1973, while straight bankruptcies increased by only 8.3 percent.[20]

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[18]See, for example, William B. Davenport, "Businesses Beyond Help: Liquidation and Winding Up," The University of Illinois Law Forum, Vol. 1958, No. 3, p. 589 and "Debtor Rehabilitation: Common Law Settlements, Chapters X and XI--An Analysis and Discussion," Comment, New York Law Forum, Vol. 7, No. 4, pp. 404-405.

[19]"Voluntary" bankruptcy petitions are those initiated by the debtor or bankrupt; "involuntary" ones are filed against the debtor by creditors. Bankruptcy Act, Secs. 4a and 5b, 11 U.S.C., Secs. 22a and 23b.

[20]Administrative Office of the United States Courts, 1974 Annual Report of the Director (Washington, D.C.: Government Printing Office, 1974), p. VII-6.

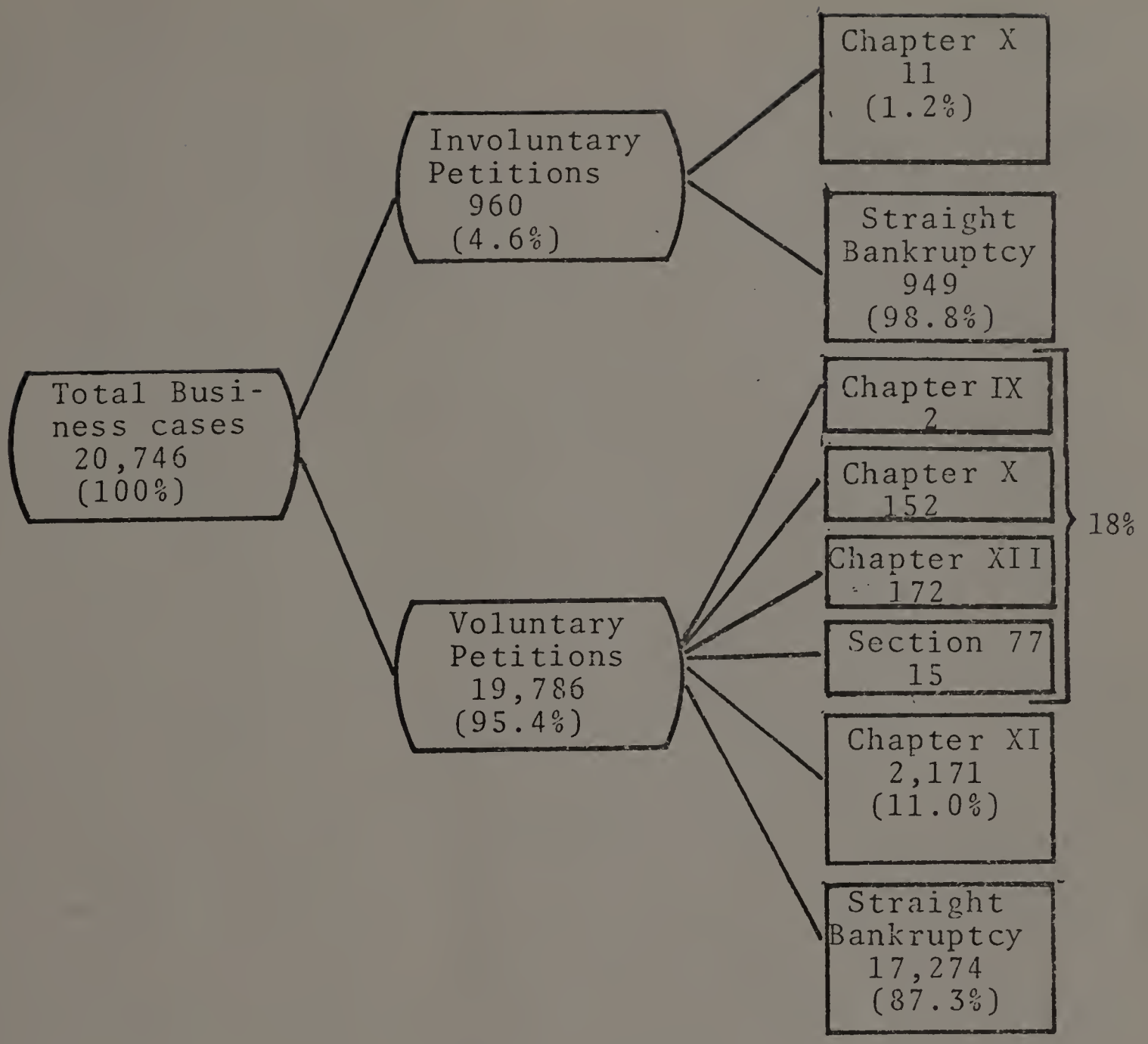

Figure 1

Number of Business Bankruptcy Filings by Chapter of the Federal Bankruptcy Act and Their Percentage of the Total Business Filings for the Fiscal Year Which Ended June 30, 1974*

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*Constructed from statistics contained in Tables F2 and F3 in 1974 Annual Report of the Director, Administrative Office of the United States Courts (Washington, D.C.: Government Printing Office, 1974), pp. A-80 through A-83.

Although it is the second most popular form of bankruptcy relief, Chapter XI is used in a very small fraction of total business failures (i.e., business discontinuances).[21] Of the 300,000 to 400,000 businesses which failed annually until 1972,[22] less than five percent were involved in bankruptcy proceedings and approximately one-half-of-one percent were Chapter XI's.[23]

In terms of costs, Chapter XI's are much larger than straight bankruptcies. Based upon FY 1971 figures, the average cost to the bankruptcy system for processing a Chapter XI case was $1,207,[24] while asset bank-

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[21]J. Eric Fredland, "The Business Bankrupts," in U.S. Congress, House, Executive Director of the Commission On the Bankruptcy Laws of the United States, Report to the Commission On the Bankruptcy Laws of the United States--Part III, Hearing, 93d Cong., 1st Sess., July 1973, (Washington, D.C.: Government Printing Office, 1973), p. 2.

[22]Fredland, p. 1.

[23]Fredland, p. 2.

[24]D. J. Dreyfuss, P. W. Greenwood, and M. R. Fiorello, "The Impact of Proposed Changes in Bankruptcy Administration," in Commission Report--Part III, p. 30.

ruptcies[25] cost $158.[26]

A study conducted by Dun and Bradstreet and reported by Stanley and Girth indicated that only 33 percent of the firms which had filed for Chapter XI relief between 1964 and 1968 were still in operation two years after their proceedings closed.[27] Thirty-eight percent had either discontinued operations or were adjudicated bankrupts. The remaining 29 percent were either unaccounted for or merged or acquired. Similarly, of the 92 Chapter XI petitioners identified for the present study, 31 percent (29) were filed by firms operationally defined as

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[25]There are three types of straight bankruptcy cases in terms of distributable assets: (1) "Asset" cases are those in which the proceeds of non-exempt assets (property which the bankrupt may not keep) are sufficient to pay administrative expenses as well as some creditors' claims; (2) "nominal-asset" cases are those in which non-exempt asset proceeds cover only administrative expenses; and (3) "no-asset" cases are those for which all of the bankrupt's property, if any, is exempt. These definitions were obtained from the inside back cover of David T. Stanley and Marjorie Girth, Bankruptcy: Problems, Process, Reform (Washington, D.C.: The Brookings Institution, 1971).

[26]Dreyfuss, Greenwood, and Fiorello, p. 30.

[27]Stanley and Girth, p. 115.

successes, 28 percent (26) failed,[28] 9 percent (8) were known to have merged or were acquired,[29] and 31 percent (29) were indeterminate as to success-failure status.

Description of the Problem Investigated

Given the rationality of the bankruptcy system,[30] one of the following implications is possible: Either the successes were indistinguishable from the failures at the time of filing for Chapter XI relief, or the dif-

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[28]Chapter XI failures (or "failures") are operationally defined as companies for which notice of filing for Chapter XI relief was included in Moody's Industrial or Over the Counter (OTC) Manual (usually indicated by the statement, "filed a petition in Federal District Court for a Chapter XI arrangement for protection from creditors"), for the 1966 through 1974 editions, and, for the 1969 through 1972 editions, whose listing in the Manual was subsequently discontinued with the note, "no further information," "adjudicated bankrupt," or "company was liquidated." Failures taken from the 1973 editions of Moody's are those firms for which Chapter XI relief was petitioned and for which listings were discontinued in the 1974 editions. These definitions pertain to firms whose Chapter XI plans were not confirmed by the court.

Chapter XI successes (or "successes") are firms for which notice of petition was included and whose listing in either Moody's manual was not discontinued between 1969 and 1973 and for which the statement, "Chapter XI plan confirmed" appeared. (These definitions are presented in more detail in Chapter 3).

[29]Very often, firms whose plans were not confirmed were merged or acquired. These were included in the "success" category in this study.

[30]In the absence of this assumption, an additional likely reason could be that the bankruptcy system is apathetic about the potential costs (to the debtor and its creditors, society in general, and bankruptcy administration) associated with unsuccessful applications of Chapter XI.

ferences were not noted when petitions were evaluated by the court. Stanley and Girth stated that their evidence suggested that little attention was paid to the potential for continued operation when Chapter XI plans were reviewed by bankruptcy courts. They specifically recommended that Chapter XI confirmation require a high chance of survival.[31] The Commission Report contains a statement to the effect that little is known about the characteristics of the two groups and that is a cause of the high failure rate.[32] Although without specific reference to the failure rate, some authors have stated that a criterion for confirmation of a Chapter XI plan of arrangement is that the debtor show the potential for successful operation after confirmation.[33] Others have implied potential for success as a requirement in recommending that Chapter XI confirmation be contingent upon determination by the court and by a majority of creditors that the debtor is "worth

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[31]Stanley and Girth, pp. 5 and 146.

[32]Commission Report, p. 37.

[33]Representative of this group are "Allocation of Corporate Reorganizations between Chapter X and XI of the Bankruptcy Act," Harvard Law Review, Vol. 69, (December 1955), p. 360; "Debtor Rehabilitation: Common Law Settlements, Chapters X and XI--An Analysis and Discussion," Comment, New York Law Forum, Vol. 7, No. 4, (November 1961), p. 405; Gerdes, pp. 41-42.

more alive than dead"[34] (the alternative for the debtor is straight bankruptcy).

The difficulty in determining whether a debtor should be given a chance at rehabilitation or placed in bankruptcy has been traditionally one of deciding whether creditors or the debtor should benefit most. The guidance offered by the Act is in its 1952 ammendment which stipulates that the court must be satisfied that the plan is in the best interests of creditors and is feasible.[35] That was interpreted in the Transvision case to mean that Chapter XI applied where there was a reasonable chance that financial recovery would not unduly prejudice the rights of interested parties.[36] More specifically, Weintraub and Levin

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[34]Davenport, p. 587; Guthman, p. 750; Mulder, p. 16; Benjamin Weintraub and Harris Levin, "Availability of Bankruptcy Rehabilitation to the Middle-Sized Corporation: The Third Circuit's Interpretation," Rutgers Law Review, Vol. 14, No. 3, (Spring 1960), pp. 571-572.

[35]Bankruptcy Act, Sec. 366, 52 Stat. 911 (1938), as amended, 66 Stat. 433 (1952), 11 U.S.C., Sec. 766 (1966 Supp.).

[36]In the Matter of Transvision, Incorporated, 217 F. 2 d, 243 (2d Cir. 1954), cert. denied 348, U.S. 952 (1955).

contended that the interests of the debtor were controlling,[37] following the finding of the Supreme Court in the General Stores case.[38] On the other hand, Davenport concluded that determination of how creditors would fare under the plan of arrangement as compared with straight bankruptcy was the most satisfactory test of the applicability of Chapter XI.[39]

Objectives of the Study

The premise of the present study is that regardless of whose interests ought to be served in deciding the applicability of Chapter XI, a potentially helpful input to that decision would be the degree to which a debtor is similar in financial structure to past Chapter XI successes or failures. There can be no rigid formula to determine

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[37]Weintraub and Levin, "Availability of Bankruptcy...," p. 575.

[38]General Stores Corporation v. Shlensky, 350, U.S. 462, 468 (1956).

[39]Davenport, p. 586, in which the author cited Fleishmann and Devine, Inc. v. Saul Wolfson Dry Goods Co., 299 Fed. 15 (5th Cir. 1924); Alder v. Jones, 109 Fed. 967 (6th Cir. 1901); In re Bruce Hunt of Albany Corp., 163 F. Supp. 939 (N.D. N.Y. 1958); In re Hoxie, 180 Fed. 508, (D. Me. 1910); In re Waynesboro Drug Co., 157 Fed. 107 (S.D. Ga. 1907). The earlier decisions were, of course, under former Sec. 12(d) of the Act. The Bruce Hunt decision applied the older cases as a guide under Sec. 366 of the Act, 66 Stat. 433, 11 U.S.C. Sec. 766 (1952).

whether a debtor is beyond help.[40] There simply are too many subjective variables which must necessarily enter into such a decision.[41] However, basic to the decision is what financial variables characterized Chapter XI successes and failures in the past and whether the successes and failures had different values on those variables at the time of filing for Chapter XI relief.[42] Therefore, the following are the objectives of this study: (1) To identify by factor analysis the financial dimensions[43]

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[40]Davenport, p. 586.

[41]Among them are cause of difficulty, market strength, quality of maangement, adequacy of records, experience and tenure of management, and location.

[42]Advocating a medical diagnostic model for business problems, Boetcher explained, "The diagnostician appraises against a background of knowledge having four principal routes for measurement and correction: First, a knowledge of what is normal, and by exception, what is abnormal; second, a knowledge of basic symtomatic features to be thoroughly examined in all cases; third, a way of correlating abnormal features to identify the type and situs of the infection; and lastly, a knowledge of potential ways of treatment...." See John E. Boetcher, "Recognizing the Problem," University of Illinois Law Forum, Vol. 1958, No. 3 (Winter 1958), p. 497.

[43]Four categories of financial ratios will be employed in this study and called dimensions or factors. They are liquidity, cash position, activity, and profitability and solvency. Definitions of each dimension are as follows:

1. Liquidity: Relative availability of short-term assets.
2. Cash position: Cash balance relative to major accounts.
3. Activity: The effectiveness with which a firm's resources are employed.
4. Profitability and Solvency: Overall management effectiveness shown by returns on investment and assets.

common to a sample of financial ratios[44] of both Chapter XI successes and failures;[45] and (2) to attempt to construct a Multiple Discriminant Analysis (MDA) model which will differentiate between the two groups on the basis of their respective values on those dimensions.

Purposes of the Study

The major purposes of the study are threefold: (1) To investigate the viability of Chapter XI as a strategy for firms experiencing financial troubles; (2) To analyze the financial characteristics of a sample of Chapter XI successes and failures; and (3) To develop a model of financial ratio profiles to classify distressed firms as potential successes or failures in Chapter XI proceedings.

Specifically, the study will be directed toward the following: (1) Analysis of the substance of Chapter XI relief; (2) Examination of the history of Chapter XI; (3)

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[3]For further elaboration on the idea of financial dimension see J. F. Weston and E. F. Brigham, Managerial Finance (2nd Edition . New York: Holt Rinehart and Winston, 1966), pp. 67-68; E. E. Nemmers and A. E. Grunewald, Basic Managerial Finance (2nd Edition. New York: West Publishing Co., 1975), pp. 35-36; and J. C. Van Horne, Financial Management and Policy (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971), pp. 639-651.

[44]The set of financial ratios with their expected financial dimensions as described in the literature are summarized in Appendix D.

[45]"Total Sample" will henceforth describe both the sample of Chapter XI successes and that of Chapter XI failures.

Empirical investigation of the financial dimensions of a sample of both Chapter XI successes and failures; and (4) Development of an MDA model to attempt differentiation between Chapter XI successes and failures along the financial dimensions.

Significance of the Study

The study is potentially significant to students and faculty of Business Policy, business practitioners in the roles of debtor and creditor, both attorneys and judges or referees within the administrative system of bankruptcy law, and public policy makers.

Business Policy

Business Policy is the study of the activities of general management and the problems confronting the total enterprise.[46] Within the affected organization, bankruptcy is a matter of policy because it simultaneously cuts across all internal and external aspects of the firm. It is not

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[46]See, for example, Bernard Taylor and Keith MacMillan Business Policy: Teaching and Research (New York: Wiley, 1973), p. 1; Hugo E. R. Uyterhoeven, Robert W. Ackerman, and John W. Rosenblum, Strategy and Organization: Text and Cases in General Management (Homewood, Illinois: Richard D. Irwin, Inc., 1973), p. 3 and William F. Glueck, quoting Dr. Kenneth Andrews, in Business Policy: Strategy Formation and Executive Action (New York: McGraw-Hill, 1972), p. 4.

solely a matter of Business Finance.[47] Of particular relevance to Business Policy are decisions concerning selection between rehabilitation and liquidation procedures.[48] Whenever rehabilitation is selected, top management must decide between remedies available under Common Law or state statute and the Federal Bankruptcy Law. Not related to the Act, for example, are Common Law settlements, and, in appropriate states, formal assignment for the benefit of creditors and sales arranged under the Bulk Sales Act. Those selecting the protection of the Bankruptcy Act must decide between Chapter X and XI relief.

In cases where termination of the business is appropriate, management and owners must decide between Common Law or state court statutes and straight bankruptcy as the legal vehicle for liquidation.

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[47]Most Managerial Finance textbooks have at least one chapter on bankruptcy. See, for example, William H. Husband and James C. Dockeray, Modern Corporation Finance (6th Edition. Homewood, Illinois: Richard D. Irwin, Inc., 1966); Van Arsdell; Van Horne; Weston and Brigham.

[48]Liquidation is included in a set of strategic alternatives by Uyterhoeven, Ackerman, and Rosenblum, pp. 51-52. It was pointed out that, "Too often management holds onto an obsolete strategy or fights a constantly escalating war with inadequate and diminishing resources. Such a strategy may destroy managerial careers as well as the shareholders' equity and, in many instances, is also detrimental to the employees."

More generally, the decision which concerns bankruptcy with which corporate policy-makers must deal is whether a troubled firm is beyond help; that is, whether circumstances call for rehabilitation or liquidation. Instructors of Business Policy should be prepared to offer instruction regarding such a decision so that business students, if placed in that situation, can be prepared to take full advantage of the legal remedies available. With increased bankruptcies and more acute collection problems expected in the years ahead,[49] preparation of top management to deal with insolvency as a debtor or creditor seems critical.

This study, consequently, would be significant to the teachers and students of Business Policy as a guideline for determining conditions under which Chapter XI may be appropriate. It would also be significant for Business Policy researchers as an example of a type of empirical research which may be conducted in the interface between Business Policy and bankruptcy.

Business Practitioners: Debtors and Creditors

The study would be significant in providing insights into the practical side of corporate arrangements for business practitioners as both debtors and creditors.

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[49]Survey conducted by New York Credit and Financial Management Association reported in New York Times, Sunday Edition, December 21, 1974, pp. 41-42.

Business Debtors. Of major concern to the business debtor who has "....sustained financial reverses...,"[50] wishes to remain in business, and hopes that he or she and creditors will benefit mutually, is whether he or she will be successfully rehabilitated in Chapter XI. Although the only sure way to determine whether Chapter XI will be successful is to try it,[51] the study would assist debtors by providing a model of "what is normal" financial structure for Chapter XI successes and failures

and information as to whether the two groups are distinguishable in terms of financial structure.

Business Creditors. Unsecured creditors have the option of filing an involuntary bankruptcy petition against an insolvent (in the bankruptcy sense) debtor or supporting a debtor in Chapter XI (or Chapter X)[52] --there are no involuntary Chapter XI petitions.[53] Where the debtor has filed a voluntary petition[54] (and even where creditors have

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[50]Krause, "Insolvent Debtor Adjustments...," p. 184.

[51]Sidney Rutberg, Ten Cents on the Dollar: The Bankruptcy Game (New York: Simon & Schuster, 1973), p. 144.

[52]In Chapter XI, creditors have only the opportunity to accept or reject debtors' plans of arrangement. See Husband and Dockeray, p. 684.

[53]Bankruptcy Act, Sec. 322 (1938), 11 U.S.C. 722.

[54]Bankruptcy Act, Sec. 321 (1938), 11 U.S.C. 721.

initiated an involuntary bankruptcy petition[55]), he or she may during the pendency of the proceeding, convert it into a Chapter XI arrangement.[56] Consequently, creditors may or may not encourage Chapter XI proceedings according as they feel a Chapter XI plan would be successful--would benefit them more than straight bankruptcy.[57]

There are two major advantages to creditors of successful Chapter XI arrangements as opposed to straight bankruptcies and adjudicated Chapter XI's.[58] First, the simpler Chapter XI proceedings can lead to substantially less administrative costs and thus leave creditors a larger portion of claims.[59] Second, creditors may benefit from successful

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[55]Bankruptcy Act, Sec. 321 (1939), 11 U.S.C. 721.

[56]Sidney Krause, "Arrangements Under the Bankruptcy Act," pp. 87-88.

[57]A discussion of the cooperative role of creditors in Chapter XI as well as the potential advantages to creditors is presented in Richard Matsch, "Bankruptcy: A Study in Functional Obsolescence," Credit and Financial Management, April 1970, p. 14.

[58]"Situations may develop where the debtor is unable to consummate a plan or defaults in carrying out the terms of a confirmed arrangement. This may result from the debtor's inability to raise the funds necessary to finance the plan, or the successful opposition of a creditor to confirmation." See Krause, "Arrangements Under the Bankruptcy Act...," p. 126 and Bankruptcy Act, Sec. 366, (1938), 11 U.S.C. 766.

[59]For discussion of this argument see Matsch, p. 16; "Debtor Rehabilitation: Common Law Settlements, Chapters X and XI--An Analysis and Discussion," Comment New York Law Forum, Vol. 7, No. 4, (November 1961), p. 405; and Rodden and Carpenter, p. 117.

Chapter XI debtor rehabilitation by maintaining a future customer and source of future profits.[60]

There are, of course, always some risks for creditors in cooperating to rehabilitate a debtor. Whether the decision is to cooperate in rehabilitation or strive for liquidation, it must be quickly made and implemented. This severe time constraint was discussed by Rodden and Carpenter as follows:

> The passage of time alone can be disastrous to general creditors. Preferences obtained by particular creditors can become protected if acquired more than four months prior to filing of bankruptcy proceedings,[61] and if corporate reorganization or arrangement under Chapter X or Chapter XI are not promptly commenced, impatience or foreclosure by secured creditors may preclude any chance of a planned rehabilitation.[62]

The study would be significant for the creditors of Chapter XI petitioners as a guideline in the timely determination of whether to support or discourage the proceedings.

Judges, Referees and Attorneys in Bankruptcy

The study would be significant for attorneys in bankruptcy by providing information enabling them to advise debtor clients of their financial similarity to Chapter XI

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[60] "Debtor Rehabilitation...," p. 405.

[61] Bankruptcy Act, Sec. 19, 11 U.S.C. Sec. 42 (1938).

[62] Rodden and Carpenter, p. 121.

successes or failures. Bankruptcy referees and judges must decide on the feasibility of proposed arrangements or the liquidated value of the business versus its going concern value so as to confirm plans of adjudicate petitioners.[63] Knowledge of the financial characteristics of successes and failures and whether they are differentiable could materially reduce time currently consumed in making such determination.

Public Policy

The study would also have significance within the realm of public policy.

On June 23, 1969, a House of Representatives resolution proposed creation of the Commission to study the Federal Bankruptcy Laws of the United States. The resolution

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[63]Regarding the basis for confirmation of arrangements in Chapter XI, the court decided in Fleishmann and Devine, Inc. v. Saul Wolfson Dry Goods Co., 299 Fed. 15 (5th Cir. 1924), "To warrant a judge in confirming an offered composition he must be satisfied that it is for the best interests of the creditors. Bankruptcy Act, Sec. 12c (Comp. St. Sec. 9895). The confirmation of an offered composition is manifestly not for the best interests of the creditors if it would pay them considerably less than they might reasonably expect to realize in the administration of the assets in due course. Adler v. Jones, 109 Fed. 967, 48 C.C.A. 761," in Davenport, p. 587, citing "299 Fed. at 18."

More recently the court held that liquidation rather than arrangement would better serve creditors' best interests, and adjudicated the debtor a straight bankrupt. In re Bruce Hunt of Albany Corp., 163 F. Supp. 939 (N.D. N.Y. 1958), cited in Davenport, p. 587.

presented the following reasons for changes in the Bankruptcy Act:

1. In the 30 years since the last major revision, there has probably been even greater change in the social and economic conditions of the country than in the 40 years prior to the enactment of the Act.

2. Population has increased by 70 million people, while installment credit has skyrocketed from about $4 billion to $80 billion. The number of total bankruptcies has risen to an annual rate of more than 200,000 from a rate of 110,000 in 1960. By far, the major increase has been in personal bankruptcies.

3. More than one quarter of the referees in bankruptcy have problems in the administration of their duties and have made suggestions for substantial improvement in the Act.

4. There is little understanding by the federal government and the commercial community in evaluating the need to update the technical aspects of the Act.

As charged by the proposal, the commission submitted its report[64] in July 1972 to Congress and the President. While the major impact of proposed changes will be in personal bankruptcy sections of the Act, there are significant changes proposed for the business sections.[65]

A February 1975 Business Week article outlined the two draft bills currently under consideration by the

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[64] Commission Report--Parts I, II, and III.

[65] This and the preceeding paragraph paraphrase Altman, Corporate Bankruptcy in America pp. 13-14.

Senate and House Judiciary Committees.[66] The first, the Commission Report, would completely overhaul present law. The second was prepared by the National Conference of Bankruptcy Judges, "...which was stung by many of the commission's proposed changes."[67] This bill would also recast the entire law but its recommended changes are less radical.

The major impact of both bills is as follows:

1. Eliminate conflict of interest among judges, trustees,[68] and lawyers.
2. Cut down on legal fees.
3. Find new ways to finance the administration of bankruptcies.
4. Reduce control by company insiders.
5. Make consumer bankruptcies cheaper.[69]

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[66]"Revising the Bankruptcy Law," Business Week, No. 2369, (February 24, 1975), pp. 99-100.

[67]"Revising the Bankruptcy Law," p. 99.

[68]A trustee, receiver or debtor in possession is a person who operates the business and manages the property of the debtor as the court authorizes. A trustee may be appointed during the proceeding upon application of any party in interest, or if a trustee has previously been appointed (in a bankruptcy proceeding), shall continue in possession of the debtor's property by order of the court; otherwise, the debtor remains in possession, exercising the powers of a trustee. Bankruptcy Act, Secs. 332, 342, and 343, 11 U.S.C. Secs. 732, 742, and 743. See "Debtor Rehabilitation: Common Law Settlements, Chapter X and XI--An Analysis and Discussion," p. 409.

[69]"Revising the Bankruptcy Law," p. 99.

The major problem within the bankruptcy system at which the bills are aimed is, in the words of University of Michigan law professor Frank Kennedy, "(T)he supposedly self-supporting bankruptcy system is going bankrupt."[70]

One cause of the system's financial difficulty is the excessively expensive litigation over whether to go into Chapter X or XI. The significance of the present study in assisting Congress, particularly in the last problem, would be to determine whether Chapter XI successes can be distinguished from failures (although the direct comparison of Chapter X's and Chapter XI's, which is beyond the scope of this project, will not be attempted.) Additionally, if the model is successful, its implementation would tend to decrease time in litigation thereby reducing costs of administration of bankruptcy.

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[70]"Revising the Bankruptcy Law," p. 99.

Summary

Chapter XI will be viewed in this study as a strategy for financially troubled firms to change their unsecured debt structure. If debtors have not degenerated too far before filing a Chapter XI petition, they may be rehabilitated by the plan of arrangement. This study will attempt to identify the degree of financial degeneration which characterizes both Chapter XI successes and failures.

In this chapter, key definitions were presented along with descriptions of the objectives, purposes and significance of the study. Definitions of the following topics were included: Plan of arrangement, social purpose of bankruptcy in general and Chapter XI, and several Chapter XI statistics. Also, three topics were referenced in this chapter but detailed descriptions of them were reserved for the Appendices. These are the nature of Chapter XI (Appendix A), its history (Appendix B), and an economic interpretation of it (Appendix C).

C H A P T E R II

Literature Search

Introduction

Three areas of research are relevant to this study. First, several studies have been undertaken which empirically investigated various business aspects of bankrupt firms.

Second, much work has been done in interpretation and explanation of bankruptcy law. These legal studies have been divided into eight categories.

Third, this study is methodologically similar to several recent applications of multivariate statistical and other mathematical techniques to financial ratios for the purpose of analyzing or predicting various types of firm behavior. The history of these ratio analyses will be highlighted and recent multivariate studies described in detail.

Empirical Investigations of Bankrupt Firms

Studies in this section may be characterized as empirical analyses of bankruptcy for business, as opposed to legal, purposes. The first is much like the present study in purpose but quite different methodologically.

White[1] described the financial features of ten companies[2] involved in leading Chapter XI cases for the purpose of defining guidelines for choosing between Chapter X and XI. Financial information was taken from Moody's Manuals, Standard and Poor's Corporation Records, and selected annual reports along with legal information from court records, to determine whether the court should have handed down different decisions from a financial point of view.[3] Each company's financial statements were also analyzed for time periods after closing of proceedings.

Each firm was described by its sales performance, liquidity, profitability, sources of capital, asset composition, and market valuation.[4] The conclusion was that after identifying the causes of failure, management should

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[1]Katie Avery White, "A Study of the Leading Cases under Chapter XI of the Federal Bankruptcy Act with Particular Reference to Their Financial Implications," unpublished doctoral dissertation, University of Illinois, 1966, p. 15.

[2]The following cases were analyzed: United States Realty Company (1940), Transvision (1955), General Stores (1956), Liberty Baking (1957), Lea Fabrics (1960), Harold Radio & Electronics Corporation (1961), Grayson-Robinson Stores (1963), In re Devaga Stores Corporation (1963), and In re Dilberts Quality Supermarkets, Inc., et. al (1963).

[3]White, pp. 20-21.

[4]White, pp. 22-29.

take any necessary steps to avoid overextension into the investment field, should restrict judiciously its guarantees of payments in investments made by its subsidiaries (U.S. Realty), and should guard against an excess of heavy short-term debt (General Stores). It should make periodic examinations of its current position, invoking the tool of comprehensive cash budgeting, so it will not fail because of inadequate cash flow with which to meet its debts as they mature (Transvision, Wilcox-Gay, and Davegal). It should surround itself with the most capable managerial staff available in order to avoid faulty timing of advertising (Liberty), continued production in light of a change in demand for the product (Lea Fabrics), and overexpansion and entry into fields in which its management has had too little, if any, previous experience (Grayson-Robinson, Dilbert's and Harold)....

> ...If a decision is made to reorganize, and not to liquidate, the firm, it is to Chapter X or Chapter XI that management properly turns with the ultimate goal being that of restoration of sustained adequate earning power with a minimum of cost to (1) creditors and (2) proprietors.[5]

Several studies examined the market price performance of bankrupt firms.[6] Two studies by Altman are characteristic of this work. In 1969 he analyzed the experience of

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[5]White, pp. 281-282.

[6]Edward I. Altman, "Bankrupt Firms' Equity Securities As an Investment Alternative," Financial Analysts Journal, Vol. 24 (December 1969), pp. 887-900, William H. Beaver, "Market Prices, Financial Ratios, and the Prediction of Failure," Journal of Accounting Research, Vol. 25 (Fall 1968), pp. 1979-192; and Randolph Westerfield, "Pre-Bankruptcy Stock Price Performance," University of Pennsylvania Working Paper, Fall 1970, reported by Edward I. Altman, Corporate Bankruptcy in America (Lexington, Massachusetts: Heath-Lexington, 1971), pp. 80-81.

common stockholders of approximately 70 firms which were reorganized under Chapter X (with two or three exceptions) between 1941 and 1965.[7] The firms were compared according to an index of stockholder profitability,[8] from three different stock purchase base periods[9] until ten years (nine years in the cases of (b + 12) firms) after bankruptcy. The hypothesis, "...average stockholder experience in bankrupt entities is not very good," was tested statistically.[10]

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[7]Altman, "Bankrupt Firms' Equity Securities...," p. 129.

[8]The index is

$$SPI = \frac{\sum_{t=0}^{n} \frac{D_t(1-.50)}{(1+k')t} + \frac{P_n - .25(P_n - P_{b-1}, \text{ or } P_{b+1}, \text{ or } P_{b+12})}{(1+k)n}}{P_{b-1}, \text{ or } P_{b+1}, \text{ or } P_{b+12}},$$

where:

SPI = Stockholder Profitability Index
D = Returns in the form of Income
Pn = Price of New (or old) Securities in the n^{th} Year
k, k' = Stockholder Opportunity Costs
P_{b-1} = Price of Old Common Stock One Month Prior to Bankruptcy
P_{b+1} = Price of Old Common Stock One Month After Bankruptcy
P_{b+12} = 12 Months After Bankruptcy.

[9]The base periods refer to the timing of purchase of a firm's stock relative to the time which the firm files for Chapter X relief. The first is one month prior to filing (b-1); the second, one month after filing (b+1); and the third, twelve months after filing (b+12).

[10]Altman, "Bankrupt Firms' Equity Securities...," p. 131.

The results showed insignificant differences of returns between equity holders of financially bankrupt corporation (when purchased after declaration date) and the average return on common stocks listed on the New York Stock Exchange (NYSE).[11] Investors who already owned the soon to be bankrupt security, however, experienced significantly smaller returns than the average NYSE return of 1.0.[12] It was concluded that since the risk of such investments is quite high, their appeal is low and risk aversion principles dictate close analysis of them.

The other study by Altman reported the experience of holders of stocks purchased before reorganization.[13] He concluded that the results showed significant evidence that share value can be expected to fall in bankruptcy.[14]

The three foregoing studies are similar to the present one for different reasons. The first is an empirical analysis of the experiences of several firms in Chapter XI

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[11]Altman, "Bankrupt Firms' Equity Securities...," p. 133.

[12]Altman, "Bankrupt Firms' Equity Securities...," p. 131.

[13]Edward I. Altman, "Corporate Bankruptcy Potential, Stockholder Returns and Share Valuation," Journal of Finance, Vol. 24 (December 1969), pp. 887-900.

[14]Altman, "Corporate Bankruptcy Potential..," p. 900.

proceedings and, consequently, is directly relevant to present research. The second and third articles are indirectly relevant because they are statistical analyses of an aspect of bankruptcy, but one that is quite different from the purpose of the present study.

Three comprehensive studies of the bankruptcy system have been undertaken, which span the last decade. Parts of each of them pertain to this research. First, the Stanley and Girth study (frequently called the Brookings Report) mentioned earlier, was commenced in the mid-sixties and completed in 1971.[15]. The 1973 Report of the Commission on the Bankruptcy Laws of the United States, which marked the end of two years and two months of analysis of the bankruptcy system, is the second.[16] Together, these two reports represent over 40 studies, and conference group reports and special papers. The third comprehensive study is a textbook on bankruptcy by Altman. The parts of these reports which are relevant to the present study are summarized next.

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[15]David T. Stanley and Marjorie Girth, Bankruptcy: Problem, Process, Reform (Washington, D.C.: The Brookings Institution, 1971).

[16]U.S. Congress, House, Executive Director of the Commission On the Bankruptcy Laws of the United States, Report of the Commission On the Bankruptcy Laws of the United States --Parts I, II, and III, Hearing, 93d Cong., 1st Sesss., July 1973, (Washington, D.C.: Government Printing Office, 1973). (Hereafter called the Commission Report.)

The Brookings Report

Stanley and Girth conducted "...the most comprehensive review of the operation of bankruptcy in the United States that has been undertaken in the past thirty years."[17] One small section of that study[18] reports the results of several empirical analyses undertaken to develop statistics regarding Chapter XI. (Their findings that most Chapter XI proceedings failed prompted the present study).

Their methods included case analyses and interviews in eight federal judicial districts: Northern Ohio, Northern Alabama, Maine, Northern Illinois, Oregon, Western Texas, Southern New York, and Southern California. Cases closed in FY 1964 were randomly sampled from records filed when cases were closed. A total of 1,675 were analyzed of which 398 were business bankrupts and debtors. The following supplementary studies were also conducted:

1. Interviews with 400 individual debtors and bankrupts.
2. Interviews with the general public to find out their knowledge and attitudes about bankruptcy.
3. Analysis of credit bureau information about bankrupts and debtors in the sample.

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[17] Stanley and Girth, p. 1.

[18] Stanley and Girth, pp. 133-144.

4. Dun & Bradstreet provided information on firms in the sample which had gone through rehabilitation proceedings.
5. Mail questionnaires were sent to a thousand attorneys to determine how much negligence suits were deterred by a defendant's threatening to file for bankruptcy or actually doing so.
6. The Administrative Office of the United States Courts provided information on backgrounds and tenure referees, cost of operation of referees' offices, and the nature and outcome of appeals.
7. Costs in liquidating property in eight federal agencies were investigated in an effort to obtain a basis for comparison with costs of bankruptcy liquidation.
8. The bankruptcy processes in several other countries were analyzed to find out if any characteristics could be applied in the United States.[19]

Some of their findings which bear directly on this study are:

1. Business bankrupts have ... increased in number.... Most of them are small businesses typically going bankrupt with $12,000 in assets and $40,000 in liabilities; but there are a few large-scale failures every year. Business bankruptcies usually result from a combination of poor business management and unfavorable market conditions....
2. Although the American people in general disapprove of bankruptcy, the bankrupts themselves show a wide range of attitudes about their experience--some are ashamed, some are angry, some are relieved, some are numb, and some are even happy....
3. There are wide variations in how bankruptcy is administered from one district to another and from one state to another, despite the uniform federal law and court structure....

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[19]Stanley and Girth, pp. 6-8.

4. Little rehabilitation takes place under the special provisions of the rehabilitative chapters of the Bankruptcy Act. A majority of these cases end in failure, and are either dismissed or converted into straight bankruptcy proceedings.
5. Despite the stigma of bankruptcy and the evidence it gives of financial failure, debtors find it really no harder to get credit after bankruptcy than they did before.
6. The effect of bankruptcy on the general economy is not substantial or detrimental.
7. Creditors get so little out of bankruptcy proceedings that they have almost no incentive to be interested. They do not bother to prove their claim or to exercise their rights to 'creditor control' of the proceedings. In any event, their losses are passed along to other customers in the form of higher prices or to the tax payer....
8. Over 70 percent of all bankruptcy cases have no assets left after exempt property is set aside and pay neither administrative costs nor creditors. In just over half of the rest, administrative costs consume the excess assets. Thus creditors receive payment in approximately 15 percent of the cases. In this last group, administrative costs consume an average of one-quarter of the assets.
9. Bankruptcy is the only federal legal proceeding that is self-supporting--that is, one in which the parties are expected to pay all or a substantial part of the costs of administering their case and a share of the overhead costs of the system....
10. Most of the priorities given to certain classes of creditors (such as taxes owed or rent due landlords) are based on dubious logic and indefensible social policy.
11. Although the debtor is discharged of the debts listed in his bankruptcy, he is sometimes harassed by his creditors about his discharged debts, and sometimes makes binding new agreements to pay them.[20]

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[20]Stanley and Girth, pp. 2-4.

The Commission Report

The Commission was established by Public Law 91-354 (84 Stat. 468) effective July 24, 1970. Its report was presented to the President, the Congress, and the Chief Justice of the United States on July 30, 1973 in three volumes. Part I assesses problems in the bankruptcy system, explains the causes and philosophy of bankruptcy, and summarizes major recommendations. Part II is a draft of a proposed new Bankruptcy Act and other recommended statutory changes along with the source, purpose and anticipated effects of the proposed legislation. Part III contains selected documents prepared by and for the Commission.[21]

Among its recommendations concerning Chapter XI are the following:

1. Chapter X, XI, and XII of the present Act be consolodated into Chapter VII of the proposed Act.
2. Creditors be able to initiate involuntary cases under Chapter VII not only against corporate debtors but also against individual and partnership debtors....
3. The necessity for and the possibility of a successful reorganization not be tested artificially and prematurely by a required 'good faith' hearing but be resolved when raised by any party in interest.

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[21]Included are Selwyn Enzer, Raul de Brigard, and Frederick D. Lazar, "Some Consideration Concerning Bankruptcy Reforms;" J. Eric Fredland, "The Business Bankrupts;" William T. Plumb, Jr., "Report on Federal Income Tax Returns and Liabilities in Bankruptcy;" William T. Plumb, Jr., "Report on Loss Carryovers and Debt Reduction in Proceedings Under Chapters X, XI, and XII;" D. J. Dreyfuss, P.W. Greenwood, and M.R. Fiorello, "The Impact of Proposed Changes in Bankruptcy Administration;" and M.R. Fiorello and A.B. MacInnes, "An Application of Automation to Bankruptcy Administration and Processes."

4. Adequate representation of creditors and equity security holders be provided by the selection of official committees by the administrator from among the holders of the largest claims and interests, subject to his authority to appoint other committee members to achieve better representation.
5. The solicitation of acceptances of plans affecting publicly held interests be prohibited prior to court approval....
6. Receivers not be utilized in cases in Chapter VII....
7. The Bankruptcy Administration be assigned the present functions of the Securities and Exchange Commission in reorganization....
8. Filing of proofs of claim or interest be substantially eliminated.
9. The acceptance of a plan by the requisite majority of creditors and security holders be based on the actual voting, that is, only negative and affirmative votes be counted in determining whether a majority has voted in favor of a plan....
10. The debts to be paid in a Chapter VII case on confirmation be those which would be entitled to priority in the distribution of the proceeds in a liquidation case.[22]

Beyond these proposed changes, the Commission's recommendations affected the entire bankruptcy system. Both the Brookings Report and the Commission Report, Part I, provide detailed explanations of what a potential debtor or creditor may expect to encounter in bankruptcy; both recommend major revisions in the Act and the bankruptcy system. In fact, the Commission's recommendations drew heavily on the findings of the Brookings study.[23]

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[22] Commission Report, pp. 27-29.

[23] The Brookings Study was conducted independently of the Commission's study but Chapter I of the latter, "The Commission's Charge and Major Recommendations," contains many references to the former and cites the Brookings study as one of its sources (Commission Report, p. 5).

Another comprehensive study appeared in 1971 in the form of a textbook on corporate bankruptcy.[24] Altman intended to provide a framework for analysis of bankruptcy as a business problem. Techniques and results of his earlier studies are described which applied multivariate statistical methods to (1) investigate the relationship between business failures and macro economic phenomena (Chapter 2), (2) predict bankruptcy for manufacturing firms (Chapter 3) and railroads (Chapter 7), and (3) analyze the effect of bankruptcy on the value of security holdings (Chapter 6). Chapters 4, 5, and 7 contain case studies involving bankruptcy-related decisions.

Commenting on the usefulness of the book, the author said,

> (It) is written to serve needs both in the classroom and in the firm. It may be used as a supplementary text in the basic business finance course and as a primary book for those advanced undergraduate and graduate courses in corporation finance, investments and industrial organization where the emphasis is on this relatively specialized subject.[25]

Legal Studies in Bankruptcy

The literature of bankruptcy is dominated by interpretations and explanations of the Act. A substantial body of

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[24]Altman, Corporate Bankruptcy in America.

[25]Altman, Corporate Bankruptcy in America, p. xv.

case law has also developed which forms the basis for such decisions as whether Chapter X or XI is appropriate in a given case and whose rights ought to be protected in bankruptcy proceedings.

One reason for the extensiveness of this legal literature is probably the complexity of the Act itself--it was amended 101 times between 1898 and 1972. In reviewing bankruptcy literature, one cannot help but notice the lack of an integrated, organized framework for bankruptcy discussion.[26] The topic is rarely discussed in either finance or business policy courses, "...due to its nonrigorous treatment and the professor's desire to cover the more 'positive' subjects."[27]

The purpose of this section is to present a taxonomy for a sample of bankruptcy-related (especially rehabilitative) articles collected for this study. It is hoped that the presentation will aid business practitioners and researchers in locating bankruptcy literature in areas which meet their needs.

Eight categories for the articles have been identified. The articles were not randomly selected for inclusion in this analysis but rather were gathered for the purpose of

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[26]Altman, Corporate Bankruptcy in America, p. xix.

[27]Altman, Corporate Bankruptcy in America, p. xix.

studying organizational- versus personal-related proceedings. Consequently the articles contain few references to the various personal bankruptcy chapters and provisions. Further, since the study deals specifically with Chapter XI, the selection of articles was biased in that Chapter XI-related categories tend to be more complete than the others.

There is an element of logic to the relationships among the categories of articles. They tend to follow major decisions a business debtor would confront in a bankruptcy situation. (The exception, of course, is category 2, Municipal Bankruptcy). These relationships are diagrammed and briefly identified in Figure 2.

The following sections identify cogent issues and describe the content of each of these categories of bankruptcy articles with appropriate citations (individual studies will not be described, except where there is only one article in a category, although many are referenced elsewhere in this study).

Category 1: Liquidation versus Rehabilitation.[28]

The article in this category compares the advantages and disadvantages of rehabilitation techniques to liquidation proceedings under both state and federal law. The main point is that often liquidation can be avoided by appropriate debtor and creditor behavior.

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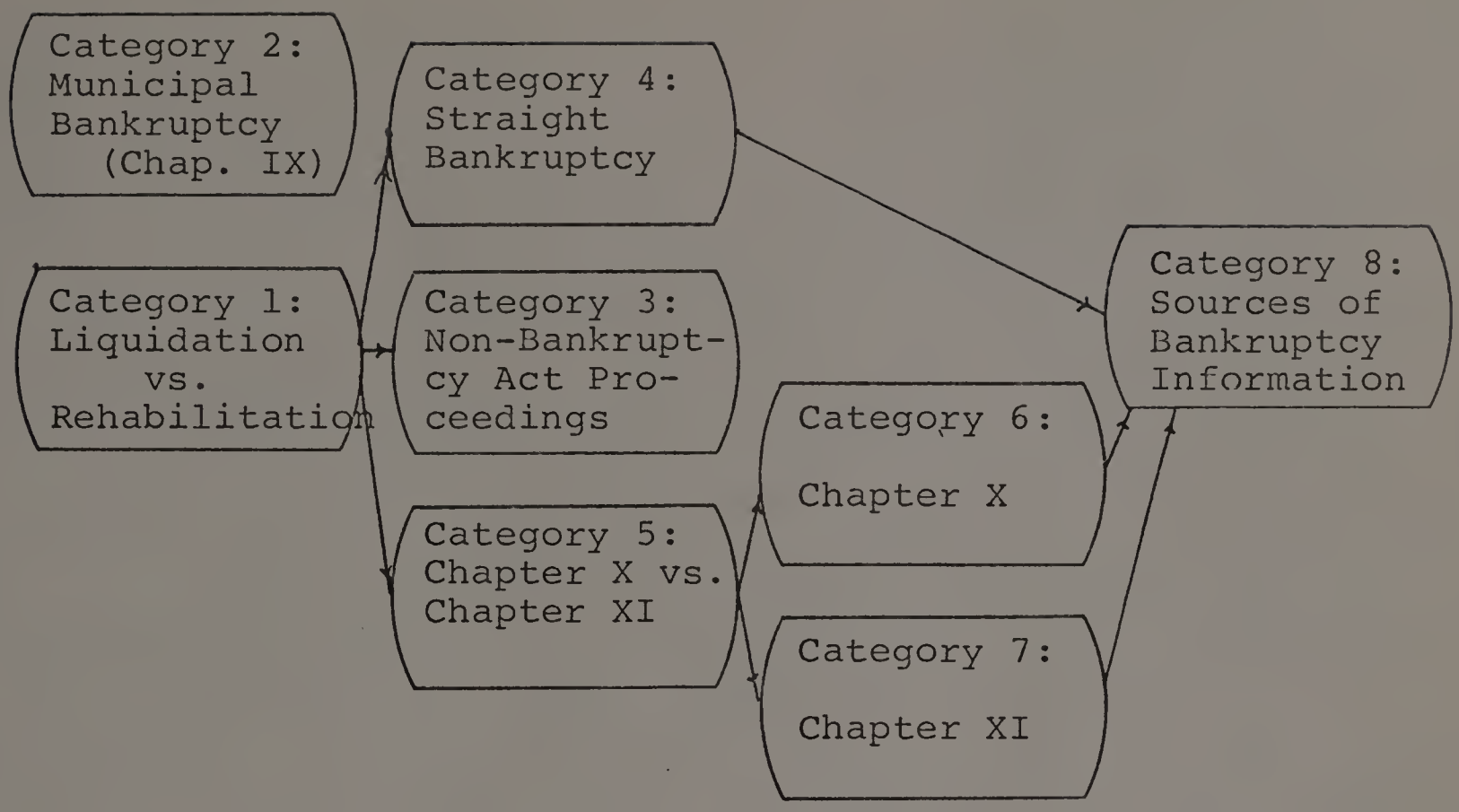
[28]Paul B. Rodden and James C. Carpenter, "Corporate Insolvency--Liquidation or Rehabilitation," University of Colorado Law Review, Vol. 36 (Fall 1963), pp. 117-142.



Category 1: Upon recognizing one's condition of insolvency, the first decision is whether to liquidate or rehabilitate the firm.

Category 2: Public organizations facing insolvency have available only a form of arrangement in Chapter IX.

Categories 3 & 4: Firms choosing liquidation may decide upon a proceeding not sanctioned by the Act (Category 3) or the straight bankruptcy proceedings in Chapters I-VII of the Act (Category 4).

Category 5: Business debtors electing the strategy of rehabilitation face two options: Reorganization and arrangement (Chapter X vs. Chapter XI).

Category 6: Reorganization traditionally utilized by large publicly held corporations to alter secured debt.

Category 7: Chapter XI is available for arrangements of unsecured debt.

Category 8: Several authoritative sources are available to assist in interpretation of the Act.

FIGURE 2

RELATIONSHIPS AMONG CATEGORIES OF BANKRUPTCY LEGAL STUDIES AND BRIEF DESCRIPTIONS OF EACH CATEGORY

Category 2: Municipal Bankruptcy.[29] Defaults on bonds and other obligations by municipalities became a problem in the mid-1930's. At the time there was no state or federal law to compel creditors to agree to a refinancing or readjustment plan. Article I, Section 10 of the Constitution was interpreted as prohibiting state legislation which compelled acceptance approved by a majority of creditors. Such laws were deemed interference with contract law. Municipal corporations were expressly excluded from the Bankruptcy Act by the 1910 amendments.[30]

The lack of power of compulsory acceptance of adjustment or refunding plans by minority bond holders made such adjustments difficult. Gaining consent from all holders frequently was impossible because they all could not be located. Sanctioned compulsion also fostered purchase by individuals or groups of depreciated bonds of defaulting municipalities and veto of adjustment plans thus enabling payback of substantially less than purchase price.

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[29]Henry W. Lehman, "The Federal Municipal Bankruptcy Act," Journal of Finance, Vol. 5, No. 3, (September 1950), pp. 242-250 and George H. Hempel, "An Evaluation of Municipal 'Bankruptcy' Laws and Procedures," Journal of Finance, Vol. 28 (December 1973), pp. 1339-1351.

[30]36 Stat. 838, Sec. 4(a), (b), (1918), 11 U.S.C. Sec. 22(a), (b), (1948). See Lehman, p. 242.

To counteract these and other problems, the federal Municipal Bankruptcy Act[31] was passed in 1934 to provide an orderly procedure of debt adjustment for defaulting communities and local governmental units. When it was found unconstitutional in 1937, a new act was passed by Congress.[32] This act was declared constitutional in 1938 and further amended in 1946 when it was made a permanent part (Chapter IX) of the federal Bankruptcy Laws. Under these laws a total of 362 cases have been filed since 1938, only 17 were filed between 1954 and 1972.[33]

Category 3: Non-Bankruptcy Act Proceedings.[34]

The single article in this category explains Common Law settlements, formal assignments for the benefit of creditors, sales under the Bulk Sales Act, and corporate liquidation and dissolution proceedings under Section 105 of the New York Stock Corporation Law. These methods are alternatives to Bankruptcy Act proceedings for adjustment of debts of insolvent debtors. Each technique

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[31] 49 Stat. 798 (May 24, 1934).

[32] 50 Stat. 653, (August 16, 1937), U.S.C. Secs. 401-4 (1946).

[33] For detailed statistics see Hampel, pp. 1341-1342.

[34] Sydney Krause, "Insolvent Debtor Adjustments Under Relevant State Court Statutes as Against Proceedings Under the Bankruptcy Act," The Business Lawyer, Vol. 12, (January 1957), pp. 186-189.

is discussed in detail with emphasis on the circumstances under which each is appropriate and the advantages and disadvantages of each.[35]

In general, the major advantage of these proceedings is that they allow the debtor to avoid the stigma of bankruptcy. Two principal disadvantages are that (1) it is often difficult to obtain acceptances of plans by all creditors and (2) none of these measures offers the alternative of discharge from obligations or part of them. In the case of either liquidation or rehabilitation, the flexibility of these alternatives should be weighed against the frequently cumbersome rigidity of proceedings under the Bankruptcy Act.[36]

Category 4: Straight Bankruptcy.[37] For firms beyond help (those which are insolvent in the bankruptcy

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[35]A comprehensive discussion of Common Law settlements and assignments for the benefit of creditors is also presented in William B. Davenport, "Businesses Beyond Help: Liquidation and Winding Up," The University of Illinois Law Forum, Vol. 1958, No. 3 (Winter 1958), pp. 585-627.

[36]Krause, "Insolvent Debtor Adjustments...," p. 195.

[37]"Bankruptcy--No Longer A Dirty Word," U.S. News and World Report, Vol. 78, No. 14 (April 7, 1975), p. 42; Davenport, "Businesses Beyond Help...; Garrard Glenn, "Essentials of Bankruptcy, Prevention of Fraud, and Control of Debtor," Virginia Law Review, Vol. 23, No. 4 (February 1937), pp. 373-397; George J. Hirsch, "Bankruptcy" in George J. Hirsch and Sydney Krause, "Bankruptcy and Arrangements Under Chapter XI (Third Edition. New York:

sense), liquidation is often the only way out. Typically in a straight bankruptcy proceeding, the debtor's assets are sold and the proceeds distributed among creditors on a priority basis. The debtor is subsequently freed from obligations to repay claims not covered by the proceeds. The intricacies of Chapter I through VII of the Bankruptcy Act are well documented in the articles included in this category.

Of particular interest is a U.S. News & World Report article claiming that the stigma formerly associated with bankruptcy is decreasing significantly at present. It was noted, "...bankruptcy is moving with a vengeance into the ranks of the middle class, wiping out professionals in upper income brackets, ...wealthy movie stars, professional athletes and prominent businessmen...with little loss of public esteem."[38] Part of the explanation for this trend is that

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[37]The Practicing Law Institute, 1968); James Angell MacLachlan, "The Title and Rights of the Trustee in Bankruptcy." Rutgers Law Review, Vol. 14, No. 4, (Summer 1960), pp. 653-277; Richard Matsch, "Bankruptcy: A Study in Functional Obsolescence," Credit and Financial Management, April 1970, p. 14; Max Radin, "The Nature of Bankruptcy," University of Pennsylvania Law Review, Vol 89, No. 1 (November 1940), pp. 1-9; Joseph J. Rifkind, "Discharge of Debts in Bankruptcy and Some Problems Related Thereto," New York Law Forum, Vol. 7, No. 4 (November 1961) pp. 354-369; and David M. Roth, "The Role of Corporate Officers Directors in Bankruptcy Proceedings," Boston University Law Review, Vol. 54 (May 1974), pp. 572-609.

[38]"Bankruptcy--No Longer A Dirty Work," p. 52.

> In a surprising number of recent cases, consumers have re-established a line of credit within days after courts had declared them bankrupt.... The common fear that a bankrupt's credit rating will be ruined forever... appears false.
>
> A major reason is that bankrupts by law, cannot file for bankruptcy again for at least six years. And fewer than 10 percent of bankrupts end up in bankruptcy court a second time.[39]

Stated differently, what has kept the number of bankruptcies small relative to the number of failures are (1) the stigma of bankruptcy and (2) fear of a ruined credit rating. With these constraints diminishing the "equilibrium" level of bankruptcies could increase even in the absence of economic disturbances. For this reason, the need for streamlining the bankruptcy system has importance beyond the sudden increase in cases due to recession.

Category 5: Chapter X versus Chapter XI.[40] Since passage of the Chandler Act in 1938, there has been controversy over whether Congress intended Chapter XI to be

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[39]"Bankruptcy--No Longer A Dirty Word," p. 52.

[40]"Allocation of Corporate Reorganization Between Chapter X and XI of the Bankruptcy Act," Harvard Law Review, Vol. 69 (December 1955), pp. 352-362; "Debtor Rehabilitation: Common Law Settlements, Chapters X and XI --An Analysis and Discussion," Comment, New York Law Forum, Vol. 7, No. 4, (November 1961), pp. 404-424; Don A. Emory, "Bankruptcy--Large Publicly-Held Corporation Allowed to Remain in Chapter XI Arrangement Proceedings," Texas Law Review, Vol. 42 (1963), p. 246; Harry S. Gleick, "Comparison of Relief Afforded by Chapters X and XI of the Bankruptcy Act and Non-Judicial Workouts," Journal of the National Association of Referees in Bankruptcy, Vol. 36

available for large, publicly-held corporations. The issue has been complicated by the SEC's contention that large corporations with publicly-held securities must seek relief under Chapter X.

The criteria emphasized by the courts in deciding in large corporate cases the appropriateness of Chapter X

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[40](January 1962), pp. 16-18; Lawrence M. Greene and David Ferber, "Chapter X or XI: Implications of the Supreme Court Decision in the General Stores Case," The Federal Bar Journal, Vol. 16 (March 1956), p. 62; Asa S. Herzog, "Reorganizations and Arrangements Under Chapters X and XI: Problems of Administration from the Standpoint of the Court," Journal of the National Association of Referees in Bankruptcy, Vol. 113 (October 1961), pp. 113-117; Sidney Krause, "Chapters X and XI--A Study in Contrasts," The Business Lawyer, Vol. 19 (January 1964), pp. 511-526; John E. Mulder, "Ambiguities in the Chandler Act," University of Pennsylvania Law Review and American Law Register, Vol. 89, No. 1 (November 1940), pp. 10-38; William J. Rochelle, "Rehabilitation in Bankruptcy: A Comparison of Chapters X and XI," The Journal of the Bar Association of the State of Kansas, Vol. 34 (Spring 1965), p. 17; Eugene M. Rostow and Lloyd N. Cutler, "Competing Systems of Corporate Reorganization: Chapters X and XI of the Bankruptcy Act," Yale Law Journal, Vol. 48 (1939), p. 1334; Benjamin Weintraub and Harris Levin, "Three Alternatives in Source of a Lawyer: An Analysis of Corporate Rehabilitation for the Middle-Sized Corporation," New York Law Forum, Vol. 7, No. 4 (November 1961), pp. 394-405; Benjamin Weintraub and Harris Levin, "Availability of Bankruptcy Rehabilitation to the Middle-Sized Corporation: The Third Circuit's Interpretation," Rutgers Law Review, Vol. 14, No. 3, (Spring 1960), pp. 564-577; and Benjamin Weintraub, Harris Levin, and Lawrence G. Novick, "Chapter X of Chapter XI: Coexistence for the Middle-Sized Corporation," Fordham Law Review, Vol. 24 (1956), p. 616.

or XI have become the guidelines in this issue. Some of the more important of these are[41] (1) the requirement for a disinterested investigation,[42] (2) the presence and status of subsidiaries,[43] (3) the reasonable chance for success of the plan,[44] (4) the feasibility of the arrangement,[45] (5) the need for safeguards available in Chapter X,[46] (6) the expected problems of the rehabilitation process,[47] (7) whether the public and private interests involved including those of the debtor would be better served in Chapter X,[48] and (8) whose needs ought to be served.[49]

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[41]The summary of criteria is condensed from Emory, pp. 248-249.

[42]SEC v. United States Realty & Improvement Co., 310 U.S. 434 (1940).

[43]U.S. Realty

[44]In re Transvision, Inc., 217 F. 2 d 243 (2d Cir. 1954(, Cert. Denied, 348 U.S. 952 (1955).

[45]General Stores Corp. v. Shlensky, 350 US.S 462 (1955).

[46]U.S. Realty

[47]Grubbs v. Pettit, 282 F. 2d 557 (2 d Cir. 1960).

[48]U.S. Realty

[49]General Stores

Category 6: Chapter X.[50] Reflecting the SEC's involvement in the development of Chapter X, this proceeding can restrict the powers of management so that the rights of investors may be protected. In cases where indebtedness is $250,000 or more, the court is required to appoint a disinterested trustee. When indebtedness exceeds $3,000,000, the court must refer the case to the SEC for advice. The court has full authority to exercise its discretion in balancing the rights of the public with those of the firm's investors.

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[50]"Allocation of Securities in Corporate Reorganization: Claims Measurement through Investment Value Analysis," Yale Law Review, Vol. 61 (May 1952), pp. 656-685; D.F. Billyou, "Priority Rights of Security Holders in Bankruptcy Reogranizations: New Directions," Harvard Law Review, Vol. 67 (February 1954), pp. 553-590; Walter J. Blum, "The Law and Language of Corporate Reoganization," University of Chicago Law Review, Vol. 17, p. 565; Francis J. Calkins, "Corporate Reorganization Under Chapter X--A Post Mortem," Journal of Finance, Vol. 3 (June 1948), pp. 19-28; Francis J. Calkins, "Involuntary Reorganization," in Merwin H. Waterman, Essays on Business Finance,(Fourth Edition, Ann Arbor, Michigan: Masterco Press, 1963), pp. 383-399; Francis J. Calkins, "Feasibility in Plans of Corporate Reogranizations Under Chapter X," Harvard Law Review, Vol. 61 (May 1948), pp. 19-28; "Cost of Corporate Reogranization Under the Chandler Act," Harvard Law Review, Vol. 52 (1938-1939), pp. 1349-1356; D.A. Fergusson, "Preferred Stock Valuation in Recapitalizations," Journal of Finance, Vol. 13 (March 1958), pp. 48-69; John Gerdes, "General Principles of Plans of Corporate Reogranization," University of Pennsylvania Law Review and American Law Register, Vol. 89, No. 1 (November 1940), pp. 39-62; M.G. Guthmann, "Absolute Priority in Reogranizations," Columbia Law Review, Vol. 45 (September 1945), pp. 739-754; Carlos L. Israels, "Some Problems of Policy and Procedure in the Conduct of Reogranization Proceedings," University of Pennsylvania Law Review and American Law Register, Vol. 89, No. 1 (November 1940), pp. 63-89; P.M. O'Leary, "The Role of Banking Groups in Corporate Reogranizations," American Economic Review, Vol. 39 (June 1939), pp. 337-344; Alfred B. Teton, "Reogranization Revised," Yale Law Journal, Vol. 48 (November-June 1939), p. 573; and J. Kirk Windle, "Obstacles

Broadly outlined, the steps for affecting a reorganization are

> (1) Processing the petition, including filing, answers, and approval by the court;
> (2) Appointment of trustees, unless the liabilities aggregate less than $250,000 and the debtor is left in possession;
> (3) Preparation and presentation of plan of reorganization;
> (4) Hearing on reorganization plan, including any stipulated advisory report by the SEC;
> (5) Tentative approval of plan by court and submission to affected creditors and stockholders; and
> (6) Final hearing, order of confirmation, and closing of estate.[51]

Because of the complexity of most corporate reorganizations, Chapter X has generated much discussion in the literature. Some of the prominant issues are methods of valuation of debtors' property, the doctrine of absolute priority of claims, interpretation of the meaning of "fair and equitable" plans and the requirement for appointment of a trustee.

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[50]to Successful Reorganization," Journal of the National Association of Referees in Bankruptcy, (January 1962), pp. 12-13.

[51]Paul M. Van Arsdell, Corporation Finance: Policy Planning, Administration (New York: The Ronald Press Company, 1968), p. 1533.

Category 7: Chapter XI.[52] Relatively few articles concern Chapter XI specifically. Much information about it is contained in the Category 5 articles. In addition to general descriptions of Chapter XI processes and experience, the most common issue is whether Chapter XI can be successfully applied to large corporations.

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[52]"A Switch in Bankruptcy Pleas--Larger Companies Turn to Chapter XI," Business Week, No. 1729 (October 20, 1962), pp. 124-126; George Ashe, "Chapter XI arrangements--Confirmation Requisites and Minority Creditors' Rights," Commercial Law Journal, Vol. 70 (April 1965), p. 92; W. H. Baldwin, "McKesson and Robbins Reorganization," Harvard Business Review, Vol. 20 (Spring 1942), p. 473; "Discounter Caught in Cash Bind," Business Week, (August 18, 1962), p. 109; Edwin Gage, "Corporate Giants and Chapter XI of the Chandler Act," George Washington Law Review, Vol. 8 (May 1940), p. 1054; Leon S. Forman, "Chapter XI--Rearranged," Commercial Law Journal, Vol. 69, (February 1964), p. 44; Sidney Krause, "Arrangements Under Chapter XI," in G. J. Hirsch and Sidney Krause, Bankruptcy and Arrangements Under Chapter XI (Third Edition. New York: Practising Law Institute, 1968), pp. 77-132; "Miller-Wohl Trims Its Style," Business Week, (May 19, 1975), pp. 62-65; Shirley Yerkes, "Rebounding From Bankruptcy," The New Englander, Vol. 21, No. 10; pp. 27-29; Nicholas Von Hoffman, "Penn Central Boondoggle: Bankruptcy Move Debated," New York Times; Benjamin Weintraub and Harris Levin, "Chapter XI Approaches Its 'Teens," Cornel Law Quarterly, Vol. 35 (Summer 1950), p. 725; Benjamin Weintraub and Harris Levin, "Bankruptcy After Chapter XI," Journal of the National Association of Referees in Bankruptcy, Vol. 31 (October 1957), p. 124.

Typically, the SEC has contended that a corporation with publicly held securities may not file a petition for an arrangement under Chapter XI. Basically, the rationale is that such firms are seeking to avoid the safeguards for their creditors and stockholders available in Chapter X. Other reasons firms prefer Chapter XI over Chapter X are (1) arrangements are quicker than reorganizations, (2) they often feel their problems are not serious enough for complete reorganization, and (3) appointment of a trustee is not required in Chapter XI.

Category 8: Sources of Bankruptcy Information. The most authoritative sources of bankruptcy legal information are bankruptcy form books.[53] Particularly relevant for business people are descriptions of bankruptcy included in Finance texts.[54] Whereas legal studies and form books are

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[53]For example Collier on Bankruptcy (Albany, New York: M. Bender & Co., Inc., 1964) and Remington on Bankruptcy (Rochester, New York: The Lawyers' Co-operative Publishing Company, 1955).

[54]Consulted for this study were William H. Husband and James C. Dockray, Modern Corporation Finance (Homewood, Illinois: Richard D. Irwin, Inc., 1966); Van Arsdell; James C. Van Horne, Financial Management and Policy (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971); and J. Fred Weston and Eugene F. Grigham, Managerial Finance (Second Edition. New York: Holt, Rinehart and Winston, 1966).

mostly intended for the use of attorneys in bankruptcy, the bankruptcy sections of Finance books are geared more for use by business managers. Of the Finance texts in the sample, the most extensive treatment of bankruptcy is Van Arsdell.[55]

Helpful sources of information on problems and practice of bankruptcy are the Brookings Report and Commission Report.[56] Since both studies were essentially analytical, they provide many insights into how the bankruptcy system really functions.

Finally, some recent articles have described the issues involved in current applications of the law and present recommended changes in it.[57]

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[55]Van Arsdell, pp. 1473-1644.

[56]These were discussed earlier in this study.

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Statistical Analyses of Ratios to Predict Firm Behavior

Statistical studies relevant to this study are those in which financial ratios were incorporated as "explainer" or independent variables while various classes of firm behavior constituted dependent variables.[58] Early attempts to classify firms by ratios were mostly univariate in nature; dependent variables usually were success and failure or continuances and discontinuances.[59]

Multivariate analysis of ratios has only recently become popular as a means of overcoming the shortcomings of univariate analysis. According to the nature of dependent variables (or firm behavior), these analyses are classified

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[58]Several researchers have recently developed mathematical programming models to predict failure. Opposed to statistical models which essentially identify characteristics of samples of firms already in the specified categories (for example, failure or success), these models predict failure based upon internal developments of individual firms. Examples of this work are P. A. Tinsley, "Capital Structure Precautionary Balances and Valuation of the Firm: The Problem of Financial Risk," Journal of Finance and Quantitative Research, Vol. 5, No. 2 (March 1970), pp. 33-62; J. Wilcox, "A Gambler's Ruin Prediction of Business Failure Using Accounting Data," Sloan Management Review, Vol. 12, No. 3 (Spring 1974), pp. 1-10; and K. E. Sahin, "Prediction of Business Failure With Mathematical Programming," Working Paper #675-75, Sloan School, M.I.T., August 1973).

[59]For a detailed analysis of business failure see Van Arsdell, pp. 301-302, 305-306, and 1473-1485.

for present purposes into three groups: Success-failure, acquisition-non-acquisition, and miscellaneous applications. Discriminant analysis of ratios has been prominent in the first type, and is gaining ground in classifications of firms in the other groupings.

Univariate Analysis of Ratios

Prior to the 1930's, financial ratios served the purposes of individual users, but no widely accepted structure existed for the practice of ratio analysis.[60] The use of ratios as predictors of failure began with a 1930 study by Smith.[61]

Data consisted of balance sheets and at least partial income statements for 29 failed firms representing 17 industry classifications. For ten years prior to failure, ratios were compared to their values in the preceding year to determine whether an increase or a decrease had occurred.

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[60]James O. Horrigan, "A Short History of Financial Ratio Analysis," Accounting Review, Vol. 43, No. 2 (April 1968), p. 288.

[61]Raymond F. Smith, "A Test Analysis of Unsuccessful Industrial Companies," University of Illinois Bulletin, No. 31, University of Illinois Bureau of Business Research (Urbana, Illinois: University of Illinois Press, 1930) cited in Robert O. Edmister, "An Empirical Test of Financial Ratio Analysis for Small Business Failure Prediction," unpublished Ph.D. dissertation, Ohio State University, 1970, pp. 13-14.

These changes were tabulated for each of the ten years to see whether any of the ratios indicated approaching failure in a majority of cases.[62]

Eight ratios were identified which showed consistent indications of impending failure they are divided into two groups as follows:

> Group 1 (Ratios whose trends resulted in an uninterrupted symptom of weakness for most companies in at least eight years before failure):
>
> 1. Working Capital to Total Assets
> 2. Surplus and reserves to Total Assets
> 3. Net Worth to Fixed Assets
> 4. Fixed Assets to Total Assets
>
> Group 2 (Those which had not more than two interruptions in an otherwise constant trend indicating weakness):
>
> 1. Current Ratio
> 2. Net Worth to Total Assets
> 3. Sales to Total Assets
> 4. Cash to Total Assets[63]

It was concluded that the best indicator of financial soundness was the Working Capital to Total Assets ratio. Its decline began ten years before financial problems occurred and continued steadily.[64] The study had a shortcoming in that no control group of successful or non-failed firms was used.[65]

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[62]Smith, pp. 51-52.

[63]Smith, pp. 51-52.

[64]Smith, p. 53.

[65]Horrigan, p. 289.

Smith and Winakor repeated the study in 1935 using a sample of 183 firms.[66] Their results substantiated the findings of the first study. The important difference between them was sample size. Because of its large sample size, the second study was a more detailed analysis, but still no control group was used.

The criticism of these studies is not to detract from the significance of their contributions. They were the first attempts to use the scientific method for determining the usefulness of ratios and as such represented an important event in the development of ratio analysis.[67]

These initial predictive studies were closely followed by similar work by Fitzpatrick. His first study incorporated thirteen ratios computed for a sample of twenty firms which had failed during the 1920's.[68] He then compared his "failed" sample with a matched sample of nineteen non-failed firms and presented the results in a second study.[69] He

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[66]Raymond F. Smith and Arthur H. Winakor, "Changes in Financial Structure of Unsuccessful Industrial Companies," University of Illinois Bulletin, No. 51, University of Illinois Bureau of Business Research (Urbana, Illinois: University of Illinois Press, 1935).

[67]Horrigan, p. 289.

[68]Paul J. Fitzpatrick, Symptoms of Industrial Failures, (Washington, D.C.: Catholic University Press, 1931).

[69]Paul J. Fitzpatrick, "A Comparison of the Ratios of Successful Industrial Enterprises With Those of Failed Companies," Certified Public Accountant, October, November, and December 1932, pp. 598-605, 652-656, and 626-731, respectively.

concluded that the following ratios were the best indicators of impending failure:

1. Net Profit to Net Worth
2. Net Worth to Debt
3. Net Worth to Fixed Assets.

Acknowledged as the culmination of the early period in the development of ratio analysis to foretell failure[70] was the Merwin Study.[71] Utilizing a sample of 200 "discontinued" and 381 "continuing" firms distributed across five industries, Merwin identified the following indicators of ultimate discontinuance:

1. Current Ratio
2. Net Worth to Total Debt
3. New Working Capital to Total Assets.[72]

Describing his methodology, Merwin explained,

> ...we have taken the year of disappearance as the point of reference, regardless of the particular calendar year it happens to be, and have tabulated the financial statements according to the number of years before discontinuance. Thus the statements of the 200 companies were grouped into six divisions, according to whether they covered the first, second, third, fourth, fifth or sixth calendar year before the company in question left the business scene. The statements in each of these divisions were then aggregated to yield a composite balance sheet and income account for each of the six year-before-discontinuance periods.[73]

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[70]Horrigan, p. 289.

[71]Charles L. Merwin, Financial Characteristics of American Manufacturing Corporations (Washington, D.C.: U.S. Government Printing Office, 1941).

[72]Merwin, p. 92.

[73]Merwin, pp. 91-92.

Differences between continuing and discontinued firms were identified by comparing average ratio values for the latter group to so-called "estimated normal" and "high-low range" values of the former. Estimated normal averages are weighted averages of ratios for continuing firms for calendar years before discontinuance of firms in the other sample. The high-low range is the 1926-1935 range of annual values for the sample of continuing companies.[74] Differences in ratio averages between the two groups were ranked from small to large. Friedman's ranking test was used to determine the probability that the evolved arrangement would occur by chance.[75] For the three ratios mentioned earlier, the chance probability was less than one in one hundred.[76]

Walter demonstrated an alternative to working capital position as an indicator of technical solvency[77] in a 1959 study.[78] This new type of ratio, the funds statement ratio,

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[74]Merwin, pp. 94-98.

[75]Merwin, pp. 136-137.

[76]Merwin, p. 139.

[77]"Technical solvency" refers to the ability of a firm to meet obligations maturing within twelve months; see James E. Walter, "Determination of Technical Solvency," Journal of Business, Vol. 30, No. 1 (January 1957), p. 30.

[78]James E. Walter, "A Discriminant Function for Earnings Price Ratios of Large Industrial Corporations," Review of Economics and Statistics, Vol. 41, (February 1959), pp. 44-52.

brought net cash flows and related considerations into prominance. Walter was the first to specifically incorporate the funds flow statement into ratio analysis.[79]

A 1966 study by Beaver[80] has been acclaimed a landmark for future ratio research.[81] Ratios of failed firms were compared individually to those of a matched sample of non-failed firms by three different techniques. First, five-year profiles of the average values of ratios for firms in the two groups were constructed. The results appear in Table 1. Beaver noted that profiles lack predictive capability.[82]

The second method of analysis he employed was a dichotomous classification test of the ratios which classified firms as either failed or non-failed.[83]

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[79]Horrigan, p. 292.

[80]William H. Beaver, "Financial Ratios as Predictors of Failure," Empirical Research in Accounting: Selected Studies, 1966 Supplement to Vol. 4 of Journal of Accounting Research, pp. 71-111.

[81]Horrigan, p. 291.

[82]Beaver, "Financial Ratios...," p. 83.

[83]Beaver, "Financial Ratios...," p. 84.

TABLE 2-1

COMPARISON OF MEAN VALUES
OF FAILED AND NONFAILED FIRMS

Ratios	Classification of Firms According to Average Value of Ratios	
	Mean Below Cutoff Point	Mean Above Cutoff Point
Cash Flow to Total Debt	Nonfailed	Failed
Net Income to Total Assets	Nonfailed	Failed
Total Debt to Total Assets	Failed	Nonfailed
Working Capital to Total Assets	Nonfailed	Failed
Current Ratio	Nonfailed	Failed

Source: William H. Beaver, "Financial Ratios as Predictors of Failure," Empirical Research in Accounting: Selected Studies, 1966, Supplement to Vol. 4 of Journal of Accounting Research, pp. 71-111.

Of the 30 ratios analyzed, the six presented in Table 1 for the two groups were categorized by the percentage of misclassifications. This index roughly approximates predictive ability--error and predictive ability are inversely related. For five years before failure, the percentage of misclassifications ranged from thirteen percent to 49 percent of the six ratios. The best predictor of failure was the Cash Flow to Total Debt ratio which had a thirteen percent error for the first year before failure and 22 percent in the fifth.[84]

The third part of the study involved construction of likelihood ratios. This is essentially a Bayesian

[84]Beaver, "Financial Ratiod...," pp. 84-86.

approach which can be viewed as a problem in assessing the probability of failure conditional upon the value of a financial ratio.[85] Beaver concluded, "The implication is that the (likelihood) ratio can convey useful information in determining solvency for at least five years before failure."[86]

Also appearing in 1966 was a study by Tamari in which an index of risk for 28 bankrupt (16 were bankrupt and 12 had been granted consolidation loans or moratoriums) Israeli firms and 1610 non-bankrupt companies were compared.[87] The index is constructed by selecting ratios and weighting them according to their importance.[88]

Ratios included in the index and their weights are[89]

1.	Equity Capital & Reserves/Total Liabilities	25
2.	Profit Trend	25
3.	Current Ratio	20
4.	Value of Production/Inventory	10
5.	Sales/Receivables (including Notes)	10
6.	Value of Production/Working Capital	10

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[85]Detailed review of this technique is beyond the scope of the present analysis and is presented in Beaver, "Financial Ratios...," pp. 95-99.

[86]Beaver, "Financial Ratios...," p. 98.

[87]Meir Tamari, "Financial Ratios As a Means of Forecasting Bankruptcy," Management International Review, Vol. 4, (1966), pp. 15-21.

[88]Tamari, p. 19.

[89]Tamari, p. 19.

Describing his results the author said,

> in the case of bankrupt firms (the index) was indeed lower than it was in 1960 for companies operating during the entire period 1956-1960. 75 percent of the bankrupt firms had less than 35 points and 50 percent less than 25, while 75 percent of the other firms had more than 46 points and 50 percent more than 63....[90]

Multivariate Analyses of Ratios

Almost all of the foregoing studies were univariate in nature: that is, they involved analysis of ratios one-at-a-time. Emphasis was placed on single ratio values which indicated impending failure. The hazard of this approach lies in the tendency of managements to offset weaknesses in one financial area with strengths in another. For example,

> a firm with a poor profitability and/or solvency record may be regarded as a potential bankrupt (meaning general failure). However, because of its above average liquidity, the situation may not be considered serious.[91]

To overcome these shortcomings of univariate analysis, researchers have applied Multivariate Discriminant Analysis (MDA) to ratios. There are two advantages to this approach.

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[90]Tamari, p. 19.

[91]Edward I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," Journal of Finance, Vol. 23, No. 4 (September 1968), p. 591.

First, an entire set of ratios common to all subjects can be analyzed simultaneously rather than sequentially as in univariate analysis. The interaction among ratios is also considered.

Second, MDA reduces the dimentionality of the data. It can be used to assign subjects (firms) to two or more groups (dependent variables). Regardless of the number of groups, K, in a particular application, the demensionality of analytical space is reduced to K-1. Thus, in the present two group application (Chapter XI successes and failures), the analysis will be performed within one dimension; that is, one linear combination of ratios (discriminant function) will be constructed on the basis of which firms will be classified as "success" or "failure."

In the next section two types of studies will be described. First, studies incorporating MDA of ratios to predict failure will be described in detail. Second, application of this technique to policy issues other than success-failure status will be reviewed.

MDA Success-Failure Studies. Analysis of ratios by MDA was begun in 1941 but did not gain momentum until the mid-1960's.[92] Professor Beaver paved the way for its application to success-

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[92]One of the first applications of MDA to financial problems was an analysis of the credit worthiness of loan applicants (D.D. Durand, Risk Elements in Consumer Installment Financing (New York: National Bureau of Economic Research, 1941), pp. 105-142 cited in Altman, "Financial Ratios..."

failure studies when he asked,

> Is it possible that a multiratio analysis, using several different ratios and/or rates of change in ratios over time, would predict even better than the single ratios?[93]

While critiquing Beaver's study, Professor John Netter said,

> I would certainly be interested to know how effective is the use of multivariate analysis utilizing a number of ratios.... (I)s discriminant analysis useful (in this context)...?[94]

The first application of MDA to bankruptcy prediction was undertaken in 1968.[95]

It has served as a model for subsequent work, most of

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[92]Walter classified high and low earnings-price ratio firms with an MDA model using ratios (Walter, "A Discriminant Function....") Installment loans were evaluated with an MDA model in H. Myers and E. W. Forgy, "Development of Numerical Credit Evaluation Systems," Journal of the American Statistical Association, Vol. 50 (September 1963), pp. 797-806. Finally, investments were classified as investment type, trading type, or speculative type with an MDA model by Keith V. Smith, "Classification of Investment Securities Using MDA," Institute Paper #101 (Purdue University Institute for Research in the Behavioral, Economic, and Management Sciences, January 1965).

[93]Beaver, "Financial Ratios...," p. 100.

[94]John Neter, "Discussion of Financial Ratios as Predictors of Failure," Empirical Research in Accounting: Selected Studies, 1966. Supplement to Vol. 4 of Journal of Accounting Research, pp. 112-118.

[95]Altman, "Financial Ratios...."

which has involved variations of Altman's approach in applications to differently defined samples. For that reason and because his techniques and method of presentation are followed in the present study, its description in this presentation will be more detailed than the descriptions of similar work which followed.

Altman constructed an MDA model of ratios to predict bankruptcy[96] as an illustrative example. The study was designed to assess the quality of ratio analysis as an analytical technique. He explained the decision to use MDA as an attempt to overcome the potential in univariate analysis for faulty interpretation, confusion, and ambiguity over the relative performance of several firms.[97]

A total of 66 manufacturing firms made up the sample which was divided into a bankrupt and non-bankrupt group. The 33 bankrupt firms had filed petitions under Chapter X between 1946 and 1965. The other group was a paired sample of non-bankrupt firms stratified by industry and size. Data were derived an average of seven and one-half months before bankruptcy from Moody's Industrial Manuals and selected annual reports.

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[96]"Bankruptcy," in the Altman study referred to firms which were legally bankrupt and either placed in receivership or granted the right to reorganize under the Act. See Altman, "Financial Ratios...," p. 589.

[97]Altman, "Financial Ratios...," p. 591.

A list of 22 ratios was compiled for evaluation. They were classified into five categories including liquidity, profitability, leverage, solvency, and activity ratios. Five of the original set did the best job of predicting bankruptcy. They were determined through these steps:

1. Observation of the significance of several different discriminant functions;
2. Computation of relative contributions of each ratio (independent variable in the discriminant functions;)
3. Analysis of intercorrelations among relevant ratios;
4. Observation of the prediction ability of each profile of ratios; and
5. Judgement of the researcher.

An important point for the present study is that ratios which were the most significant contributors when evaluated individually (that is, following the usual univariate methodology), were not the ones included in the best discriminant function. About this development Altman commented,

> The variable profile established did not contain the most significant variables, amongst the twenty-two original ones, measured independently. This would not necessarily improve upon the univariate, traditional analysis.... The contribution of the entire profile is evaluated, and since this process is essentially iterative, there is no claim regarding the optimality of the resulting discriminant function. The function, however, does the best job among the alternatives which include numerous computer runs analyzing different ratio-profiles.

The discriminant function finally selected is

$$Z = .012X_1 + .014X_2 + .033X_3 + .006X_4 + .999X_5 ,$$

where:

X_1 = Working Capital/Total Assets

X_2 = Retained Earnings/Total Assets

X_3 = Earnings before interest and Taxes/ Total Assets

X_4 = Market Value of Equity/Book Value of Total Debt

X_5 = Sales/Total Assets

Z = Overall Index.[98]

The overall power of the discriminant function was tested with an F-ratio. This statistic is the ratio of between-groups sums-of-squares to within-groups sums-of-squares. The operation performed by MDA is essentially to identify the variables, and their relationships to each other, which best distinguish between groups but which are most similar within groups. The F-ratio was used to test the hypothesis that all ratios come from the same population. Altman found the two original groups to be significantly different and the hypothesis was rejected.

Once the discriminant function was identified, a discriminant score (called "Z-score") was computed for each firm. This operation was accomplished by multiplying the

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[98]Altman, "Financial Ratios...," p. 594.

function's coefficients by each firm's appropriate ratios (X_1 through X_5). According to each firm's Z-scores, then, they were each classified as belonging to one or the other group. A Chi-square value was utilized to measure the relative proximity of each firm's Z-score to each group.

The model correctly classified 95 percent of the total sample, which is not an unexpected result considering the bias present in classifying the data on which the model was derived. Even when data two years before bankruptcy were used, the model correctly classified 83 percent of the total sample.

The model was validated with two new samples, one containing 25 bankrupt firms, the other, 66 firms of below average performance. Ninety-six percent of the first sample was correctly classified and 79 percent of the second.

The last test of the model involved predicting failure for the initial sample with data from three, four, and five years before bankruptcy (it had already been successfully applied for one and two year). Results are outlined in Table 2:

Table 2-2

PREDICTIVE ACCURACY OF THE MDA MODEL FOR DATA FROM EACH OF THE FIVE YEARS BEFORE BANKRUPTCY

Year Prior to Bankruptcy	Sample Size	Number Correctly Classified	Number Incorrect	Percent Correct
1	33	31	2	95
2	32	23	9	72
3	29	14	15	48
4	28	8	20	29
5	25	9	16	36

Source: Edward I. Altman, "Financing Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," Journal of Finance, Vol. 23, No. 4, September 1968, p. 604.

The author explained that the apparent increase in accuracy in the fifth year was erroneous and probably due to unreliability of the model after the second year. The MDA model was an accurate predictor of bankruptcy up to two years prior to bankruptcy.

As part of his 1969 dissertation, Blum constructed a model to differentiate between failed and non-failed companies.[99] Failed firms were those which had entered bankruptcy proceedings or an agreement with creditors for reduction of debt. The total sample consisted of 230 industrial

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[99]Marc P. Blum, "The Failing Company Doctrine," unpublished Ph.D. dissertation, Columbia University, 1969 in Edmister.

firms of which half had failed between 1954 and 1968. The non-failed half was a paired sample matched by industry, sales, number of employees and year of failure. Variables in the discriminant model were the following:

1. Market Rate of Return
2. Quick Flow Ratio
3. Cash Flow/Total Debt
4. Market Value of Net Worth/Total Debt
5. Quick Assets/Inventory
6. Book Value of New Worth/ Total Debt
7. Standard Deviation of Net Quick Assets/ Inventory
8. Rate of Change of Income
9. Rate of Change of New Quick Assets/ Inventory
10. Breaks in Income Trends
11. Breaks in Net Quick Asset Trends/ Inventory

The model averaged 94 percent accuracy on data from financial statements within one year prior to failure. It declined to 80 percent and 70 percent, respectively, for two and three years prior to failure. By considering the slopes of variables (rates of change) this study added a new type of data to MDA success-failure studies.

The next published application of MDA to ratios for failure prediction was in 1972. Edward Deakin[100] replicated Beaver's dichotomous classification test and then devised a discriminant function from his 14 ratios. Deakin defined failed firms as those "...which experienced bankruptcy, insolvency, or were otherwise liquidated for the benefit of creditors."[101] For the replication, each of 32

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[100]Edward B. Deakin, "A Discriminant Analysis of Predictors of Business Failure," Journal of Accounting Research, Vol. 10, (1972), pp. 167-179.

[101]Deakin, p. 168.

failed firms was matched with a non-failed firm by industry classification, asset size and year of financial information. Since Beaver included as failures firms which had defaulted on loan obligations or missed preferred dividend payments, and did not match the non-failed companies by financial structure, there could have been bias in some ratios.

The total sample was divided into two subsamples, each consisting of about half of the pairs of firms. The members of each subsample were then ranked by ratio values. Ratio values which showed the smallest number of misclassifications in the first subsample were then used as the critical value of the ratio to classify firms in the other subsample. Then the procedure was reversed and the members of the first subsample were classified by critical values determined on the second. The number of misclassifications for each ratio in each of the five years before failure was calculated. Results of this replication were described as follows by Deakin:

> Considering that differences could arise from the use of independent samples and from the later time period of the second sample, the results would tend to confirm Beaver's observations.[102]

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[102]Deakin, p. 169.

A twenty percent error was recorded in classifications in the first year before bankruptcy. An MDA model was then constructed in an attempt to improve upon that result.

Recognizing that an assumption of MDA is random selection of group members from independent samples, Deakin randomly selected another sample of 32 nonfailed firms from the same five-year period as the first. The five discriminant functions (one for each year) were tested for their significance.[103] The models were significant at the .001 level in the first three years, the .011 level in the fourth, and the .05 level in the fifth. Each model utilized all fourteen ratios.

Rather than classifying individual firms based upon comparison of their Z-scores with a critical score which correctly classified the most firms, the author implemented a classification technique described by Tatsuoka.[104] The essence of this method is to compute a Chi-square dissimilarity measure which may be viewed as the generalized distance

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[103] F-tests, converted from Wilk's Lambda, were used to test the significance of the difference between Z-scores for each group in each year.

[104] See Maurice M. Tatsuoka, Multivariate Analysis: Techniques for Education and Psychological Research (New York: John Wiley & Sons, Inc., 1961) and Maurice M. Tatsuoka, "Discriminant Analysis: The Study of Group Differences," Selected topics in Advanced Statistics: An Elementary Approach, No. 6. (Champaign, Illinois: The Institute for Personality and Ability Testing).

of a point (representing an individual firm's Z-score) from the centroid of one of the groups. The larger a firm's Chi-square value, the more dissimilar to the "average" firm in that group. Conversely, a firm may be interpreted as closer to the average member of the group, the smaller its Chi-square value. This rule (called the minimum Chi-square rule by Tatsuoka)[105] may be stated,

> Compute the (Chi-square) value of the unclassified individual with respect to each of the K groups, and assign him to that group with respect to which his (Chi-square) value is the smallest.[106]

The minimum Chi-square rule may be implemented whenever the assumption can be made that the scores follow a p-variate normal distribution and that the variance-covariance matrix of the groups matches the population variance-covariance matrix. The Chi-square value is computed as follows:

$$\underset{\sim}{d}' \; \underset{\sim}{\Sigma}^{-1} \; \underset{\sim}{d} \sim \chi^2_p \quad ,$$

where:

d' = Row vector of deviation scores

d = Column vector of deviation scores

$\underset{\sim}{\Sigma}$ = Population variance-covariance matrix, and

p = Degrees of freedom of the Chi-square distribution equal to the number of elements in the deviation score vector.[107]

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[105] Tatsuoka, Multivariate Analysis..., p. 218.

[106] Tatsuoka, Multivariate Analysis..., p. 218.

[107] Deakin, p. 175.

Minimum Chi-square values were computed for each firm in the original sample. Misclassification errors averaged 3, 4.5, and 4.5 percent for the first, second and third years, respectively. These are better results than were experienced with Beaver's dichotomous classification test and Altman's one-year MDA model. The error rate increased sharply for the fourth and fifth years to 21 and 17 percent, respectively.

Next, a 34 firm sample (11 failed and 23 non-failed) was randomly drawn for testing the model. Error rates of 22, 6, 12, 23 and 15 percent were reported for each of the five years before failure. The severe deterioration in the first year was not explained although some deterioration could be reasonably expected in such a validation study. Deakin concluded,

> The application of statistical techniques, particularly discriminant analysis, can be used to predict business failure from accounting data as far as three years in advance with a fairly high accuracy.... (P)robabilities of group membership should be used only as further evidence of probable failure rather than as conclusive proof in themselves.[108]

The next MDA failure prediction model was constructed in 1972 by Edmister.[109] Whereas previous researchers used

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[108]Deakin, p. 178.

[109]Robert O. Edmister, "An Empirical Test of Financial Ratio Analysis For Small Business Failure Prediction," Journal of Financial and Quantitative Analysis, Vol. 7, No. 2 (March 1972), pp. 1477-1493 and Robert O. Edmister, "Financial Ratios As Discriminant Predictors of Small Business Failure," unpublished Ph.D. dissertation, Ohio State University, 1970.

predominantly large corporations' data, Edmister concentrated on small businesses, using Small Business Administration (SBA) data. Nineteen ratios were analyzed by MDA in five hypothesized methods of ratio analysis to select the best method for discriminating between SBA loss and non-loss borrowers and guarantee recipients. The ratios are,

1. Quick Ratio
2. Current Ratio
3. Inventory/Net Working Capital
4. Net Working Capital/ Total Assets
5. Current Assets/ Total Debt
6. Total Debt/Equity
7. Fixed Assets/Equity
8. Cash Flow/Current Liabilities
9. Current Liabilities/ Equity
10. Equity & Long-term Debt/Fixed Assets
11. Inventory/Sales
12. Fixed Assets/Sales
13. Total Assets/Sales
14. Net Working Capital/ Sales
15. Equity/Sales
16. EBIT/Sales
17. EBIT/Total Assets
18. EBIT/Equity
19. EBIT + Depreciation/ Total Debt

Regarding these ratios, the following hypothesis were tested:

1. A ratio's level is a predictor of small business failure;
2. The three-year trend[110] of each ratio is a predictor of small business failure;
3. The three-year average of a ratio is a predictor of small business failure;
4. The combination of the industry relative trend and the industry relative level for each ratio is a predictor of small business failure.

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[110]"Trend" was defined as the significant relationship between a dependent variable and time. A runs count was selected as a means of discerning trend; Edmister, "An Empirical Test...," p. 1481.

Each hypothesis represents a different method of ratio analysis. Results were summarized as follows:

> Using step-wise multiple discriminant analysis with a restriction on the simple correlation of the entering variable with the included variables, a function of independent ratio variables, which is highly accurate in classifying borrowers in the test sample, is developed. Methods of analysis found useful are (1) classification of a borrower's ratio into quartiles relative to other borrowers in the sample, (2) observation of an up- or down-trend for a three-year period, (3) combinatorial analysis of a ratio's trend and recent level, (4) calculation of the three-year average and (5) division of a ratio by its respective Robert Morris Associates (RMA) industry average ratio.[111]

Two 1973 studies, one by Altman[112] and the other, Balmeister and Jones,[113] attempted prediction of railroad bankruptcy with MDA models utilizing ratio inputs.

Altman's objective was to develop an early-warning system from the railroad industry. After construction and validation, the model was applied to currently operating railroads in America to assess their potential for bankruptcy.

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[111] Edmister, "An Empirical Test...," p. 1491.

[112] Edward I. Altman, "Predicting Railroad Bankruptcy in America," Bell Journal of Economics and Management Science, Vol. 4, No. 1 (Spring 1972), pp. 184-211.

[113] Philip W. Balmeister and Richard W. Jones, "Railroads, Failure and MDA-made Mergers," Mergers and Acquisitions, Vol. 8, No. 2 (Summer 1973), pp. 12-15.

The bankruptcy proceeding appropriate for railroads is Section 77. The author compiled information on 21 railroads that went bankrupt between 1939 and 1970. Financial information was taken from their balance sheets and income statements for one and two periods before bankruptcy. Industry ratios and measures of performance were also gathered from aggregated totals for the various financial statements from all railroads in the industry. Financial ratios for individual railroads were then compared to the industry averages.

Ratios and financial dimensions included in the study are,

A. Liquidity Measures
   1. Net Current Assets/Total Assets
   2. Net Current Assets/Total Operating Revenues
B. Profitability and Efficiency Measures
   3. Income Before Interest & Taxes/Total Assets
   4. Operating Revenue/Total Transportation Property
   5. Operating Revenue/ Net Transportation Property
   6. Operating Expenses/Operating Revenue
   7. Transportation Expenses/Operating Revenue
   8. Income After Taxes and Fixed Charges/ Operating Revenue
   9. Total Maintenance/Total Transportation Property
   10. 3-Year Compound Growth Rate of Operating Revenue
C. Solvency & Leverage Measures
   11. Earned Surplus/Total Assets
   12. Total Debt/Total Assets
   13. Fixed Charges Earned (Before Taxes)
   14. Cash Flow/Fixed Charges[114]

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[114]Altman, "Predicting Railroad Bankruptcy...," p. 208.

The author explained that he expected the liquidity, profitability and solvency measures of the bankrupt railroads to be significantly worse than the industry averages; these differentials were expected to increase as bankruptcy approached. The results of the study were summarized as follows:

> The ratio results...conform with our *a priori* expectations and indicate that a multivariate prediction model is a viable possibility. The bankrupt group's ratios show significantly worse measures (F-ratio significantly at .01 level) than the industry averages (with 3 exceptions) for both one and two statements prior to failure. In addition, the bankrupt averages all show deterioration as failure approaches.[115]

Balmeister and Jones attempted to predict failure of railroads with a variation of Altman's model. They pointed out a problem with the Altman study:

> ...(M)any of the railroads in the sample were very small. There was a distinct possibility that significant differences would exist between large and small bankrupt railroads.[116]

Because of that possibility, their sample was limited to larger railroads. The ratios used in the model *which were different* than the ratios Altman used are,

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[115]Altman, "Predicting Railroad Bankruptcy...," p. 139.

[116]Balmeister and Jones, p. 13.

I. Liquidity
   1. Current Assets/Current Liabilities
   2. Net Current Assets/Fixed Charges
   3. Income Before Interest and Taxes/ Current Liabilities

II. Profitability and Efficiency
   4. Net Income/Total Assets
   5. Income Available for Fixed Charges/ Fixed Charges
   6. Fixed Charges/Operating Revenues

III. Solvency and Leverage
   7. Current Liabilities/Total Assets
   8. Long-Term Debt/Total Assets
   9. Shareholders' Equity/Total Assets

(Altman's ratios 2, 4, 7, 8, 9, 10, 13, and 14 were not used by Balmeister and Jones).

Their results showed more misclassifications than had been experienced by Altman. First, of their total sample of 26 railroads, eight failed between 1958 and 1970 for which the MDA model indicated at least a .5 probability of bankruptcy at least one statement prior to failure. In none of these cases was the probability of failure less than .67 one statement prior to bankruptcy. Second, only one railroad failed during the period for which the model indicated at most a .5 probability of bankruptcy. Third, seventeen railroads did not fail between 1958 and 1970 for which the model had shown a probability of greater than .5 of bankruptcy.

The authors concluded that "MDA simply points out those companies which possess a profile which is significantly similar to firms which have failed in the past."[117]

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[117]Balmeister and Jones, p. 15.

Financial Analysis by MDA. MDA has been applied to ratios for the purpose of analyzing the financial characteristics of merged versus non-merged firms. The Stevens study, cited earlier, appeared in 1972.[118] Methodologically, the present study is similar to this research.

Stevens used two multivariate techniques to analyze merged and non-merged companies. First, financial ratios for the five groups of firms were evaluated by Principal Components Analysis (PCA). Then, the PCA output was input to an MDA program.

PCA enables the researcher to simplify and summarize a data matrix into a smaller one without an appreciable information loss. Among financial ratios, a perplexing problem is how much of the same information is contained in several different ratios? For example, consider the well known Current and Quick liquidity ratios.[119] The Current

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[118]Donald L. Stevens, "A Multivariate Analysis of the Financial Characteristics of Acquired Firms in Industrial Mergers," unpublished Ph.D. dissertation, Michigan State University, 1972 and Donald L. Stevens, "Multivariate Tools for Financial Analysis: The Case of Acquired Firms in Industrial Mergers," Paper presented at the March 1972 meeting of the Southwestern Finance Association, San Antonio, Texas. (Mimeographed).

[119]The Current Ratio is Current Assets/Current Liabilities weheras the Quick Ratio is (Current Assets-Inventory/Current Liabilities.

Ratio measures the degree to which current assets cover current obligations. By contrast, the Quick Ratio, when used in conjunction with the Current Ratio, indicates how much a firm's current assets are burdened by relatively illiquid inventory. If it were shown that the Quick Ratio, for instance, conveyed 90 percent of the same information as the Current Ratio, it could be concluded that computation of the latter is really unnecessary.

This problem of overlapping information content is, of course, multiplied many times when a large number of possible ratios exists for the analyst's use. Stevens' goal was to identify financial characteristics in terms of traditional financial structure dimensions, liquidity, profitability, leverage, and activity. Within a set of ratios of which there were several representing each dimension, interpretational problems were foreseeable.

By subjecting the 20 ratios of the 80 firms in his sample to PCA, the author was able to identify the predominant financial dimensions. He described the process as follows:

> Principal components analysis reduces a data matrix X of size n X N to a factor matrix F of size r X N where r (the rank of the matrix--the maximum number of linearly independent vectors) is less than n. The greater the difference between r and n, the greater the simplification. The original data matrix X is linearly dependent upon matrix F and the coefficients of this dependence are presented in another matrix A

> of size n X r. Matrix A is called the factor loadings matrix, and Matrix F is called the factor scores matrix.[120]

Ninety percent of the variance in the model was explained by the first eight factors identified by factor analysis; 82 percent was explained by the first six factors. This was interpreted to mean that there were essentially six dimensions in the total data set, and the remaining variance (18 percent) found in the other 14 factors was error variance.

The six factors were retained and an axes rotation was performed into six-space (this procedure is explained generally in Appendix G, Part 4). Coefficients in the rotated factor matrix, which may be interpreted as correlations between each of the factors and each of the ratios, were analyzed to find the highest. Of the original ratio set, the leverage ratios had the highest loadings on one factor, the profitability ratios had the highest loadings on another factor, and so on for activity, liquidity, dividend policy, and price earnings ratios. Consequently, the six factors were interpreted as representing leverage, profitability, etc.

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[120]Stevens, "Multivariate Tools...," p. 6.

These six dimensions, each measuring a separate financial variable, then represented the original 20 ratios. The dimensions accounted for most of the variance in the original data and were orthogonal or independent of the other dimensions.

Next, individual ratios which had factor loadings closest to 1.0 for each of the six dimensions were retained for input to the MDA model. Five of the six contributed significantly to discrimination power of the MDA model which was of the form,

$$Z = .052X_1 + .163X_2 + .079X_3 - .953X_4 + .236X_5$$

where:

X_1 = Dividend Payout Ratio;

X_2 = Net Income/Total Assets;

X_3 = Net Working Capital/Total Assets;

X_4 = Sales/Total Assets; and

X_5 = Long-Term Debt/Total Assets.

This model was used to classify firms in the original sample and also in a hold-out sample. The discriminant function correctly classified 92 percent of the firms in both the original and validation samples.

Alternative combinations of the original ratios were then input to several discriminant models for comparison with the derived model. Because of the intercorrelations among the ratios, none of the alternative models successfully discriminated between groups. The result occurred because

PCA had derived a subset of the original ratios which represented the important financial dimensions of that set while maintaining a minimal amount of intercorrelation.

This methodology was also successfully implemented in two studies by Robert Libby.[121] In one study, the usefulness of ratios to loan officers in the prediction of business failure was examined.[122] In the other, three necessary conditions for the use of the MDA model as a predictor of failure were analyzed. "These necessary conditions are (a) accurate predictions of decision maker behavior, (b) stability of the functions over time, and (c) stability of the functions over response thresholds."[123]

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[121] Robert Libby, "Accounting Ratios and the Prediction of Failure: Some Behavioral Evidence," Journal of Accounting Research (forthcoming -cited with permission of the author); Robert Libby, "The Use of Simulated Decision Makers in Information Evaluation," The Accounting Review (forthcoming--cited with permission of the author); and Robert Libby, "Prediction Achievement and the Use of Simulated Decision Makers in Information Evaluation," unpublished Ph.D. dissertation, University of Illinois, 1974).

[122] Libby, "Accounting Ratios...," p. 3.

[123] Libby, "The Use of Simulated...," p. 1.

Both studies consisted of two parts. The first was a deriviation of an MDA classification model following Stevens' approach. The second involved testing the perceptions of proposed users of financial ratios (decision-makers).

In both studies, the fourteen ratios used were those found to be highly related to failure in Beaver's[124] univariate and Deakin's[125] multivariate tests (thus, the choice to use the same ratios in this research). After inputting the correlation matrix of the fourteen ratios, they were analyzed by PCA with a VARIMAX axis rotation. Significant factors were identified by the scree test[126] and a five percent variance significance criterion.

Five independent dimensions (sources of variation) were found in the set of ratios by identifying the types of ratios which had high factor loadings on each of the five significant factors. The dimensions were labeled "...(a) profitability, (b) activity, (c) liquidity, (d) asset balance, and (e) cash position.[127] Then the variables with the highest loading on each factor were chosen to represent it. Those chosen were,

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[124]Beaver, "Alternative Accounting Measures...."

[125]Deakin.

[126]R. B. Cattell, "The Scree Test for the Number of Factors," Multivariate Behavioral Research, Vol. 1 (1966), pp. 254-276 in Libby, "The Use of Simulated...," p. 9.

[127]Libby, "The Use of Simulated...," p. 9.

1. Net Income/Total Assets
2. Current Assets/Sales
3. Current Assets/Current Liabilities
4. Current Assets/Total Assets
5. Cash/Total Assets

Two discriminant analyses were performed on a two group (success-failure) sample using first, all fourteen ratios, and then, the reduced set of five. Results of these tests were explained.

> Based upon the derivation sample, predictive ability is only decreased by 5% by reducing the number of predictor variables from 14 to 5. The reduction in variables and the resulting decrease in sample sensitivity produced a 3.3% increase in predictive ability upon double cross-validation. This indicated that reduction of the 14 ratio information set to 5 ratios by factor analysis for use in this experiment resulted in only slight loss of predictive ability.[128]

Similar results to the first part of the other study were reported. The author then went on, in both cases, with perception tests, detailed description of which are beyond the scope of the present study.

Results of one study were described as follows:

> The discriminant function models provided highly accurate predictions of subject responses and proved to be stable over response threshholds and a one week period of time. Linear predictability averaged at 88%. Considering that the average test-retest reliability of 8.9 out of 10 sets a theoretical maximum for linear predictability of 94.5%, on the average the models correctly predicted 93.5% of the subjects' reliable responses. These results indicate that the models may indeed provide

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[128]Libby, "The Use of Simulated...," p. 10.

> an efficient method of estimating the effects of accounting errors and changes upon decisions of predictions.[129]

This result is significant for the development of failure prediction models in general. The MDA model accurately predicted failure even when decision-makers' perception processes "intervened" in the analysis of firms. In earlier studies this condition was implied, but not addressed directly.

Similar results were reported in the second study.[130] Accounting ratios provided useful information to loan officers in predicting failure. Further, group differences among decision-makers were insignificant in reducing prediction accuracy as were individual differences.

Summary

This chapter has reviewed three categories of literature related to the study.

The first set of studies was made up of analyses of various business aspects of bankruptcy. These studies were similar to the present one in purpose, although they were quite different methodologically.

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[129]Libby, "The Use of Simulated...," p. 10.

[130]Libby, "The Accounting Ratios...," pp. 8-10.

Studies included in the second category were legal analyses of parts of the Bankruptcy Law. They were collected in eight groups for which general characteristics were explained. This was done to offer a taxonomy of the Bankruptcy Law legal literature.

The final set of research articles included analyses of financial ratios to predict various forms of firm behavior. This work was grouped into two parts: Univariate and multivariate analyses. The latter part presented the methodological predecessors of the present study.

C H A P T E R III
METHODOLOGY

Introduction

The methodology employed in the study is explained in this chapter. First, the procedures and definitions used to derive the test data are explained. Second, the three general hypotheses are developed along with their respective working hypotheses. As the hypotheses are explained, the statistical techniques which will be employed to test them will be outlined. Appendices G and H contain detailed descriptions of the multivariate methods employed.

Chapter XI Successes and Failures

In this study the usage of "success" and "failure" differs somewhat from that in the success-failure studies described in Chapter 2. The object here is essentially to analyze a subset of firms which would all probably be labeled failures in a typical success-failure study. The total sample consists of firms which have filed petitions for Chapter XI relief--they are all, in that sense, bankrupts.

Of the firms which petition for Chapter XI relief, some are more successful afterwards than others. At the extremes, some go on to become thriving corporations; others are adjudicated bankrupts and some simply cease operations. Still others are merged or acquired and, categorically, are neither clearly successes nor failures.

Choice of Population

A problem in any success-failure study employing ratios as variables is finding a sample of failures for which ample financial information is available with which to compute ratios as bases for comparison. In this study, all firms analyzed came from the 1966 through 1973 editions of Moody's Industrial Manual and the 1970 through 1973 editions of Moody's OTC Manual.[1] This is because most of the listings in Moody's include balance sheet and income statement data. The firms are industrial, publicly-held corporations; noncorporate, privately-owned, and non-industrial firms are excluded from the manuals and from the study.

Since railroads, public utilities, financial and banking corporations and other non-industrial companies are also excluded from Chapter XI,[2] the choice of Moody's population of firms is appropriate for the study in a horizontal sense. Yet, because individuals and partnerships

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[1]Moody's began publishing the OTC Manual in 1970.

[2]Bankruptcy Act Sec. 4, 11 U.S.C. Sec. 22.

as well as corporations may file Chapter XI petitions, Moody's population may not be generally representative in a vertical sense; that is, in terms of size. However, even though small firms which enter Chapter XI would not be represented in Moody's population, larger firms may be the most relevant segment of Chapter XI firms to study. The most extensive litigation over the applicability of Chapter XI has centered upon middle-sized corporations with a relatively small issue of publicly-held stock, and with unsecured liabilities (usually trade credit or, more generally, current liabilities) between, say, two and three million dollars.[3] Further, there has been a trend toward unsecured debt settlement by large corporations in Chapter XI.[4]

Although the small business segment is not represented in Moody's, middle-sized and large corporations are. The troublesome fact remains that a small proporation of annual Chapter XI cases concern firms which are listed in

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[3]Benjamin Weintraub and Harris Levin, "Reorganization or Arrangement: An Analysis of Contemporary Trends in Recent Cases," Journal of the National Association of Referees in Bankruptcy, Vol. 37 (1963), p. 103.

[4]See, for example, "A Switch in Bankruptcy Pleas--Larger Companies Turn to Chapter XI," Business Week, No. 1729 (October 20, 1962), pp. 124-126 and Don A. Emory, "Bankruptcy--Large Publicly-held Corporations Allowed to Remain in Chapter XI Arrangement Proceedings," Texas Law Review, Vol. 42 (1963), p. 246.

Moody's. For that reason, any inferences drawn from the study will apply only to members of Moody's population of Chapter XI petitioners.

"Successes" and "Failures"

Even though the words, "success-failure," have absolute connotations, they are usually used relatively in the literature. Failures often are not firms which ceased to exist. Rather, they are operationally defined such that those that qualify are less successful than the set of operationally defined successes. For example, Deakin defined failure to include firms which experienced bankruptcy, insolvency, or liquidation; successes were firms which did not meet those criteria.[5] Altman's bankrupt firms were those which were either placed in receivership or granted the right to reorganize under the Bankruptcy Act; a sample of non-bankrupts was selected from firms which had not so filed[6] (the success or failure of bankruptcy proceedings was not addressed). Beaver defined failure as bankruptcy, default on bond payment, nonpayment of preferred stock dividends, or overdrawn bank

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[5]Edward B. Deakin, "A Discriminant Analysis of Predictors of Failure," Journal of Accounting Research, Vol. 10 (1972), pp. 168-169.

[6]Edward I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," The Journal of Finance, Vol. 23, No. 1, p. 589.

account.[7] Edmister defined financial failure as default on a Small Business Administration (SBA) loan; repayment of an SBA loan constituted financial success.[8] Finally, firms which were declared bankrupt, given consolidation loans, or granted a moratorium on debt were analyzed by Tamari.[9]

Definition and Selection of Chapter XI Failures

Most relevant for present purposes was the definition of failure utilized in Beaver's first study:

> In the front of Moody's there appears a list of firms--firms on whom Moody's has formerly reported but no longer does so. There are many reasons why a firm may be dropped--name change, merger, liquidation, lack of public interest, and, most importantly, failure. The list of several thousand names was condensed into a list of firms that had failed.[10]

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[7]William H. Beaver, "Alternative Accounting Measures As Predictors of Failure," The Accounting Review, Vol. 43, (January 1968), p. 113.

[8]Robert O. Edmister, "Financial Ratios As Discriminant Predictors of Small Business Failure," unpublished Ph.D. dissertation, The Ohio State University, 1970, pp. 4-5.

[9]Meir Tamari, "Financial Ratios as a Means of Forecasting Bankruptcy," Management International Review, Vol. 4 (1966), p. 16.

[10]William H. Beaver, "Financial Ratios as Predictors of Failure," Empirical Research in Accounting: Selected Studies, 1966. Supplement to Vol. 4 of Journal of Accounting Research, p. 73.

Three additional categories are used in Moody's discontinued firm list: "Adjudicated bankrupt," "no recent information," and no reason given--that is, some discontinued firms are entered in the list with notice only of name and year of the last edition in which they were included. (A Moody's representative interviewed by telephone explained that firms in the last two categories are ones for which no information was found by Moody's staff for two consecutive years. Their sources include the S.E.C., the various stock exchanges, and others). Accompanying name and last edition of inclusion for all the others, however, is one of the statements described above explaining why the firm's listing was discontinued.

For this study, the first task was to peruse the 1966 through 1974 editions of Moody's and construct a list of companies which had filed Chapter XI petitions[11] (there is no index of Chapter XI firms).

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[11]This method is not recommended by the researcher. After the list was completed, it was learned that Disclosure Journal, Index of Corporate Events, separately identifies firms which have entered bankruptcy, Chapter X, and Chapter XI and also those which have discontinued operations. While verifying the initial list by this index, several additional Chapter XI cases were identified which were described in Moody's with no reference to their bankruptcy status. These firms were added to the appropriate list (success or failure).

Next, this list was cross-tabulated with the list of discontinued firms described above. Those discontinued for reasons of bankruptcy adjudication, no recent information, and no reason given were retained. (At the same time, a separate list of Chapter XI firms which were discontinued because of merger was constructed). Twenty-six firms which meet the following operational definition of Chapter XI failure were found: Firms which had petitioned for Chapter XI relief, for which financial information was available and listings in Moody's were discontinued because of bankruptcy adjudication, no recent information, or no reason given. Then, ten firms discontinued for these last two reasons were randomly selected[12] and traced to make sure they were not "successful." For none of them was the arrangement confirmed within two years after the petition was filed. No further information could be found for five of them--they were not listed in their respective telephone books, their states' industrial directories contained no reference to them and they were listed on no stock exchange. Of the remaining five, two were adjudicated bankrupt after their listings were dropped, one was placed in Chapter X by the S.E.C. and was subsequently adjudicated bankrupt (this was learned

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[12]Firms were numbered from 1 to 26 and ten were selected by reference to the table of random numbers presented in Irwin Guttman, S. S. Wilkes, and J. Stuart Hunter, Introductory Engineering Statistics (Second Edition. New York: John Wiley & Sons, Inc., 1971), pp. 493-495.

coincidentally from a note in Moody's for another firm which had unsuccessfully tried to acquire the Chapter XI company), and the remaining two were still in operation. Of the last two, one had undergone a court-directed take-over by a group of outside investors. The other one appeared three years after discontinuance by Moody's as a subsidiary of another corporation in Moody's Directory of Corporate Affiliates. Both were retained as Chapter XI failures.

Based on the experience of this random sample of ten firms, it was concluded that Chapter XI firms discontinued by Moody's for the reason of "no recent information" and "no reason given" were sufficiently less successful than firms not discontinued after filing petitions, to be included in the Chapter XI failure group.[13]

Definition and Selection of Chapter XI Successes

A Chapter XI success is operationally defined as a firm for which a Chapter XI petition was filed, whose plan of arrangement was confirmed, and whose listing in the respective Moody's manual was not discontinued for at least two years after filing. For these firms Chapter XI was

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[13]This contention was also verified over the telephone by a representative of the Manual Department of Moody's Investors' Service, Inc.

assumed to have had a rehabilitative effect and, therefore, was "successful." Further, they are "more successful" than Chapter XI petitioners which may even have continued operations, but whose listings were discontinued by Moody's.

Moody's discontinued firm list includes companies which were discontinued during the current and the proceeding nine years. Chapter XI successes were identified by absence from the 1974 Moody's discontinued firm list of firms which appeared on the initial Chapter XI petition list.

A set of thirty-seven Chapter XI firms were identified in this fashion of which twenty-six subjects for the study were randomly selected.[14]

Whether firms which filed Chapter XI petitions and were subsequently merged or acquired were successes or failures, could not be determined generally. For the eight firms in this category, however, success was assumed since merger was a condition of confirmation of the plan in the three cases in which information was available. Thus Chapter XI status to some extent contributed to the occurrence of the merger.

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[14]Firms were numbered from one to thirty-seven and twenty-six were selected by reference to the table of random numbers in Gutman, Wilkes, and Hunter, pp. 493-495.

Hypotheses

The analysis will proceed in two steps. First, the set of ratios[15] for the total sample will be factor analyzed (explained in Appendix G) to test the first hypothesis. In so doing, the financial dimensions will be identified which contain most of the information present in the whole data set. Second, each of the original ratios which has the highest correlation with each dimension (or factor) will be retained as an independent variable in a Multiple Discriminant Analysis (MDA--explained in Appendix H) model. This model will test Hypothesis 2 and will ascertain whether the two groups of firms (Chapter XI successes and failures--the dependent variables) differ on the variables.

This model (labeled "Model A" for present purposes) combining the multivariate techniques, factor analyses and direct mode MDA (see Appendix H for an explanation of direct mode MDA), facilitates interpretation of the financial dimensions of the groups. It may tend to be less sensitive, however, to group differences than the so-called stepwise MDA method (called "Model B" herein and

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[15]The initial set of ratios and their explanations are presented in Appendix D. Beaver found the Cash Flow/Total Debt ratio to be the most significant predictor of failure. Because depreciation values did not appear consistently in the manuals, this ratio was not included in this study.

also explained in Appendix H) which is not preceded by factor analysis. (The reasons for these differences between the two methods are discussed in Appendix H). Because of these differences the data will be analyzed by both methods. The objective of this strategy is to roughly determine the amount of the discriminatory power which is lost by Model A over Model B, if any, and to check for different levels of multicollinearity.

Once the two models are constructed they will be validated by testing Hypothesis 3. The purpose of this third step is to determine the presence of bias in the analysis data which may provide false discriminatory power.

Data Reduction

> Hypothesis 1: The set of financial ratios is reducible to a smaller set of financial dimensions.

This general hypothesis is a statement asserting that the original ratios have intercorrelations such that they can be simplified into a smaller set of relatively independent dimensions which contains almost as much information. The factor matrix (explained in Appendix G, Part 4) produced by principal factoring with iterations (explained in Appendix G, Part 2) will be analyzed to test Hypothesis I. Retained for further analysis will be those factors with eigenvalues greater than 1.0; they will be compared to

the results of the "scree test" for final selection.[16] Factors extracted in this way will be referred to as "significant factors."

The following working hypotheses reflect the expected interpretations of each of the significant factors:[17]

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[16]A combination of two rules for the retention of factors will be used. The first, proposed by H. F. Kaiser, "The Application of Electronic Computers to Factor Analysis," Educational and Psychological Measurement, Vol. 20 (1960), pp. 141-151 and discussed in Tatsuoka, Multivariate Analysis, p. 147 calls for retaining only those factors whose eigenvalues (see Appendix G) are greater than 1.0. The second, a graphical method called the scree test, (proposed by R. B. Cattell, "The Scree Test for the Number of Factors," Multivariate Behavioral Research, Vol. 1 (1966), pp. 245-276 and discussed by Tatsuoka, Multivariate Analysis, p. 147) consists in plotting the set of eigenvalues against their ordinal numbers (this plot for the present study is presented in Figure 4-1). Such plots usually have a steep initial descent followed by a straight line with a gradual downward slope. The rule is to retain all the factors associated with eigenvalues which fall on the first line segment and the largest one on the "scree line."

Subprogram FACTOR automatically retains factors whose eigenvalues are greater than 1.0. These output eigenvalues will be tested with a scree line against the ones excluded by this feature of the program.

[17]That factor analysis may be used to test taxonomic hypotheses such as these is attested to by SPSS, p. 209 and Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1964), pp. 680-685.

Hypothesis 1A: One factor represents the liquidity dimension.

Hypothesis 1B: One factor represents the profitability and solvency dimension.

Hypothesis 1C: One factor represents the cash position dimension.

Hypothesis 1D: One factor represents the activity dimension.

Hypothesis 1E: The above factors are exhaustive.

These hypotheses will be tested by observing the financial nature of ratios which have the highest factor loadings on vectors in the VARIMAX rotated factor matrix (see Appendix G, Parts 3 and 4). For example, if ratios which are acknowledged as liquidity measures in the literature have higher loadings than other ratios on, say, Factor 1, then that factor will be interpreted as representing liquidity.[18]

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[18]This method of interpretation was suggested by Tatsuoka, Multivariate Analysis, pp. 148-149 and implemented by Donald L. Stevens, "Multivariate Tools for Financial Analysis: The case of Acquired Firms in Industrial Mergers," Paper presented at the March 1972 meeting of the Southwestern Finance Association, San Antonio, Texas; Robert Libby, "Accounting Ratios and the Prediction of Failure: Some Behavioral Evidence," Journal of Accounting Research (forthcoming)--cited with permission of the author; Robert Libby, "The Use of Simulated Decision Makers in Information Evaluation," The Accounting Review (forthcoming)--cited with permission of the author; and Marion L. Chiattello, "On the Use of Principal Components Analysis to Interpret Cross-sectional Differences Among Commercial Banks," Journal of Financial and Quantitative Analysis, December, 1974, pp. 1047-1051 (who was commenting on a similar application by R. J. Saunders, "On the Interpretation of Models Explaining Cross-Sectional Differences among Commercial Banks," Journal of Financial and Quantitative Analysis, Vol. 4 (March 1969), pp. 25-35).

In the event that combinations of ratios which load highly on significant factors can not be interpreted according to any subset of the dimensions specified in Hypotheses 1A through 1D, then the appropriate hypotheses will be rejected and the factor's interpretation will be explained. This would occur if the set of ratios with high loadings on a significant factor represented more than one of the groups (financial dimensions) specified in the list of ratios in Appendix D. In this case, commonalities among the high loading ratios will be judgementally determined to interpret the appropriate factors.

If more than four factors are significant, Hypothesis 1E will be rejected and the additional factors similarly will be interpreted by analysis of their respective sets of high loading ratios.

Discrimination between Successes and Failures

Once the financial dimensions (or common factors) present in the total sample's ratios are identified, the next concern is whether the two groups exhibit different average values on them. Chapter XI failures will be expected to have weaker positions in terms of liquidity, profitability and solvency, cash position, and activity or other factors which may emerge. This sort of analysis and interpretation is possible when ratios are factor

analyzed before the discriminant analysis--the Model A approach. With Model B, the analysis is centered on specific ratios; financial dimensions are not as readily interpretable, especially when high levels of multicollinearity exist.

Since all Chapter XI's are insolvent in at least the equity sense, and since the successes continued operations, they should be in stronger liquidity (the ability to meet short-term obligations as they mature) positions, at the time of filing, than the failures. Further, Chapter XI successes are firms whose plans of arrangement were confirmed. A condition of confirmation is a plan which is accepted by creditors and the court. Consequently, a better liquidity position among the successes would account for their ability to at least partly satisfy the claims of creditors and facilitate confirmation.

In terms of their profitability (overall effectiveness of management shown by return on investments and sales), Chapter XI successes should have been in stronger positions than failures. This dimension may be viewed as a measure of the ability of management to manage assets and sales. Management teams with higher amounts of this skill (as measured by profitability ratios) would be expected to be more successful than those without it.

Stronger leverage positions (owners' contributions relative to creditors' financing) could explain the ability

of successful Chapter XI firms' managers to work out agreements leading to confirmation and continuation. Weak leverage positions would, in all likelihood, bar such agreements in many cases.

Finally, Chapter XI successes will be characterized by more effective employment of resources (assets) than failures. Thus, the activity factor is expected to be higher than for failures. Activity, or turnover, ratios typically represent various classes of assets as percentage of total sales (or its reciprocal).

To construct an MDA model to test for group differences, a set of ratios must be selected which represents the firms in the sample. The original set will be reduced to as few ratios as possible which still represent a large part of the information in the original set. This parsimony would facilitate practical applications of the model.

Defending the factor analysis method, Stevens noted

> When discriminant analysis has been employed in recent published studies in finance (see Altman and the Monroe and Simkowitz studies) the variables employed in the final discriminant model were retained only after numerous experimental runs to see which set of variables did the "best" job and, at the same time were minimally correlated. It would appear that the principal components method would be a more analytical substitute and much less subjective.[19]

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[19] Stevens, p. 15.

Whereas the principal components method (Model A) may be more analytical and less subjective than trial-and-error selection of variables, stepwise selection of variables (Model B) is not. The researcher in stepwise MDA adjusts the F-to-enter and F-to-remove levels (see Appendix H) to generate the highest significance level and the highest percent of correct classifications. This stepwise method, however, does not result in a maximal solution (merely optimal) because when partial F-values are computed not every possible subset of variables is considered.[20].

More importantly, though, Model A may result in a large loss of discriminating power relative to the Model B solution. This would be the case, for instance, when one ratio (or several) had moderately high loadings on two or more factors, but not the highest, which condition was accompanied by somewhat greater than comparable amounts of discriminating power. In this case of multicollinearity, the factor analysis process could reject a variable or two which stepwise MDA would include in its best discriminant function. This would indicate that two moderately correlated variables, for example, had more discriminating

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[20]See SPSS, 2nd Edition, p. 448.

power <u>together</u>, than either one separately. The root of this problem is simply that factor analysis selects variables for different reasons than stepwise MDA. More specifically, factor analysis selects dimensions with maximum residual variance. In two-group MDA, individual ratios are selected in the stepwise mode according to the increase in significance of the function produced by adding each variable to it.

In more concrete terms this means that following Model A, a loss of information during the reduction process could destroy large amounts of discriminating ability in the reduced set of ratios. Before concluding by Method A that no differences were present in the financial structure of Chapter XI successes and failures, the discriminating power of the original set of ratios (the complete set) would have to be tested by Model B. If the complete set of ratios (reduced by Model B rather than A) showed significant differences between the two groups, the resulting model would demonstrate identifiable differences between them which would be useful in predicting group membership in the future.

Because a hypothesis of no group differences cannot be rejected with confidence by Method A, two hypotheses will be developed in this section - one for each of Models A and B.

Since the factor matrix represents the correlation between each of the ratios and each of the dimensions (that this contention is true is explained in Appendix G, Part 4), a ratio with a factor loading close to 1.0 for a certain dimension would closely describe that dimension. Such ratios (one for each dimension) could serve as substitutes for their respective dimensions in the discriminant analysis. The resulting set of ratios will be minimally intercorrelated and will account for most of the information in the original set of ratios.

There must be significant differences between the ratios of firms in the two groups for the MDA model to distinguish between them.[21] Hypothesis 2 tests this discriminatory power for Model A; Hypothesis 2A, for Model B. The test in both cases is performed by first computing a test statistic (Wilk's Lambda) from the between- and within-groups variance. It is then converted into an F-variate for comparison with a table of F-values.[22] It may also

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[21]The converse does not hold. The means of the ratios for the two groups may not be the same, but may be so close that discrimination is not effective. (See Ronald E. Frank, William F. Massy, and Donald G. Morrison, "Bias in Multiple Discriminant Analysis," Journal of Marketing Research, Vol. 2 (August 1965), p. 252.

[22]See Tatsuoka, Multivariate Analysis, pp. 164-165.

be converted to a Chi-square value for the same purpose. The hypothesis will be accepted if groups differences are significant at the .99 level.

> Hypothesis 2: An MDA model based upon the financial ratios which represent the dimensions identified by factor analysis, discriminates between Chapter XI successes and failures in the sample.
>
> Hypothesis 2A: The original ratios analyzed by stepwise MDA are significantly different for the groups of Chapter XI successes and failures.

Support of both Hypotheses would indicate that the two groups are significantly different on the ratios identified by factor analysis and on those identified by stepwise discriminant analysis. If both approaches result in significant discrimination but different sets of ratios emerge, the set identified by stepwise MDA will be preferred. This is because factor analysis, while it identifies common sources of information in the data, does not necessarily identify factors along which discrimination would result in the discrimination analysis. Another reason for preferring Model B in this case is that intercorrelations among ratios in the sample will be assumed to exist also in the population. Edmister explained,

> ....multicollinearity is not likely to decrease the value of the model as a forecaster as long as the relationships remain constant.[23]

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[23]Robert O. Edmister, "Financial Ratios are Discriminant Predictors of Small Business Failure," unpublished Ph.D. dissertation, The Ohio State University, 1970, p. 50.

After noting that the result of multicollinearity is the same for MDA as for regression, he commented in another paper,

> Attempts to apply regression techniques to highly multicollinear independent variables generally result in parameter estimates that are markedly sensitive to changes in model specification and to sample coverage.... Successful forecasts with multicollinear variables require not only the perpetuation of a stable dependency relationship between Y and X, but also the perpetuation of stable interdependency relationships within X.[24]

In a similar vein, Johnston discussed the problem of multicollinearity as follows:

> If forecasting is a primary objective, then intercorrelation of explanatory variables may not be too serious, provided that it may reasonably be expected to continue in the future.[25]

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[24]Donald E. Farrar and Robert R. Glouber, "Multicollinearity in Regression Analysis: The Problem Revisited," The Review of Economics and Statistics, Vol. 49 (February 1967), pp. 92-107 cited in Robert O. Edmister, "An Empirical Test of Financial Ratio Analysis for Small Business Failure Prediction," Journal of Financial and Quantitative Analysis, March 1972, p. 1484.

[25]J. Johnston, Econometric Methods (New York: McGraw-Hill Book Company, Inc., 1963), p. 207 in Edmister, "Financial Ratios," p. 50.

On the other hand, multicollinear independent variables present problems of interpretation and "... (O)ne should not expect to obtain estimates of their independent effects...."[26] In selecting from among variables which are correlated, MDA may choose some for entry while leaving out others which are nearly as significant.

If collinearity in the analysis sample is assumed present in the population and at least one of a collinear set of ratios is selected, then discrimination should not be materially reduced. However, for descriptive as opposed to predictive purposes, Model A would be preferred over Model B, for these same reasons.

Support of Hypothesis 2A after rejection of Hypothesis 2 would indicate that the two groups, while not significantly different on the ratios representing significant factors (the reduced set), are different on the centroids of the entire set of original ratios reduced by Model B. This development would demonstrate that discriminatory power in the original set of ratios was lost by the factor analysis reduction. The predictive ability of the model, however, would be still subject to question.[27]

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[26]Arthur S. Goldberger, Econometric Theory (New York: John Wiley & Sons, Inc., 1964), p. 193 in Edmister, "Financial Ratios," p. 50.

[27]As Frank, Massy, and Morrison pointed out, "Finding a difference between the means of the explanatory variables for the populations underlying the discriminant analysis does not guarantee that effective prediction will prove to be possible," ("Bias", p. 252).

Hypothesis 3 attempts to test this predictive ability.

If neither Hypothesis 2 nor 2A is accepted, the MDA model will not be analyzed further since there will be no basis for discrimination between the two groups of ratios.

Predictive Ability of Models A and B

> Hypothesis 3: The MDA model based upon the financial ratios which represent the dimensions identified by factor analysis is a valid predictor of potential success or failure of Chapter XI petitioners.
>
> Hypothesis 3A: The stepwise MDA model is a valid predictor of potential success or failure of Chapter XI petitioners.

These hypotheses will be employed to test either or both of the reduced-or complete-set MDA models, whichever has significant discriminatory power. The rationale is as follows: Even if an MDA model correctly classifies the sample of firms, the resulting apparent discriminatory power is illusory if it is due solely to the effects of sample bias.

Two types of bias are possible. First, sampling error can inflate the proportion of cases correctly classified in the sample relative to the population. This may occur since peculiar characteristics of the sample, which may not be present in the population, are fitted with the discriminant function. Second, bias due to reasons such as intensive searching for variables and/or subjects that

work best for the sample may be present.[28]

The third hypothesis (which states essentially that the proportion of cases correctly classified by the discriminant model is due to true differences between the groups and not to bias), will be tested by a variation of a simulated sample procedure proposed and implemented by Frank, Massy, and Morrison[29] and implemented by Edmister.[30] This is not the best validation method--Frank, et. al recommend a split-half sample approach (denoted by "V_1") as preferred when a large sample is available. Since the maximum possible number of variables in the present analysis is eighteen, splitting the sample (in half) would reduce the total sample to well below the recommended number (fifty-four).

The simulated sample approach (called "V_2"),

> ...is mainly a technique for inferring true predictive power when the original data are not available, thus eliminating the possibility of using the ... V1 procedure.[32]

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[28]Frank, Massy, and Morrison, "Bias," p. 254.

[29]Frank, Massy, and Morrison, "Bias," p. 254-258.

[30]Edmister, pp. 51-55.

[31]Tatsuoka suggested that the total sample should be at least (two or preferably) three times the number of variables used. (See Maurice M. Tatsuoka, Discriminant Analysis: The Study of Group Differences. Selected Topics in Advanced Statistics: An Elementary Approach, Number 6 (Champaign, Ill.: Institute for Personality and Ability Testing, 1970), p. 38).

[32]Frank, Massy, and Morrison, "Bias," p. 254.

It is based upon the use of a synthetic validation sample made up of a set of randomized data, for which no real differences among groups exist. "However, Frank et. al suggest an alternative method using the original data and having the advantage of maintaining the variance-covariance matrix of the original analysis."[33]

The procedure is the following:

1. Coefficients of the discriminant function are derived with the analysis sample and a classification table is generated.

2. Original data are "scrambled" by randomly reallocating subjects to the two populations, or generally, by randomly ordering them.

3. Discriminant coefficients are estimated from the scrambled data and classification tables are generated and analyzed.

Randomly ordering observations ensures that the expected discriminatory power of the analysis is zero. Therefore the discriminating power given by the scrambled data classification table can be interpreted as a measure of the bias associated with the given numbers of degrees of freedom.[34] In order for the synthetic validation sample to demonstrate that the analysis discriminant model has predictive ability and, therefore, is based upon true differences between the groups, its discriminant function must not correctly classify significantly more than 50

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[33]Edmister, p. 54.

[34]Frank, Massy, and Morrison, "Bias," pp. 254-255 and Edmister, p. 55.

percent of the validation sample at the .99 level.[35] An example may best explain this process. Suppose that a discriminant function correctly classified 80 percent of the analysis data. Suppose further that a randomly scrambled validation sample produced 78 percent "correct" classifications, and that this result was significantly different (based upon the t-test) than the zero discriminating power (50 percent correct classification) actually present in the scrambled data. The researcher could then conclude that the former result of 80 percent correct classifications of the analysis data was illusory and the apparent predictive power of the discriminant analysis is almost entirely due to the effects of sample bias.

In the present research, three synthetic validation samples will be employed to protect against the effects of chance.[36] Their mean proportion of correct classifications will be compared to the chance proportion with the following test statistic:[37]

$$t = \frac{Q-P}{\sigma_p}$$

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[35]This test was employed by Edmister, p. 68.

[36]Frank, Massy, and Morrison recommend several replications of the validation sample to protect against chance ("Bias," p. 255). Edmister employed three replications.

[37]Based on a test presented by Frank, Massy, and Morrison, p. 253.

where:

Q = the proportion of observations correctly classified by the discriminant analysis,

P = the proportion one expects by chance (P = .5 assuming the groups are of equal size as in the present study).

$$\sigma_p = \sqrt{\frac{P(1-P)}{n}} \quad .$$

Constructing Ratio Profiles

With the overall significance of the discriminant functions thus determined, the relative contributions of their ratios will be evaluated to determine the profile of ratios which discriminates between successes and failures. (In the event that Hypothesis 3 or 3A is rejected, this last step will, of course, not be implemented for the corresponding model). The procedure for interpreting significant contributions to discrimination differs somewhat for Models A and B.

Model A. If the Model A discriminant function is valid, the nature of its variables can be easily interpreted. MDA will determine weights for each ratio in such a way that a linear combination of all input variables best discriminates between successes and failures.

Ratios in the resulting discriminant function, however, will not be equal in their discrimination importance; that is, in the amount by which each one contributes to the discriminatory power of the overall function. The measure of this discrimination importance is simply the sign and size of the coefficients of each ratio. However, since the coefficients are not all comparable to each other, simple observation of them is misleading.[38] A useful technique for determining the ratio profile is to compute the relative contributions of variables to the total discriminatory power of the function, and the interaction between them. The relevant statistic is derived by standardizing the coefficients; that is, by multiplying each variable's coefficient by the square root of the corresponding diagonal element in the variance-covariance matrix (standard deviation).[39]

Scaled vectors produced in this way enable ranking of Model A variables (ratios) according to their contributions to the model.

Model B. The main difference between Model A and B variables will be that those in the latter may be highly intercorrelated; those in the former will be less so.

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[38]Edward I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," Journal of Finance, Vol. 23 (September 1968), p. 596.

[39]Altman, "Financial Ratios," p. 596.

Blum pointed out that there is no conclusive method for determining the relative contributions of variables when correlations exist. He commented,

> Relative importance is usually assessed by comparing standardized discriminant function coefficients. However, discriminant function coefficients are unstable when the variables composing the model are highly correlated. If two variables composing a multivariate model are collinear, the information each adds to the model is similar, and their coefficients are assigned arbitrarily. Thus, the relative weights of the variables do not necessarily signify their relative importance.[40]

Therein lies the principal advantage of Model A over Model B. Because factor analysis identifies factors which are nearly orthogonal (see Appendix G for the explanation of selection of factors), Model A results in selection of a set of ratios that are substantially uncorrelated. Model B, which selects variables according to group separation caused by the set of variables, may produce a discriminant function which contains high degrees of multicollinearity. Because of the arbitrariness of assignment of discriminant coefficients in Model B with multicollinearity, erroneous relative contributions can easily result.[41]

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[40]Marc Blum, "Failing Company Discriminant Analysis," Journal of Accounting Research, Vol. 12, No. 1, (Spring 1974), pp. 10.

[41]Blum explained an example from his data which clearly demonstrates the problems of interpretation of coefficient contributions in the presence of multicollinearity, "Failing Company," p. 10.

Therefore, interpretation of relative contributions of variables in Model B is more judgemental than for Model A. Standardized discriminant coefficients will be compared and then the degree of intercorrelation will be determined so that weaknesses can be identified.

Summary

The methodology followed in this research was explained in this chapter. Samples of Chapter XI successes and failures were selected from Moody's Industrial and OTC Manuals. All of the twenty-six failures which were identified were retained for analysis. Twenty-six successes were randomly selected from a sample of thirty-seven. Eignteen ratios (explained in Appendix D) were then computed from the partial balance sheets and income statements in Moody's.

Next, the set of ratios will be factor analyzed (presented in Appendix G). By testing the first hypothesis, this technique will be used to determine which financial dimensions are predominant in the original set of ratios. Then, a reduced set of ratios will be identified, each of which has the highest correlation in the set with each factor.

The second hypothesis will then be tested to determine if the two groups' means differ significantly in terms of the reduced set of ratios. If they do, an MDA model (discussed in Appendix H) will be analyzed using the

reduced set of ratios as inputs. Rejection of Hypothesis 2 will lead to testing of Hypothesis 2A which states that an MDA model based upon the complete set of ratios has discriminatory power. Rejection of both will demonstrate the absence of discriminatory power in the set of ratios thus establishing that Chapter XI successes and failures do not differ in financial characteristics. Acceptance of one of these hypotheses will demonstrate significant differences between specific ratios of firms in the two groups.

C H A P T E R IV

RESULTS OF THE STUDY

Introduction

This chapter containes descriptions of (1) the samples of Chapter XI successes and failures and (2) results of the analysis of them by factor analysis (explained in Appendix G) and multiple discriminant analysis (MDA) (explained in Appendix H) which was described in the previous chapter.

Description of the Sample

As indicated in Chapter 3, 26 Chapter XI failures and 26 successes were selected from Moody's Industrial and OTC Manuals. The set of failures constitutes all firms identifiable as failures. The success set consists of 26 firms randomly slected from 37 which were identifiable as successes. Twenty-nine additional Chapter XI petitioners were found for which neither success nor failure status could be determined or complete financial data were not available. Most of the former are firms for which Chapter XI petitions were filed after 1973 but final deposition was not yet recorded in Moody's.

No attempt was made to match firms in the two groups in this study. Pair-wise matching or stratified sampling could have interfered with the generalizability of results,

although it could have reduced ratio variability between the groups.[1]

Four very large Chapter XI successes--sales exceeding $100 million--were excluded from the analysis. Chapter XI cases of this large size with widely held stock and large numbers of creditors may not be subject to the same success criteria as smaller cases.[2] Consequently it seemed unwise to include them in the analysis and also to apply results of the study to them.

The characteristics chosen for identification are industry classification, year petition was filed, number of employees, total assets, total liabilities, and total sales.

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[1]The major assumptions underlying multiple discriminant analysis are that each of the independent variables has a multivariate normal distribution; the variables are assumed to have a common dispersion (variance-covariance) matrices for all groups. See Ronald E. Frank, William F. Massy, and Donald G. Morrison, "Bias in Multiple Discriminant Analysis," Journal of Marketing Research, Vol. 2 (August 1965), p. 251.

[2]A bankruptcy judge (who did grant permission for reference) explained to the researcher that firms with large amounts of debt (in an absolute sense) have better chances of remaining in operation than their smaller counterparts. Creditors will tend to oppose liquidation in such instances, regardless of financial weakness, in the hope of recovering a larger portion of their investments through operation of the debtor than through liquidation.

Values for each of these characteristics for the samples of failures and successes are summarized in Tables 4-1 through 4-3.

Table 4-1 contains the industry classifications of the firms in both samples. The groups of firms are roughly comparable by industry. Approximately 50 percent of

TABLE 4-1

MAJOR INDUSTRY CLASSIFICATIONS OF CHAPTER XI SUCCESSES AND FAILURES IN THE UNITED STATES BETWEEN 1963 AND 1973

	Chapter XI's					
	Failures		Successes		Total	
Industry Classification	No.	%	No.	%	No.	%
Manufacturing	16	62	12	46	28	54
Retail	6	23	6	23	12	23
Merchandising	2	8	6	23	8	15
Construction	1	4	1	4	2	4
Mining	1	4	--	--	1	2
Consulting	--	--	1	4	1	2
Total	26	101*	26	100	52	100

*Rounding Error

each sample is made up of manufacturing firms; 23 percent of each consists of retail firms. Twenty-three percent of the success group is in merchandising (wholesaling) which accounts for only eight percent of the failures. Of the two remaining failures, one is a construction firm and the other, mining. The final two successes are in construction and consulting services. In total, 54 percent are manufacturing companies, 23 percent are retailers, and the remaining

23 percent are in merchandising, construction, mining, and consulting.

Years in which Chapter XI petitions were filed by firms in the two groups are summarized in Table 4-2. It includes years of petition in three year increments since 1965. When interpreted as elapsed number of years since the petition was filed, in the base year 1975, differences between the two groups become apparent. As shown in Table 4-3, the average elapsed time since petition is five years for the successes and four years for failures--it is four years for the total sample. The effect of this one year difference is to conservatively bias the samples. That is, it tends to mitigate rather than facilitate the expected differences between the groups, albeit in a minor way. The ratios' components for successes would tend to be smaller because they pre-date those for failures by an average of one year.

To the extent that number of employees measures size of a firm, this variable's average value for the two groups also represents a conservative bias. The average number of employees for the group of failures is 652--nearly twelve percent larger than successes (584). For size to contribute to group differences and thereby unfavorably bias the results, successes would have to be larger than failures.

TABLE 4-2

YEAR OF CHAPTER XI PETITION FOR FIRMS
IN FAILURE AND SUCCESS SAMPLES IN UNITED STATES

	Chapter XI's					
	Failures		Successes		Total	
Year of Petition	No.	%	No.	%	No.	%
1965-67	1	4	5	19	6	12
1968-70	5	19	9	35	14	27
1971-73	19	73	12*	46	31	60
1974	1	4	--	--	1	2
Total	26	100	26	100	52	101**

* One firm's year of petition estimated due to absence of year in Moody's.
** Rounding error.

TABLE 4-3

ELAPSED NUMBER OF YEARS IN 1975 SINCE FILING
CHAPTER XI PETITION FOR UNITED STATES
SAMPLE OF SUCCESSES AND FAILURES

Years Since Petition	Number of Chapter XI's		
	Failures	Successes	Total
10	--	4	4
9	--	1	1
8	1	--	1
7	--	--	--
6	--	2	2
5	5	7	12
4	8	6	14
3	9	4	13
2	2	2*	3
1	1	--	1
Total	26	26	52
Mean (Years)	5	4	4

* One firm's year of petition estimated due to absence of year in Moody's.

Key financial variables (total assets, liabilities, and sales) are summarized in Table 4-4. The mean value for each is roughly the same for the two groups. The range of asset values is between $ .3 million and $48.0 million for failures and $ .7 million and $79.9 million for successes. Similarly, total liabilities has a range of between $ .2 million and $44.6 million for failures, and $ .1 million and $60.1 million for successes.

TABLE 4-4

MEANS AND RANGES (IN MILLIONS OF DOLLARS) OF TOTAL ASSETS, LIABILITIES, AND SALES OF CHAPTER XI SUCCESSES AND FAILURES, 1963 TO 1973

	Chapter XI's			
	Failures		Successes	
Variable	Range	Mean	Range	Mean
Total Assets	.3-48.0	13.3	.7-79.9	13.2
Total Liabilities	.2-44.6	9.5	.1-60.1	10.2
Total Sales	.4-63.8	15.0	.5-57.0	12.8

One large firm in the success group has distorted the range for assets and liabilities. If its values for assets and liabilities ($79.9 and $60.1 million, respectively) were removed from this computation, the ranges for the two accounts would fall to between $ .7 million and $32.5 million and $ .1 million and $26.8 million, respectively.

This firm was included in the sample since ratios have the effect of deflating size-sensitive statistics[3] and because it was randomly selected. Mean values and ranges for total sales are approximately the same for the two groups.

Therefore, the two sets of firms are approximately comparable in terms of distributions of industry classifications, elapsed years since petition, number of employees, total assets, total liabilities, and total sales. The two groups could have been more closely matched with pair-selection. By utilizing all of the Chapter XI failures which were found and by randomly selecting an equal number of successes from the set of all Chapter XI successes which excluded those above $100 million in total sales (from companies), no major between-groups differences were obtained which would bias the study in favor of the hypotheses.

Data Reduction

Hypothesis 1: The set of financial ratios is reducible to a smaller set of financial dimensions.

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[3]Edward I. Altman, Bankruptcy in America (Lexington, Mass.: Heath-Lexington, 1971), p. 61.

Reduction of the original eighteen ratios computed for each of the 26 firms in each group was accomplished by factor analysis. The largest possible number of factors (sources of variation) available in any factor analysis is the number of variables. Of the eighteen possible factors, those which are significant are the ones with eigenvalues (see Appendix G) greater than 1.0 in Table 4-5, and which fall on the significant portion of the scree line in Figure 4-1. In this study, the first six factors meet both criteria and Hypothesis 1 was accepted. Cumulatively these six factors explain 79.7 per cent of the information present in the original set as seen in Table 4-5, while the principal components derived with estimated communalities on the diagonal of the correlation matrix explained 71.9 percent of the total variance. (Subsequent hypotheses will be discussed in the order of factors).

Hypothesis 1C: One factor represents the cash position dimension.

By comparing Appendix D (Summary of Financial Ratios and Dimensions) with Table 4-6 (Varimax Rotated Factor Matrix--see Appendix G), the financial dimensions represented by each significant factor were interpreted. Ratios 6, 9, and 13 all have high loadings for the first factor. The ratios which remain have coefficients closer to zero and are comparatively "independent" of that factor. Consequently the interpretation of Factor 1 centers

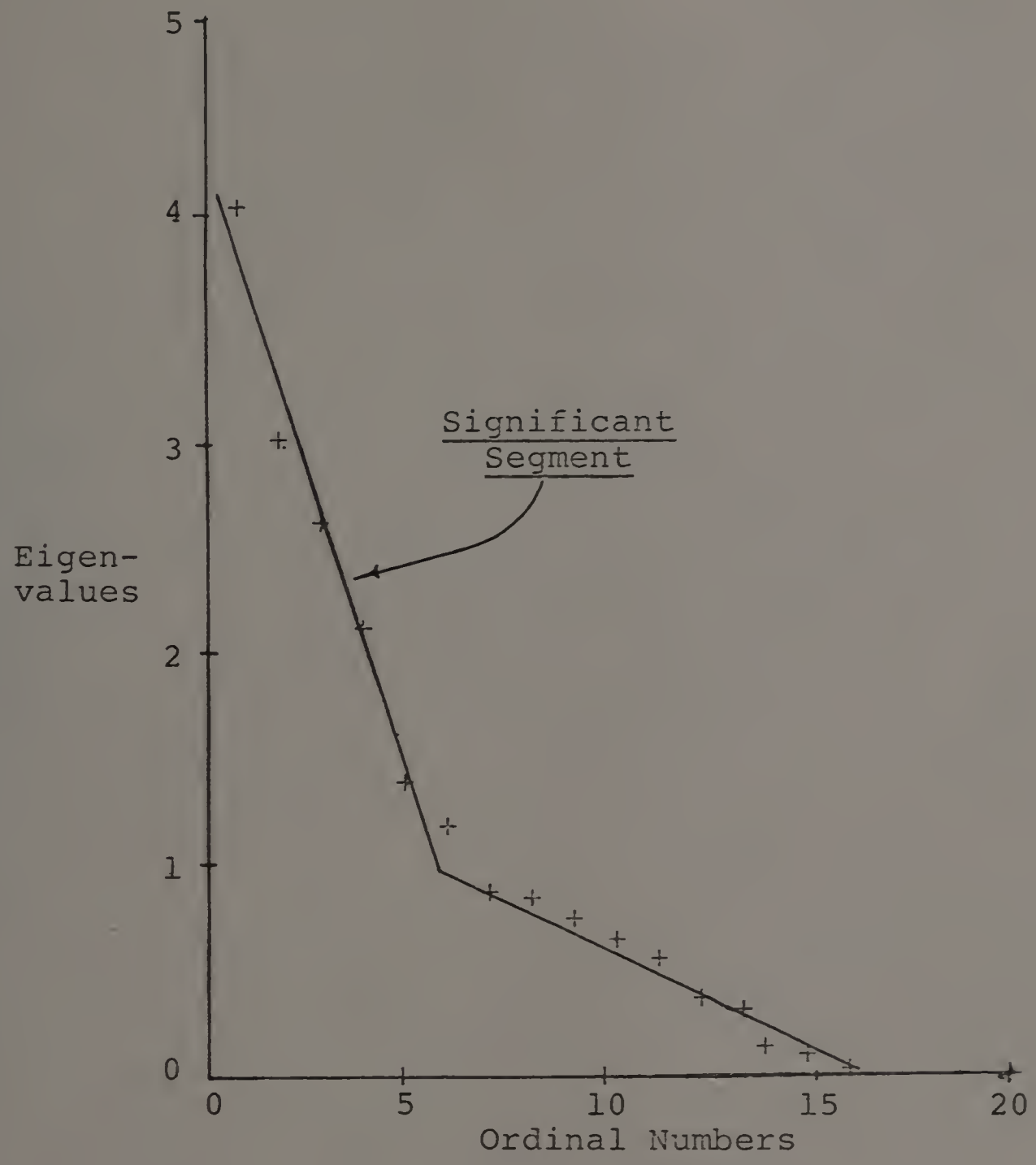

FIGURE 3

SCREE LINE PLOT OF EIGENVALUES AGAINST THEIR ORDINAL NUMBERS FOR U.S. CHAPTER XI SUCCESSES AND FAILURES, 1963-1973

on the three ratios above. Appendix D indicates that these ratios are partial measures of cash position.[4] One could determine intuitively that they all have the cash account in common. As a result Hypothesis 1C was accepted.

TABLE 4-5

FACTORS PRODUCED BY PRINCIPLE FACTORS ANALYSIS OF EIGHTEEN ORIGINAL RATIOS TAKEN ON SAMPLE OF UNITED STATES CHAPTER XI SUCCESSES AND FAILURES FROM 1963 TO 1973

Factor	Eigenvalue	Percentage of Variation	Cumulative Percentage
1	4.17203	23.2	23.2
2	2.98930	16.6	39.8
3	2.59842	14.4	54.2
4	2.09187	11.6	65.8
5	1.33996	7.4	73.3
6	1.16254	6.5	79.7
7	.99606	4.9	84.7
8	.78694	4.4	89.0
9	.51279	2.8	91.9
10	.41999	2.3	94.2
11	.30344	1.7	95.9
12	.22757	1.3	97.2
13	.17228	1.0	98.1
14	.15063	.8	99.0
15	.06719	.4	99.3
16	.05100	.3	99.6
17	.04258	.2	99.9
18	.02540	.1	100.0

[4]This rationale follows Donald L. Stevens, "Multivariate Tools for Financial Analysis: The case of Acquired Firms in Industrial Mergers," Paper presented at the Southwestern Finance Association, San Antonio, Texas, March 1972 p. 7.

TABLE 4-6

VARIMAX ROTATED FACTOR MATRIX FOR RATIOS MEASURED ON UNITED STATES CHAPTER XI SUCCESSES AND FAILURES BETWEEN 1963 TO 1973

Ratios	Ratio Number	Factor 1 Cash Balance	Factor 2 Equity Contribution	Factor 3 Liquidity	Factor 4 Total Asset Balance	Factor 5 Activity	Factor 6 Current Asset Balance
Net Income to Total Assets	1	-.17622	.11992	.07484	-.47418	-.17557	.01884
Total Debt to Total Assets	2	-.12420	-.15795	-.28177	.80057	-.08738	.08350
Current Assets to Total Assets	3	-.23985	.01893	.40559	.57498	-.03433	.42375
Quick Assets to Total Assets	4	.14734	.14399	-.02643	.17521	.34596	.90010
Working Capital to Total Assets	5	-.01270	.16576	.74392	-.48799	.10734	-.01948
Cash to Total Assets	6	.85141	.00914	-.06324	.04233	-.12192	.19166
Current Assets to Current Liabilities	7	.19663	.07471	.87213	-.19518	-.00841	-.03989
Quick Assets to Current Liabilities	8	.46062	.11977	.52066	-.35751	.18388	.45372
Cash to Current Liabilities	9	.93680	-.00556	.28409	-.11790	-.04770	-.00607
Current Assets to Sales	10	.02404	-.00139	.46201	-.17707	.68936	-.18819
Quick Assets to Sales	11	.13889	-.08747	.02909	-.00900	.76115	.15599
Working Capital to Sales	12	.09260	-.07649	.42631	.07989	.19266	.07753
Cash to Sales	13	.92039	.00227	.13878	.07133	.18256	-.10991
Net Income to Stockholders' Equity	14	-.09025	-.93359	.04086	.07924	-.02151	.13486
Total Debt to Stockholders' Equity	15	.00536	.93176	.07181	-.15740	-.10611	.04360
Long-term Debt to Stockholders' Equity	16	.00379	.70514	.10190	-.20567	-.16806	.14373
Receivables to Sales	17	-.08674	.36309	-.02952	.10434	.22445	.13446
Average Collection Period	18	-.20311	.00739	.12505	-.06537	.67798	.34487

Hypothesis 1E: The above factors (namely, liquidity, profitability and solvency, cash position, and activity) are exhaustive.

The second factor in Table 4-6 has high loadings by Ratios 14, 15 and 16 which are Net Income to Stockholders' Equity, Total Debt to Stockholders' Equity, and Long-term Debt to Stockholders' Equity, respectively. Other coefficients are close to zero on this factor. These three ratios provide the basis for interpretation of Factor 2. Examination of Appendix D reveals that the three ratios are all in the Profitability and Solvency category. Two other ratios (Net Income to Total Assets (1), and Total Debt to Total Assets (2)) in that financial dimension do not load highly on Factor 2. Therefore it is questionable whether the two sets of ratios both measure the same dimension. As a result, Factor 2 was labeled, "Equity Contribution" since the entity shared by the high loading ratios is stockholders' equity. Since Equity Contribution was not a pre-specified financial dimension, Hypothesis 1E was rejected.

Hypothesis 1A: One factor represents the liquidity dimension.

Factor 3 in Table 4-6 contains high coefficients for Ratios 5, 7, and 8. These ratios (Working Capital to Total Assets (5), Current Assets to Current Liabilities (7), and Quick Assets to Current Liabilities (8)) are included in

the Liquidity dimension in Appendix D and are common measures of liquidity. This factor was interpreted as "Liquidity." As was the case in the interpretation process for Factor 2, two of the pre-specified ratios of the Liquidity dimension did not load highly on Factor 3. These ratios are Current Assets to Total Assets (3) and Quick Assets to Total Assets (4). Again, this indicates that these two sets of ratios do not measure the same financial characteristics. Contrary to the method employed for Factor 2, the pre-determined dimension--Liquidity--was retained in this case because the high loading ratios are widely acknowledged as liquidity measures. Accordingly, Hypothesis 1A was accepted.

Hypothesis 1D: One factor represents the activity dimension.

The same procedure was followed for Factors 4, 5, and 6 and the following labels were assigned to them: Asset Balance, Activity, and Quick Asset Balance, respectively. Of the remaining hypotheses, Hypothesis 1D was accepted according to the interpretation for Factor 5 and Hypothesis 1B was rejected. Since interpretations of Factors 4 and 6 did not conform to any pre-specified financial dimensions, they contributed to the rejection of Hypothesis 1E.

Results of the data reduction step and interpretation of the reduced factors are presented in Table 4-7. The first column (labeled "Factor") contains the ordinal numbers of the six significant factors. Final interpretations or labels for each factor are contained in the second column. Columns 3 and 4 contain the sets of ratios and their factor loadings, respectively, which were the highest loading ratios on each of the six significant factors.

TABLE 4-7

SUMMARY OF HIGHEST LOADING RATIOS ON EACH SIGNIFICANT FACTOR AND THEIR ASSIGNED LABELS FOR UNITED STATES SAMPLE OF CHAPTER XI SUCCESSES AND FAILURES BETWEEN 1963 AND 1973

Factor	Assigned Label	Highest Loading Ratios	Factor Loading
1	Cash Balance	Cash to Current Liabilities	.937
		Cash to Sales	.920
		Cash to Total Assets	.851
2	Equity Contribution	Net Income to Stockholder's Equity	-.934
		Total Debt to Stockholder's Equity	.932
		Long-term Debt to Stockholder's Equity	.705
3	Liquidity	Current Assets to Current Liabilities	.872
		Working Capital to Total Assets	.744
		Quick Assets to Current Liabilities	.521
4	Total Asset Balance	Total Debt to Total Assets	.801
		Current Assets to Total Assets	.575
		Working Capital to Total Assets	.488
		Net Income to Total Assets	.474
5	Activity	Quick Assets to Sales	.761
		Current Assets to Sales	.689
		Average Collection Period	.678
6	Current Asset Balance	Quick Assets to Total Assets	.900
		Quick Assets to Current Liabilities	.454
		Current Assets to Total Assets	.424

Discrimination between Successes and Failures--Two Models

The second hypothesis was tested to determine whether a reduced set of ratios which represents the six significant factors could discriminate between the two groups. Although factor analysis facilitates interpretation of data, it may conceal large amounts of discriminating power contained by it. To approximate the opportunity costs in terms of reduced group discriminating power associated with the factor analysis-direct MDA model (called Model A), the eighteen original ratios were analyzed by stepwise discriminant analysis called Model B (see Appendix H). The results of the analysis of Models A and B, respectively, are presented in the remainder of this section.

Model A

First, ratios had to be selected to represent each significant factor in the MDA model. The six ratios were those with the highest loadings on each of the significant factors in Table 4-7. They are Cash to Current Liabilities, Net Income to Stockholders' Equity, Current Assets to Current Liabilities, Total Debt to Total Assets, Quick Assets to Sales, Quick Assets to Total Assets, respectively, for Factors 1 through 6. The six factors are independent sources of variation within the data; these ratios with the highest loading on each factor were used as substitutes for each factor due to their high loadings.

The following (standardized) discriminant function was constructed with the reduced set of ratios.

$$Z = 1.66X_1 + 2.61X_2 + .11X_3 - 1.70X_4 - .31X_5 + .39X_6 ,$$

where:

X_1 = Total Debt to Total Assets

X_2 = Quick Assets to Total Assets

X_3 = Current Assets to Current Liabilities

X_4 = Cash to Current Liabilities

X_5 = Quick Assets to Sales

X_6 = Net Income to Stockholders' Equity.

Significance of Discriminant Function--Model A. Hypothesis 2 was tested by testing the significance of this discriminant function.

> Hypothesis 2: An MDA model based upon the financial ratios which represent dimensions identified by factor analysis, discriminates between Chapter XI successes and failures in the sample.

Output for Subprogram DISCRIM in SPSS, 2nd Edition[5] enables three methods for testing this significance: A canonical correlation coefficient, and two conversions of Wilks' lambda into a Chi-square and an F-variate.

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[5]N. H. Nie, C. H. Hull, J. G. Jenkins, K. Steinbrenner, and D. H. Bent, Statistical Package for the Social Sciences. (Second Edition. New York: McGraw-Hill, 1975). Hereafter referred to as SPSS, 2nd Edition.

The canonical correlation coefficient measures the association between the discriminant function and the set of dummy variables which define group memberships. It shows how closely the function and the dummy variable for the groups are related.[6] In this study the canonical correlation coefficient was .52, indicating that the function is moderately correlated with the groups.

Wilks' lambda is also computed by Subprogram DISCRIM; its value was .73. This statistic is an inverse measure of the discriminatory power in the set of criterion variables which was not removed by the discriminant function. This means that the smaller lambda is, the more information remains. Since its value is rather large, a moderate amount of discriminating power remains.

Lambda can be converted into both a Chi-square and an F-variate to easily test statistical significance. The program computes the Chi-square statistic, its degrees of freedom, and its level of significance (α). These values are 14.92, 6, and .021, respectively, in the present analysis. They mean that the lambda value, or a

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[6]SPSS, 2nd Edition, p. 442; William W. Cooley and Paul R. Lohnes, Multivariate Data Analysis (New Yrok: Wiley, 1971), p. 253; and Maurice M. Tatsuoka, Multivariate Analysis (New York: Wiley, 1971), pp. 177-183.

smaller one, has a .021 probability of occurring due to chance or, stated differently, it is not significant at the .99 level. This criterion is limited to applications in which the samples are randomly selected. It may represent a liberal estimate of significance in this case because the group of Chapter XI failures constitutes the entire population and, as such, is not a randomly selected sample. A further shortcoming of the Chi-square statistic is that it is also limited to "large" samples.[7] Some might conclude that the present sample is not "large."

Finally, Wilks' lambda can also be converted into an F-variate to test the significance of the difference between group centroids. For the p-variate, two group case, the following function expresses the relationship between F and Wilks' lambda (Λ):[8]

$$F\text{-ratio} = [(1 - \Lambda)/\Lambda]\ [(N - p - 1)/p]$$

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[7]SPSS, 2nd Edition, pp. 442-443; Cooley and Lohnes, pp. 248-249; and Tatsuoka, pp. 164-170.

[8]Cooley and Lohnes, pp. 227-229.

where:

N = Size of total sample

p = number of variables,

and for which

n_1 (degrees of freedom of numerator) = p

and

n_2 (degrees of freedom of denominator) = $N - p - 1$.

The resulting F-value of 2.73 for $n_1 = 6$ and $n_2 = 45$ is not significant at the .99 level. This means that the two groups established by the Model A discriminant function are not significantly different.

Based upon these statistics, Hypothesis 2 was rejected. The MDA model using the reduced set of ratios as criterion variables does not significantly discriminate between the two groups of analysis data. As described in Chapter 3, this lack of discriminating power also necessitates rejection of the Model A component of the third hypothesis:

> Hypothesis 3: The MDA model based upon the financial ratios which represent the dimensions identified by factor analysis is a valid predictor of potential successes or failure of Chapter XI petitioners.

Model B

Ratios selected in Model B for inclusion in the final discriminant function are those with the largest F-for-inclusion values (for this process see Appendix H). This is equivalent to selecting the variables which minimize Wilk's lambda. The results of the six steps required to select the final six ratios are summarized in Table 4-8. A value of 1.6 was selected by trial-and-error for both the F-to-enter and F-to-remove parameters. The twelve ratios not included in the final function did not produce an increase in the function's overall F-value of 1.6 or greater. In Table 4-8, F-values for each of the six ratios that were included are listed in the "F TO ENTER" column. The steady reduction of Wilks' lambda and corresponding increase of the Chi-square level of significance are evident in Table 4-8.

TABLE 4-8

SUMMARY OF STEPWISE SELECTION OF RATIOS (MODEL B) FOR ANALYSIS DATA FROM UNITED STATES SAMPLE OF CHAPTER XI SUCCESSES AND FAILURES FROM 1963 TO 1973

Step In Which Ratio Selected	Ratio Selected	F-To-Enter	Wilk's Lambda	Overall Significance Of Function
1	Net Income to Stockholder's Equity	6.86179	.87933	.012
2	Total Debt to Total Assets	5.67577	.78804	.003
3	Net Income to Total Assets	2.29154	.75214	.003
4	Quick Assets to Total Assets	1.94306	.72198	.004
5	Quick Assets to Current Liabilities	2.72439	.68161	.003
6	Current Assets to Current Liabilities	2.36640	.64756	.002

Significance of Discriminant Function--Model B

The discriminant function which was derived by Model B is

$$z = 1.44X_1 - 1.78X_2 + 6.06X_3 + .62X_4 - 2.56X_5 + .37X_6$$

where:

X_1 = Net Income to Total Assets

X_2 = Total Debt to Total Assets

X_3 = Quick Assets to Total Assets

X_4 = Current Assets to Current Liabilities

X_5 = Quick Assets to Current Liabilities

X_6 = Net Income to Stockholders' Equity

Key statistics representing both the Model A and B discriminant functions are listed in Table 4-9 for comparison. All statistics point to more discriminating power for Model B than Model A with the same degrees of freedom (6). As a result, Hypothesis 2A was accepted:

TABLE 4-9

STATISTICS FOR EVALUATION OF MODEL A AND B DISCRIMINANT FUNCTIONS COMPUTED ON ANALYSIS SAMPLE OF UNITED STATES CHAPTER XI SUCCESSES AND FAILURES FROM 1963 TO 1973

Model Used to Derive Function	Canonical Coefficient	Wilks' Lambda	Chi-Square	Level of Significance	Degrees of Freedom
A	.52	.73	14.92	.021	6
B	.59	.65	20.86	.002	6

Hypothesis 2A: The set of ratios identified by stepwise MDA is significantly different for the groups of Chapter XI successes and failures.

Classification of Analysis Data-Model B. Even though the discriminant function is significant, it may not adequately classifiy individual firms in the two analysis samples into the correct a priori groups. (Note that classification of the analysis data does not test the model's predictive ability--only the adequacy of the function to classify the firms on whose ratios it was derived.) dictive ability will be tested with a validation proce- dure.

The test for determining the adequacy of the model is to measure percent of correct classifications of the analysis data. Classification scores are computed for each firm in the sample by multiplying its appropriate ratios by the discriminant function's coefficients and assigning each firm to one of the groups based upon this score.

The format for analysis of classification results is presented in Table 4-10.

TABLE 4-10

EXAMPLE OF FORMAT FOR CLASSIFICATION OF CHAPTER XI SUCCESSES AND FAILURES

Actual Group Membership	Computed Group Membership	
	Chapter XI Failures	Chapter XI Successes
Chapter XI Failure	CC	IC_1
Chapter XI Success	IC_2	CC

The letters CC stand for "correct classification" and IC, "incorrect classification." IC_1 is analogous to a Type I error and IC_2, a Type II error. By summing the diagonal elements, quantities are derived for determining the percent of correct classifications.

Model B correctly classified 21 failures and 23 successes as outlined in Table 4-11. This amounted to an overall correct classification of 85 percent.

TABLE 4-11

RESULTS OF CLASSIFICATION BY MODEL B OF UNITED STATES ANALYSIS SAMPLE OF CHAPTER XI SUCCESSES AND FAILURES FROM 1963 TO 1973

Actual Group Membership of Chapter XI's	Computed Chapter XI Group Membership		
	Failures	Successes	Total
Failures	21	5	26
Successes	3	23	26
Total	24	28	52

Table 4-12 presents Table 4-11 in percentage terms.

TABLE 4-12

PERCENTAGE OF MODEL B CORRECT AND INCORRECT CLASSIFICATIONS OF ANALYSIS SAMPLE OF UNITED STATES CHAPTER XI SUCCESSES AND FAILURES FROM 1963 TO 1973

Actual Group Membership	Computed Chapter XI Group Membership				
	Correct		Incorrect		Total
	No.	%	No.	%	No.
Failure	21	81	5	19	26
Success	23	88	3	12	26
Total	44	85	8	15	52

These classifications, however, were based solely on the analysis data and due to the possible presence of bias cannot be statistically tested.[9]

The section which follows explains the validity tests of the significant discriminant functions.

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[9]A detailed explanation for this is presented by Frank, et. al, "Bias," pp. 253-255.

Validation of Model B

Model B will be validated by testing for bias in the analysis sample with the technique presented by Frank, et. al.[10] Edmister's application of this technique will be followed to compare analysis and validation sample classifications.[11] The objective is to determine whether its apparent discriminating power is due to true differences between groups or to bias in the data. This procedure may be viewed as a direct test of the data and an indirect test of the discriminant function. The process described by Frank, et. al (which is the basis for Edmister's method) is "Mainly a technique for inferring true predictive power when the original data are not available..."[12]

The 52 sets of ratios were randomly ordered by selecting numbers at random between 1 and 52. This was done three times. Then a discriminant function followed by a classification table was computed in the direct mode (explained in Appendix) with Subprogram DISCRIM in SPSS, using Model B's ratios. The proportions of

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[10]Frank, et. al., "Bias."

[11]Frank, et. al., Edmister, p. 68.

[12]Frank, et. al., p. 254.

correct classifications for each of the three validation runs are tabulated in Table 4-13 along with the significance test of their average.

TABLE 4-13

PERCENT OF CORRECT CLASSIFICATION FOR THREE VALIDATION RUNS AND TEST OF SIGNIFICANCE USING MODEL B RATIOS FROM U.S. CHAPTER XI SUCCESSES AND FAILURES FROM 1963 TO 1973

Computer Run	Percent of Correct Classifications
1	54
2	60
3	57
Average	57*

* $t = 1.01$, not significant at the .95 level; and not at the .99 level.
$t = \frac{\text{proportion correct} - .5}{\sqrt{\frac{.5(1 - .5)}{n}}}$, see R.E. Frank, W. F. Massey, and D. G. Morrison, "Bias in Multiple Discriminant Analysis," Journal of Marketing Research, Vol. 11 (August 1965), pp. 256-257.

The proportion of correct classifications of 57 was not significantly different from the zero-bias proportion at the .95 level (t = 1.01) according to the validation technique described by Frank, et. al.[13] The Edmister test showed significant differences at the .99 level (t = 5.05) .[14]

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[13]Frank, et. al, "Bias," pp. 255-257.

[14]Edmister, p. 68. Frank, et. al compared these two quantities by observation; they did not test the significance of their different values.

Thus it was concluded that the power exhibited by the Model B function is not caused by bias in the data. Consequently, Hypothesis 3A was accepted:

> Hypothesis 3A: The discriminant function produced by the stepwise MDA model (Model B) is a valid predictor of potential success or failure of Chapter XI petitioners.

Since Hypothesis 3A was accepted but Hypothesis 3 was not, a potential weakness of the Model A approach is demonstrated; namely, the factor analysis--direct MDA technique can indicate that no significant differences between groups exist when, in fact, they do. Further, acceptance of Hypothesis 3A indicates that significant differences exist between Chapter XI successes and failures at the time of filing.

Tests of Major Assumptions of MDA

Following another test employed by Edmister, the assumptions of population Z-score (discriminant score) distribution normality and equality were tested. This was done by constructing frequency distributions of the Z-scores for each group. Then the graphs for Chapter XI successes and failures were compared to see if they appeared to be bell-shaped and equal.[15] The graphs are presented in Figure 4-2.

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[15]Robert O. Edmister, "Financial Ratios...," p. 6.

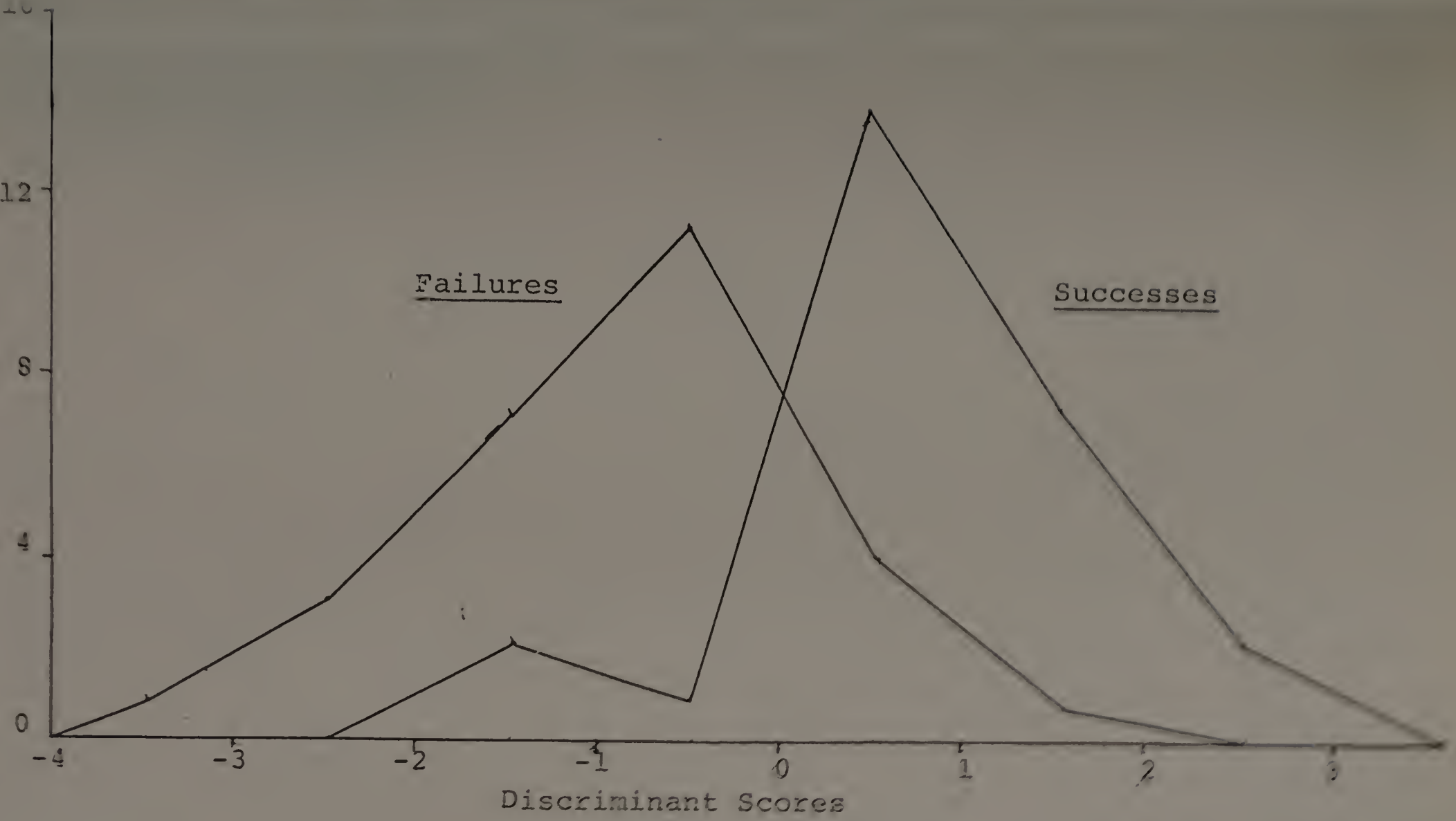

FIGURE 4

DISTRIBUTIONS OF MODEL A DISCRIMINANT SCORES FOR CHAPTER XI FAILURES AND SUCCESSES, 1963 TO 1973, IN U.S.

Both histograms approximate normality and their dispersions are similar. Since MDA is very robust and these assumptions need not be strongly adhered to,[16] the frequency distributions demonstrate sufficient normality and homoskedasticity for generalization to the proper population.

Relative Importance of Ratios--Model B

The model B discriminant function is (in standardized) form--the dispersion matrix is presented in Appendix F).

$$Z = 1.44X_1 - 1.78X_2 + 6.06X_3 + .62X_4 - 2.56X_5 + .37X_6$$

where:

X_1 = Net Income to Total Assets

X_2 = Total Debt to Total Assets

X_3 = Quick Assets to Total Assets

X_4 = Current Assets to Current Liabilities

X_5 = Quick Assets to Current Liabilities

X_6 = Net Income to Stockholders' Equity

This function is recommended for classifying Chapter XI petitioners as potential successes or failures. This reflects the assumption of stable interdependencies.

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[16] SPSS, Second Edition, p. 435.

Attempting to assess the relative contributions of variables in this function will be hampered by multicollinearity. Blum pointed out that weights are assigned arbitrarily in discriminant analysis between ratios that are collinear; their rankings do not necessarily signify their relative contributions.[17] (The correlation matrix for the variables included in the Model B function is presented in Table 4-15). Similarily, Morrison explained that if the independent variables "...(A)re highly correlated, they are measuring almost the same thing" and "...(W)ill be unstable and hart to interpret."[18]

Most important of the six ratios in the Model B function is X_3, Quick Assets to Total Assets, as indicated by its ranking in Table 4-14. Ranked second is X_5, Quick Assets to Current Liabilities. Reference to Table 4.7 shows that X_3 and X_5 both had high factor loadings on Factor 6 (Current Asset Balance) when the entire set of ratios was factor analyzed. Additionally, Table 4-15,

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[17]Blum, p. 10.

[18]Donald G. Morrison, "On the Interpretation of Discriminant Analysis," Journal of Marketing Research, Vol. 6 (May 1969), p. 160.

TABLE 4-14

COEFFICIENTS AND RANKINGS OF RATIOS IN THE MODEL B DISCRIMINANT FUNCTION OF CHAPTER XI FAILURES AND SUCCESSES FROM 1963 TO 1973

Variable	Ratio	Standardized Coefficient	Ranking
X_3	Quick Assets to Total Assets	6.06	1
X_5	Quick Assets to Current Liabilities	-2.56	2
X_2	Total Debt to Total Assets	-1.78	3
X_1	Net Income to Total Assets	1.44	4
X_4	Current Assets to Current Liabilities	.62	5
X_6	Net Income to Stockholders' Equity	.37	6

TABLE 4-15

WITHIN-GROUPS CORRELATION COEFFICIENTS FOR RATIOS IN MODEL B DISCRIMINANT FUNCTION FOR U.S. CHAPTER XI FAILURES AND SUCCESSES FROM 1963 TO 1973

Ratios	Ratios					
	NI/TA[1]	TD/TA[2]	QA/TA[3]	CA/CL[4]	QA/CL[5]	NI/SE[6]
NI/TA[1]	1.00					
TD/TA[2]	-.34	1.00				
QA/TA[3]	-.19	.16	1.00			
CA/CL[4]	.12	-.43	-.06	1.00		
QA/CL[5]	.08	.47	.49	.65	1.00	
NI/SE[6]	-.23	.32	-.05	-.14	-.15	1.00

[1]Net Income to Total Assets
[2]Total Debt to Total Assets
[3]Quick Assets to Total Assets
[4]Current Assets to Current Liabilities
[5]Quick Assets to Current Liabilities
[6]Net Income to Stockholders' Equity

shows that these two ratios have a .49 correlation. Therefore, the actual relative contribution of Variables X_3 and X_5 are uncertain.

This problem is compounded by the fact that Variable X_2, Total Debt to Total Assets, which is ranked third in importance in the discriminant function, is also rather highly correlated with X_5 (correlation coefficient = .47). In the factor analysis, X_2 loaded highly on Factor 4, which was labeled "Total Asset Balance." (since an orthogonal rotation (VARIMAX) was performed, Factors 4 and 6 have nearly a zero correlation, but these two ratios are substantially correlated). At this point it is uncertain which of the three highest ranked but collinear ratios, X_3, X_5, or X_2, makes the greatest contribution to the function.

Referring again to Table 4-14, Variables X_1 (Net Income to Total Assets) is ranked fourth. Table 4-15 shows it to be substantially uncorrelated with the other variables. However, it had a moderate factor loading on Factor 4, a trait shared with X_2.

Ranked fifth is Variable X_4 which is the familiar Current Ratio. It loaded very highly on the liquidity dimension (Factor 2) in Table 4-7, but is dramatically correlated with X_5 (correlation coefficients = .65), which also had a high factor loading on Factor 3. It is still uncertain which ratios are most and least important.

Finally, the variable which was ranked sixth in the discriminant function is Net Income to Stockholders' Equity. This ratio is neither highly correlated with any of the other five, nor does it share a high factor loading with any of them. It had a very high loading on Factor 2, Equity Contribution. Compared with the other five ratios, which are unquestionably collinear, X_6 contributes the least to the function. Relative contributions of the other five, however, cannot be determined because of high levels of multicollinearity.

It appears that the four factors represented by these six ratios which do in fact provide the greatest amount of group centroid separation, were detected by the discriminant analysis. Consequently, the only generalization which can be made about the variables in the significant function is that X_1 through X_5 jointly measure the financial dimensions of Liquidity, Total Asset Balance, and Current Asset Balance (Factors 3, 4, and 6 in Table 4-7), and Variable X_6 measures Equity Contribution, Factor 2 in Table 4-7. Also, X_6 is inferior to the group consisting of the other five in terms of contribution to discrimination.

It is concluded that attempting to estimate relative importance of the first five ratios would be speculative. Thus, group discrimination occurs along the financial dimensions of Liquidity and Total and Current Asset Balance,

measured jointly by Variables X_1 through X_5, and the financial dimension, Equity Contribution, measured by Variable X_6.

All six ratios jointly provide the most significant amount of group separation and should be used together to decide the potential relative success of a Chapter XI petitioner.

Summary

This chapter presented descriptions of the samples of Chapter XI firms and the results of the analysis of them.

A total of 52 firms were selected for analysis. They were evenly divided between Chapter XI successes and failures. All firms were taken from the 1963 to 1973 Moody's Industrial and Over the Counter manuals. The two groups of firms were similar in terms of distributions of industry classifications, elapsed years since petition, number of employees, total assets, and total liabilities.

Eighteen financial ratios computed on each firm in the sample were analyzed to test three hypotheses. The first hypothesis was tested to determine the nature of financial dimensions present in the data. The following dimensions were identified by factor analysis for Factors 1 through 6: Cash Balance, Equity Contribution, Liquidity,

Total Asset Balance, Activity, and Current Asset Balance, respectively. These factors explained 80 percent of the variance in the data and were selected by the scree test and the 1.0 minimum eigenvalue rule.

Next, Hypothesis 2 was tested to determine whether either of two MDA models significantly discriminated between the two groups of firms. Model A consisted of selecting ratios with the highest loadings on each significant factor for evaluation by MDA. This model did not significantly differentiate between the two groups at the .99 level. The Model A component of Hypothesis 2 was rejected.

Model B selected ratios which maximized group centroid separation by a stepwise procedure. It was significant at the .99 level. Consequently, the Model B part of the second hypothesis was accepted.

Model A was not analyzed further but the predictive power of Model B was tested by constructing three synthetic validation samples. Each one was made up of different random orders of the analysis sample. New discriminant functions constructed on each validation sample produced an average of 57 percent correct classifications. Based upon this result, Model B's 85 percent correct classifications were found to be significantly free of bias at the .95 level. Thus the Model B part of Hypothesis 3 was accepted.

C H A P T E R V

IMPLICATIONS, LIMITATIONS, AND CONCLUSIONS

Introduction

In this chapter, analysis of the objectives of the study is presented along with a review of the methodology and results, their implications and limitations, and suggestions for future research.

The Research Objectives Reviewed

The major objective of this research was to identify the financial dimensions and ratios which discriminate between Chapter XI successes and failures at the time of filing.

Toward this objective the proposed methodology--discriminant analysis of financial ratios identified by factor analysis--failed to adequately distinguish between successes and failures. The alternative technique--stepwise multiple discriminant analysis (MDA)--succeeded. Although the factor analysis revealed the presence of six financial dimensions in the data, stepwise MDA showed group differences in six ratios interpreted as representing only four of them. These dimensions are liquidity, total asset balance, current asset balance, and equity contributions. The discriminant function which represents them was found significant at the .99 level. More importantly, it correctly classified 85 percent of the analysis sample which, upon validation, was found to be free of significant levels of bias.

Methodology

Fifty-two U.S. firms which had petitioned for Chapter XI arrangements between 1963 and 1973 were selected from Moody's Industrial and Over the Counter manuals. Half of them were firms which had failed to consumate plans of arrangement to continue operations. All of them (26) which could be so identified were included in the Chapter XI failure group. The other group contained 26 firms randomly selected from a list of 37 identified as Chapter XI successes.

The two groups were approximately comparable in terms of distributions of industry classifications, elapsed years since petition, number of employees, total assets, total liabilities, and total sales.

Eighteen financial ratios were computed for each of the 52 firms and were employed to test three hypotheses. The first hypothesis concerned reduction of the original set of ratios and was tested with factor analysis; the second, discrimination between successes and failures, was tested with MDA; and the third, predictive power of the MDA model, was tested by synthetically validating the discriminant

function. Each hypothesis was accompanied by a set of working hypotheses.

The set corresponding to the first hypothesis specified the nature of financial dimensions expected in the data. By factor analyzing all ratios, six underlying sources of variation of factors were identified. Factors 1 through 6 were interpreted as Cash Balance, Equity Contribution, Liquidity, Total Asset Balance, Activity, and Current Asset Balance, respectively. These factors were deemed significant because their eigenvalues were all greater than 1.0 and fell on the significant portion of the scree line.

The second set of hypotheses was tested to determine whether an MDA model could significantly discriminate between the two groups. Two MDA models were constructed.

The first was a "direct" discriminant analysis of ratios selected to represent each of the six significant factors. This combination of factor analysis and MDA, herein referred to as Model A, was employed to retain minimally intercorrelated ratios and to facilitate interpretation of the financial characteristics of the sample. Ratios used in Model A were those which had the highest loadings on each significant factor as indicated by the VARIMAX rotated factor matrix. One ratio was selected for each factor.

Model A may result in a large loss of discriminant ability because only one ratio is chosen to represent each factor. Further, the factors, which are more complete measurements of variation than single ratios, do not explain all the variability in the data. To assess the loss of discriminant ability another MDA model was constructed which did not rely upon factor analysis to select ratios. Instead, it utilized a stepwise procedure which selected ratios that maximized group centroid separation regardless of the level of intercorrleation. This second approach was labeled Model B.

When tested with an F-variate, the Model A function was not significant at the .99 level but the Model B function was. Consequently, Model A was not analyzed further but the predictive ability of Model B was tested by constructing a synthetic validation sample. This validation approach involved randomly ordering the analysis sample and constructing a discriminant function for comparison with the analysis function. Thus subjects in addition to the analysis sample which were not available in this study, were not necessary for validation.

Whereas 85 percent of the analysis sample was correctly classified by Model B, three synthetic validation samples averaged only 57 percent correct classifications. Because the latter was not different from the zero-bias

proportion of correct classifications at the .95 level, the data was deemed free of bias. Consequently, Model B's classifications were due to true discriminating power and not bias in the sample. The Model B component of the third hypothesis was accepted.

Results

The substantive result of the study was the finding that Chapter XI successes could be distinguished from failures when petitions were filed, solely on the basis of financial ratios. Further, only six ratios were required to generate 85 percent correct classifications.

Methodologically it was shown that the process of selecting ratios for MDA by factor analysis (Model A) could generate an insignificant discriminant function where stepwise MDA (Model B) would produce a significant function. If predictive ability of the function is important and if interdependencies among independent variables can reasonably be expected to exist in the population, then the former method could reject a potentially useful discriminant function which the latter method would accept. This does not detract from the usefulness of Model A, especially where its results are significant. It merely highlights the need for checking insignificant Model A functions with Model B.

A peripheral result of the study was the realization of a need for more complete bankruptcy data for purposes of research. If recent reports of problems within the bankruptcy system reflect reality, then surely research on those problems could help correct them. However, even though bankruptcy court records are public information, substantive data is buried within the system or not recorded at all. For example, records on the disposition of Chapter XI cases are not formally maintained. (The researcher was fortunate in the preliminary stages of the study, and very grateful, to be granted access to Chapter XI disposition records handwritten on yellow legal pads by the secretaries of three bankruptcy judges). It was necessary to leaf through Moody's manuals to find the names of Chapter XI firms for which adequate financial data was available to do the study; Moody's does not index Chapter XI's.

Also in the preliminary stages of the study, an attempt was made to cross-tabulate bankruptcy system records with Small Business Administration records. The plan was to produce a set of Chapter XI firms for which adequate financial data was available and for which success or failure could be determined. This approach was also unsuccessful.

Implications of the Results

These research findings have implications for the field of Business Policy, the business practitioner as both debtor and creditor, attorneys and judges within the bankruptcy system, and legislators dealing with proposed changes in the Bankruptcy Law.

Business Policy

The implication for the field of Business Policy is that Chapter XI can be taught as a strategy for ailing firms with more predictability of outcome. A firm's discriminant score can be compared with Figure 5-1 to determine whether it is a potential success or failure, or if its outcome in Chapter XI is indeterminate. Regarding the latter possibility, there is usually a problem in discriminant analysis of how to classify subjects whose scores fall within both groups' distribution of scores. The computer program simply classified firms with discriminant scores above zero as successes, and below, as failures. Since misclassification of a success could lead to its liquidation following the proposed decision model, the costs of such misclassification could be excessive. Costs of misclassification of a failure, although possibly a less traumatic occurrance than the former, could generate excessive dollar costs for the bankruptcy system (it would bear the expense of, first, an unsuccessful Chapter XI proceeding, and, second, a straight bankruptcy proceeding).

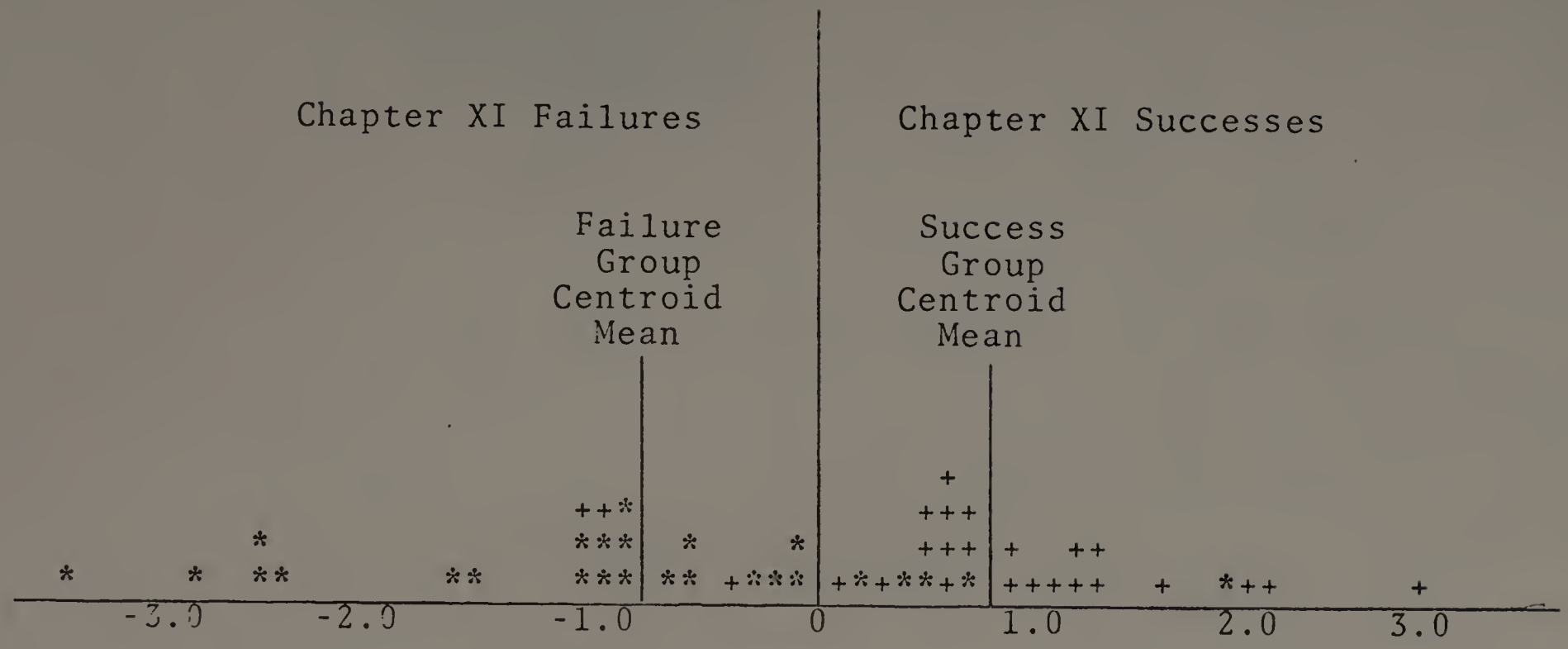
In light of these costs, additional research might show that establishing an "indeterminate" area between the success and failure boundaries in Figure 5-1, would be advisable. Separate policies for the disposition of firms whose discriminant scores fall within this indeterminate zone (meaning that they are clearly neither potential successes nor failures) could be developed.

Conversely, if subsequent research demonstrated that misclassification costs were not excessive, the indeterminate zone could be eliminated in favor of the strict success-failure dichotomy where the zero-boundary is observed (as in Figure 5-1).

Debtors and Creditors

Creditors could develop policies regarding debtors' discriminant scores above which Chapter XI would be supported. Similarly, creditors' committees could use discriminant scores as guides to assist in determining whether to confirm proposed plans of arrangement. For firms with scores indicating potential failure, Chapter XI support could be withheld in favor of straight bankruptcy.

For debtors, discriminant score comparison could indicate similarity to past Chapter XI successes or failures. Potential for success in the proceeding could thus be estimated.



+Chapter XI Success
*Chapter XI Failure

FIGURE 5

PLOT OF STANDARD DISCRIMINANT SCORES FOR U.S. CHAPTER XI FAILURES AND SUCCESSES FROM 1963 TO 1973

Bankruptcy Judges and Attorneys

Judges in bankruptcy could use the discriminant scores of Chapter XI petitioners as guides in deciding upon confirmation of arrangement plans. The multivariate nature of such scores provides a rational alternative to univariate analysis of selected financial entities. The results of the study show that the liquidity measures typically evaluated in Chapter XI proceedings (current assets and liabilities), can be supplemented with the dimensions of total asset balance and equity contribution in the multivariate discriminant model to obtain a clearer separation between success and failure potential.

Attorneys could use the scores similarly in counseling clients.

Public Policy

The model has three implications for public policy. First, with the guideline available, more timely decisions could be made about whether to confirm a petitioner's plan of arrangement. Second, it would tend to decrease the resources wasted by the failure of Chapter XI firms, were entry limited only to those demonstrating potential for success. Third, implementation would tend to reduce the amount of control of proceedings by the man-

agements of Chapter XI firms. In fewer words, the model introduces an element of objectivity to the confirmation decision which has been absent historically.

Limitations of the Study

There are a number of ways in which generalization of the results is limited. First, since the analysis sample was derived from Moody's manuals, the model should be applied only to firms included therin. Such firms would tend to be middle-sized, publicly held corporations.

Second, the model pertains only to firms for which a Chapter XI petition has been filed or is immanent.

Third, the model has not been validated with the usual split-half sample. Instead, a synthetic validation sample was employed to show that correct classifications were not due to significant levels of bias. Consequently, the 85 percent correct classification could either underestimate or overestimate the result that would obtain could the model be validated by a split-half sample.

A fourth limitation is that only 52 of a total of 94 Chapter XI firms in Moody's was used in the analysis. The difference is attributable to inconclusive evidence on disposition of proceedings and/or incomplete financial records.

Finally, any number of ratios computed on the same firm are not independent. Even if they are minimally intercorrelated, they are not actually independent. This dependence seriously interferred with the interpretability of results in the study.

Suggestions for Future Research

Little attention has been paid to the demise of firms in the business literature. Not only Chapter XI and all business bankruptcy proceedings, but the broader area of business failure represents a fruitful area of study for Business Policy researchers. There are several studies which could be undertaken to analyze it and the related area of bankruptcy.

Business Failure

Research is needed to define the behavior of marginally profitable firms. The categorization of firms for accounting purposes as either going concerns or failures needs to be analyzed for its inclusiveness. There may be a large number of firms which are neither clearly going concerns nor failures.

Bankruptcy

An important issue within the purviews of both bankruptcy law and business policy is whether the appropriateness of either Chapter X or XI can be determined by financial analysis. An approach which could resolve this issue would be to replicate the present study on a sample containing both Chapter X and XI firms.

Another issue is whether Chapter X successes differ from failures in their financial characteristics. This problem could be analyzed by the same approach used in this study.

This technique could also be employed to investigate the financial characteristics of Chapter XI firms which were transferred to Chapter X proceedings.

If the foregoing studies showed that successful Chapter X firms differed markedly in financial structure from Chapter XI's, the problem of deciding which of the proceedings should be employed to rehabilitate a given firm could be reduced to financial terms. Subsequently, the suggestions to combine Chapters X and XI in a new bankruptcy law could be re-evaluated in light of these findings. Chapter XI is a valuable strategic alternative for ailing firms which may soon be partially eliminated by a new bankruptcy law.

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APPENDIX A

The Nature of Chapter XI

Chapter XI[1] provides for a court approved arrangement between a debtor and his unsecured creditors.[2] An arrangement is "any plan of a debtor for the settlement, satisfaction, or extension of the time of payment of his unsecured debts, upon any terms."[3] A debtor is anyone who could become a bankrupt under the Act;[4] thus, individuals, partnerships, corporations, etc., may file petitions, but railroads, insurance and banking corporations, etc., are ineligible.[5]

The proceeding is initiated by a debtor filing a voluntary petition[6] with the federal district court,[7] either before or after a pending bankruptcy liquidation proceeding.[8]

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[1]Bankruptcy Act Secs. 301-399, 52 Stat. 905 (1938), 11 U.S.C. 701-799. (Bankruptcy Act will henceforth be abbreviated "B.A.")

[2]B.A. Sec. 323, 11 U.S.C. Sec. 732 (1958).

[3]B.A. Sec. 306 (1), 52 Stat. 906 (1938), 11 U.S.C. Sec. 706 (1) (1958).

[4]B.A. Sec. 306 (3), 11 U.S.C. Sec. 706 (3) (1938).

[5]B.A. Sec. 4, 11 U.S.C. Sec. 22

[6]B.A. Secs. 306 (5), 322, 11 U.S.C. Secs. 706 (%), 722 (1958).

[7]B.A. Sec. 322, 11 U.S.C. Sec. 722

[8]B.A. Sec. 321, 11 U.S.C. Sec. 721.

The debtor may even contest his adjudication in an involuntary proceeding and file an arrangement petition after he has been adjudged a bankrupt.[9] There is provision for investigation in Chapter XI upon application of any officer, debtor, or creditor,[10] and appointment of a trustee is not mandatory in the absence of application of any party in interest. If a trustee was previously appointed (in bankruptcy proceedings), he will continue in possession of the debtor's property;[11] otherwise, the debtor remains in possession and exercises the powers of a trustee.[12] Whether receiver, trustee, or debtor in possession is appointed, the property of the debtor is managed as authorized by the court.[13] When a petition is filed, the court obtains exclusive jurisdiction of the debtor and

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[9]Sidney Krause, "Arrangements under Chapter XI of the Bankruptcy Act," in George J. Hirsch and Sidney Krause, Bankruptcy and Arrangements Under Chapter XI (New York: Practicing Law Institute, 1968), p. 88.

[10]B.A. Sec. 21 (a), 11 U.S.C. Sec. 44 (a) (Suppl. IV, 1962).

[11]B.A. Sec. 332, 11 U.S.C. Sec. 732. In some jurisdictions appointment of a receiver in Chapter XI cases is customary. (See on this point Asa S. Herzog, "Reorganizations and Arrangements Under Chapters X and XI; Problems of Administration from the Standpoint of the Court," Journal of the National Association of Referees in Bankruptcy, Vol. 35 (October 1961), p. 113.

[12]B. A. Sec. 342, 11 U.S.C. Sec. 742.

[13] B.A. Sec. 343, 11 U.S.C. Sec. 743.

his/her property, regardless of location.[14] This provision empowers the court to decide disputes concerning the debtor's property throughout the arrangement proceeding and even after the plan's confirmation (if provided in the plan).[15] The court may stay or enjoin, without notice, suits against the debtor and stay lien foreclosure upon notice and for shown cause.[16] This procedure prevents disruption of the debtor's estate and facilitates conclusion of a workable arrangement.[17] Further, the court may allow the rejection of burdensome executory contracts[18] and relegate the other party to the status of general creditor (with certain limitations on amount).[19]

The plan of arrangement is usually filed along with the petition, although this is no longer necessary.[20] It is mandatory that notice of a first meeting of creditors be given within ten days after the petition is filed; the

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[14]B.A. Sec. 311, 11 U.S.C. Sec. 711.

[15]B.A. Sec. 368, 11 U.S.C. Sec. 768.

[16]B.A. Sec. 314, 11 U.S.C. Sec. 714

[17]"Debtor Rehabilitation, Common Law Settlements, Chapter X and XI--An Analysis and Discussion," Comment, New York Law Forum, Vol. 7, No. 4 (November 1961), p. 409.

[18]B.A. Sec. 313 (1), 11 U.S.C. Sec. 713 (1).

[19]B.A. Sec. 353, 11 U.S.C. Sec. 353.

[20]B.A. Sec. 323, 11 U.S.C. Sec. 723 (1958).

meeting must be set not less than fifteen days nor more than thirty days from the date of mailing of the notice.[21] If the plan is not filed with the petition, the court must, at the first creditors' meeting, set a deadline for filing the arrangement and must adjourn the meeting at least fifteen days after the petition.[22] In the event that the plan accompanied the petition and both were filed with the notice of the first creditors' meeting, the court must determine at the meeting the written acceptance by creditors of the plan.[23] The debtor, however, may solicit creditor acceptances of the plan at any time even prior to filing of the petition.[24] To qualify for court consideration, the plan must be accepted by a

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[21]"...(B)y Public Law 88-175 (Act of November 13, 1963, Sec. 1), a most salutory amendment to Chapter XI was adopted. Prior to the adoption of this latest amendment and since the enactment of Chapter XI, the statute by express provision (B.A. Sec. 367 (3), 11 U.S.C. Sec. 767 (3) permitted the claims of creditors scheduled by the debtor, irrespective of filing, to participate under the terms of aconfirmed arrangement. The 1963 amendment alters this procedure and limits participation under a confirmed arrangement solely to those creditors who filed claims." Krause, "Arrangements," p. 83.

[22]B.A. Sec. 335 (2), 11 U.S.C. 735 (2) (1958).

[23]B.A. Sec. 336, 11 U.S.C. 736 (1958).

[24]B.A. Sec. 336 (4), 11 U.S.C. Sec. 736 (4) (1958).

majority in number and amount of unsecured claims of creditors.[25] If all creditors affected by the plan accept it, regardless of whether their claims were filed, the court must confirm it after receiving a required deposit.[26] (providing that the court is satisfied that the plan and its acceptance are in good faith and not made by means forbidden by the Act.)[27] The deposit is the amount paid by the debtor to cover administrative costs and the priority claims of creditors who have not waived the requirement.[28]

If all creditors have not accepted the plan of arrangement but a majority in number and amount have, the court must confirm it if the following conditions have been met; (1) An application for confirmation has been filed; (2) the deposit has been made; (3) the court finds that there has been compliance with the Act; (4) the plan is in the best

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[25]B.A. Sec. 362 (1), 11 U.S.C. Sec. 762 (1) (1958). "...(O)nly the claims of creditors whose proofs of claim have been filed and allowed before the conclusion of the meeting may be counted in determination of the majority." See Paul B. Rodden and James C. Carpenter, "Corporate Insolvency--Liquidation or Rehabilitation" University of Colorado Law Review, Vol. 36 (Fall 1963), p. 139.

[26]B.A. Sec. 337, 11 U.S.C. Sec. 737 (1958).

[27]B.A. Sec. 361, 11 U.S.C. Sec. 761 (1958).

[28]Rodden and Carpenter, p. 139.

interests of creditors and is feasible; (5) the debtor is eligible for a bankruptcy discharge; and (6) the plan's proposal and acceptance have been in good faith.[29] It should be noted that any one creditor can oppose confirmation regardless of the size of his claim.[30] Such opposition may be that (1) the plan is not in creditors' best interests, (2) the debtor committed an act that would bar discharge, (3) the provisions of Chapter XI have not been complied with, or (4) the arrangement has not been made in good faith and was procured by acts forbidden by the act.[31]

Upon confirmation of the plan, the debtor is discharged from all unsecured debts and liabilities except (1) those provided for in the arrangement or the confirmation[32] and (2) non-dischargeable debt.[33] When the order of confirmation is entered, the debtor's deposit is disbursed to its claimants except in instances where the plan provides for

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[29]B.A. Secs. 365, 366, 11 U.S.C. Secs. 765, 766 (1958). See Rodden and Carpenter, p. 139.

[30]B.A. Sec. 366, 11 U.S.C. Sec. 766 (1958), Krause, "Arrangements," p. 97-98.

[31]See In re Admiral Container Corp., 95 Supp. 723, 726 (D.N.J. 1951) cited in Krause, "Arrangements," p. 98.

[32]B.A. Sec. 371, 11 U.S.C. Sec. 771 (1958).

[33]B.A. Secs. 367 (2), 367 (3), 11 U.S.C. Secs. 767 (2), 767 (3) (1958).

deferred payments to creditors.[34] Of interest to the debtor is that securities issued persuant to an arrangement do not have to be registered with the SEC.[35] Also, a new creditor granting credit to the debtor in Chapter XI can be granted a higher priority than that of old creditors.[36]

A final decree is entered after consummation of the proceedings, which discharges the receiver or trustee, if any, and closes the estate.[37]

An arrangement may be dismissed or the debtor may be adjudicated bankrupt.[38] The grounds for adjudication are that (1) the arrangement was not proposed in the manner and within the time fixed by the court,[39] (2) the debtor was unable to raise funds to finance the arrangement, (3) the debtor and creditors were unable to agree on terms of

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[34]B.A. Sec. 393 (a), 11 U.S.C. Secs. 767, (2), 767 (3) (1958).

[35]B.A. Sec. 393 (a), 11 U.S.C. Sec. 793 (a) 1958. Creditors may exchange a stock interest in the debtor after completion of proceedings for a contribution of funds to finance the plan. Large creditors may view this opportunity as a way to recover all of their losses through ownership profits in the future. See Rodden and Carpenter, p. 138.

[36]B.A. Secs. 344, 357, (c), 11 U.S.C. 744, 757 (c).

[37]B.A. Sec. 372, 11 U.S.C. Sec. 772 (1958).

[38]These contingencies are set out in B.A. Secs. 376-378, 381, 11 U.S.C. Secs. 776-778, 781 (1958).

[39]B.A. Sec. 376, 11 U.S.C. Sec. 776.

the plan, or (4) the confirmation was successfully opposed by a creditor.[40] In such circumstances the court shall (1) dismiss the plan and institute bankruptcy proceedings if an arrangement was filed in a pending straight bankruptcy proceeding, or (2) adjudge the debtor a bankrupt after notice if the original proceeding was an arrangment, or dismiss the petition, whichever is found by the court to be in the best interests of the creditors.[41]

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[40]B.A. Sec. 366, 11 U.S.C. Sec. 776.

[41]B.A. Sec. 376 (2), 11 U.S.C. Sec. 776 (2).

APPENDIX B

A History of Chapter XI

Early in the history of bankruptcy law, English concern for the welfare of creditors, not debtors, predominated. There was no process whereby creditors could collectively liquidate a debtor. Each creditor acting individually used techniques such as seizure, execution and imprisonment. Such collection activities often resulted in strong competition between creditors as they collected accounts. There were few effective procedures for discovering assets and debtors frequently absconded.[1]

As a result of these ineffective early processes, the first legislation which dealt only with recovery by business creditors was designed to provide machinery for seizing and distributing debtors' possessions. Many years would pass before consideration was given to the plight of debtors upon seizure of their property and condemnation.[2]

In the United States, "uniform laws on the subject

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[1]Edward Jenks, A Short History of English Law (London: Mathuen & Co., Ltd, 1912), p. 382 cited in Katie Avery White, "A Study of the Leading Cases Under Chapter XI of the Federal Bankruptcy Act with Particular Reference to their Financial Implications," (unpublished Ph.D. dissertation, University of Illinois, 1969), pp. 33-34.

[2]White, p. 34.

of bankruptcy," were authorized in 1800 by Article I, Section 8, of the Constitution. This Act essentially copied the English system which was then in force in the colonies. The premise of this system was that debtors were dishonest. It was repealed in 1803 because the framers of the Constitution had intended that Congress should only exercise the power it granted to provide uniformity in the states.[3]

After 1803, state insolvency laws sufficed until 1841 when the "Panic of 1837," which followed Van Buren's "economic revolution," generated renewed concern over bankruptcy. The second general bankruptcy law was enacted upon the belief that debtors were not necessarily dishonest. Some were simply unfortunate and should be conditionally discharged from obligation so as to continue their activities freed of burdensome debt. Although this law lasted only two years, it did succeed in paving the way for general acceptance of the concept of debt discharge.[4]

Again, state insolvency laws were called upon to deal with the bankruptcy problem. The third general Bankruptcy Act was enacted in 1887 following the economic disturbance precipitated by the Civil War. It sustained

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[3]White.

[4]White, pp. 36-37.

major amendment in 1874, following the 1873 panic, and was repealed in 1878.[5]

The present Bankruptcy Act was passed into law in 1898 following the panic of 1893. It was followed by a series of amendments in 1903, 1906, 1910, 1915, 1916, 1917, 1922, and 1926. Even with this long list of amendments in force, the Act recognized only two classes of debtors, the honest but unfortunate and the dishonest. Generally, the Act posed obstacles to discharge for the latter class and slowly the theory of compositions became an established part of the system the Act created.[6]

President Hoover authorized the first investigation of the bankruptcy system undertaken by the federal government. Solicitor General Thatcher directed the study and the report was named the Thatcher Report.[7] It concluded that the liquidation and limited composition provisions of the Act were inadequate and recommended,

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[5]White, p. 37.

[6]White, pp. 37-38.

[7]U.S. Congress, House, Executive Director of the Commission On the Bankruptcy Laws of the United States, Report of the Commission On the Bankruptcy Laws of the United States--Part I, Hearing, 93d Cong., 1st Sess., (Hereafter the Commission Report). July 1973, (Washington, D.C.: Government Printing Office, 1973), pp. 237-240.

> remedial process in voluntary proceedings under which debtors, unable to pay their debts in due course, may have the protection of the court, without being adjudicated a bankrupt, for the purpose of composing or extending the maturity of their debts out of future earnings, procuring the liquidation of their property under voluntary assignments to a trustee, and in the case of corporations, for the purpose of reorganization.[8]

Based upon recommendations contained in the Thatcher Report, Chapter VIII was added to the Act in 1933.[9] It consisted of Section 74 which provided for compositions and extensions generally; Section 75, compositions for farmers; and Section 77, reorganization of railroads engaged in interstate commerce. Provision for general corporate reorganization was added in the form of Section 77B in 1934.[10]

Prior to the 1933 and 1934 amendments, Corporate reorganizations were accomplished by Section 12, composition, and the nonstatutory equity receivership. Section 12 dealt with the settlements between debtors and creditors but was inadequate for complex organizations; equity

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[8]Report to the President On the Bankruptcy Act and Its Administration in the Courts of the United States, Sen. Doc. No. 65, 72d Cong., 1st Sess., 39 (1931) in Commission Report--Part I, p. 238.

[9]Act of March 3, 1933, 47 Stat. 1467 in Commission Report--Part I, p. 239.

[10]Act of June 7, 1934, 48 Stat. 911 in Commission Report--Part I, p. 240.

receivership provided for settlements for complex corporations and it was widely implemented.[11] The Securities and Exchange Commission, in its Protective Committee Report,[12] commented as follows on equity receiverships:

> (It) was a technique which gave complete control of a reorganization with little or no judicial check, to those who had resort to it, managed its initiation, and guided its subsequent stages. The not infrequent, although not invariable, result, where those persons had conflicting motives and interests, was to make this procedure an instrument of personal benefit to them, and by that token an instrument of detriment to creditors and stockholders.[13]

Acting upon that dissatisfaction, the Senate established the McAdoo Hearings in 1932 to investigate receiverships and bankruptcy.[14] The first legislation was consequently introduced in 1932. It reflected the McAdoo

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[11]Sidney Krause, "Arrangements Under Chapter XI of the Bankruptcy Act," p. 81 in G. J. Hirsch and Sidney Krause, Bankruptcy and Arrangements Under Chapter XI (Third Edition. New York: Practicing Law Institute, 1968), pp. 77-132.

[12]Securities and Exchange Committee Report on the Study and Investigation, Personnel and Functions of Protective and Reorganization Committees: Part I, Strategy and Techniques of Protection and Reorganization Committees 24-26 and 29 (May 10, 1937) (hereafter called Protective Committee Report), cited in Commission Report--Part I, p. 239.

[13]Taken from quotation by Protective Committee Report in Commission Report, p. 239.

[14]Citing from the Commission Report--Part I, p. 239, this Committee was established by Senate Resolution 78, 73d Cong., 1st Sess. (1933) and twice extended by Senate Resolutions 72, 74th Cong., 1st Sess. (1935) and 15, 75th Cong., 1st Sess. (1937).

Committee's recommendation to restrict Section 77B relief to corporations insolvent in the Bankruptcy sense only if publicly owned or indebted, and it followed the recommendations of the Thatcher Report. The Commission Report contained the following observation regarding that law:

> The legislation was opposed by lawyers whose practice involved bankruptcies and reorganizations, primarily on the basis that the proposed legislation (1) changed the Bankruptcy Act of 1898, thereby losing the advantages of over 30 years of court interpretation, and (2) created a control bureau responsible for the administration of the law. At the invitation of the Senate Committee holding hearings on the proposed legislation, a group of these lawyers drafted new legislation; the group evolved into the National Bankruptcy Conference. The group worked on the amendments for a period of five years.[15]

Congressman Chandler (hence the name of the subsequent 1938 revisions: The Chandler Act) introduced the sixth draft of amendments to the House in the Spring of 1936.[16] The Chandler Act is "...one of the most 'scientifically' created pieces of legislation ever penned up by the hand of man."[17] The six years of intensive work

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[15] Commission Report--Part I, p. 239.

[16] Commission Report--Part I, p. 240.

[17] John E. Mulder, "Ambiguities in the Chandler Act," University of Pennsylvania Law Review and American Law Register, Vol. 89, No. 1 (November 1940), pp. 10-11.

was conducted by "...the bankruptcy committees of the American Bar Association of Bankruptcy Referees, The National Association of Credit Men, the American Bankers Association, law school professors, authors of texts on bankruptcy, and others, comprising the National Bankruptcy Conference."[18] The new law revamped Section 12 of the Bankruptcy Act and provided for what the draftsmen referred to as reorganizations, arrangements, real property arrangements, and wage earner amortizations. That terminology was cumbersome and those subdivisions became separate Chapters X, XI, XII, and XIII, respectively.[19]

The report of the National Bankruptcy Converence contained this explanation of the relationships between Chapter XI and the provisions it replaced:

> We believe that the section as rewritten has been sufficiently flexible to permit the offer of a settlement in a variety of situations not now covered either by Section 12 or by Section 74. The inclusion of corporations will permit a large number of the smaller companies such as are now seeking relief under Section 77B but do not require the complex machinery of the section, to resort to the simpler and less expensive, though fully adequate, relief afforded by Section 12.[20]

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[18]Mulder, p. 11.

[19]Commission Report--Part I, p. 240.

[20]National Bankruptcy Conference, Analysis of H. R. 12889, 74th Cong. 2d Sess., at (Comm. Print 1936) as cited in the Commission Report--Part I, p. 240.

The nature of Chapter XI is described in Appendix A; the other chapters of the Chandler Act are beyond the scope of this study although they are briefly described on page 1.

APPENDIX C

Economic Interpretation of Bankruptcy

The business cycle periodically takes heavy tolls of businesses which either discontinue operations or sustain severe financial disturbances. Altman found a significant relationship between quarterly changes in Gross National Product and Dun & Bradstreet's failure rate.[1] Fredland pointed out that the National Bureau of Economic Research has used business failures and liabilities of business failures as economic indicators.[2]

The impact of recession on aggregate failure can be represented by an analysis of variations in money income and the level of unemployment diagrammed in Figure A-1.[3] At any point in time, most business firms have contractual obligations to pay lenders fixed charges (interest) on outstanding debt. These payments, which are the debtor's

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[1]Edward I. Altman, Corporate Bankruptcy in America (Lexington, Massachusetts: Heath Lexington, 1971), pp. 46-47 in J. Eric Fredland, The Business Bankrupts, p. 13 in U.S. Congress, House, Commission on the Bankruptcy Laws of the U.S. Report of the Commission on the Bankrutpcy Laws of the United States--Part III, 93d Cong., 1st Sess., July 1973 (Washington, D.C.: Government Printing Office, 1973).

[2]Fredland, p. 13.

[3]This section paraphrases Paul Davidson and Eugene Smolensky, Aggregate Supply and Demand Analysis (New York: Harper & Row, Publishing, 1964), pp. 139-141.

fixed costs, must be made regardless of the level of recession or the debtor's profit position. To the holders of the debt contracts (rentiers), these fixed payments of money are income. This rentier income is related to aggregate employment by the horizontal line RI in Figure A-1a.

At any employment level, there would be a flow of money wage payments to employees. Assuming that wage rate and employment level vary directly, aggregate money wages and employment would be related by line OW in Figure A-1b.

Total costs for integrated firms are the sum of wages plus fixed costs (RI added to W) and are represented by line RI+W in Figure A-1c. At each level of employment, total costs subtracted from total revenues, of course, yields gross profits. Total revenue for employment level is shown by line TR, the aggregate supply function[4] in Figure A-1c. Its upward slope is due to the tendency of employers to hire larger numbers of workers to accomodate increasing expected sales. Since total costs subtracted from total revenue yields gross profits, the difference

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[4]Since intrepreneurs will seek to hire some quantity of workers for each expected sales level, there will be, in the aggregate, a systematic relationship between number of workers (N) hired and expected total revenues (TR). This relationship is called the aggregate supply function. (See Davidson and Smolensky, pp. 3-4). Its derivation is presented by Davidson and Smolensky, Chapter 9.

between aggregate supply (TR in Figure A-1c) and total costs (RI+W) represents aggregate profits.

In Figure A-1c, employment levels below N_1 yield negative profits. During periods of high unemployment (Below N_1 in Figure A-1c), total business losses of some firms will, on average, exceed total profits of others. The aggregate impact of employment below N_1 will be an increase in business failures (and in bankruptcies). This condition will be only temporary because these failures will, for the economy as a whole, have the effect of scaling down aggregate fixed costs. Since Chapter XI proceedings, successfully applied, temporarily reduce total costs for individual debtors by composition or extension, their aggregate impact will be to shift RI+W downward to $RI+W_1$ in Figure A-1c.[5] This exogenous change makes affected firms able, essentially, to "ride out" recession conditions which might otherwise force them into bankruptcy.

Following consumation of a plan of arrangement, and presumably after (more) judiciously assuming new debt, aggregate Chapter XI successes would tend to push $RI+W_1$ back toward RI+W. Hopefully, that change would not occur

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[5]Since wage rates usually remain unaffected by Chapter XI arrangements, the slope of the total cost line would tend not to change.

until employment had regained some ground, rising above N_2, or only after some behavioral change had occured in managements which precluded their re-attaining RI+W too soon. Although provision is made in the Bankruptcy Act for debtors to obtain new debt even while in Chapter XI proceedings,[6] two forces are at work which would tend to prevent their rapid re-attainment of RI+W. First, since the court is in control of debtors in Chapter XI, the application of new debt would be closely monitored. Second, since the debtor's credit rating would reflect his having been involved in Chapter XI, there would be resistance on the part of potential creditors to "lend" former Chapter XI's "back up to" RI+W until their credit worthiness had been re-established.

The aggregate affect of Chapter XI failures would be to move downward both TR and RI+W in Figure A-1c. Assuming a state of bankruptcy insolvency among them, the total cost function would probably decrease by a factor greater than TR. As in the case of normal bankruptcies, then, adjudicated Chapter XI's would tend to scale down total fixed costs.[7]

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[6]This is accomplished by assigning the claims of new creditors a higher priority than old creditors. (B.A. Secs. 344, 357 (c), 11 U.S.C. 744, 757 (c).

[7]In that regard, therefore, adjudicated Chapter XI's serve at least a little aggregate economic advantage. The disadvantage, of course, rests with the consequent unnecessary administrative expenses associated with the dysfunctional Chapter XI portion of the firm's litigation.

APPENDIX D

Financial Ratios and Expected Dimensions

Financial Dimension	Financial Ratio	Abbreviation for Financial Ratio
Liquidity	Current Assets to Current Liabilities	CATCL
	Quick Assets[1] to Current Liabilities	QATCL
	Working Capital[2] to Current Liabilities	WCTCL
	Current Assets to Total Assets	CATTA
	Quick Assets to Total Assets	QATTA
Profitability and Solvency	Net Income to Total Assets	NITTA
	Total Debt[3] to Total Assets	TDTTA
	Net Income to Stockholder's Equity	NITSE
	Total Debt to Stockholder's Equity	TDTSE
	Long-term Debt to Stockholders' Equity	LTDTSE
Activity	Cash to Total Assets	CTTA
	Cash to Total Liabilities	CTCL
	Cash to Sales	CTS
	Current Assets to Sales	CATS
	Quick Assets to Sales	QATS
	Working Capital to Sales	WCTS
	Receivables to Sales	RXTS
	Average Collection Period[4]	ACP

[1]Current Assets-Inventories
[2]Current Assets-Current Liabilities
[3]Current Liabilities + Long-term Debt
[4]Receivables X 360 / Sales

APPENDIX E

Correlation Matrix of Financial Ratios For U.S. Sample of 52 Chapter XI Failures and Successes, 1963 To 1973

	NITTA	TDTTA	CATTA	QATTA	WCTTA	CTTA	CATCL	QATCL	CTCL
Net Income to Total Assets	1.00								
Total Debt to Total Assets	-.32	1.00							
Current Assets to Total Assets	-.20	.43	1.00						
Quick Assets to Total Assets	-.19	.16	.44	1.00					
Working Capital to Total Assets	.27	-.68	.04	-.06	1.00				
Cash to Total Assets	-.01	-.01	-.13	.29	-.13	1.00			
Current Assets to Current Liabilities	.12	-.43	.16	-.06	.71	.10	1.00		
Quick Assets to Current Liabilities	.07	-.47	.06	.48	.58	.38	.64	1.00	
Cash to Current Assets	-.13	-.33	-.17	.09	.28	.76	.44	.62	1.00
Current Assets to Sales	-.17	-.02	.17	.07	.32	-.06	.40	.17	.08
Quick Assets to Sales	-.16	-.06	.03	.41	.09	.03	-.02	.30	.11
Working Capital to Sales	-.03	.01	.21	.09	.28	.11	.35	.29	.20
Cash to Sales	-.23	-.16	-.15	.11	.10	.75	.27	.45	.88
Net Income to Stockholders' Equity	-.22	.32	.13	-.04	-.19	-.01	-.13	-.15	-.05
Total Debt to Stockholders' Equity	.30	-.30	-.02	.13	.29	.02	.16	.20	.02
Long-term Debt to Stockholders' Equity	.30	-.34	.04	.14	.27	.04	.15	.23.	.04
Receivables to Sales	-.12	-.03	.11	.30	.04	-.10	-.02	.07	-.11
Average Collection Period	-.03	-.03	.15	.50	.15	-.18	.05	.27	-.18

	CATS	QATS	WCTS	CTS	NITSE	TDTSE	LTDSE	RXTS	ACP
Current Assets to Sales	1.00								
Quick Assets to Sales	.55	1.00							
Working Capital to Sales	.33	.16	1.00						
Cash to Sales	.24	.27	.19	1.00					
Net Income to Stockholders' Equity	-.01	.06	.06	-.05	1.00				
Total Debt to Stockholders' Equity	-.02	-.12	-.27	-.04	-.85	1.00			
Long-term Debt to Stockholders' Equity	-.08	-.13	-.03	-.04	-.58	.79	1.00		
Receivables to Sales	.06	.09	.08	-.08	.45	.21	.09	1.00	
Average Collection Period	.47	.49	.19	-.05	-.01	.02	.01	.25	1.00

APPENDIX F

Covariance Matrix of Financial Ratios For U.S. Sample of 52 Chapter XI Failures and Successes, 1963 to 1973

	NITTA	TDTTA	CATTA	QATTA	WCTTA	CTTA	CATCL	QATCL	CTCL
Net Income to Total Assets	.09								
Total Debt to Total Assets	.05	.25							
Current Assets to Total Assets	.01	.05	.06						
Quick Assets to Total Assets	.01	.01	.01	.02					
Working Capital to Total Assets	.03	-.13	.01	-.01	.14				
Cash to Total Assets	-.01	-.01	-.01	.01	-.01	-.01			
Current Assets to Current Liabilities	.03	-.21	.03	-.01	.26	.01	.96		
Quick Assets to Current Liabilities	.01	-.11	.01	.03	.10	.01	.29	.21	
Cash to Current Assets	-.01	-.04	-.01	.01	.02	.01	.11	.07	.06
Current Assets to Sales	-.03	-.01	.02	.01	.06	-.01	.22	.04	.01
Quick Assets to Sales	-.01	-.01	.01	.02	.01	.01	-.01	.05	.01
Working Capital to Sales	-.01	.01	.07	.02	.15	.01	.49	.18	.07
Cash to Sales	-.01	-.01	-.01	.01	.01	.01	.03	.02	.02
Net Income to Stockholder's Equity	-.16	.38	.07	-.01	-.17	-.01	-.31	-.16	-.03
Total Debt to Stockholder's Equity	.66	-1.08	-.04	.15	.78	.01	1.15	.66	.04
Long-term Debt to Stockholders' Equity	.25	-.47	.03	.06	.29	.01	.42	.29	.03
Receivables to Sales	-.03	-.01	.02	.04	.01	-.01	-.02	.02	-.02
Average Collection Period	-.58	-1.03	2.24	5.01	3.42	-.86	2.95	7.50	-2.77

	CATS	QATS	WCTS	CTS	NITSE	TDTSE	LTDSE	RXTS	ACP
Current Assets to Sales	.31								
Quick Assets to Sales	.11	.13							
Working Capital to Sales	.26	.08	1.97						
Cash to Sales	.01	.01	.03	.01					
Net Income to Stockholders' Equity	-.01	.05	.21	-.01	5.31				
Total Debt to Stockholders' Equity	-.09	-.32	-.26	-.03	-13.77	49.26			
Long-term Debt to Stockholders' Equity	-.13	-.13	-.12	-.01	-3.72	15.47	7.60		
Receivables to Sales	.02	.02	.09	-.01	-.85	1.20	.20	.65	
Average Collection Period	15.74	10.51	16.28	-.34	-.59	8.64	2.03	11.92	3422.64

APPENDIX G

Factor Analysis

Subprogram FACTOR from Statistical Package for the Social Sciences (SPSS) was utilized in the study.[1] It offers a variety of alternative factor analytic techniques; only those employed will be described.

After correlations among variables are computed, it performs two operations. First, principal components analysis (PCA) is undertaken on the correlation matrix to extract an initial set of factors or dimensions.[2] Second, since the structure of factors obtained by PCA may be difficult to interpret, the factors are rotated about their

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[1]Norman H. Nie, Dale H. Bent, and C. Hadlei Hull, Statistical Package for the Social Sciences (New York: McGraw-Hill Book Company, 1970), pp. 208-244. (henceforth referred to as SPSS). Since this program was used in the study, its methodology will be explained in the operational sections. For detailed statistical deriviations of factor analysis techniques, the following standard treatments are recommended: Harry H. Harman, Modern Factor Analysis (Chicago: University of Chicago Press, 1967): R. J. Rummel, "Understanding Factor Analysis," Conflict Resolution, Vol. 11, 1967, pp. 444-480; and Raymond F. Cattell, "Factor Analysis: An Introduction to Essentials. (1) The Purpose and Underlying Models, (2) The Role of Factor Analysis in Research," Biometrics, Vol. 21, 1965, pp. 190-215, 405-435.

[2]Tatsuoka referred to PCA as a first stage solution in factor analysis, noting, "...most modern factor rotations are performed, subsequent to the principal-axes rotation, in order to achieve what is known as simple structure in the factor matrix." For statistical explanation of PCA, and explanation of its use as the first stage in factor analysis, see Maurice M. Tatsuoka, Multivariate Analysis: Techniques For Educational and Psychological Research (New York: John Wiley & Sons, 1971), pp. 128, 144-149, and 269.

axes to a terminal solution which is the simplest, interpretable structure (the so-called simple structure). The term, factor analysis, then, will refer to principal components analysis followed by rotation of the components.

Part I: Principal Components Analysis-- General Description

In this first step, the linear combination of variables that accounts for more of the variance in the data than any other linear combination is identified. In order to explain the underlying rationale of PCA, a general model of the technique[3] will be summarized along with a solution procedure and following Tatsuoka's notation (henceforth, underlined capital letters are matrices; underlined lower case letters, vectors):

A set of weights

$$\underline{v}' = [v_1, v_2, \ldots, v_p]$$

is sought with which to construct a linear combination

$$y = v_1x_1 + v_2x_2 + \ldots + v_px_p$$

such that the quantity

$$\Sigma y^2 = \underline{v}'\underline{S(X)v}$$

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[3]This method is taken from Tatsuoka, pp. 115-116 and SPSS, p. 210.

becomes as large as possible, within the constraint (the significance of which will be explained shortly) that

$$\underline{v'v} = \sum_{i=1}^{p} v_i^2 = 1.$$

Within these four expressions, the following relations hold:

$\underline{S(X)} = \underline{X'X} - \underline{\bar{X}'\bar{X}}$, where $\underline{X}$ is the matrix of observations,

y = each variable

$\underline{v}$ = vector of factor loadings, and

x_i = hypothetical factors (components.

By constructing a new function

$$F = f(y_1, v_2, \ldots, v_p) - \lambda g(v_1, v_2, \ldots, v_p)$$

this maximization problem with side conditions can be solved by Lagrange Multipliers. In matrix notation, the new function is

$$F = v'S(X)v - \lambda(v'v-1).$$

Its symbolic derivative is found with respect to $\underline{v}$ by applying the rule[4]

$$\frac{\sigma}{\sigma \underline{X}} (\underline{X'AX}) = \underline{2AX}.$$

Thus, the symbolic partial derivative of F with respect to $\underline{v}$ is

$$\frac{\sigma F}{\sigma \underline{v}} = \underline{2S(X)} - 2\lambda \underline{v}$$

which, when set equal to the null vector $\underline{0}$, becomes

$$(\underline{S(X)} - \lambda \underline{I})\underline{v} = \underline{0}. \qquad (G.1)$$

---

[4]See Tatsuoka, pp. 261-263.

This expression is the necessary condition to be satisfied so that $\underline{v}'\underline{S(X)}v$ is maximized subject to the constraint $v'v = 1$.[5] (A method for solution to the matrix equation).

$$(\underline{A}-\lambda\underline{I})\underline{v} = \underline{0}.$$

in which the square matrix $\underline{A}$ replaces S(X), is explained in Tatsuoka, Multivariate Analysis, pp. 117-125. Generally, this equation (G.1) (called the characteristic equation) is solved by (1) finding its roots or eigenvalues, and (2) computing the eigenvector or characteristic vector, $\underline{v}_i$, which corresponds to each eigenvalue, λ_i, of the characteristic equation. The resulting values are

$$\underline{v}_i = [v_1, v_2, \ldots, v_p]$$

which are the factor loadings (sought initially) where vector $\underline{v}_i$ represents the loadings for each variable on each factor.[6]

When the squares of the loadings are summed by factor across all variables, the value arrived at is the eigenvalue for that factor. This value is the total amount of variance in the data accounted for by that factor. The proportion of variance accounted for by a given factor is derived by simply dividing the factor's eigenvalue by the number of variables represented by it. This is

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[5]Tatsuoka, pp. 116-117.

[6]SPSS p. 218.

because of the condition stipulated earlier that

$$\underline{v'v} = 1,$$

which constituted the normalization of variables.

These two statistics (namely, the eigenvalue or total amount of variance and the proportion of variance accounted for by each factor) are the major measures used to decide which factors will be retained for further analysis by MDA.

In Subprogram FACTOR, this information is presented in the initial factor matrix. To summarize, what one derives from this first step and from the resultant initial factor matrix, is the extraction of an unrotated factor matrix[7] containing the following properties:

1. All factors are orthogonal (that is, they are uncorrelated).

2. Factors are arranged in order of their importance (that is, the first factor is the best summary of linear relationships in the data; the second is the best linear combination of variables after the effect of the first is accounted for, and is orthogonal to the first; and so on for all factors).

3. The first factor tends to have high loadings on every variable while other factors tend to have both positive and negative loadings.

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[7]To visualize this process, suppose that a four foot square sheet of one-half inch thick fiber board were viewed directly at its edge. It would be perceived as a four foot long stick, one-half inch wide. Now, if the sheet were rotated slowly, its other dimension, after 90 degrees of rotation, would be fully perceived. Eventually, after some trial-and-error, its true structure would be grasped.

Similarly, by rotating the PCA-identified factors, one attempts to find that best vantage point for the factors at which the factor loadings by each variable are the largest.

Part 2:
Principal Components Analysis--
Operational Description[8]

The method of PCA employed in Subprogram FACTOR (called "Principal Factoring with Iterations" (PA2)) differs from the general description above in one important way. Whereas the former uses a correlation matrix with 1's on the main diagonal as a starting point, PA2 replaces the main diagonal elements with communality estimates.[9] A communality of a variable is the proportion of its variance that is accounted for by common factors, that is, factors simultaneously involved in more than one of the set of variables being analyzed.[10]

It is assumed in PA2 that each variable is affected by two types of influences. First, the common part of the variable is affected by determinants which also affect other variables in the set. Second, the unique part of the variable is due to components which are not shared with other variables. Consequently, the common part contributes to the relationships among variables, whereas the unique part is idiosyncratic. It follows, then, that any correlation

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[8]This section paraphrases SPSS, pp. 211-212.

[9]SPSS, p.219.

[10]Tatsuoka, p. 145.

among variables is due to common determinants shared by the correlated variables; the unique part does not contribute to relationships among variables.

The basic model is (using SPSS notation)

$$z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jm}F_m + d_jU_j \quad (j=1 \text{ to } n)$$

where:

z_j = standardized variable j

F_i = hypothetical factors

U_j = unique factor for variable j

a_{ji} = standardized coefficient of variable j on factor i (factor loading)

d_j = standardized coefficient of variable j on unique factor j.[11]

It is assumed that the unique factor U_j is orthogonal to all the common and unique factors of other variables (that is, the unique part of a variable is uncorrelated with all other variables and to the common part of itself). Therefore, any correlation between the variables j and k, is assumed to be due to the common factors. Then, since the common factors are also assumed to be orthogonal, the following fundamental factor theorem can be stated (referring to the basic model):[12]

$$r_{jk} = r_jF_1r_kF_1 + r_jF_2r_kF_2 + \ldots + r_jF_mr_kF_m$$
$$= a_{j1}a_{ki} + a_{j2}a_{k2} + \ldots + a_{jm}a_{km}$$
$$= \sum_{i=1}^{m} a_{ji}a_{ki} \quad .$$

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[11] SPSS, p. 211.

[12] SPSS, p. 211.

"That is, the correlation between variables j and k is the sum of the cross-products of the correlations of j and k with the respective common factors."[13]

The basic rationale of this technique may be stated as follows: "... (A) minimum number of hypothetical variables are specified in such a way that after controlling for these hypothetical variables, all the remaining (partial) correlations between the variables would become zero."[14]

Output for PA2 is presented in the initial factor matrix which is used primarily as a means of data reduction. The factors it contains are orthogonal and ordered in descending importance.

> On the basis of this matrix, one would normally decide how many factors to retain and evaluate how complete a given factor analysis is. Therefore, it is important to examine the proportion of variance accounted for by each factor and jointly by the first m significant factors that will be used in further rotation.[15]

Part 3:
Why Factor Rotation to a Terminal Solution?

In an unrotated solution (PA2), variables can be decomposed into several significant common factors. When an

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[13] SPSS, p. 211.

[14] SPSS, p. 212.

[15] SPSS, p. 216.

unrotated solution is rotated into a terminal solution, each variable is decomposed into a single significant common factor (this state is called the "simple structure"). As a result, the rotated factor loadings are easier to interpret than their unrotated counterparts. This is one important reason for extending the analysis beyond the principal components solution to a rotated one.

Another reason is that loadings on the unrotated factors depend heavily upon the relative number of variables. This means that if one variable is deleted, the relative loadings on the unrotated factors may change drastically. In this respect the rotated factors are more stable than the unrotated ones.

Part 4
VARIMAX Rotation and Output Matrices--
Operational Descriptions

VARIMAX[16]

Factor rotations may be oblique or orthogonal. Obliquely rotated axes are not necessarily orthogonal. They are more realistic, however, since the constraint that their underlying dimensions remain unrelated is not imposed. Orthogonal axes are 90 degrees apart. If clusters of data are, say, 70 degrees apart, orthogonally rotated axes would

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[16]This explanation of VARIMAX paraphrases SPSS, pp. 221-224. For a detailed derivation of the technique the reader is referred to Harman.

split the difference between 70 and 90 degrees while remaining 90 degrees from each other. Obliquely rotated axes would, in this case, fall on the clusters (like a regression line on data points) 70 degrees apart).

The objective of this part of the present study is to identify the minimum number of uncorrelated ratios which accurately discriminates between the two groups of firms. Since ratios selected for the MDA model (providing that the test of the groups' ratios' means reveals discriminatory power) will be based upon their loadings on rotated factors, orthogonal (independent) factors are desireable. Therefore, orthogonal rotation will be implemented rather than oblique.

Of the three alternative methods of orthogonal rotation available in Subprogram FACTOR, VARIMAX rotation will be used.

VARIMAX attempts to simplify the columns of a factor matrix. An ideal simple factor in VARIMAX is one with only 1's and 0's in a column. This method essentially involves maximizing the variance (hence the name, VARIMAX) of the squared loadings in each column. Accordingly, simplification of the structure is achieved (simplification refers to making as many values as possible in each column close to zero).

Output Matrices[17]

Subprogram FACTOR produces four terminal solution matrices. The initial factor matrix, mentioned earlier, is the result of the first step of factor analysis: Extraction of principal--or common--factors. The second step, rotation of factors to a terminal solution, results in the following four output matrices: Factor-pattern matrix, factor-estimate matrix, factor-structure matrix, and a correlation matrix for terminal factors. These four constitute the main sources of information about the factor analysis application; each is discussed separately below:

1. Factor-pattern Matrix. This matrix contains the weights (factor loadings) of the common factors after rotation and tells us the composition of a variable in terms of factors.

2. Factor-estimate Matrix. This matrix is composed of regression weights with which factors can be estimated from the original variables.

3. Factor-structure Matrix. The program offers the matrix which contains correlation coefficients between each factor and each variable. However, in an orthogonal

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[17]The output matrices for Subprogram FACTOR are explained in SPSS, pp. 213-216.

rotation, which is used in this application, this matrix and the factor-pattern matrix would be identical. Therefore, the two matrices are present in one labeled factor matrix. (This matrix will be used to determine which ratios to select as a best representative of each factor).[18]

4. Correlation Matrix for Terminal Factors. This matrix is also available in the program, however, it is not used in orthogonal rotations. This is because the correlation between factors is assumed to be zero. For an oblique rotation, however, this matrix would contain factor correlation coefficients.

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[18]A detailed description of this matrix is presented in SPSS, pp. 214-215.

Appendix H

Multiple Discriminant Analysis

The major statistical task in this research is to identify the financial variables of a model to classify an individual Chapter XI petitioner as a member of one of two categories, success or failure. To do this, the financial structures of the two categories are analyzed statistically by finding a linear combination of a set of ratios that shows large differences in group means. Multiple discriminant analysis (MDA) is a method for determining such linear combinations. It will first be described geometrically and then mathematically in general terms and also for the special case of two groups.

Geometrical Interpretation of MDA

MDA can best be depicted geometrically for the case of two variables and, as in this study, two groups. Figure H-1 shows the bivariate plot for groups (I and II) of observations on two variables X_1 and X_2, defined by two linear combinations (represented by axes Y and Z) of the variables. By projecting the two distributions of observations onto axes Z instead of Y, notice that the size of the overlap between distributions is reduced to the least possible amount. What distinguishes axis Z from Y is that Z is a line perpendicular to the line A, which is defined

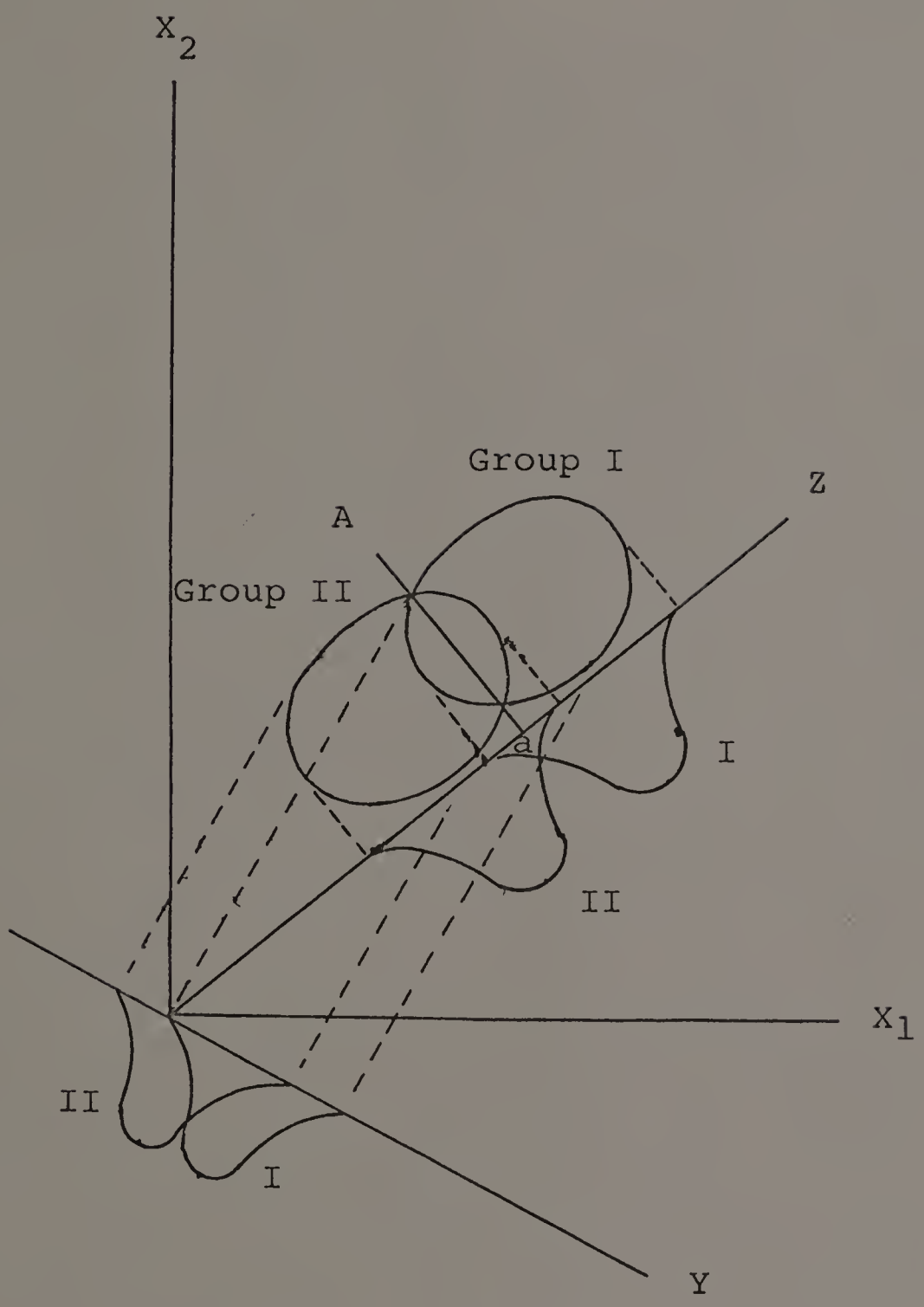

FIGURE H-1

GEOMETRICAL REPRESENTATION OF A HYPOTHETICAL BIVARIATE DISTRIBUTION OF TWO GROUPS OF OBSERVATIONS ON TWO VARIABLES (X_1 AND X_2) PROJECTED ON TWO AXES (TWO LINEAR COMBINATIONS)

by the points of intersection of the two ellipses. The set of discriminant scores, z_j's, which are individual variables transformed into single values by a discriminant function, is located on Z. The point, a, divides the one-dimensional space on Z into two sections, each having a probability of membership in Group I or II.[1] Because of the smaller overlap area on Z, compared to Y, the probability of misclassification of a groupmember is smaller on Z. Reducing the probability of a misclassification of individual subjects is the objective of MDA.

Mathematical Interpretation of MDA[2]

MDA may be viewed as a two step process. First, a criterion for measuring group mean differences must be found. Second, a set of weights is needed which maximizes the criterion.

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[1]William W. Cooley and Payl R. Lohnes, Multivariate Procedures for the Behavioral Sciences (New York: John Wiley & Sons, Inc., 1962), pp. 116-117 cited in Robert O. Edmister, "Financial Ratios as Discriminant Predictors of Small Business Failur," unpublished Ph.D. dissertation, The Ohio State University, 1970, p. 44.

[2]This section was taken from Maurice M. Tatsuoka, "Discriminant Analysis: The Study of Group Differences" Selected Topics in Advanced Statistics: An Elementary Approach, Number 6 (Champaign, Ill.: Institute for Personality and Ability Testing, 1970), pp. 25-38 and Maurice M. Tatsuoka, Multivariate Analysis: Techniques for Educational and Psychological Research (New York: John Wiley & Sons, Inc., 1971), pp. 157-166.

Discriminant Criterion

The objective is to find a linear combination of the original predictor variables that shows large differences in group means. A criterion for measuring these differences is needed. The F-ratio may be used for this purpose. It is appropriate for testing the significance of the overall difference among several group means on a single variable.

The F-ratio is

$$F = \frac{SS_b/(K-1)}{SS_W/(N-K)} = \frac{SS_b}{SS_w} \cdot \frac{N-K}{K-1} \quad ,$$

where:

K = number of groups

N = total number of individuals = $\sum_{g=1}^{k} n_g$

SS_b = Sum-of-Squares between groups, and

SS_w = Sum-of-Squares within groups.

In any problem, K and N are fixed. Therefore, the essential quantity in the F-ratio for measuring group-mean variability among the groups, relative to within groups, is SS_b/SS_w. Stated succinctly, then, the problem is to express the two kinds of sums-of squares,

$$SS_w = \sum_{g=1}^{k} (n_g - 1)s^2_{y(g)} = \sum_{g=1}^{k} \sum_{i=1}^{n} (Y_{(g)i} - \bar{Y}_{(g)})^2 \qquad (H.1)$$

$$SS_b = \sum_{g=1}^{k} n_g(\bar{Y}_{(g)} - \bar{Y}.)^2 \qquad (H.2)$$

where:

$Y_{(g)}$ is the Y-score of the i^{th} individual in the g^{th} group,

n = size of g groups, (g=1, 2, ..., k),

$\bar{Y}_{(g)}$ = Mean of Y-score of each group, and

$\bar{Y}. = \frac{\Sigma ng\bar{Y}(g)}{n}$ = grand mean of Y in the total sample (N) comprising all K groups.

for any linear combination

$$Y = v_1X_1 + v_2X_2 + \ldots + v_pX_p$$

of the p predictor variables (ratios), X_1, X_2, ... X_p, as functions of the unknown weights v_1, v_2, ... , v_p. The discriminant criterion,

$$\lambda = \frac{SS_b}{SS_w}$$

which is sought, then also becomes a function of the combining weights. This derivation is more commonly expressed in matrix form as in the following section.

Within-groups Sum-of-squares (Matrix Deriviation).

(Henceforth underlined uppercase letters denote matrices; underlined lower case letters, vectors). Denoting the sum-of-squares of Y for the k^{th} group by $SS_k(Y)$ and letting

$\underline{v}' = [v_1, v_2, \ldots, v_p]$, $SS_k(Y)$ can be derived by applying the expression[3]

$$SS_k(Y) = \underline{v}' \ \underline{S(X)} \ \underline{v} \qquad (H.3)$$

where:

$\underline{S(X)} = \underline{X'X} - \underline{\overline{X}'\overline{X}}$ = Sum-of-squares and Cross Products (SSCP) matrix of the p predictor variables

to each of the K groups individually and then adding the results as follows:[4]

$$\begin{aligned} SS_w(Y) &= SS_1(Y) + SS_2(Y) + \ldots + SS_K(Y) \\ &= \underline{v}'\underline{S}_1\underline{v} + \underline{v}'\underline{S}_2\underline{v} + \ldots + \underline{v}'\underline{S}_K\underline{v} \\ &= \underline{v}'(\underline{S}_1 + \underline{S}_2 + \ldots + \underline{S}_K)\underline{v} \end{aligned}$$

or

$$SS_w(Y) = \underline{v'Wv} \qquad (H.4)$$

because

$$\sum_{k=1}^{k} \underline{S}_k = \underline{W}.$$

Between-groups Sum-of-squares (Matrix Derivation). Derivation of the formula for the between-groups sum-of-squares, $SS_b(Y)$, which corresponds to H.4, is a more complex procedure. First, the following expression for the

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[3]Explained as analgous to a derivation presented in Tatsuoka, Multivariate Analysis, pp. 106-108.

[4]This expression is derived mathematically in Tatsuoka, Multivariate Analysis, pp. 45-46.

between-groups SSCP matrix $\underline{B}$, for the original p variables, must be derived:[5]

$$B = (\underline{\bar{X}}-\underline{\bar{\bar{X}}}')\ (\underline{\bar{X}}-\underline{\bar{\bar{X}}}). \qquad (H.5)$$

(This formula contains two classes of means--the group means, $\underline{\bar{X}}$'s, and the grand means, $\underline{\bar{\bar{X}}}$'s).[6]

Recalling equation (H.3), (H.5) is then pre- and post-multiplied by $\underline{v}'$ and $\underline{v}$, respectively,

$$\underline{v'Bv} = \underline{v}'(\underline{\bar{X}}-\underline{\bar{\bar{X}}})'\ (\underline{\bar{X}}-\underline{\bar{\bar{X}}})v$$

which becomes

$$\underline{v'Bv} = (\underline{\bar{X}v}-\underline{\bar{\bar{X}}v})'(\underline{\bar{X}v}-\underline{\bar{\bar{X}}v}).$$

This operation in turn reduces to

$$\underline{v'Bv} = \sum_{k=1}^{k} n_k(\bar{Y}_k-\bar{Y})^2.$$

The latter expression is the between-groups sum-of squares of the transformed variable Y, presented as equation (H.2). Accordingly, then,

$$SS_b(Y) = \underline{v'Bv}\ . \qquad (H.6)$$

Utilizing expressions (H.4) and (H.6), the discriminant criterion on matrix form is

$$\lambda = \frac{SS_b(Y)}{SS_w(Y)} = \frac{\underline{v'Bv}}{\underline{v'Wv}}.$$

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[5]Presented in Tatsuoka, Multivariate Analysis, pp. 170-173.

[6]$\underline{\bar{X}}$ is an N x p matrix made up of n_1 rows of Group I means of the p variables, the next n_2 rows of Group 2 means of the p variables, and so forth for n_K rows.

As noted before, λ is the criterion sought for measuring group differentiation along the dimensions specified by $\underline{v}$.

Maximizing the Discriminant Criterion. The next task after determining the discriminant criterion is to derive a set of weights $[v_1, v_2, \ldots, v_p]$, which maximizes it.

First, the partial derivative[7] of (H.6) must be set equal to zero. This operation yields

$$\frac{\sigma\lambda}{\sigma\underline{v}} = \frac{2[(\underline{Bv})(\underline{v'Bv}) - (\underline{v'Bv})(\underline{Wv})]}{(\underline{v'Wv})^1} = 0$$

which ultimately reduces to

$$\frac{2[Bv - \lambda Wv] = 0.}{\underline{v'Wv}}$$

This equation is equivalent to

$$(\underline{B} - \underline{\lambda W})\underline{v} = 0. \qquad \text{(H.7)}$$

Then, providing that $\underline{W}$ is nonsingular, both sides of (H.7) are premultiplied by it, yielding

$$(\underline{W^{-1}B} - \underline{\lambda I})\underline{v} = 0 \qquad \text{(H.8)}$$

within which taking the second derivative of λ with respect to $\underline{v}$ would show that the solutions are maxima inflexion points. Thus (H.8) is a sufficient and necessary

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[7]The rule for this process presented in Tatsuoka, Multivariate Analysis, pp. 261-264.

condition for maximizing λ.

Since (H.8) is of the form

$$(A - \lambda I)\underline{v} = 0$$

it is a standard eigenvalue problem, solution of which is presented in Tatsuoka, Multvariate Analysis, Chapter 5. The problem, therefore, of maximizing the discriminant criterion, has been solved.

When the expression (H.8) is solved, a set of r nonzero eigenvalues is produced denoted as $\lambda_1, \lambda_2, \ldots, \lambda_r$ in descending order of magnitude, and r corresponding eigenvectors $\underline{v}_1, \underline{v}_2, \ldots, \underline{v}_r$. The eigenvalues are quantities assumed by the discriminant criterion when the linear combinations contain combining weights made up of the elements of the corresponding eigenvector $\underline{v}'_1 = [v_1, v_2, \ldots, v_p]$. Therefore, the transformed variable

$$Y_1 = v_{11}X_1 + v_{12}X_2 + \ldots + v_{1p}X_p$$

has the largest discriminant criterion, λ_1, of the whole set of λ's. It is the largest eigenvalue achievable by any linear combination of the p predictor variables. (In the case of two groups, such as the present study, it is also the only eigenvalue produced).

For the more than two group case, the magnitude of each eigenvalue establishes the optimality with which linear combinations of the predictors using corresponding eigenvectors differentiate among the K groups. Of the

remaining (after $\underline{v}_1$) eigenvectors, $\underline{v}_2$, $\underline{v}_3$, ..., $\underline{v}_r$, the linear combination

$$Y_2 = v_{21} X_1 + v_{22} X_2 + \ldots + v_{2p} X_{p1}$$

which uses the combining weights of $\underline{v}_2 = v_{21}, v_{22}, \ldots, v_{2p}$, has the discriminant criterion value, λ_2, which is the largest achieveable by any linear combination of the X's that is uncorrelated with Y_1. In like manner, the third linear combination, Y_3, would have the largest discriminant criterion of those remaining after Y_2, which is uncorrelated with both Y_1 and Y_2. This process continues through Y_r. These first, second, ..., r^{th} linear combinations of the X's, Y_1, Y_2, ..., Y_r, are called <u>discriminant functions</u> which maximally differentiate among the K groups.

<u>Two Group Discriminant Analysis</u>.[8] Whereas more than two group applications of discriminant analysis reduce to canonical correlation analysis,[9] the <u>two group</u> case reduces to multiple regression. That is, the discriminant weights are proportional to the coefficients of a multiple regression equation incorporating a dummy variable Y which is assigned the score of 1 for Group 1 members and a score of 0 for members of Group 2 (or visa versa).

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[8]This section paraphrases Tatsuoka, <u>Multivariate Analysis</u>, pp. 170-173.

[9]See Tatsuoka, <u>Multivariate Analysis</u>, pp. 177-183.

To illustrate this simplified model, note first that discriminant functions can be derived from

$$(\underline{T^{-1}B} - u\underline{I})v = \underline{0} \qquad \text{(H.9)}$$

as well as from equation (H.8). In this expression (H.9), $\underline{W} + \underline{B} = \underline{T}$ is the total SSCP matrix of the p predictor variables (X's). Equation (H.8), rewritten as

$$\underline{Bv} = \underline{\lambda Wv} ,$$

becomes

$$(1 + \lambda)\underline{Bv} = \lambda(\underline{W} + \underline{B})\underline{v} \qquad \text{(H.10)}$$

when $\underline{\lambda Bv}$ is added to both sides. Then, since[10]

$$u = \frac{\lambda}{1+\lambda} ,$$

(H.10) reduces further to (H.9) by

$$(T^{-1}B - \frac{\lambda}{1 + \lambda})\underline{v} = \underline{0} .$$

Now, the off-diagonal elements of $\underline{B}$ are the between-groups sums-of-squares for pairs of variables from equation (H.5). In computational form, the matrix $\underline{B}$ in the two group case becomes[11] (for i = 1, 2, ..., p variables and j = 1, 2 groups)

$$b_{ij} = \frac{n_1 \, n_2}{n_1+n_2} = (\bar{X}_{i1} - \bar{X}_{i2})(\bar{X}_{j1} - \bar{X}_{j2}) .$$

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[10]This relationship is explained in Tatsuoka, Multivariate Analysis, p. 171. The eigenvectors which satisfy equations (H.8) and (H.9) are the same; their eigenvalues stand in the relation

$$u = \frac{\lambda}{1+\lambda} .$$

[11]This process is presented by Tatsuoka, Multivariate Analysis, p. 171.

Then, if the differences between the means of the two groups of p variables are expressed in the row vector

$$\underline{d}' = [\bar{X}_{11} - \bar{X}_{12}, \bar{X}_{21} - \bar{X}_{22}, \ldots, \bar{X}_{p1} - \bar{X}_{p2}],$$

the expression for B is obtained:

$$\underline{B} = \frac{n_1 n_2}{n_1+n_2} \underline{dd}' \quad .$$

Letting $c = n_1 n_2 / n_1+n_2$ and substituting this new form of $\underline{B}$ into (H.9) results in

$$(\underline{cT}^{-1}(dd') - \underline{uI})\underline{v} = \underline{0} \quad ,$$

which reduces to

$$\underline{uv} = c(\underline{T^{-1}d})(\underline{d'v}). \qquad \text{(H.11)}$$

Therein, $\underline{d'v}$ is a scalar, as, of course, are u and c. They are collected into one multiplier and the expression (H.11) becomes

$$\underline{v} = \underline{mT^{-1}d} \qquad \text{(H.12)}$$

in which m is the unknown multiplier.

Equation (H.12) means that discriminant analysis in the two group case can be solved without solving an eigenvalue problem. This equation has interesting properties which are discussed by Tatsuoka.[12]

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[12] Tatsuoka, Multivariate Analysis, pp. 172-173.

(H.12) reduces to the form

$$v = S_{pp}^{-1}(md) \ ,$$

in which S_{pp} is identical to the p predictor variables' SSCP matrix T (in which the two groups are brought together in one sample along with the dummy variable which takes on values of 0 and 1 (or others) for members of Groups 1 and 2, respectively).

Computational Approaches to MDA

There are two alternative modes of analysis in SPSS Subprogram DISCRIM for computing discriminant functions. They are the so-called direct and stepwise modes.

In direct mode, the program constructs the discriminant function with all of the variables specified by the researcher. This is the method which will be employed to analyze the set of ratios identified by factor analysis.

Stepwise MDA, however, is more complicated and time-consuming. Here, the variables are allowed to enter the discriminant function one-at-a-time. That is, the significance of the function is computed each time a variable is entered. Only those variables will be entered which result in a significant increase in the discriminating power of the function. Whenever a new variable is added the relative contribution to its discriminating power of the variables already in it can change dramatically. A formerly significant contributor can become insignificant. Because of this possibility, after a new variable has been entered, it will be removed anytime its contribution becomes too small.

These two criteria for entry and exit of variables are specified as the F-values, "F to enter: and "F" to remove," respectively. The researcher selects and F to enter (labeled "FIN") which becomes the minimum F-level for inclusion, and F to remove (called "FOUT") which is the maximum F-level for deletion. In so doing, one can restrict the variables in the final discriminant function to those which are the most significant contributors to the function's discriminating power.

The disadvantage of the stepwise mode is the large amount of computer time necessary to compute discriminant functions for each additional variable. By factor analyzing the variables first, and then using direct mode MDA to discriminate between groups on the basis of variables with highest loadings on significant factors, much time can be saved. It is significant to note that the factor analysis-direct MDA methodology (the so-called Model A) is <u>not</u> necessarily going to produce the same results as stepwise MDA without factor analysis (Model B). This is because the former method selects variables on the basis of their inter-relationships; the latter, on their group differences.