

71-20,935

FELDMAN, Stephen, 1944-  
SELECTING THE OPTIMUM INTEREST RATE AND  
CORRESPONDING CONVERSION RATIO FOR A  
CONVERTIBLE BOND.

The City University of New York, Ph.D.,  
1971  
Business Administration

University Microfilms, A XEROX Company, Ann Arbor, Michigan

© COPYRIGHT BY

STEPHEN FELDMAN

1971

SELECTING THE OPTIMUM INTEREST RATE AND CORRESPONDING  
CONVERSION RATIO FOR A CONVERTIBLE BOND

by

STEPHEN FELDMAN

A dissertation submitted to the Graduate  
Faculty in Business in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy, The City  
University of New York.

1971 .

This manuscript has been read and accepted for the Graduate Faculty in Business in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

1/7/71  
date

James B. Chew  
Chairman of the Examining Committee

1/7/71  
date

Conrad Perenson  
Executive Officer

Pat M. Gutman  
Lloyd Rosenburg  
Martha Zweis  
Supervisory Committee

## ACKNOWLEDGEMENTS

On the road to receiving a Doctor of Philosophy degree in Business I became indebted to many people. Now as I receive the degree, I would like to express my belated appreciation to these individuals.

First, I wish to thank Dr. Jerome B. Cohen, Acting President of the Baruch College and Chairman of my Dissertation Committee, who always found the time to offer professional and personal guidance. I am also indebted to Dr. Peter M. Gutmann, Dr. Lloyd Rosenberg, and Dr. Martin Zweig who provided invaluable advice concerning the preparation of my dissertation, and to Dr. Conrad Berenson who flawlessly directed the administrative aspects of the Doctoral Program.

Most of all I want to thank my wife, Connie, for the continuous support she gave to me in my pursuit of this degree. And it is to her that I dedicate this dissertation.

Abstract

SELECTING THE OPTIMUM INTEREST RATE AND CORRESPONDING  
CONVERSION RATIO FOR A CONVERTIBLE BOND

by

Stephen Feldman

Advisor: Professor Jerome B. Cohen

The use of convertible debentures as a major source of capital has grown rapidly in recent years. However, there has never been developed a systematic method for selecting the optimum interest rate and corresponding conversion ratio when a convertible bond was issued.

The optimum combination for each company is one that would maximize the earnings per share and, therefore, the price per share of the company's common stock without increasing the risk associated with the ownership of the stock. Consequently, this would maximize the wealth of those investors who are common shareholders on the date that the convertible bonds are issued.

Past studies have indicated that many corporate financial executives did not utilize a systematic, rational method of selecting the optimum interest rate and conversion ratio

where they recommended the issuance and proceeded to issue convertible bonds. There were some indications also that they were not cognizant of the various alternatives available to them.

In this dissertation a model was developed that would enable a company that is issuing convertible bonds to select the optimum interest rate and corresponding conversion ratio.

Case studies were then conducted to determine whether any convertible bonds currently have sub-optimum interest rate/conversion ratio combinations. Six companies, representing 26.09 percent of all of the companies analyzed, chose interest rate/conversion ratio combinations that were definitely sub-optimum. And it is probable that sub-optimum combinations were also chosen for some of the other seventeen convertible bonds. In some cases this sub-optimization could affect the earnings per share by over ten percent.

If each of the companies that issue convertible bonds in the future would utilize the model developed in this dissertation, then each would be able to select the optimum interest rate and corresponding conversion ratio that would maximize the wealth of its common stockholders.

In order to select the optimum interest rate and corresponding conversion ratio for a given convertible bond, it is necessary to know what potential combinations were available to the issuing corporation. It is known that the actual combination

chosen by the corporation was one available alternative. Using this as a starting point, it is possible to calculate what other alternatives were available if one knows the percentage change in the conversion price that would have been necessitated by a one percent change in the actual interest rate when the convertible bond was issued. A linear regression model was utilized in order to determine what interest rate/conversion ratio combinations were available for each convertible bond being analyzed.

For the 23 convertible bonds analyzed in the study it was observed that the quality of the bond and the date of issue were both instrumental in determining how much of an increase in the conversion ratio the market would demand for a given decrease in the interest rate.

## TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION.....	1
The Convertible Bond.....	1
Importance of convertible debentures.....	3
Cost of capital of convertible bonds.....	3
Conversion ratios and interest rates.....	8
The Problem.....	10
Objectives of the Study.....	14
Methodology.....	16
II. DEVELOPING A MODEL THAT CAN SELECT THE OPTIMUM INTEREST RATE/CONVERSION RATIO COMBINATION.....	20
The Value of a Convertible Bond.....	20
When does conversion occur?.....	24
Proposed Model for Determining the Optimum Interest Rate and Corresponding Conversion Ratio.....	27
Interest Rate - Conversion Ratio.....	30
Solving the Equation.....	37
Graphical Presentation.....	41
III. EMPIRICAL RESEARCH AND ANALYSIS.....	46
Defining Objectives.....	46
Present value theory.....	46
Data collection and interpretation.....	48
Analysis of Each Convertible Bond.....	51
Analysis of Total Data.....	79
Presentation of Data.....	83
IV. THE INTEREST RATE/CONVERSION PRICE TRADE-OFF.....	116
Trade-Off Opportunities.....	116
Objectives.....	117
Bond Ratings.....	120
Analysis of Trade-Off Opportunity Data.....	122
Date of issue--its influence on the trade-off.....	122
Quality of the bond--its influence on the trade-off.....	125
Empirical Data.....	128

CHAPTER	PAGE
V. SUMMARY AND CONCLUSIONS.....	144
Summary.....	144
Conclusions.....	148
BIBLIOGRAPHY.....	150

LIST OF TABLES

Table	Page
1. The Effect of the Interest Rate and Conversion Ratio on the Earnings Per Share.....	42
2-24. The Effect of any Sub-Optimization on the Earnings Per Share for Each of the 23 Companies Analyzed.....	84
25. The Number of Years From the Date of Issue Until Conversion Occurs That Would Make the Interest Rate/Conversion Ratio Combination Selected by the Company to be the Optimum One.	114
26. Presentation of d and F Values.....	119
27. Bond Quality Ratings as Compared to Their Rate of Default.....	121
28. Mean Average d Value for All Bonds.....	125
29. The Mean Values of d for BB and BBB Convertible Bonds in the Years Specified.....	125
30-52. F and d Values for Each Bond.....	129

## LIST OF ILLUSTRATIONS

Figure	Page
1. Interest Rate/Conversion Price Trade-Off Curve.	10
2. The Value of a Convertible Bond.....	20
3. Interest Yields on New and Existing Bonds.....	36
4. Interest Rate/Conversion Ratio Combinations Acceptable to the Market.....	44
5. Earnings Per Share Given Alternative Interest Rates.....	44
6. Graphical Determination of the Optimum Interest Rate/Conversion Ratio Combination.....	45
7. Mean Average d Value for All Bonds.....	123
8. Mean Values of d for BB and BBB Convertible Bonds in the Years Specified.....	126

## CHAPTER I

### INTRODUCTION

#### The Convertible Bond

The convertible bond is a hybrid and intricate method of raising capital. It is an unsecured debt instrument which gives the investor the privilege of exchanging his bond for a specified number of shares of common stock in the same company under certain pre-established conditions. The investor is given the protection of a bond as well as the capital gain potential of common stock. However, the current yield on a convertible bond will generally be lower than that on a straight bond of equivalent risk, and the investor will usually pay more for the common stock that he has the privilege to receive in conversion than if he had purchased the stock directly.<sup>1</sup> From the issuer's point of view, the decision to use convertible debentures is an extremely difficult one. There are four major reasons why a corporation may choose to issue convertible bonds. First, convertibles enable the company to obtain equity capital at a higher price for the stock than the current market levels would allow. Second, the convertible feature allows the cor-

---

<sup>1</sup>James E. Jensen, A Pricing Model for the Convertible Debenture: A Selective Study, Unpublished Doctoral Dissertation University of Pittsburgh, 1965. pp. 1-10.

poration to sell debt at an interest rate below that which would have had to be offered if straight debt were sold. A third advantage of selling convertibles is that they can attract the funds of certain institutions which are not permitted to buy common stock but can purchase high grade convertible debentures. Finally, convertibles may enable management to raise equity capital indirectly without diluting the primary computation of earnings per share for common stock until the proceeds are at work earning an added return to support the additional stock.<sup>2</sup> At the time that a corporation issues convertible bonds, if the coupon interest rate for these bonds is greater than two-thirds of the prime interest rate then the additional shares of common stock that will be created when conversion occurs are not considered in the primary earnings per share computation.

Convertible debentures also have some significant potential disadvantages to the issuer. Although the convertible may give the issuer the opportunity to sell common stock at a premium above its prevailing market price, if the common stock greatly increases in price, the corporation may have been better off to have temporarily engaged in short term borrowing and then waited to sell common stock directly at a significantly higher price. Furthermore, if the company truly desires to raise equity capital and if the price of the stock declines or remains the same after the bond is issued, then the investor

---

<sup>2</sup>Jerome B. Cohen and Sidney M. Robbins, The Financial Manager (Harper and Row, New York, 1966) pp. 598-599.

may never convert and the corporation will be permanently saddled with debt that it did not desire.<sup>3</sup>

#### Importance of convertible debentures

The use of convertible debentures as a major source of capital has grown rapidly in recent years. For example, on March 1, 1970 there were 278 convertible bonds listed on the New York Stock Exchange, 106 listed on the American Stock Exchange and 215 being traded over-the-counter. These figures were significantly greater than in years past as shown in a study by James C. Pilcher of the securities issued between 1933 and 1952. In this period 9,315 different issues of bonds and stocks were sold. Of these, 5,122 were sold publicly and 3,358 of the public issues were bonds. However, of this total, only 20 percent were convertible, or less than 700 convertible bonds issued in 20 years.<sup>4</sup>

#### Cost of capital of convertible bonds

When a firm decides to issue convertible bonds, its main concern should be to optimize the position of the pre-convertible share holder. In order to choose the conversion ratio and corresponding interest rate on a convertible bond that will yield the maximum benefits for these stockholders, it is necessary to understand the cost of capital before and after conver-

---

<sup>3</sup>J. Fred Weston and Eugene F. Brigham, Essentials of Managerial Finance, (Holt, Rinehart, Winston, Inc., New York, 1968) p. 405.

<sup>4</sup>James C. Pilcher, Raising Capital With Convertible Securities, (Ann Arbor Michigan Business Studies, Vol. XII No. 2, 1955) pp. 1-78.

sion occurs.

The marginal cost of the debt capital that is incurred when convertible bonds are sold can be measured by the amount of annual interest that must be paid on these bonds minus the associated tax savings, plus any additional earnings that are necessary to maintain the market price of the common stock, divided by the funds raised from the sale of the convertible bonds.

marginal cost of debt capital when convertibles are issued	=	annual interest expense	-	associated tax savings	+	additional earnings that are necessary to maintain the market price of the common stock
---	---	----------------------------	---	---------------------------	---	---

---

funds raised from the sale of the  
convertible bonds

It is appropriate to include any additional earnings that are necessary to maintain the price of the common stock as part of the cost of debt capital because as more debt is added to the capital structure, it increases the financial risk of that corporation; this causes a lower price-earnings ratio and a higher cost of equity capital. This higher cost of equity capital is a direct result of the additional debt, and it should be considered as part of the marginal cost of the debt capital.

If a given company decides to issue x dollars of convertible bonds, and it has the option of issuing these bonds with a higher current interest rate and a lower conversion

ratio, then the difference in the cost of debt capital between these two alternatives before conversion occurs is the difference in their annual interest expense less any associated tax savings. This is true because a given company that issues x dollars of convertible bonds will have the same business risk and the same percentage of debt, and, therefore, the same financial risk regardless of whether it sets a higher or lower interest rate or conversion ratio. Therefore, the cost of equity capital and earnings necessary to maintain the price of the stock will not be affected by the interest rate or conversion ratio before conversion occurs. This is predicated on the assumption that if the company uses a higher interest rate, then the slightly higher interest expense will not have a significant impact on the overall interest earnings coverage and will not affect the financial risk of the corporation.

If a company sets a higher interest rate and lower conversion ratio, it will incur a higher cost of debt capital and a higher weighted average cost of capital before conversion occurs because the cost of equity capital will not be affected. Since the weighted average cost of capital is an average of debt and equity, then if the cost of one segment is raised and the other segment remains constant, then there will be a higher weighted average cost of capital.

Conversely, it can be argued that a convertible bond will not have exactly the same cost of debt capital as an equivalent amount of straight debt because the conversion privilege causes

potential dilution which could affect the cost of equity capital and, therefore, the marginal cost of debt capital.

The total cost of equity capital and the total market value of the shares of stock outstanding after conversion occurs will each remain unchanged regardless of how many new shares are issued. The capitalization rate for a particular stock is dependent upon such factors as the degree of risk involved and the amount of anticipated growth. Once the capitalization rate is determined, the number of shares outstanding will affect the earnings per share and, therefore, the price per share, but the total earnings, the total market value, and the overall cost of equity capital will not be affected by the total number of shares outstanding.

For example, assume that two identical companies, each with \$11,000 of earnings after tax, price-earnings ratios of 10 (capitalization ratios of 10%), and zero debt have recently had convertible bonds converted into common stock. Company A now has 11,000 shares of stock outstanding, while Company B has 12,222 shares of stock outstanding. It can be seen in the example following that the total market value and cost of capital for these firms are identical.

	Company A	Company B
Shares outstanding	11,000	12,222
Total earnings	\$11,000	\$11,000
Future E.P.S.	\$1	\$.90
Price/Earnings	10	10
Price per share	\$10	\$9
Total market value of shares	\$110,000	\$110,000
Equity cost of capital	10%	10%

Although the conversion ratio does not affect the overall cost of capital after conversion, it does affect the distribution of equity between the new and old shareholders. From the point of view of the shareholders before the convertibles are issued, a lower conversion ratio gives them a greater percentage of the total equity capital after conversion occurs. If, for example, a company with 9000 shares of common stock outstanding issues 50 convertible bonds with a conversion ratio of 20, then after conversion occurs there will be 10,000 shares of stock, 90% of which belongs to the pre-convertible shareholders. However, if the conversion ratio is 16 then after conversion occurs there will be 9800 shares of stock outstanding, 91.8% of which belongs to the pre-convertible shareholders.

It is relatively easy to view the convertible bond as debt until conversion occurs and then as common stock, and in this way measure the cost of capital for the convertible debenture. However, as a hybrid security it is questionable if this is truly an accurate measurement of the cost of capital for a convertible bond. Actually, the cost of capital for any security is really the annual dollars that the security holder has a claim against minus any tax savings that may accrue to the company, divided by the funds raised by the corporation from the issuance of that security, or in the case of equity capital, the funds that could be raised at the prevailing market price. It is an extremely difficult task to determine accurately what is the true cost of capital for a convertible bond because both the numerator and denominator in the equation

discussed above cannot be readily measured for three reasons. First, the convertible bondholder receives interest payments until the time of conversion and after that time receives earnings that are available to common shareholders. Second, there is a tax savings from the security only until conversion occurs. Finally, the denominator used in a cost of capital analysis will change significantly when conversion occurs. This is an area which deserves further research and could be the topic of some future study. However, this question does not have a direct bearing upon the objectives or results that are included in this study, because the study is examining the optimum interest rate and conversion ratio that will maximize the earnings per share of common stock and, therefore, its value per share; and the study is not primarily concerned with the absolute cost of capital.

#### Conversion ratios and interest rates

When a corporation issues convertible bonds, there are 7 key determinants of the investor's return on investment which must be considered:

1. The issue price of the bond.
2. The final value of the bond when it matures, is converted, or is called by the corporation.
3. The market price of the common stock.
4. The expected growth rate of the price of the stock.
5. The conversion price and ratio.
6. The interest rate.
7. The effective tax rate.

Only two of these factors can be directly controlled by the financial manager in such a way as to affect the cost of

capital of the corporation. The conversion ratio and the interest rate can be controlled by trading them off against one another.

If a company is willing to pay a relatively high interest rate then it can set a relatively high conversion price. The investor receives his return on investment as a combination of the interest and capital gains which he receives. And he will accept a lower rate of interest if he can have the potential for a higher capital gain, or he will accept a higher interest rate with less potential for a capital gain.

The relationship between the interest rate and the conversion price is shown in Figure 1 below. The vertical axis measures what the interest rate would be on a straight debt issue of equivalent quality as compared to the coupon rate on the convertible issue. The horizontal axis gives the ratio of the conversion price to the initial market price of the stock. The minimum figure on each axis is 1.0 because: (a) the convertible interest yield can never exceed the yield on straight debt of equivalent risk (If it did, this would indicate that the value of the option to convert was negative.), and that (b) the conversion price is rarely set below the stock's market price at the time the bonds are issued.<sup>5</sup>

---

<sup>5</sup>J. Fred Weston and Eugene F. Brigham, "Some Theoretical Aspects of Convertible Securities," in Readings: Essentials of Managerial Finance by E. F. Brigham and R. B. Ricks (Holt, Rinehart, Winston, Inc., New York, 1968), p. 385.

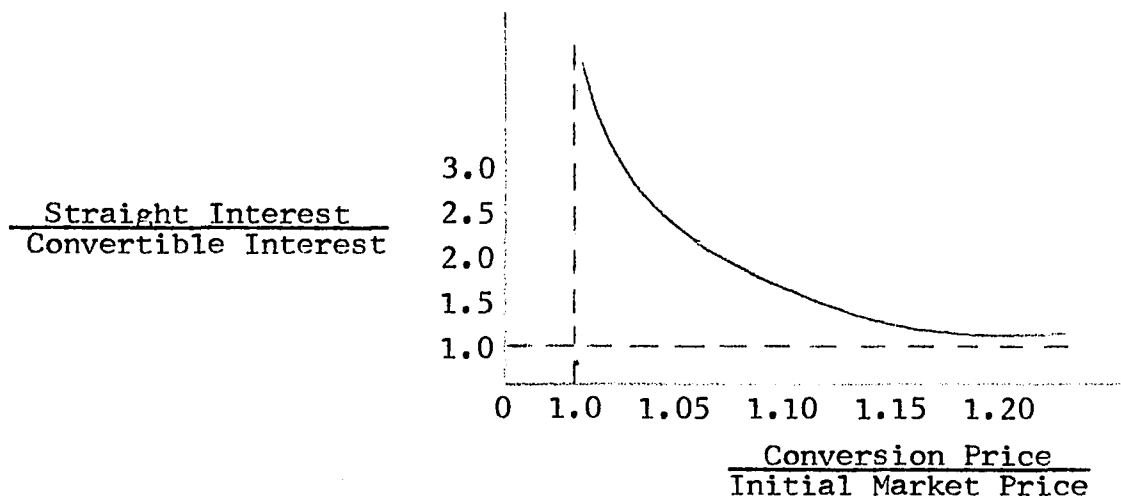


Fig. 1.--Interest rate/conversion price trade-off curve.

As one moves higher up on the vertical axis, the interest rate on the convertible becomes lower, and the investor is more dependent on the capital gain aspect of the convertible. Since the risk associated with this segment of the investor's return is relatively high, he may desire a higher net return on investment because a greater percentage of his return comes from the high risk conversion factor.

#### The Problem

When a corporation issues convertible bonds, the market will be willing to accept various combinations of interest rates and corresponding conversion ratios on the bond. However, the corporation must attempt to choose the optimum interest rate and corresponding conversion ratio that will optimize the pot-

sition of the pre-convertible shareholder. Whichever combination is chosen will effect the interest expense and, therefore, the total earnings and earnings per share until conversion occurs, and then it will control the amount of common stock dilution that occurs when the bonds are converted. The problem of choosing the optimum combination of interest rate and conversion ratio is complicated by the fact that the trade-off between these two variables is not constant, but instead varies both over time and with the quality of the convertible debenture. Due to the importance of choosing the optimum combination, it would seem that corporate financial managers would have formulated a systematic method of selecting the optimum combination, yet almost all of the research done in this area points toward the opposite conclusion. Weston and Brigham sent a questionnaire to all 42 of the companies which had sold convertible bonds in 1961, 1962, or 1963, and whose common stocks were listed on the New York Stock Exchange.<sup>6</sup> Of these 42 companies, 22 responded to the questionnaire and all of these were rated between A and B by Standard and Poor's; 67 percent were rated B or BB. One of the questions asked, "What opportunities did you have for trade-offs between conversion prices and bond interest rates."<sup>7</sup>

---

<sup>6</sup>Ibid. p. 385.

<sup>7</sup>Eugene F. Brigham, "An Analysis of Convertible Debentures: Theory and Some Empirical Evidence," Journal of Finance, XXI (March 1966) pp. 35-54.

	<u>Conversion Price</u>	<u>% Rate</u>
Actual	_____	_____
Available	_____	_____
Available	_____	_____
Available	_____	_____
Available	_____	_____

Only five companies responded to this question, which did not even go so far as to ask how did the corporation determine which combination was optimum. It merely asked what combinations were available and yet over 77 percent of the respondents failed to answer this question.

In a preliminary survey taken specifically for this paper a questionnaire was sent to 16 corporations having convertible bonds listed on the N.Y.S.E.<sup>8</sup>

Two of the questions are shown below:

1) At various interest rates ranging from  $\frac{1}{4}$  percent to  $1\frac{1}{2}$  percent higher and lower than the rate actually used, what do you estimate that the conversion price would have been?

<u>Higher Interest Rate</u>	<u>Conversion Price</u>	<u>Lower Interest Rate</u>	<u>Conversion Price</u>
$\frac{1}{4}$		$\frac{1}{2}$	
$\frac{1}{2}$		$\frac{1}{2}$	
$\frac{3}{4}$		$\frac{3}{4}$	
1 -		1 -	
$1\frac{1}{4}$		$1\frac{1}{4}$	
$1\frac{1}{2}$		$1\frac{1}{2}$	

2) The coupon interest rate and the conversion price can be traded-off against each other. How did your company arrive at the conversion price and corresponding interest rate that

---

<sup>8</sup>Questionnaire on convertible debentures, Fall 1968. pp. 1-4.

you deemed to be optimum?

Of the four financial managers who responded to the questionnaire, only one of them answered these two questions and even in that instance the response to the second question was qualitative and indirect.

The idea that corporate executives do not have a logical and systematic method of choosing the optimum interest rate and conversion ratio when their corporation issues convertible bonds was given further support by Lewis Weston who states that in reality, the overwhelming majority of corporations issuing convertible bonds do not calculate the anticipated cost of capital, earnings per share, or estimated long-run benefits to stockholders. Instead, convertible bonds are considered to be merely an expedient means of selling common stock at a premium above the market price; the conversion ratio is set as low as the market will allow, and the coupon interest rate is treated as a residual figure.<sup>9</sup>

These corporations consider interest rates primarily for public relations purposes. If a company in a given industry has convertible bonds outstanding with a 5 percent coupon interest rate and another company in that same industry is going to issue convertible bonds, the second firm may not want to pay more than 5 percent because this would hurt its image and

---

<sup>9</sup>Lewis Weston of Goldman Sachs & Co., in a personal interview on January 3, 1969, estimated that over 90% of all convertible bonds are issued as a means of selling equity at a premium and that interest rates on these bonds are treated as a residual value.

could lead the public to believe that it is not as secure as it competitor.<sup>10</sup>

It is obviously necessary for a corporation to have a method of choosing the optimum interest rate and corresponding conversion ratio when it issues convertible bonds. It appears, however, that a systematic method of selecting the optimum combination that will give the maximum benefit to the shareholders at the date of issue does not exist.

#### Objectives of the Study

In addition to analyzing thoroughly the problems facing a corporation in attempting to choose the optimum interest rate and corresponding conversion ratio when a convertible bond is issued, there are three specific objectives which this paper will attempt to accomplish.

First, it will be necessary to determine whether a model can be developed which can be utilized in the selection of the optimum interest rate and corresponding conversion ratio for a given company issuing convertible bonds at a given point in time.

Ideally, the second objective should be to determine whether convertible bonds issued in current and future time frames will have sub-optimum interest rate/conversion ratio combinations if the model developed in the diessertation is not utilized. Since this is impossible, an attempt will be made to determine whether any of the convertible bonds that are

---

<sup>10</sup>Idem.

currently outstanding have interest rate/conversion ratio combinations which are sub-optimum. If any sub-optimization currently exists and is expected to continue to exist if the model developed in the dissertation is not utilized, then it appears that the development of the model is a meaningful contribution to the field.

In order to evaluate the convertible bonds that will be studied in this paper, it will be necessary to determine what trade-off opportunity existed between the interest rate and conversion ratio for each bond when it was issued. The percentage increase in the conversion price that will occur for every one percent that a company is willing to increase its interest rate when it issues convertible bonds is its trade-off opportunity. The third objective of the dissertation is to determine if any relevant characteristics are revealed from the trade-off data generated from the case studies conducted in this paper which would suggest the desirability of a future comprehensive study in that specific area.

One possible characteristic is that for a higher rated bond the percentage increase in the conversion price, for every one percent that a company is willing to raise its interest rate will be more than that of a lower rated bond. A second possible characteristic is that for convertible bonds issued in recent years the percentage increase in the conversion price for every one percent increase in the interest rate will be more than a bond of equivalent quality issued in the late 1950's or early 1960's.

### Methodology

All of the convertible bonds<sup>11</sup> listed on the N.Y.S.E. on March 1, 1970 that were rated B, BB, or BBB and were issued without the use of a rights offering in the years 1959 through 1966 were each analyzed in the paper.

Attempts were made to determine what trade-off potential existed for each convertible bond given its quality rating<sup>12</sup> and date of issue, and then to select the specific interest rate and conversion ratio that would be the optimum combination for each company. In the case of some companies there were less than three other convertible bonds of the same quality rating outstanding at the date of issue and selling in the \$850-\$1,150 price range; in these cases the bond in question was eliminated due to a lack of sufficient data with which to determine the potential trade-off between the interest rate and conversion ratio. Only bonds issue since 1959 were considered because prior to that date it was very rare that there were sufficient data available to establish an accurate trade-off percentage. The rationale for selecting bonds that were issued prior to 1967 is that the most accurate method of determining what the future return on assets will be for a given corporation that issued convertible bonds, is to wait and see what the actual return on assets are for the three

---

<sup>11</sup>Corporate Financing, (Investment Dealers' Digest, 1951-1960, 1961-1963, 1964-1966).

<sup>12</sup>Quality ratings were based on the evaluations of Standard and Poor's Bond Guide.

years after the bonds were issued. Only bonds rated from B to triple-B were included because there were not enough convertible bonds rated above BBB or below B to be able to make meaningful comparisons in these areas.<sup>13</sup>

Only bonds issued without the use of a rights offering were included in the dissertation because if a corporation sold convertible bonds through the use of a rights offering, then the common shareholders had the opportunity to buy the bonds. Since the same investors own both the stocks and bonds of the corporation it is unnecessary to attempt to maximize the wealth of the stockholders at the expense of the bondholders.

Bonds that were outstanding on March 1, 1970 were analyzed in the dissertation in order to satisfy one of the objectives of the paper which is to determine whether financial managers are able to select optimum interest rate/conversion ratio combinations. As was previously mentioned, the dissertation ideally would examine bonds issued in current and future time frames to determine whether any sub-optimization would exist among these bonds because if any sub-optimization does exist in these cases, then it certainly appears that at this point in time corporate financial managers do not have an accurate, systematic method of selecting the optimum interest rate and conversion ratio when a convertible bond is issued. Since it is obviously impossible to analyze bonds which are currently being issued or which have not yet been issued, the best alternative appears to be to conduct case

---

<sup>13</sup>There were very few bonds rated above BBB because most convertible bonds are subordinated, and subordinated bonds are assigned lower quality ratings than non-subordinated bonds in the same company.

studies of all the bonds currently (March 1, 1970) outstanding on the N.Y.S.E. The fact that a convertible bond is currently outstanding tends to be an indication that the current financial managers of that corporation believe that its interest rate/conversion ratio combination is acceptable, because if they believed that the interest rate was excessively high, they could probably have called the bond and/or forced conversion at some point in the late 1960's.<sup>14</sup> If a bond was originally issued with a sub-optimum combination but was called and is no longer outstanding then it is not possible to conclude that its current financial managers do not have a method of choosing the optimum combination. Although there were over 200 convertible bonds listed on the N.Y.S.E. on March 1, 1970 a great many of these bonds were issued with the use of a rights offering and many others were issued in 1967, 1968, 1969 or 1970. A total of 23 convertible bonds met the standards established in this dissertation and each of these cases will be individually analyzed.

The trade-off potential for each bond at its date of issue will be calculated. Then a series of optimum interest rates and corresponding conversion ratios will be established for each company in order to correspond with a series of potential conversion dates. The first of the dates will be five

---

<sup>14</sup>When sub-optimization does occur, it has been predicted that it often occurs due to an excessively high interest rate.

years from the date of issue, and subsequent dates will be at successive five year intervals until the maturity date of the bond.

By comparing the optimum interest rates and conversion ratios as derived from the model presented in this study against those actually used by the corporations, it will be possible to achieve the previously discussed objectives of the dissertation.

## CHAPTER II

DEVELOPING A MODEL THAT CAN SELECT THE OPTIMUM INTEREST RATE/  
CONVERSION RATIO COMBINATION

## The Value of a Convertible Bond

The minimum market value that a convertible bond can assume is the higher of the straight debt value of the bond and its conversion value. The straight debt value of the bond is its value without the conversion feature, while the conversion value is the conversion ratio times the current market price of the company's common stock. This relationship is shown in Figure 2.<sup>1</sup>

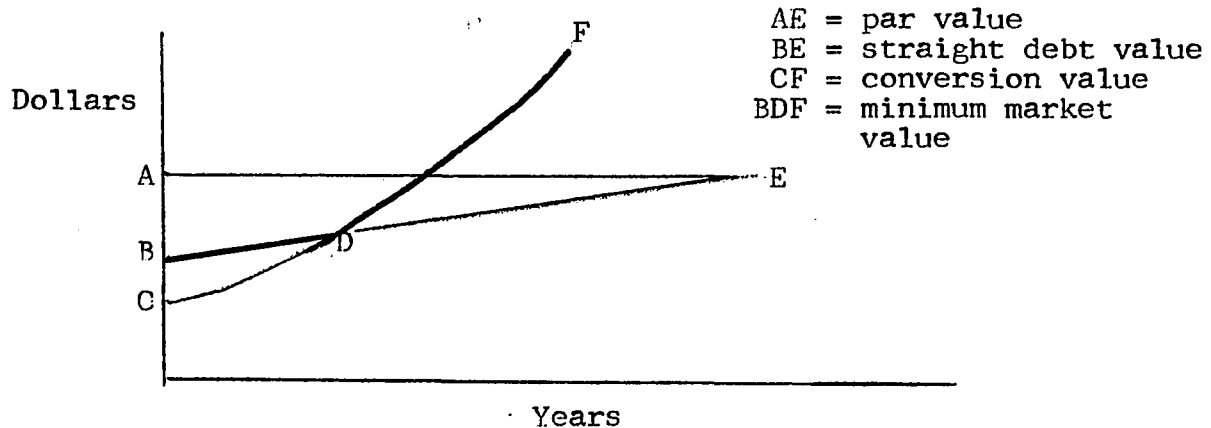


Fig. 2.--The value of a convertible bond

<sup>1</sup>J. Fred Weston and Eugene F. Brigham, "Some Theoretical Aspects of Convertible Securities," in Readings: Essentials of Managerial Finance by E. F. Brigham and R. B. Ricks, (Holt, Rinehart and Winston, Inc., New York, 1968) p. 378.

If the bond possessed a higher interest rate and a lower conversion ratio, then it would have a higher straight debt value and a lower conversion value at all points in Figure 2. Conversely, if the bond possessed a lower interest rate and a higher conversion ratio, then it would have a lower straight debt value and a higher conversion value at all points in Figure 2. This fact becomes clear if one examines how the values in the chart were derived. The straight debt value of the bond could be determined by the following equation:<sup>2</sup>

$$B_t = \sum_{k=1}^{(T-t)} \frac{I}{(1+i)^k} + \frac{M}{(1+i)^{(T-t)}}$$

where:

- Bt = convertible bond's value as a straight debt instrument at time t
- T = original term to maturity
- i = market rate of interest on straight bonds of equivalent risk
- I = dollars of interest paid each year
- M = bond's redemption value at maturity.
- t = number of years that have elapsed since the issuance of the bond
- If  $I = i M$ , then  $B_t = M$ , but if  $I < i M$ , as is typically true, then  $B_t < M$  prior to the maturity date.

This equation is simply stating that the current value of a bond is equivalent to the present value of all future interest payments plus the present value of the maturity

---

<sup>2</sup>Ibid. p. 379.

price discounted at the market rate of interest for debt issues of equivalent risk. If the interest rate,  $I$ , paid on the convertible were lower than the interest rate on straight debt of equivalent risk, then the bond price  $B_t$  would decline below the par value  $M$ .

Assuming a constant growth rate for the company's common stock, then the conversion value line in Figure 2 could be derived through the use of the following equation.<sup>3</sup>

$$C_t = P_o (1 + g)^t R$$

where:

- $C_t$  = conversion value at time  $t$
- $P_o$  = initial price of the common stock when the bond was issued
- $g$  = growth rate of the stock's price
- $R$  = conversion ratio

If the conversion ratio  $R$  would rise or decline, then  $C_t$  would also rise or decline.

The conversion value and the straight debt value combine to form a minimum market value for the convertible bond. Logically, the bond should not sell for less than its straight debt value, and if it should fall below the conversion value, then arbitrageurs would enter the market, short the stock, and cover their short positions by buying and converting the bonds. This process would continue until the market price of the bond is driven up to its conversion value.

Although the actual price of the convertible can never fall below the floor established by the conversion value and

---

<sup>3</sup>Ibid. p. 382.

straight debt value, it can be, and often is at a value somewhat above this floor. Let:

AP = actual price of the convertible  
 CV = conversion value  
     = conversion ratio times market price of common stock  
 SD = straight debt value of the convertible

then:

$AP \geq CV$       and       $AP \geq SD$   
 $F_1$  = minimum price floor = CV or SD whichever is greater

The spread between the actual price of the convertible bond and the minimum price ( $AP - F_1$ ) is the premium that the investor is willing to pay in order to get both the capital gain potential of common stock and the safety of straight debt in one security, namely, a convertible bond. When the stock price is depressed and the value of the convertible is supported by the straight debt, the premium exists because if the stock price rises, ultimately the convertible bond will rise and a potential capital gain exists which does not exist on straight debt. On the other hand, when the conversion value is higher than the straight debt value, the convertible bond will still sell at a premium because the straight debt value limits the potential loss of the convertible bond holder. As the conversion value rises higher and higher above the straight debt value, then the premium becomes smaller because the protection against loss is not as great. For example, assume that a convertible bond has a straight debt value of \$900 and a conversion ratio of 25. If the common stock were selling at \$40, then the conversion value equals \$1,000, and since the straight debt value is \$900 the maximum loss is 10 percent. Therefore, this bond might sell at a comparatively high premium. However, if the price of the stock rose to \$80, then the conversion value would

be \$2,000, and since the straight debt value is \$900, the convertible bond could decline 55 percent. The straight bond value, therefore, is not offering very much protection, and the premium would probably be quite small or non-existent.<sup>4</sup>

When does conversion occur?

In the survey by Weston and Brigham which was described in Chapter I, one of the questions asked, "When a firm sells convertible bonds it does so for one of two primary reasons: 1) it wants equity capital and believes that convertibles are an expedient means of selling common stocks, or 2) it desires debt but finds that by adding the convertible feature interest costs are reduced substantially."<sup>5</sup> Of the firms replying to the questionnaire, 73 percent were primarily interested in obtaining equity, while 27 percent used convertibles to sweeten debt issues.

This would indicate that 73 percent of these companies would like to encourage conversion in a relatively short period of time, while the other 27 percent of the corporations would prefer to delay conversion until maturity.

Williams<sup>6</sup> developed a model to determine when the holder of a convertible bond will convert it into common stock.

---

<sup>4</sup>R. L. Weil, "Premium on Convertible Bonds," Journal of Finance, XXII (June, 1968), p. 37.

<sup>5</sup>J. Fred Weston and Eugene F. Brigham, Managerial Finance (Holt, Rinehart and Winston, New York, 1969) p. 681.

<sup>6</sup>John B. Williams, The Theory of Investment Value, (Harvard University Press, Cambridge Mass. 1938), pp. 172-185.

Williams accepts the fact that when the bond matures it will be converted if the conversion ratio times the market price of the common stock is greater than the maturity value. He then attempts to show under what conditions the bond will be converted before maturity. He also makes an implicit assumption that the bonds are not callable or if they are, that the corporation will not force conversion by calling the bonds.

Williams compares the yield that the investor would receive by holding the bond as opposed to the return he will get if he converts his bond into stock.<sup>7</sup> He lets  $Y_b = \frac{B}{M_b}$

where:

$Y_b$  = income yield on the bond

$B$  = bond coupon per annum

$M_b$  = market price of the bond

If the bond is perpetual with a perpetual conversion privilege on a one-share for one-bond basis, the bondholder may exchange his coupon annuity  $\sum_{t=1}^{t=\infty} B$  for a dividend annuity  $\sum_{t=1}^{\infty} \pi_t$  at his pleasure. The consideration of a perpetual bond merely simplifies the expression for the bond which in reality could be treated as a series of coupon payments with a lump payment at maturity expressed as follows:<sup>8</sup>

$$V_0 = \sum_{t=1}^n \frac{C}{1+i} V^t + CV^n$$

where:  $V_0$  = present value of the bond  
 $n$  = interest periods to maturity  
 $C$  = principal of the bond  
 $V$  =  $\frac{1}{1+i}$

---

<sup>7</sup> Idem.

<sup>8</sup> Idem.

$\pi_b$  = worth of each coupon

Going back to the perpetual bond, conversion is justified whenever the common dividend exceeds the bond coupon by an amount great enough to compensate the investor for the increased risk he incurs if he converts.

Williams creates a situation in which a convertible bond and the stock into which it is convertible are each of \$100 par, conversion is on a one-stock for one-bond basis, and the number of bonds outstanding are equal to the number of shares of stock outstanding.

If  $\pi$  is the dividend which could be paid if no bonds were outstanding,  $\pi_b$  is the coupon interest rate paid on the bonds until conversion takes place, and  $\pi_c$  equals the dividends to actually be paid on the stock, then:

$$\begin{array}{l} \pi = \pi_b + \pi_c \quad \text{or } \pi_c = \pi - \pi_b \\ \pi = \pi_b + \pi_c \quad \text{or } \pi_c = \pi - \pi_b \end{array}$$

B =

Then, prior to the time of conversion designated  $t \leq n$ ,  $\pi_b = B =$  a constant. After  $t > n$ ,  $\pi_b = \pi_c = \frac{1}{2}\pi$ .

When  $\frac{1}{2}\pi$  exceeds  $\pi_b$  by an amount which is sufficient to to the fact that he owns common stock rather than a convertible bond, then he will convert.<sup>9</sup>

Williams assumes the true value of a bond or stock is the present value of all future inflows generated from this security discounted for risk.

In reality, conversion may be expected to occur under

---

<sup>9</sup> Idem.

any of the following conditions:<sup>10</sup>

1. The dividend yield on the common stock that could be received in conversion is higher than the interest yield on the bonds by an amount great enough to compensate the investor for the additional risk that he incurs with conversion.

2. The issue is called at a time when the conversion privilege has enough value to warrant conversion by the holder.

3. The conversion privilege is about to expire, and it has enough value to warrant conversion by the holder.

4. The action of arbitrage will cause some bonds to be converted if the bond price falls below its conversion value.

Most conversion occurs either when the bond is about to expire or when the corporation encourages conversion either by calling the bond or by raising dividends on the stock. Therefore, until the bond expires the corporation often has the option of letting the bond remain as debt or having it converted to stock.

#### Proposed Model for Determining the Optimum Interest Rate and Corresponding Conversion Ratio

When a corporation issues convertible bonds, it should select which interest rate and corresponding conversion ratio will optimize the position of its current stockholders. The optimum combination can be predicted from a model which will be developed based on the following assumptions:

---

<sup>10</sup>Jensen, op. cit. pp. 11-14.

1. The company's goal is to optimize the position of the preconvertible shareholder.

2. The company will reinvest all earnings resulting from the capital raised from the sale of the convertible bonds until conversion occurs. (The model would be effective whether or not this assumption is true; however, this assumption facilitates the building of the model.)

3. The company can forecast its return on assets and the conversion date on its convertible bond. (The conversion date may be difficult to forecast and allowances are made for this in the model.)

4. The convertible bonds are ultimately converted.

5. If a company maximizes its earnings per share without increasing its risk, then it will increase the price per share of its common stock, because the price of the stock is equal to the present value of net future earnings discounted for risk. (Which is roughly equivalent to the present value of all future dividends.)

The logic can be demonstrated in the following example:

xyz Company

Shares of common stock outstanding	1,000
Book values of assets	\$10,000
Debt	-0-
Return on assets (after taxes)	10%
Earnings	\$1,000
Earnings per share	\$1
Price-earnings ratio	10
Market price	\$10
Dividends per share	\$1

The company wishes to maintain dividends at \$1 per share.

It will sell one \$1,000 convertible bond which will be converted in 10 years.

Alternative 1: 5% convertible bond with a conversion ratio of 43.2 and a conversion price of \$23.15.

Alternative 2: 6% convertible bond with a conversion ratio of 40 and a conversion price of \$25.

Assumes a 50% tax rate.

\$1,000 invested at 10% for 10 years minus \$25 per year (after-tax cost of 5% bond) = \$2,198 compounded annually.  
 \$1,000 invested at 10% for 10 years minus \$30 per year (after-tax cost of 6% bond) = \$2,116 compounded annually.

Alternative 1:

Additional assets which the firm will have in 10 years from the sale of 5% convertible bond	\$2,198.00
Original assets of company	<u>10,000.00</u>
Total Assets	\$12,198.00
Annual earnings at 10%	\$1,219.80
Shares outstanding	1043.2
Earnings per share	\$1.170

Alternative 2:

Additional assets which the firm will have in 10 years from the sale of 6% convertible bond	\$2,116.00
Original assets of company	<u>10,000.00</u>
Total assets	\$12,116.00
Annual earnings at 10%	\$1,211.60
Shares outstanding	1040
Earnings per share	\$1.165

In this instance the superior alternative will increase the earnings per share and presumably the price per share by .43 percent. Under different circumstances earnings per share can be affected by as much as two, five, or ten percent if the interest rate and conversion ratio are improperly chosen.

This hypothesis can be condensed into the following model:

$$\text{Earnings per share} = \frac{x + y (1 + r - (i-t))^n}{s + b} \cdot r \quad (\text{Equation \#1})$$

$$= \frac{x + y (1 + r - i + t)^n}{s + b} \cdot r \quad (\text{Equation \#2})$$

The problem is to determine what value of  $b$  and corresponding value of  $i$  maximizes EPS. Where

- $x$  = initial assets owned by the company
- $y$  = price of the bond times the number of bonds
- $r$  = anticipated return on assets
- $n$  = years to conversion
- $s$  = number of shares of common stock initially outstanding
- $b$  = additional shares from conversion (conversion ratio times the number of bonds)
- $i$  = coupon interest rate
- $t$  = annual tax savings from interest payments expressed as a percentage of  $i$

For every value of  $b$  there is a corresponding value for  $i$  and  $t$ . The values of  $b$ ,  $i$  and  $t$  that maximize this equation are the optimum combination for the company. Using this model it is therefore possible to determine what conversion ratio and corresponding interest rate will optimize the position of the current stockholders.

#### Interest Rate - Conversion Ratio

In order to determine the optimum interest rate and corresponding conversion ratio for each corporation being studied, it is first necessary to find out what alternative combinations were available to this corporation at the time that it issued the convertibles. We know that the interest rate and conversion ratio actually used by the company was one available alternative, however, for every one quarter of one percent that the company could have raised or lowered its interest rate

it is necessary to determine how much lower or higher the conversion ratio would have had to be in order to have been acceptable to the market. This trade-off that the market is willing to accept is not a constant, but varies both with time and with the quality of the bond issue.

The two variables that must be isolated in determining what trade-off exists for a given convertible bond are the date of issue and the bond quality rating (i.e. BBB, BB).<sup>11</sup> Therefore, for each bond under consideration the date of issue and the quality rating were determined. Ideally, at this point we would take all of the other convertible bonds issued at the same time and with the same quality rating and then use a linear regression to determine what potential trade-off existed between the interest rate and the conversion ratio. However, due to the scarcity of convertible bonds, this procedure was impossible, as there were very rarely even two convertible bonds of the same quality rating issued in the same week or even the same month. Therefore, an alternative approach had to be developed which would make it possible to get an accurate account of the potential trade-off between the conversion ratio and interest rate. The following procedure was utilized to determine this information.

If a given BB rated bond was issued on June 23, 1966

---

<sup>11</sup>Quality ratings were based on the evaluations of Standard and Poor's Bond Guide.

with a 7 percent interest rate then all of the convertible bonds listed on the N.Y.S.E. on the date of issue, with a quality rating of BB and a market price no greater than \$1,150 and no less than \$850 and an interest rate of at least 4 percent, were taken as a universe for determining what trade-off exists between the interest rate and conversion ratio for that bond. Bonds in this price range give the investor the safety of a bond and the capital gain potential of stock, while a bond selling, for example, at \$1800 would not realistically give very much protection to the bondholder. Furthermore, if the current prevailing interest rate for a BB rated bond is 7 percent, then an outstanding BB rated bond with a coupon interest rate which is more than 3 percent less than the 7 percent would not provide sufficient protection for the bondholder. For each bond chosen in this universe it was then necessary to calculate:

1. the yield to maturity<sup>12</sup> and
2. the percentage decline that would be necessary in the conversion price in order to eliminate any premium that may exist on the bond. Then a linear regression analysis can be used to determine what effect a one percent rise or decline in the interest rate will have on the conversion price of a bond

---

<sup>12</sup>The tax benefits associated with a potential capital gain in the yield to maturity calculation will be ignored because many holders of convertibles are tax exempt (pension funds) or pay a minimum tax rate (life companies). In addition, individuals are in varying tax brackets so it would be unrealistic to try to consider this tax advantage. Furthermore, the bonds chosen were generally very close to par.

of the specific quality rating at the specified date for which the universe was defined.

The least squares model will be used to estimate the linear regression. This model can be expressed as

$$y = a + bx + u$$

where:  $x$  = the independent variable (interest yield)  
 $y$  = the dependent variable (premium)  
 $a$  = the intercept  
 $b$  = the slope (d value in the model)  
 $u$  = the random deviation of the observed  $y_i$  from the mean  $a + bx_i$

According to the least squares method, the best estimate of the linear regression is the one that minimizes the sum of the squares of the deviations of the observed values of the dependent variable from those predicted by the regression line.

This is accomplished when the following equation is minimized.

$$\sum_{i=1}^n e_i^2 = \sum_{i=1}^n (y_i - a - bx_i)^2 = \sum_{i=1}^n (y_i - y'_i)^2$$

$y_i$  = actual value  
 $y'_i$  = estimated value

When the best estimates of the regression coefficients have been found, the estimated values of the dependent variable may be found from the relation  $y_i = a + bx_i$

In order to use the least squares approach certain assumptions must be made. First, it must be assumed that there are only two variables  $x$  and  $y$  and there is a desire to investigate a linear relationship between them in the form  $y = a + bx + u$ , where  $a$  and  $b$  are unknown parameters called the

population regression coefficients, and  $u$  is an unknown random variable which is made necessary by the departure of  $y$  from an exact linear dependence on  $x$ . Second, it is assumed that the random components  $u_1$  have zero means and a constant variance  $\sigma^2$ . Furthermore, it is assumed that the observations  $x_1$  on the independent variable  $x$  are selected by the investigator and are fixed and have no sampling variation associated with them. Any sampling variations in the data are in the observations  $y_1$  on the dependent variable  $y$ .

The reciprocal of the  $d$  value, which is the actual change in the interest rate divided by the percentage change in the conversion price, represents the  $F$  value in the model developed in this paper. This value shows what potential trade-off was available between the interest rate and conversion ratio. Even after this trade-off is known, the choices available to the corporation are limited by the fact that the market will very rarely allow the company to set a conversion price which is more than 30 percent above the market price of the common stock at the date that the convertible bond is issued, and the company will be very reluctant to issue a convertible bond with a conversion price that is more than 10 percent below the market price of the common stock at the date of issue.

It can be assumed that if a number of convertible bonds of the same quality are all outstanding at a given point in time and the premium on each of these bonds is zero, where the conversion ratio times the market price of the stock for each

company exactly equals the price of the bond in question, then each of these bonds must give an equivalent interest yield. If the yield on one bond was higher than the others, then its conversion price would be higher by a certain percentage, and this would cause a premium. In order to eliminate the premium, the conversion price must decline by the exact percentage amount of the premium. An example of this is shown below.

	<u>Company 1</u>	<u>Company 2</u>
Bond Price	\$1000	\$1000
Common Price	\$20	\$20
Conversion Price	\$20	\$21
Conversion Ratio	50	47.619
Premium	0	4.762%
Yield	6%	7%

The premium in this example was calculated as follows:

$$\text{premium} = \frac{\text{Bond price} - (\text{common price}) (\text{conversion ratio})}{\text{Bond price}}$$

If Company 2 conversion price were reduced by 4.762 percent (premium), this would eliminate the premium but then this company would be able to offer a six percent yield which is equivalent to Company 1, since they are both of equivalent quality and both would be selling at a zero premium. As things exist in the example, however, Company 2 requires the investor to pay a premium of 4.762 percent, and for this the investor receives a one percent increase in his yield. The trade-off in the example, therefore, is 1.0 percent of yield against 4.762 percent of the conversion price.

One additional factor that had to be considered in establishing a trade-off by using currently outstanding convertibles was that new convertible bond issues of a given quality may have a slightly higher yield than an

existing issue of equivalent quality.<sup>13</sup> It is not at all certain whether or not this phenomenon would hold true for convertible bonds, but, fortunately, it would not effect the trade-off in any way because the trade-off is only concerned with the change that occurs in the conversion price, given a change in the interest rate and is not concerned with the absolute return to the investor. The concept that a new issue must offer a higher return is aimed at the absolute return to the investor, not at the potential trade-off that exists. Even if the investor in a new convertible demands a slightly higher return than if he invests in existing issues, he will still accept the return as a combination of the interest yield and capital gain aspect of the convertible and his trade-off opportunity schedule will not be changed. This relationship is shown in the chart below.

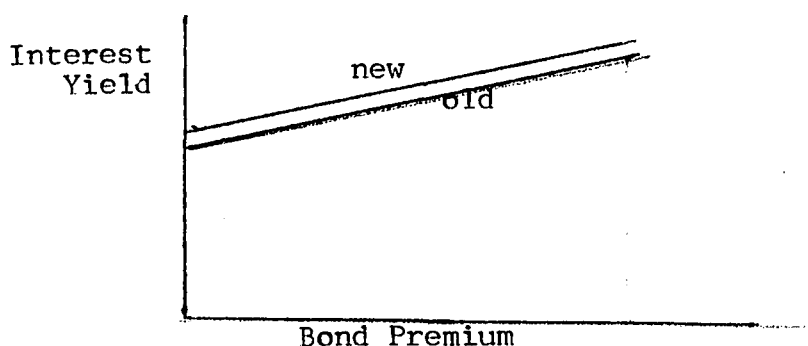


Fig. 3.--Interest yields on new and existing bonds

<sup>13</sup>Mortimer Kaplan, "Yields on Recently Issued Corporate Bonds; a New Index," Journal of Finance, XVII (March 1962), pp. 81-110.

Although the return to the investor is higher for the new bond, the slope of the lines are parallel, therefore, the trade-off opportunities are identical in both cases.

#### Solving the Equation

In equation (1) if  $n$  were held constant, then there are two variable factors,  $b$  and  $i$ . In order to facilitate the solution of this problem, it is necessary to eliminate one of these variables by expressing  $b$  in terms of  $i$ .

When each one of the corporations under study issued its convertible bonds, it established one set of values for  $b$  and  $i$ . It can be assumed that for the value of  $b$  in question, the value of  $i$  that was established was the minimum value that the corporation was able to negotiate.

Given the above assumption and given a proposed change in the conversion ratio (and, therefore, the conversion price), the new value of  $i$  can be computed from the following equation:

$$i = \frac{(cp - cp_1)}{cp_1} F + i_1 \quad \text{where} \quad (\text{Equation \#3})$$

$i$  = the new interest rate  
 $cp$  = the new conversion price  
 $i_1$  = the original interest rate set by the company  
 $cp_1$  = the original conversion price set by the firm  
 $F$  = the absolute change in the interest rate divided by the percentage change in the conversion price

Beginning with Equation #3 the following equations can be derived:

$$F cp = cp_1 (i - i_1) + cp_1 (F) \quad (\text{Equation \#4})$$

$$cp = \frac{cp_1 (i - i_1) + cp_1 (F)}{F} \quad (\text{Equation \#5})$$

F

This logic can be demonstrated in a relatively simple example by assuming that the initial value of  $cp_1$  is \$20 and the initial value for  $i_1$  is 5% and  $F$  is .125.

$$i = \frac{(cp - 20)}{20} .125 + .05$$

Further assume that the company wishes to raise its conversion price by 10 percent from \$20 to \$22. Then the new interest rate that must be paid in order to get the higher conversion price can be computed as shown below:

$$i = \frac{(22 - 20)}{20} (.125) + .05$$

$$i = (.10) (.125) + .05$$

$$i = .0625 = 6.25\%$$

Thus a rise of 10% in the conversion price resulted in a rise of 1.25% in the interest rate.

$$F = \frac{\text{Change in the interest rate}}{\% \text{Change in the conversion price}} = \frac{.0125}{.10} = \frac{.0025}{.02} = \frac{.25\%}{2.0\%} = .125$$

The conversion ratio ( $b$ ) equals the price of the bond ( $y$ ) divided by the conversion price ( $cp$ ).

$$b_1 = \frac{y}{cp_1} \quad (\text{Equation \#6}) \quad b = \frac{y}{cp} \quad (\text{Equation \#7})$$

$b_1$  = the conversion ratio established by the company  
 $b$  = the optimum (new) conversion ratio

It is possible, therefore, to express the new conversion ratio in terms of the new interest rate by algebraic substitution.

$$cp = \frac{cp_1 (i - i_1) + cp_1 (F)}{F} \quad (\text{Equation \#5})$$

$$\text{and } b = \frac{y}{cp} \quad (\text{Equation \# 7})$$

Therefore,

$$b = \frac{y}{\frac{cp_1 (i-i_1) + cp_1 (F)}{F}} \quad (\text{Equation \#8})$$

Now that  $b$  has been expressed in terms of  $i$ , it is possible to substitute into the original equation and remain with only one variable which when optimized will maximize the earnings per share of the given corporation.

$$\text{EPS} = \frac{x + y (1 + r - (i-t))^n}{s + b} (r) \quad (\text{Equation \#1})$$

and

$$b = \frac{y}{\frac{cp_1 (i-i_1) + cp_1 (F)}{F}} \quad (\text{Equation \#8})$$

Therefore,

$$\text{EPS} = \frac{x + y (1 + r - (i-t))^n}{\frac{S + y}{\frac{cp_1 (i-i_1) + cp_1 F}{F}}} (r) \quad (\text{Equation \#9})$$

This can be simplified to:

$$\text{EPS} = \frac{cp_1 xi - cp_1 xi_1 + cp_1 x(F) + cp_1 yi (1+r - i+t)^n}{\frac{-cp_1 yi_1 (1+r - i+t)^n + Fcp_1 y (1+r - i+t)^n}{scp_1 i - scp_1 i_1 + scp_1 F + Fy}} (r) \quad (\text{Equation \#10})$$

Let:  $A = cp_1 x$

$B = cp_1 y$

$D = cp_1 s$

$Q = (1 + r - i+t)^n$

Then:

$$\text{EPS} = \frac{(i-i_1 + F) (A + BQ)}{D (i-i_1 + F) + Fy} (r) \quad (\text{Equation \#11})$$

The only variable in the above equation is  $i$  (the optimum interest rate). This model must be solved to determine

what value of  $i$  will maximize EPS subject to the constraints that  $i$  cannot be greater than the straight interest rate that would have been paid if the bond were not convertible, and  $i$  cannot be so high that the conversion price would be more than 30% above the prevailing market price of the stock at the date of issue, nor be so low that the conversion price is more than 10% below the current market price at the date of issue. (The reasons for these limitations were discussed earlier).

Growth in the earnings per share for a given company will occur if that corporation can increase its assets per share. At the point in time when a company is issuing convertible bonds there are two specific ways in which they may expect to increase the assets per share. First, the assets presently owned by this corporation may generate earnings, and a portion of these earnings may be retained in the business, thereby increasing the assets of this company without increasing either the shares outstanding or the expenses of the company and, thus, increasing the earnings per share. The second method of increasing the assets per share is by setting the proper interest rate and conversion ratio for the convertible bonds so that the increased assets generated by the convertible will increase the earnings per share for that company.

The increase in assets and earnings per share as a result of the first method discussed above will occur whether or not the convertible bond is issued, and it does not affect

any of the variables in the model used in this paper. Therefore, this element of growth is a constant which does not affect the optimum interest rate or conversion ratio even though it is a major factor in insuring that conversion will occur.

#### Graphical Presentation

When a corporation issues convertible bonds with a given quality rating at a given point in time there are a series of alternative interest rate/conversion ratio combinations which it can choose. Operating within the previously discussed constraints the company must determine what interest rate/conversion ratio combination would maximize the wealth of its common stockholders by maximizing the long run earnings per share. The optimum combination will be determined for each of the convertible bonds analyzed in the dissertation by using the model that has been developed in the paper. However, it would be of further interest to view the problem graphically.

The alternative interest rate/conversion ratio combinations available to the firm are dependent upon the observed behavioral actions of the market. The corporation can chart the available alternative combinations that exist when it issues convertible bonds. These alternatives as they exist for the hypothetical xyz corporation are shown in Figure 4. Then, by going to the table for that company which has been derived from the model developed in this paper it is possible

to determine the earnings per share that will exist for each interest/rate conversion ratio combination at a given conversion date. For the xyz company the hypothetical interest rate/conversion ratio combinations, earnings per share for each combination, d and f values, common stock price and conversion prices are shown in Table 1.

The earnings per share as it will exist for each alternative interest rate is plotted in Figure 5. The interest rate that will yield the highest EPS is the optimum interest rate. Both Figures 4 and 5 are plotted on the same chart in Figure 6, with the interest rate on the vertical axes and with two horizontal axes, one representing the conversion ratio and the other representing the EPS. The interest rate that maximizes the EPS is the optimum interest rate (point m) and the conversion ratio that is associated with that interest rate is the optimum conversion ratio (point n).

TABLE 1.-- The effect of the interest rate and conversion ratio on the earnings per share

XYZ Corporation<sup>14</sup>

d = 10  
f = 10%  
market price of common = \$33

<u>Interest Rate</u>	<u>Conversion Price</u>	<u>Conversion Ratio</u>	<u>EPS</u>
3.00	30	33.3	\$2.010
3.25	31	32.3	2.022
3.50	32	31.3	2.034
3.75	33	30.3	2.046

<sup>14</sup>It is assumed that conversion occurs in "a" years.

<u>Interest Rate</u>	<u>Conversion Price</u>	<u>Conversion Ratio</u>	<u>EPS</u>
4.00	34	29.4	\$2.058
4.25	35	28.6	2.069
4.50	36	27.8	2.080
4.75	37	27.0	2.090
5.00	38	26.3	2.101
5.25	39	25.6	2.112
5.50	40	25.0	2.120
5.75	41	24.4	2.115
6.00	42	23.8	2.108
6.25	43	23.3	2.100

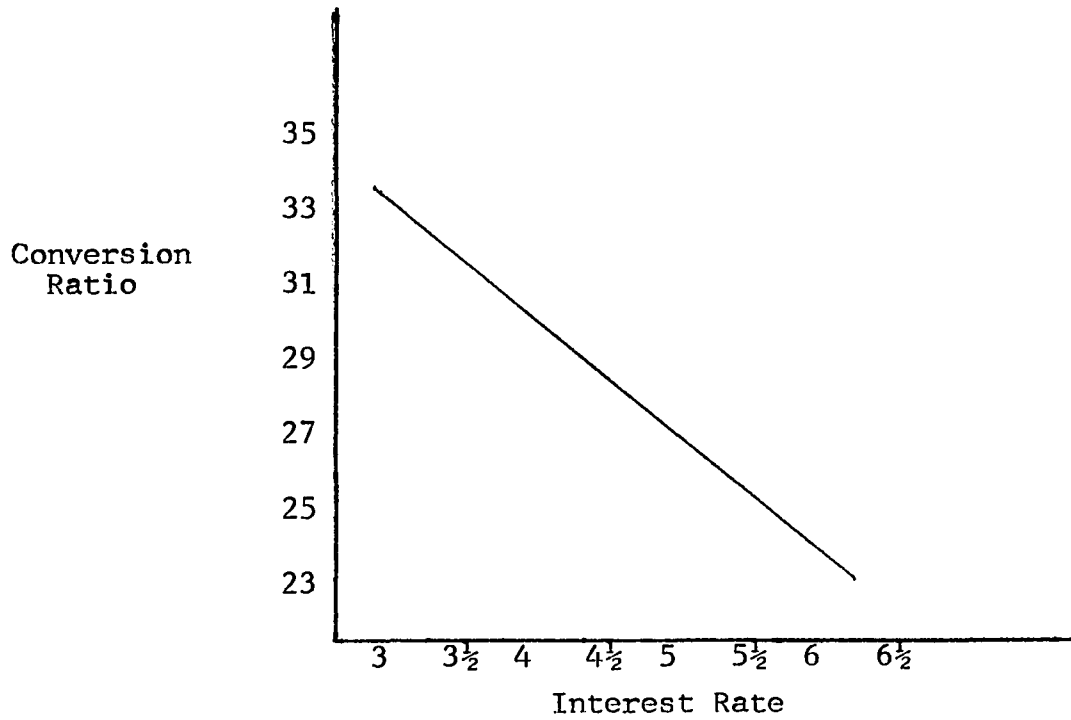


Fig. 4.--Interest rate/conversion ratio combinations acceptable to the market.

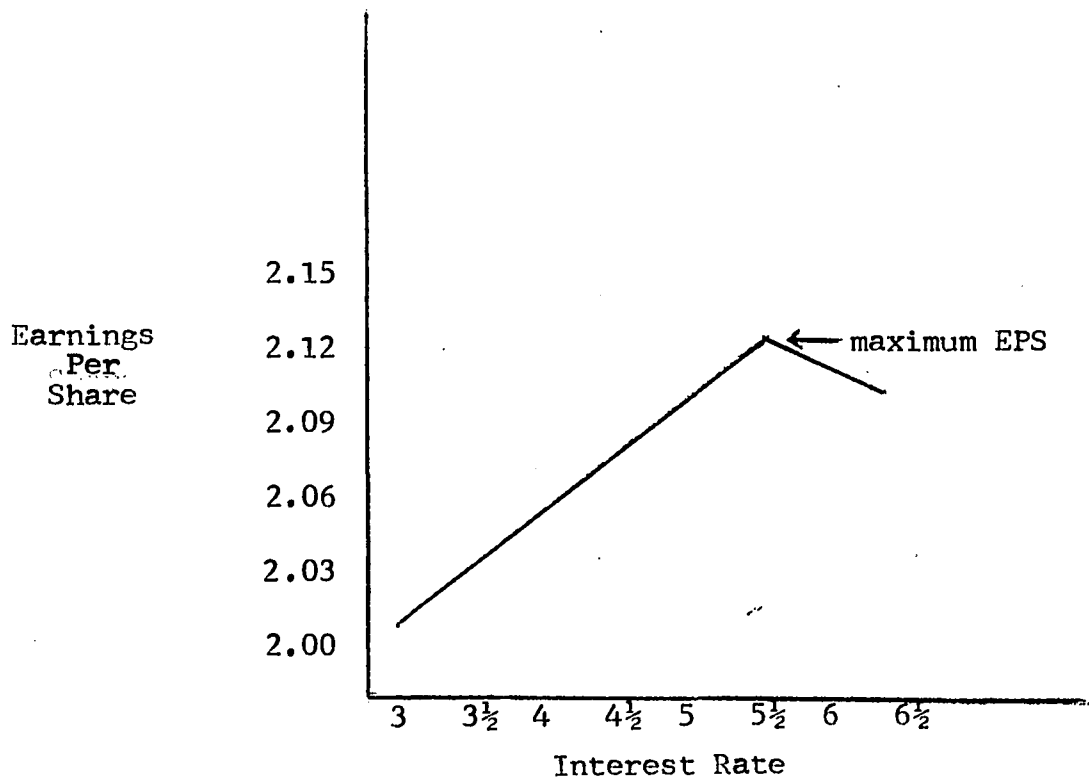


Fig. 5.--Earnings per share given alternative interest rates.

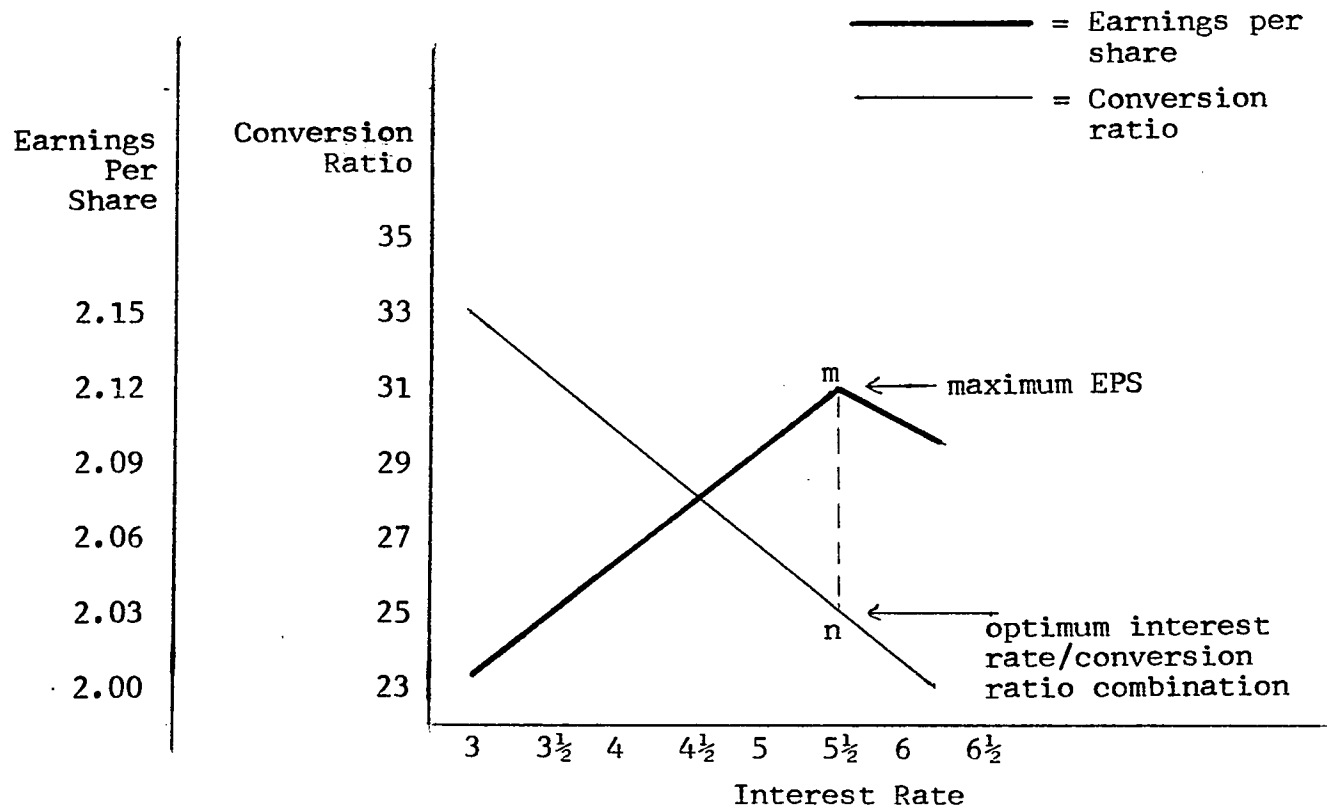


Fig. 6.--Graphical determination of the optimum interest/rate/conversion ratio combination.

## CHAPTER III

## EMPIRICAL RESEARCH AND ANALYSIS

## Defining Objectives

Present value theory

The main objective of the management of a corporation should be to maximize the wealth of its common shareholders.<sup>1</sup>

A model was developed in Chapter II of this paper that would enable a corporation issuing convertible bonds to maximize the long-term earnings per share and, consequently, dividends per share of its common stockholders without decreasing current dividends or increasing the element of risk associated with the stock. Maximizing the earnings and dividends per share in this manner will maximize the intrinsic value and ultimately the market value of the common stock. This conclusion is clear if one accepts the concept that the intrinsic value of a stock is the present value of all future dividends discounted for risk. Then if the long-term dividends increase and the risk remains constant, the value of the stock also increases. This theory was first discussed by Robert F. Wiese,<sup>2</sup> Samuel E. Guild,<sup>3</sup> and John B. Williams<sup>4</sup>

---

<sup>1</sup>Ezra Solomon, The Theory of Financial Management (Columbia University Press, New York, 1963), pp. 14-17.

<sup>2</sup>Robert F. Wiese, "Investing For True Value," Barron's (Sept. 8, 1930), p. 5.

<sup>3</sup>Samuel E. Guild, Stock Growth and Discount Tables (Financial Publishing Company, Boston, 1931), pp. 1-71.

<sup>4</sup>Williams, op. cit. pp. 1-89.

in the 1930's. In recent years it has been refined by Eugene M. Lerner and Willard T. Carleton<sup>5</sup> R. M. Soldofsky, and James T. Murphy,<sup>6</sup> W. Scott Bauman,<sup>7</sup> and Nicholas Molodovsky, Catherine May, and Sherman Chottiner.<sup>8</sup> Even those who criticize the present value theories of stock evaluation, such as David Durand<sup>9</sup> and Douglas A. Hayes,<sup>10</sup> are critical because they believe it is almost impossible to predict the long-run total profits and total risk associated with the stock of a particular corporation. However, if one act of a corporation - for example, setting the optimum interest rate and corresponding conversion ratio for a convertible bond - could increase the long-run earnings and dividends per share, then even these critics would probably agree that this act would increase the value of the stock. In the study it will be assumed that if the earnings and dividends per share are maximized without any increase in risk, then the price per share of the common

---

<sup>5</sup>Eugener M. Lerner and Willard T. Carleton, A Theory of Financial Analysis (Harcourt, Brace and World Inc., New York, 1966), pp. 10-11.

<sup>6</sup>R. M. Soldofsky and James T. Murphy, Growth Yields on Common Stocks: Theory and Tables (Bureau of Business and Economic Research, Iowa, 1964).

<sup>7</sup>W. Scott Bauman, Estimating the Present Value of Common Stocks by the Variable Rate Method, (Bureau of Business Research, Michigan).

<sup>8</sup>Nicholas Molodovsky, Catherine May, and Sherman Chottiner, "Common Stock Valuation: Theory and Tables," Financial Analysts Journal XXI (March-April 1965), pp. 104-112.

<sup>9</sup>David Durand, "State of the Finance Field: Further Comment," Journal of Finance XXII (December, 1968), p. 853.

<sup>10</sup>Douglas A. Hayes, "The Dimension of Analysis, A Critical Review," Financial Analysts Journal XXII (Sept-October, 1966), pp. 81-84.

stock and the wealth of the common shareholders will also be maximized.

#### Data collection and interpretation

For each of the 23 corporations analyzed in the study, all of the relevant data pertaining to the company and its convertible bonds at the date that the bonds were issued were collected.<sup>11</sup> These included the development of a trade-off opportunity schedule for each bond given its quality rating and date of issue. These schedules are developed in Chapter IV of the dissertation.

For each of the bonds analyzed, the model that was developed in Chapter II will be used to generate a series of optimum interest rates and corresponding conversion ratios in order to correspond with a series of potential conversion dates. The first of these dates will be five years from the date of issue, and subsequent dates will be at successive five-year intervals until the maturity date of the bonds.

The optimum interest rates and conversion ratios will be compared to those actually chosen by each company and an analysis will be made to determine to what degree the earnings per share for each company could have been increased at the successive alternative conversion dates if the optimum as opposed to the actual interest rate and conversion ratio were

---

<sup>11</sup>These data were collected from the reports on file with the Securities and Exchange Commission, Moody's Manual, the ISL Stock Price Index, and the Wall Street Journal Bond Quotations.

used.

Given the actual interest rate and conversion ratio chosen by each company, an analysis will be made to determine what number of years must elapse between the date that the bonds are issued and the date that they are converted, so that the actual combination will also be the optimum combination. In some cases the actual interest rate/conversion ratio combination can never be optimum regardless of when conversion occurs, and in these instances the company has clearly chosen a sub-optimum combination.

If given some time period,  $x$  years, between the date of issue and the date that conversion would have to occur in order to allow the actual combination to coincide with the optimum one, then one would expect that the company established the particular combination that it did because it expected conversion to occur  $x$  years from the date of issue. To carry the analysis a step further, if a company is expecting to have its convertible bonds converted in five years, then it is reasonable to assume that the company is primarily interested in raising equity capital when it sells its convertible bonds, because if it were primarily interested in raising debt capital, it would want to have conversion occur in 20 or 25 years. Therefore, if a company chooses an interest rate/conversion ratio combination that is optimum if conversion occurs in five years, but its management says they are pri-

marily interested in raising debt capital, it certainly appears that they have chosen a sub-optimum combination.

The model that was developed in Chapter II and will be used in the selection of the optimum interest rate/conversion ratio combination is:

$$EPS = \frac{(i - i_1 + F)(A + BQ)}{D(i - i_1 + F) + Fy} \quad (r)$$

where:  $A = cp_1 x$

$B = cp_1 y$

$D = cp_1 s$

$Q = (1 + r - i + t)^n$

$x$  = assets owned by the company at the date the convertible bonds are issued

$y$  = price of the bond times the number of bonds

$r$  = anticipated return on assets

$n$  = years to conversion

$b$  = additional shares from conversion  
(conversion ratio times the number of bonds)

$i$  = coupon interest rate

$t$  = annual tax savings from the interest payments  
expressed as a percentage of  $i$

$s$  = number of shares of common stock initially  
outstanding

$i_1$  = actual interest rate selected by the corporation

$cp_1$  = actual conversion price selected by the company

$F = \frac{\text{absolute change in the interest rate}}{\text{percentage change in the conversion price}}$

### Analysis of Each Convertible Bond

A total of 23 convertible bonds are studied in the dissertation. The relevant data for each of these bonds will be presented and analyzed on the following pages.<sup>12</sup>

#### AIR REDUCTION

Rated: BBB

Issued: 8-29-62

Actual interest rate  $i_1 = 3.875\%$

Actual conversion price  $cp_1 = \$62.50$

Common stock price at the date of issue = \$53.25

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i (Approx.)</u>
Common stock price	\$53.25	2.75%
Low (common - 10%)	\$47.93	2.25%
High (common + 30%)	\$69.22	4.75%

#### Data as of 8-29-62

$x = \$279,445,841$

$y = \$45,000,000$

$r = .06001$

$n = 5, 10, 15, 20, 25$

$s = 4,754,779$  shares

$b = 720,000$  shares

$F = .0706$

---

<sup>12</sup>The tables showing the actual effect of varying interest rate/conversion ratio combinations on the earnings per share are presented at the end of this chapter.

If the Air Reduction management intended to have its bonds converted five, ten, or fifteen years from the date of issue, then the interest rate/conversion price combination actually chosen was lower than the optimum combination, and this would sub-optimize the EPS by 1.1%, .7%, and .1% respectively in the aforementioned years. If the bonds were converted in 20 or 25 years, then the combination selected by the company is higher than the ones that would be optimum, and this would sub-optimize the EPS by .4% and 2.5% respectively. In fifteen years the actual combination is below the optimum and in 20 years it is above the optimum; therefore, the combination chosen by Air Reduction would be ideal if the bonds are converted at some point in time between 15 and 20 years from the date of issue.

AURORA PLASTICS (AURORA PRODUCTS)<sup>13</sup>

Rated: B

Issued: 10-17-65

Actual interest rate  $i_1 = 4.625\%$

Actual conversion price  $cp_1 = \$25.32$

Common stock price at the date of issue = \$25.50

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$25.50	4.75%
Low (common - 10%)	\$22.95	4.00%
High (common + 30%)	\$33.15	6.75%

<sup>13</sup> Aurora Plastics was the name of the company at the date of issue. Aurora Products is the current name for the same firm.

Data as of 10-17-65

$x = 10,573,151$

$y = 3,500,000$

$r = .08660$

$n = 5, 10, 15$

$s = 970,045 \text{ shares}$

$b = 138,229 \text{ shares}$

$F = .0690$

If Aurora Plastics' convertible bonds are converted in ten years, then the interest rate/conversion price combination actually selected by the company is also the optimum combination. However, if conversion occurs in five years, then the actual combination is lower than the optimum and this would sub-optimize the EPS by 1.4%. If the bonds are converted in fifteen years, then the actual combination is higher than the optimum and this would reduce EPS by .9%.

BOBBIE BROOKS

Rated: BB

Issued: 8-24-66

Actual interest rate  $i_1 = 5.25\%$ Actual conversion price  $cp_1 = \$37.50$ 

Common stock price at the date of issue = \$33.625

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$33.625	.0400%
Low (common - 10%)	\$30.263	.0300%
High (common + 30%)	\$43.711	.0725%

Data as of 8-24-66

x = \$59,141,105

y = \$10,000,000

r = .01837

n = 5, 10, 15

s = 3,377,775 shares

b = 266,670 shares

F = .1178

If the Bobbie Brooks convertible bonds are converted in ten years, then the interest rate and conversion price combination actually chosen by the company is also the optimum combination. If, however, conversion occurs in five years, then the optimum combination is higher than the actual one and this would sub-optimize the EPS by .3%. The actual combination is lower than the optimum one if conversion occurs in fifteen years and this reduces EPS by .6%.

## BURLINGTON INDUSTRIES

Rated: BBB

Issued: 9-13-66

Actual interest rate  $i_1 = 5.0\%$ Actual conversion price  $cp_1 = \$39.00$ 

Common stock price at the date of issue = \$32.375

Range of possible interest rate/conversion price combination

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$32.375	3.75%
Low (common - 10%)	\$29.138	3.00%
High (common + 30%)	\$42.087	5.75%

Data as of 9-13-66

$$x = \$942,625,116$$

$$y = \$40,000,000$$

$$r = .0747$$

$$n = 5, 10, 15, 20, 25$$

$$s = 25,047,707 \text{ shares}$$

$$b = 1,025,640 \text{ shares}$$

$$F = .0784$$

If the Burlington Industries' convertible bonds are converted in five or ten years, the actual interest rate/conversion price combination selected by the company is below the optimum combination and this would sub-optimize the EPS by .3% and .1% respectively. If conversion occurs in fifteen, twenty, or twenty-five years, the actual combination is higher than the optimum, and EPS will be sub-optimized by .03%, .8% and 2.0% respectively. The interest rate/conversion ratio combination chosen by Burlington Industries would be the optimum one if conversion was expected to occur at some point in time between ten and fifteen years from the date of issue.

## CHAMPION PAPER &amp; FIBRE (U.S. PLYWOOD-CHAMPION PAPER)

Rated: BB

Issued: 1-15-59

Actual interest rate  $i_1 = 4.50\%$ Actual conversion price  $cp_1 = \$46.083$ 

Common stock price at the date of issue = \$42.00

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$42.00	3.25%
Low (common - 10%)	\$37.80	2.00%
High (common + 30%)	\$54.60	7.00%

Data as of 1-15-59 $x = \$166,214,618$  $y = \$20,036,400$  $r = .05303$  $n = 5, 10, 15, 20, 25$  $s = 4,408,015$  shares $b = 434,890$  shares $F = .1399$ 

If the Champion Paper & Fibre convertibles are converted in ten years, then the interest rate/conversion price combination selected by the company is also the optimum combination. However, if the bonds are converted in five years, then the actual combination is lower than the optimum and this would sub-optimize the EPS by .7%. If conversion occurs in fifteen, twenty or twenty-five years, then the actual

combination is higher than the optimum ones, and the EPS would be sub-optimized by 1.1%, 2.7%, and 4.9% respectively.

As of March, 1970, eleven years have already elapsed since these bonds were issued; therefore, Champion has definitely chosen a sub-optimum combination.

COLLINS & AIKMAN

Rated: BB

Issued: 6-21-66

Actual interest rate  $i_1 = 4.625\%$

Actual conversion price  $cp_1 = \$31.00$

Common stock price at the date of issue =  $\$26\frac{1}{2}$

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$26.50	3.00%
Low (common - 10%)	\$23.85	2.00%
High (common + 30%)	\$34.45	6.00%

Data as of 6-21-66

$x = \$70,164,994$

$y = \$10,000,000$

$r = .10084$

$n = 5, 10, 15, 20, 25$

$s = 2,486,900$  shares

$b = 322,580$  shares

$F = .1164$

If the Collins & Aikman convertible bonds are converted in five years, then the actual interest rate/conversion price

selected by the company is below the optimum combination and this would sub-optimize the EPS by .7%. If conversion occurs in ten, fifteen, twenty or twenty-five years, then the actual combination is higher than the optimum ones and this would sub-optimize the EPS by .03%, 2.9%, 7.2%, and 13.9% respectively in the years listed above. The interest rate/conversion ratio combination chosen by Collins & Aikman would be the optimum one if conversion was expected to occur at some point in time between five and ten years from the date of issue.

#### COMMERCIAL SOLVENTS

Rated: BB

Issued: 6-23-66

Actual interest rate  $i_1 = 4.50\%$

Actual conversion price  $cp_1 = \$68.00$

Common stock price at the date of issue = \$57.125

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$57.12	2.25%
Low (common - 10%)	\$51.41	1.25%
High (common + 30%)	\$74.26	5.75%

#### Data as of 6-23-66

$x = \$110,047,344$

$y = \$20,000,000$

$r = .03685$

$n = 5, 10, 15, 20, 25$

$s = 2,978,418$  shares

$b = 294,120$  shares

$F = .1374$

If the Commercial Solvents bonds are converted five years from the date of issue, then the actual interest rate/conversion price combination chosen by the company is lower than the optimum combination and this would sub-optimize the EPS by .3%.

If these bonds are converted in ten, fifteen, twenty, or twenty-five years, however, the actual combination is higher than the optimum ones and this would sub-optimize the EPS by .3%, 2.2%, 4.6%, and 7.4% respectively in those years. The interest rate/conversion ratio combination chosen by Commercial Solvents would be the optimum one if conversion was expected to occur at some point in time between five and ten years from the date of issue.

#### COPPERWELD STEEL

Rated: BB

Issued: 12-16-59

Actual interest rate  $i_1 = 5.0\%$

Actual conversion price  $cp_1 = \$56.00$

Common stock price at the date of issue = \$52.50

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$52.50	3.75%
Low (common - 10%)	\$47.25	1.75%
High (common + 30%)	\$68.25	9.50%

Data as of 12-16-59

x=\$72,571,927

y=\$8,000,000

r=.05656

n=5, 10, 15, 20

s=1,160,251 shares

b=142,856 shares

F=.2045

If the Copperweld Steel convertible bonds are converted in five years, then the actual interest rate and conversion price chosen by the company will be below the optimum combination and this would sub-optimize the EPS by .6%. However, if the bonds are converted in ten, fifteen or twenty years, then the actual combination is higher than the optimum ones and this would sub-optimize the EPS by .1%, 1.7%, and 3.9% respectively in those years. The interest rate/conversion ratio combination chosen by Copperweld Steel would be optimum if conversion was expected to occur at some point in time between five and ten years from the date of issue.

As of March, 1970, twelve years have elapsed since the date that these bonds were issued; therefore, Copperweld Steel has definitely chosen a sub-optimum combination.

## GENERAL INSTRUMENTS

Rated: BB

Issued: 12-3-65

Actual interest rate  $i_1 = 4.50\%$ Actual conversion price  $cp_1 = \$34.24$ 

Common stock price at the date of issue = \$31.875

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$31.87	3.75%
Low (common-10%)	\$28.68	2.50%
High (common + 30%)	\$41.43	7.00%

Data as of 12-3-65

$$x = \$53,262,271$$

$$y = \$12,000,000$$

$$r = .06585$$

$$n = 5, 10, 15, 20$$

$$s = 2,661,448 \text{ shares}$$

$$b = 350,472 \text{ shares}$$

$$F = .1177$$

If the General Instruments' convertible bonds are converted five years from the date of issue, then the interest rate and conversion price selected by the company will be below the optimum combination and this would sub-optimize the EPS by .8%. However, if the bonds are converted in ten, fifteen or twenty years, the combination selected by the company will be higher than the optimum ones and this would sub-optimize the EPS by .3%, 2.4%, and 5.0% respectively. The interest rate/conversion ratio combination chosen by General Instruments would be optimum if conversion was expected to occur at some point in time between five and ten years from the date of issue.

GRANITE CITY STEEL

Rated: BB

Issued: 12-8-64

Actual interest rate  $i_1 = 4.625\%$

Actual conversion price  $cp_1 = \$30.00$

Common stock price at the date of issue = \$24.625

## Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$24.62	3.00%
Low (common- 10%)	\$22.16	2.50%
High (common + 30%)	\$32.00	5.25%

Data as of 12-8-64

$$x = \$220,565,134$$

$$y = \$30,000,000$$

$$r = .03583$$

$$n = 5, 10, 15, 20, 25, 30$$

$$s = 4,339,924 \text{ shares}$$

$$b = 1,000,000 \text{ shares}$$

$$F = .0838$$

If the Granite City Steel convertible bonds are converted five, ten, fifteen, twenty or twenty-five years from the date of issue, then the interest rate and conversion price chosen by the company is below the optimum ones and this would sub-optimize the EPS by 1.1%, .8%, .6%, .4%, and .2% respectively.

If conversion occurs in thirty years, however, then the actual combination is higher than the optimum ones and this would sub-optimize the EPS by .1%. The interest rate/conversion ratio combination chosen by Granite City Steel would be optimum if conversion was expected to occur at some point in time between twenty-five and thirty years from the date of issue.

W. T. GRANT

Rated: BBB

Issued: 6-23-65

Actual interest rate  $i_1 = 4.0\%$

Actual conversion price  $cp_1 = \$28.00$

Common stock price at the date of issue = \$23.375

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$23.32	2.75%
Low (common - 10%)	\$21.04	2.25%
High (common + 30%)	\$30.38	4.50%

Data as of 6-23-65

$x = \$309,920,972$

$y = \$35,000,000$

$r = .09234$

$n = 5, 10, 15, 20, 25$

$s = 12,016,745$  shares

$b = 1,249,990$  shares

$F = .0685$

If the Grant convertible bonds are converted in five or ten years, then the interest rate/conversion price combination will be below the optimum combinations and this would sub-optimize the EPS by .5% and .2% respectively in those years. However, if conversion occurs in fifteen, twenty or twenty-five years, then the actual combination will be higher than the optimum ones and this would sub-optimize the EPS by .2%,

2.4%, and 5.7% respectively. The interest rate/conversion ratio combination chosen by Grant would be optimum if conversion was expected to occur at some point in time between ten and fifteen years from the date of issue.

GREAT NORTHERN PAPER

Rated: BB

Issued: 3-29-66

Actual interest rate  $i_1 = 4.25\%$

Actual conversion price  $cp_1 = \$56.50$

Common stock price at the date of issue = \$48.00

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$48.00	2.25%
Low (common - 10%)	\$43.20	1.25%
High (common + 30%)	\$52.40	5.75%

Data as of 3-29-66

$x = \$200,964,374$

$y = \$10,000,000$

$r = .06797$

$n = 5, 10, 15, 20, 25$

$s = 2,660,643$  shares

$b = 176,490$  shares

$F = .1326$

If the Great Northern Paper convertible bonds are converted in five or ten years then the actual interest rate and conversion price are below the optimum combination and this would

sub-optimize the EPS by .6% and .1% respectively. If the bonds are converted in fifteen, twenty or twenty-five years, however, then the actual combination is higher than the optimum ones and this would sub-optimize the EPS by .4%, 1.9%, and 4.0% respectively. The interest rate/conversion ratio combination chosen by Great Northern Paper would be optimum if conversion was expected to occur at some point in time between ten and fifteen years from the date of issue.

HESS OIL & CHEMICAL (AMERADA-HESS)

Rated: BBB

Issued: 8-1-66

Actual interest rate  $i_1 = 4.50\%$

Actual conversion price  $cp_1 = \$21.00$

Common stock price at the date of issue = \$20.625

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$20.62	4.25%
Low (common - 10%)	\$18.56	3.50%
High (common + 30%)	\$26.80	6.75%

Data as of 8-1-66

$x = \$326,937,871$

$y = \$35,000,000$

$r = .07362$

$n = 5, 10, 15, 20$

$s = 9,427,457$  shares

$b = 1,666,000$  shares

$F = .0778$

If the Hess Oil convertible bonds are converted in five, ten, or fifteen years, then the actual interest rate/conversion price combination will be below the optimum combinations and this would sub-optimize the EPS by 2.7%, 1.8%, and .5% respectively. However, if the bonds are converted in twenty years, then the actual combination is higher than the optimum and this would sub-optimize the EPS by .2%. The interest rate/conversion ratio combination chosen by Hess Oil would be optimum if conversion was expected to occur at some point in time between fifteen and twenty years from the date of issue.

OUTLET

Rated: B

Issued: 7-12-66

Actual interest rate  $i_1 = 5.50\%$

Actual conversion price  $cp_1 = \$18.75$

Common stock price at the date of issue = \$15.75

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$15.75	1.75%
Low (common - 10%)	\$14.18	below 1.0%
High (common + 30%)	\$20.47	7.75%

Data as of 7-12-66

x = \$27,656,994

y = \$7,500,000

r = .06180

n = 5, 10, 15, 20

s = 1,035,184 shares

b = 399,952 shares

F = .2396

If the Outlet convertible bonds are converted in five years, then the interest rate and conversion price actually chosen by the company are below the optimum combination and this would sub-optimize the EPS by 1.1%. However, if the bonds are converted in ten, fifteen or twenty years, then the actual combination is higher than the optimum ones and this would sub-optimize the EPS by .4%, 5.4%, and 12.1% respectively in those years. The interest rate/conversion ratio combination chosen by Outlet would be optimum if conversion was expected to occur at some point in time between five and ten years from the date of issue.

PAN AMERICAN WORLD AIRWAYS

Rated: BB

Issued: 7-30-59

Actual interest rate  $i_1 = 4.875\%$

Actual conversion price  $cp_1 = \$30.00$

Common stock price at the date of issue = \$28.00

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$28.00	4.00%
Low (common - 10%)	\$25.20	3.00%
High (common + 30%)	\$36.40	7.25%

Data as of 7-30-59

$$x = \$397,711,000$$

$$y = \$46,971,000$$

$$r = .04940$$

$$n = 5, 10, 15, 20$$

$$s = 6,583,233 \text{ shares}$$

$$b = 1,565,700 \text{ shares}$$

$$F = .1161$$

Regardless of when the Pan American Airlines convertible bonds issued in 1959 are expected to be converted, the interest rate and conversion price actually chosen will always be lower than the optimum combination. This is a clear case of sub-optimization of the EPS due to the inappropriate selection of an interest rate and conversion price. The EPS will be sub-optimized by 2.7% if conversion occurs in five years; 1.9% if conversion occurs in ten years; 1.0% if conversion occurs in fifteen years, and .1% if conversion occurs in twenty years.

## PAN AMERICAN WORLD AIRWAYS

Rated: BB

Issued: 8-10-66

Actual interest rate  $i_1 = 4.50\%$ Actual conversion price  $cp_1 = \$77.75$ 

Common stock price at the date of issue = \$67.25

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$67.25	3.00%
Low (common - 10%)	\$60.53	2.00%
High (common + 30%)	\$87.42	6.00%

Data as of 8-10-66

x = \$828,313,000

y = \$175,000,000

r = .05220

n = 5, 10, 15, 20

s = 15,556,384 shares

b = 2,150,675 shares

F = .1144

If the Pan American Airlines convertible bonds issued in 1966 are converted in ten years then the actual interest rate and conversion price would also be the optimum combination. However, if the bonds are converted in five years, the actual combination would be below the optimum one and the EPS would be sub-optimized by .7%. If conversion were to occur in

fifteen or twenty years, then the actual combination would be higher than the optimum ones and this would sub-optimize the EPS by 1.5%, and 4.1% respectively in those years.

REEVES BROTHERS

Rated: BB

Issued: 1-11-66

Actual interest rate  $i_1 = 4.0\%$

Actual conversion price  $cp_1 = \$42.00$

Common stock price at the date of issue = \$34.375

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$34.37	2.50%
Low (common - 10%)	\$30.94	2.00%
High (common + 30%)	\$44.68	4.50%

Data as of 1-11-66

$x = \$64,787,638$

$y = \$12,500,000$

$r = .06725$

$n = 5, 10, 15, 20, 25$

$s = 1,310,874$  shares

$b = 297,613$  shares

$F = .0763$

If the Reeves Brothers' convertible bonds are converted in five, ten, or fifteen years, the actual interest rate and conversion price chosen by the company will be below

the optimum combinations and this would sub-optimize the EPS by .9%, .6% and .1% respectively in those years. If, however, the bonds are converted in twenty or twenty-five years, the actual combination will be higher than the optimum ones, and this would sub-optimize the EPS by .6% and 3.7% respectively. The interest rate/conversion ratio combination chosen by Reeves Brothers would be optimum if conversion was expected to occur at some point in time between fifteen and twenty years from the date of issue.

## REYNOLDS METALS

Rated: BB

Issued: 3-15-66

Actual interest rate  $i_1 = 4.50\%$ Actual conversion price  $cp_1 = \$63.00$ 

Common stock price at the date of issue = \$54.00

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$54.00	2.50%
Low (common - 10%)	\$48.60	1.25%
High (common + 30%)	\$70.20	6.00%

Data as of 3-15-66 $x = \$1,200,747,834$  $y = \$75,000,000$  $r = .04475$  $n = 5, 10, 15, 20, 25,$

$s = 16,632,326$  shares

$b = 1,190,250$  shares

$F = .1403$

If the Reynolds Metals convertible bonds are converted in five or ten years, the actual interest rate and conversion price chosen by the company will be below the optimum combinations and this would sub-optimize the EPS by .4% and .1% respectively. However, if conversion occurs in fifteen, twenty, or twenty-five years the actual combination will be higher than the optimum ones and this would sub-optimize the EPS by .2%, 1.3%, and 2.8% respectively. The interest rate/conversion ratio combination chosen by Reynolds Metals would be optimum if conversion was expected to occur at some point in time between ten and fifteen years from the date of issue.

ROHR CORPORATION

Rated: BB

Issued: 12-2-66

Actual interest rate  $i_1 = 5.25\%$

Actual conversion price  $cp_1 = \$26.00$

Common stock price at the date of issue = \$20.875

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$20.87	2.75%
Low (common - 10%)	\$18.79	1.75%
High (common + 30%)	\$27.13	5.75%

Data as of 12-2-66

$x = \$127,678,139$

$y = \$15,000,000$

$r = .06147$

$n = 5, 10, 15, 20$

$s = 3,341,771$  shares

$b = 576,915$  shares

$F = .1244$

If the Rohr Corporation convertible bonds are converted in fifteen years, then the interest rate/conversion price combination chosen by the company is the optimum combination. If conversion occurs in five or ten years, however, then the actual combination is below the optimum ones and this would sub-optimize the EPS by .4% and .2% respectively. The actual combination would be higher than the optimum one if conversion occurs in twenty years and this would sub-optimize the EPS by 1.9%

## SPARTANS INDUSTRIES

Rated: B

Issued: 12-17-65

Actual interest rate  $i_1 = 5.0\%$

Actual conversion price  $cp_1 = \$38.00$

Common stock price at the date of issue = \$40.625

## Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$40.62	5.50%
Low (common - 10%)	\$36.56	4.75%
High (common + 30%)	\$52.80	7.50%

Data as of 12-17-65

$$x = \$94,421,028$$

$$y = \$19,156,000$$

$$r = .05556$$

$$n = 5, 10, 15, 20$$

$$s = 1,968,663 \text{ shares}$$

$$b = 504,109 \text{ shares}$$

$$F = .0670$$

Regardless of when the Spartans Industries bonds are converted, the optimum interest rate/conversion price combination will always be higher than the one actually chosen by Spartans. This is a clear case of sub-optimization of EPS due to inappropriate selection of the interest rate and conversion price. The EPS will be sub-optimized by: 4.6% if conversion occurs in five years; 3.1% if conversion occurs in ten years; 1.4% if conversion occurs in fifteen years; and .1% if conversion occurs in twenty years.

## STOKELY-VAN CAMP

Rated: BB

Issued: 3-6-62

Actual interest rate  $i_1 = 4.50\%$ Actual conversion price  $cp_1 = \$31.00$ 

Common stock price at the date of issue = \$28.75

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$28.75	3.50%
Low (common - 10%)	\$25.88	2.50%
High (common + 30%)	\$37.17	7.00%

Data as of 3-6-62

x = \$100,352,300

y = \$15,000,000

r = .05182

n = 5, 10, 15, 20

s = 1,892,515 shares

b = 483,870 shares

F = .1209

If the Stokely-Van Camp convertible bonds are converted in five, ten or fifteen years, the actual interest rate and conversion price chosen by the company will be below the optimum combinations and this would sub-optimize the EPS by 2.8%, 1.7%, and .5% respectively in those years. However, if conversion occurs in twenty years, the actual combination will be higher than the optimum one and this would sub-optimize the EPS by

.3%. The interest rate/conversion ratio combination chosen by Stokely-Van Camp would be optimum if conversion was expected to occur at some point in time between fifteen and twenty years from the date of issue.

UNITED MERCHANTS AND MANUFACTURERS

Rated: BB

Issued: 10-25-65

Actual interest rate  $i_1 = 4.0\%$

Actual conversion price  $cp_1 = \$34.25$

Common stock price at the date of issue = \$28.875

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$28.87	3.00%
Low (common - 10%)	\$25.99	2.25%
High (common + 30%)	\$37.53	4.75%

Data as of 10=25=65

$x = \$485,645,680$

$y = \$40,000,000$

$r = .05270$

$n = 5, 10, 15, 20, 25$

$s = 5,969,735$  shares

$b = 1,167,880$  shares

$F = .0695$

Regardless of when the United Merchant and Manufacturers bonds are converted, the optimum interest rate/conversion

price combination will always be higher than the one actually chosen. This is a clear case of sub-optimization of EPS due to the inappropriate selection of an interest rate and conversion price. The EPS will be sub-optimized by: 1.4% if conversion occurs in five years; 1.2% if conversion occurs in ten years; 1.0% if conversion occurs in fifteen years; .6% if conversion occurs in twenty years, and .2% if conversion occurs in twenty-five years.

VENDO

Rated: BB

Issued: 9-8-60

Actual interest rate  $i_1 = 4.50\%$

Actual conversion price  $cp_1 = \$47.50$

Common stock price at the date of issue = \$42.75

Range of possible interest rate/conversion price combinations

	<u>cp</u>	<u>i(Approx.)</u>
Common stock price	\$42.75	3.25%
Low (common - 10%)	\$38.48	2.00%
High (common + 30%)	\$55.57	6.75%

Data as of 9-8-60

$$x = \$30,346,856$$

$$y = \$5,225,000$$

$$r = .08067$$

$$n = 5, 10, 15, 20$$

$$s = 2,595,878 \text{ shares}$$

$$b = 110,101 \text{ shares}$$

$$F = .1286$$

Regardless of when the Vendo convertible bonds are converted, the optimum interest rate/conversion price combination will always be below the actual combination chosen by the company. This clear case of sub-optimization of EPS is due to inappropriate selection of the interest rate and conversion price. The EPS will be sub-optimized by: .1% if conversion occurs in five years; 1.8% if conversion occurs in ten years; 4.3% if conversion occurs in fifteen years, and 7.8% if conversion occurs in twenty years.

### Analysis of the Total Data

The primary question which must be answered from an analysis of the data in the chapter is whether or not any of the companies in the study are choosing sub-optimum interest rates and conversion ratios for their convertible bonds, and if so, to what degree will this reduce the earnings per share for the companies involved. The analysis is complicated by the fact that if a company chooses a combination that would prove to be optimum only if the bonds are converted  $x$  years from the date of issue, then it is impossible to be certain if the combination is truly optimum unless one waits for the  $x$  years to expire to see if conversion actually occurs at that time. However, if this particular convertible debenture matures  $x - y$  years (any time period less than  $x$  years) from the date of issue, then it is certain that the bonds will not be converted in  $x$  years and, consequently, clearly this company chose a sub-optimum combination. Furthermore, if  $x + z$  years (any time period greater than  $x$  years) have already elapsed since the date that the bonds were issued, then the company definitely chose a sub-optimum combination, because these bonds cannot be converted  $x$  years from the date of issue.

In Chapter Two of the dissertation two studies<sup>14</sup> were cited which seem to indicate that the financial executives of corporations issuing convertible bonds do not have a systematic

---

<sup>14</sup>One of these studies was conducted by Weston and Brigham and the other one was conducted by the author of the dissertation.

method of choosing the optimum interest rate/conversion ratio combinations. If these executives used the model developed in this paper, it has been hypothesized that many of them could improve the accuracy of their selections and consequently increase the earnings per share and, therefore, the price per share of the common stocks of their corporations.

Of the 23 companies analyzed in this study, six companies chose interest rate/conversion ratio combinations that will be sub-optimum regardless of when these bonds will be converted. Each of these companies, representing 26.09 percent of all of the companies analyzed, definitely reduced the long-run earnings and price per share of its stocks. These six companies are: Pan American Airways (1959), Spartans Industries, United Merchants and Manufacturers, Vendo Corporation, Champion Paper and Fibre, and Copperweld Steel.

Dependent upon when conversion actually occurs, Pan American may have reduced its earnings per share by as much as 2.7 percent; Spartans as much as 4.6 percent; United Merchants by as much as 1.4 percent; Vendo by as much as 7.8 percent; Champion by as much as 4.9 percent, and Copperweld by as much as 3.9 percent. Pan Am, Spartans, and United Merchants all chose interest rate/conversion price combinations that are lower than the optimum combinations regardless of when each of their bonds will be converted. While Vendo, Champion P & F, and Copperweld all chose combinations that

are higher than the optimum ones regardless of when the bonds will be converted.

In these six cases the combinations chosen are definitely sub-optimal, however, in some of the other seventeen cases it is probable that sub-optimal combinations were also chosen. This can occur, for example, if a company desires equity capital and is using the convertible debenture as a method of obtaining a good price for its common stock; therefore, it expects to have the bonds converted at an early date so that the debt can be turned into equity capital. Consequently, the company proceeds to force conversion of the bonds five years after the date of issue. However, it chose an interest rate/conversion ratio combination that would be optimum if conversion occurred in twenty years. It is apparent that this company is clearly sub-optimizing when one looks back on the situation and sees that the bonds were converted in five years when the interest rate/conversion ratio combination chosen by the company would have been optimum if they were converted in twenty years. However, an ex ante optimum interest rate/conversion ratio combination can be selected for various time frames, but it is not possible to forecast exactly when conversion will occur or even when the management of the company in question expects conversion to occur, because if they have any definite expectations of this nature they have generally refused to release the information. Therefore, as long as the actual interest rate/conversion ratio combination will be

the optimum combination at any time period that exists during the life of the bond, then it is impossible to conclusively say that the ex ante combination chosen by the company will not be optimum.

The same type of problem can exist if a company truly desires debt and uses the convertible as a means of securing a lower interest rate. In this instance the company will not force conversion and conversion may not occur until twenty-five years from the date of issue. However, the particular interest rate/conversion ratio combination chosen by the company may be optimum only if conversion occurs in ten years; hence, this combination is clearly sub-optimum. However, once again it is impossible to say that the ex ante combination chosen by the company is sub-optimum unless one knows the specific plans of the company with respect to forcing conversion.

Although it is not possible from an ex ante point of view to say that a particular company has chosen a sub-optimum combination unless there is no time period when the combination is optimal, it is possible to develop certain general conclusions concerning the bonds in the study.

When the fact that 26.09 percent of the convertible bonds studied have interest rate/conversion ratio combinations that are definitely sub-optimum is combined with the fact that it is often impossible to tell when an ex ante combination will be sub-optimum, it becomes possible to conclude that by not using an accurate, systematic method of choosing the optimum com-

mination when a convertible bond is issued, many companies are choosing sub-optimum combinations which will have a deleterious effect on their earnings per share and, consequently, on their prices per share. This problem could be avoided in the future if those companies that issue convertible bonds would use the model developed in this study in order to choose an optimum interest rate and corresponding conversion ratio.

Even if only 26.09 percent of the companies have combinations that are sub-optimum and all of the remaining companies actually chose optimum combinations there is still enough sub-optimization to conclude that a model that could eliminate the sub-optimization would provide a worthwhile contribution to the field.

#### Presentation of Data

For each company analyzed in the dissertation the tables on the following pages present the actual interest rate/conversion ratio combination, the optimum combination that coincides with each potential conversion date, the effect of any sub-optimization on the earnings per share, and the number of years from the date of issue until conversion occurs that would maximize the EPS given the interest rate/conversion ratio combination actually selected by the company.

Tables 2-24--The effect of any sub-optimization on the earnings per share for each of the 23 companies analyzed

AIR REDUCTION <sup>15</sup>					
<u>i</u>	<u>cp</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0225	\$48.12	\$3.550	\$3.714	\$3.922	\$4.187
.0250	50.33	3.572	3.732	3.934	4.189
.0275	52.54	3.593	3.748	3.944	4.190*
.0300	54.76	3.612	3.763	3.952	4.188
.0325	56.97	3.629	3.776	3.959	4.185
.0350	59.18	3.645	3.788	3.964	4.181
.0375	61.39	3.660	3.798	3.968	4.176
<u>.03875</u>	<u>62.50</u>	<u>3.666</u>	<u>3.803</u>	<u>3.969</u>	<u>4.173</u>
.0400	63.61	3.673	3.807	3.970	4.170
.0425	65.82	3.686	3.815	3.972	4.163
.0450	68.03	3.698	3.822	3.973*	4.155
.0475	70.24	3.708*	3.829*	3.973*	4.147
Effect of Sub-optimization on the EPS		1.1%	.7%	.1%	.4%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 15-20 years

<sup>15</sup> Asterisk denotes optimum combination  
Underline denotes actual combinations

The effect of any sub-optimization on the earnings  
for each of the 23 companies analyzed

AIR REDUCTION<sup>15</sup>

	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
0.12	\$3.550	\$3.714	\$3.922	\$4.187	\$4.524*
0.33	3.572	3.732	3.934	4.189	4.512
0.54	3.593	3.748	3.944	4.190*	4.498
0.76	3.612	3.763	3.952	4.188	4.483
0.97	3.629	3.776	3.959	4.185	4.467
1.18	3.645	3.788	3.964	4.181	4.450
1.39	3.660	3.798	3.968	4.176	4.432
<u>1.50</u>	<u>3.666</u>	<u>3.803</u>	<u>3.969</u>	<u>4.173</u>	<u>4.413</u>
1.61	3.673	3.807	3.970	4.170	4.394
1.82	3.686	3.815	3.972	4.163	4.375
2.03	3.698	3.822	3.973*	4.155	4.355
2.24	3.708*	3.829*	3.973*	4.147	4.335
sub- on	1.1%	.7%	.1%	.4%	2.5%

of years from the date of  
conversion occurs that  
the interest rate/con-  
o combination selected  
ny to be the optimum one . . . . . 15-20 years

isk denotes optimum combination  
line denotes actual combinations

## AURORA PLASTICS (AURORA PRODUCTS)

<u>i</u>	<u>cp</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>
.0400	\$23.03	\$1.187	\$1.326	\$1.518*
.0425	23.94	1.191	1.327*	1.513
.0450	24.86	1.194	1.327*	1.508
<u>.04625</u>	<u>25.32</u>	<u>1.196</u>	<u>1.327*</u>	<u>1.505</u>
.0475	25.78	1.198	1.327*	1.502
.0500	26.70	1.200	1.327*	1.496
.0525	27.61	1.203	1.326	1.490
.0550	28.53	1.205	1.325	1.484
.0575	29.45	1.207	1.324	1.477
.0600	30.37	1.209	1.322	1.470
.0625	31.28	1.210	1.320	1.463
.0650	32.20	1.212	1.318	1.456
.0675	33.12	1.213*	1.316	1.449
Effect of sub- optimization on the EPS		1.4%	-	.9%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . 10 years

## BOBBIE BROOKS

<u>i</u>	<u>cp</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>
.0300	\$30.34	\$.343	\$.343	\$.344*
.0325	31.13	.343	.344*	.344*
.0350	31.93	.344	.344*	.344*
.0375	32.72	.344	.344*	.343
.0400	33.52	.344	.344*	.343
.0425	34.32	.345	.344*	.343
.0450	35.11	.345	.344*	.343
.0475	35.91	.345	.344*	.342
.0500	36.70	.346	.344*	.342
<u>.0525</u>	<u>37.50</u>	<u>.346</u>	<u>.344*</u>	<u>.342</u>
.0550	38.30	.346	.344*	.341
.0575	39.09	.346	.344*	.341
.0600	39.89	.346	.343	.341
.0625	40.68	.347*	.343	.340
.0650	41.48	.347*	.343	.340
.0675	42.27	.347*	.343	.340
.0700	43.07	.347*	.343	.339
.0725	43.87	.347*	.343	.339
Effect of sub- optimization on the EPS		.3%	-	.6%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 10 years

## BURLINGTON INDUSTRIES

<u>i</u>	<u>cp</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0300	\$29.05	\$2.815	\$2.865	\$2.932	\$3.021*
.0325	30.29	2.820	2.869	2.933	3.019
.0350	31.54	2.825	2.872	2.934	3.016
.0375	32.78	2.829	2.875	2.935*	3.013
.0400	34.02	2.833	2.877	2.935*	3.010
.0425	35.27	2.836	2.879	2.935*	3.007
.0450	36.51	2.840	2.881	2.935*	3.004
.0475	37.76	2.843	2.883	2.935*	3.000
<u>.0500</u>	<u>39.00</u>	<u>2.845</u>	<u>2.884</u>	<u>2.934</u>	<u>2.997</u>
.0525	40.24	2.848	2.886	2.933	2.993
.0550	41.49	2.850	2.887	2.932	2.989
.0575	42.73	2.853*	2.888*	2.931	2.986

Effect of sub-  
optimization on  
the EPS

.3%                      .1%                      0                      .8%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 10-15 years

BURLINGTON INDUSTRIES

	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
05	\$2.815	\$2.865	\$2.932	\$3.021*	\$3.139*
29	2.820	2.869	2.933	3.019	3.132
54	2.825	2.872	2.934	3.016	3.124
78	2.829	2.875	2.935*	3.013	3.116
02	2.833	2.877	2.935*	3.010	3.108
27	2.836	2.879	2.935*	3.007	3.100
51	2.840	2.881	2.935*	3.004	3.092
76	2.843	2.883	2.935*	3.000	3.084
<u>00</u>	<u>2.845</u>	<u>2.884</u>	<u>2.934</u>	<u>2.997</u>	<u>3.076</u>
24	2.848	2.886	2.933	2.993	3.069
49	2.850	2.887	2.932	2.989	3.061
73	2.853*	2.888*	2.931	2.986	3.053
on	.3%	.1%	0	.8%	2.0%

7 years from the date of conversion occurs that the interest rate/con- combination selected by to be the optimum one . . . . . 10-15 years

## CHAMPION PAPER &amp; FIBRE (U.S. PLYWOOD- CHAMPION PAPER)

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0200	\$37.85	\$2.051	\$2.114	\$2.192*	\$2.288*
.0225	38.67	2.054	2.115	2.190	2.282
.0250	39.49	2.057	2.116	2.188	2.276
.0275	40.32	2.060	2.117	2.186	2.270
.0300	41.14	2.063	2.117	2.183	2.263
.0325	41.96	2.065	2.118	2.181	2.257
.0350	42.79	2.067	2.118	2.179	2.251
.0375	43.61	2.070	2.118	2.176	2.245
.0400	44.44	2.072	2.119*	2.174	2.239
.0425	45.26	2.074	2.119*	2.171	2.233
<u>.0450</u>	<u>46.08</u>	<u>2.076</u>	<u>2.119*</u>	<u>2.169</u>	<u>2.227</u>
.0475	46.91	2.078	2.118	2.166	2.221
.0500	47.73	2.079	2.118	2.163	2.215
.0525	48.55	2.081	2.118	2.161	2.210
.0550	49.38	2.082	2.118	2.158	2.204
.0575	50.20	2.084	2.117	2.155	2.198
.0600	51.02	2.085	2.117	2.153	2.193
.0625	51.85	2.086	2.116	2.150	2.187
.0650	52.67	2.087	2.116	2.147	2.182
.0675	53.50	2.089	2.115	2.144	2.177
.0700	54.32	2.090*	2.114	2.142	2.172

Effect of sub-  
optimization on  
the EPS

.7%                      -                      1.1%                      2.7%

over

## CHAMPION PAPER &amp; FIBRE (U.S. PLYWOOD- CHAMPION PAPER)

	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
85	\$2.051	\$2.114	\$2.192*	\$2.288*	\$2.408*
67	2.054	2.115	2.190	2.282	2.395
49	2.057	2.116	2.188	2.276	2.383
32	2.060	2.117	2.186	2.270	2.372
14	2.063	2.117	2.183	2.263	2.360
96	2.065	2.118	2.181	2.257	2.349
79	2.067	2.118	2.179	2.251	2.338
61	2.070	2.118	2.176	2.245	2.327
44	2.072	2.119*	2.174	2.239	2.316
26	2.074	2.119*	2.171	2.233	2.305
<u>08</u>	<u>2.076</u>	<u>2.119*</u>	<u>2.169</u>	<u>2.227</u>	<u>2.295</u>
91	2.078	2.118	2.166	2.221	2.285
73	2.079	2.118	2.163	2.215	2.275
55	2.081	2.118	2.161	2.210	2.266
38	2.082	2.118	2.158	2.204	2.256
20	2.084	2.117	2.155	2.198	2.247
02	2.085	2.117	2.153	2.193	2.238
85	2.086	2.116	2.150	2.187	2.230
67	2.087	2.116	2.147	2.182	2.221
50	2.089	2.115	2.144	2.177	2.213
32	2.090*	2.114	2.142	2.172	2.205
on	.7%	-	1.1%	2.7%	4.9%
	over				

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 10 years

## COLLINS &amp; AIKMAN

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0200	\$24.01	\$ 2.972	\$3.262	\$3.709*	\$4.399*
.0225	24.67	2.980	3.265	3.701	4.369
.0250	25.34	2.988	3.267	3.692	4.340
.0275	26.01	2.995	3.269	3.683	4.311
.0300	26.67	3.002	3.270	3.674	4.281
.0325	27.34	3.009	3.271	3.664	4.252
.0350	28.00	3.015	3.272*	3.654	4.223
.0375	28.67	3.020	3.272*	3.644	4.194
.0400	29.34	3.026	3.272*	3.633	4.165
.0425	30.00	3.031	3.271	3.623	4.136
.0450	30.67	3.035	3.271	3.612	4.108
<u>.04625</u>	<u>31.00</u>	<u>3.037</u>	<u>3.271</u>	<u>3.606</u>	<u>4.094</u>
.0475	31.33	3.040	3.270	3.601	4.080
.0500	32.00	3.044	3.268	3.590	4.053
.0525	32.66	3.048	3.267	3.579	4.025
.0550	33.33	3.051	3.265	3.568	3.998
.0575	34.00	3.054	3.263	3.557	3.972
.0600	34.66	3.058*	3.261	3.546	3.945

Effect of sub-  
optimization on  
the EPS

.7%                      0                      2.9%                      7.2%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 5-10 year range

COLLINS & AIKMAN

P	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
4.01	\$ 2.972	\$3.262	\$3.709*	\$4.399*	\$5.462
4.67	2.980	3.265	3.701	4.369	5.394
5.34	2.988	3.267	3.692	4.340	5.327
6.01	2.995	3.269	3.683	4.311	5.260
6.67	3.002	3.270	3.674	4.281	5.195
7.34	3.009	3.271	3.664	4.252	5.131
8.00	3.015	3.272*	3.654	4.223	5.068
8.67	3.020	3.272*	3.644	4.194	5.007
9.34	3.026	3.272*	3.633	4.165	4.946
10.00	3.031	3.271	3.623	4.136	4.887
10.67	3.035	3.271	3.612	4.108	4.828
<u>11.00</u>	<u>3.037</u>	<u>3.271</u>	<u>3.606</u>	<u>4.094</u>	<u>4.799</u>
11.33	3.040	3.270	3.601	4.080	4.771
12.00	3.044	3.268	3.590	4.053	4.716
12.66	3.048	3.267	3.579	4.025	4.661
13.33	3.051	3.265	3.568	3.998	4.608
14.00	3.054	3.263	3.557	3.972	4.555
14.66	3.058*	3.261	3.546	3.945	4.504
on	.7%	0	2.9%	7.2%	13.9%

f years from the date of conversion occurs that the interest rate/con- o combination selected ny to be the optimum one . . . . . 5-10 year range

## COMMERCIAL SOLVENTS

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0125	\$51.92	\$1.460	\$1.501*	\$1.548	\$1.604*
.0150	53.16	1.462	1.501*	1.546	1.598
.0175	54.40	1.464	1.501*	1.543	1.592
.0200	55.63	1.466	1.501*	1.541	1.587
.0225	56.87	1.468	1.501*	1.538	1.581
.0250	58.11	1.470	1.501*	1.536	1.575
.0275	59.34	1.471	1.500	1.533	1.570
.0300	60.58	1.473	1.500	1.531	1.564
.0325	61.82	1.474	1.500	1.528	1.559
.0350	63.05	1.475	1.499	1.525	1.554
.0375	64.29	1.476	1.498	1.522	1.548
.0400	65.53	1.478	1.498	1.519	1.543
.0425	66.76	1.479	1.497	1.517	1.538
<u>.0450</u>	<u>68.00</u>	<u>1.479</u>	<u>1.496</u>	<u>1.514</u>	<u>1.533</u>
.0475	69.24	1.480	1.495	1.511	1.528
.0500	70.47	1.481	1.494	1.508	1.523
.0525	71.71	1.482	1.493	1.505	1.518
.0550	72.95	1.482	1.492	1.503	1.513
.0575	74.18	1.483*	1.491	1.500	1.509

Effect of sub-  
optimization on  
the EPS

.3%      .3%      2.2%      4.6%

## COMMERCIAL SOLVENTS

EPS	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
1.92	\$1.460	\$1.501*	\$1.548	\$1.604*	\$1.668*
3.16	1.462	1.501*	1.546	1.598	1.658
4.40	1.464	1.501*	1.543	1.592	1.648
5.63	1.466	1.501*	1.541	1.587	1.638
6.87	1.468	1.501*	1.538	1.581	1.629
8.11	1.470	1.501*	1.536	1.575	1.620
9.34	1.471	1.500	1.533	1.570	1.611
10.58	1.473	1.500	1.531	1.564	1.602
11.82	1.474	1.500	1.528	1.559	1.593
13.05	1.475	1.499	1.525	1.554	1.585
14.29	1.476	1.498	1.522	1.548	1.577
15.53	1.478	1.498	1.519	1.543	1.569
16.76	1.479	1.497	1.517	1.538	1.561
<u>18.00</u>	<u>1.479</u>	<u>1.496</u>	<u>1.514</u>	<u>1.533</u>	<u>1.533</u>
19.24	1.480	1.495	1.511	1.528	1.546
20.47	1.481	1.494	1.508	1.523	1.538
21.71	1.482	1.493	1.505	1.518	1.531
22.95	1.482	1.492	1.503	1.513	1.525
24.18	1.483*	1.491	1.500	1.509	1.518
sub- on on	.3%	.3%	2.2%	4.6%	7.4%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 5-10 year range

## COPPERWELD STEEL

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0175	\$47.10	\$3.516	\$3.630	\$3.774*	\$3.957*
.0200	47.79	3.520	3.630	3.769	3.944
.0225	48.47	3.524	3.631*	3.765	3.932
.0250	49.16	3.527	3.631*	3.760	3.920
.0275	49.84	3.531	3.631*	3.755	3.908
.0300	50.52	3.534	3.631*	3.750	3.896
.0325	51.21	3.538	3.631*	3.745	3.885
.0350	51.89	3.541	3.631*	3.740	3.873
.0375	52.58	3.544	3.630	3.735	3.862
.0400	53.26	3.547	3.630	3.730	3.851
.0425	53.95	3.549	3.630	3.725	3.840
.0450	54.63	3.552	3.629	3.721	3.829
.0475	55.32	3.555	3.628	3.716	3.819
<u>.0500</u>	<u>56.00</u>	<u>3.557</u>	<u>3.628</u>	<u>3.711</u>	<u>3.808</u>
.0525	56.68	3.559	3.627	3.706	3.798
.0550	57.37	3.562	3.626	3.701	3.788
.0575	58.05	3.564	3.625	3.697	3.779
.0600	58.74	3.566	3.625	3.692	3.769
.0625	59.42	3.568	3.624	3.687	3.760
.0650	60.11	3.570	3.623	3.683	3.750
.0675	60.79	3.572	3.622	3.678	3.741
.0700	61.48	3.573	3.620	3.673	3.733
.0725	62.16	3.575	3.619	3.669	3.724

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0750	\$62.84	\$3.577	\$3.618	\$3.664	\$3.715
.0775	63.53	3.578	3.617	3.660	3.707
.0800	64.21	3.580	3.616	3.656	3.699
.0825	64.90	3.581	3.615	3.651	3.691
.0850	65.58	3.582	3.612	3.647	3.683
.0875	66.27	3.584	3.611	3.643	3.675
.0900	66.95	3.585	3.609	3.638	3.668
.0925	67.64	3.586	3.608	3.634	3.661
.0950	68.32	3.587*	3.607	3.630	3.653

Effect of sub-  
optimization on  
the EPS

.6%      .1%      1.7%      3.9%

The number of years from the date  
of issue until conversion occurs that  
would cause the interest rate/con-  
version ratio combination selected  
by the company to be the optimum one . . . . . 5-10 year range

## GENERAL INSTRUMENTS

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0250	\$28.48	\$1.469	\$1.566*	\$1.692*	\$1.855*
.0275	29.20	1.472	1.566*	1.688	1.844
.0300	29.92	1.474	1.566*	1.683	1.833
.0325	30.64	1.477	1.566*	1.678	1.821
.0350	31.36	1.479	1.565	1.674	1.810
.0375	32.08	1.481	1.564	1.669	1.799
.0400	32.80	1.483	1.564	1.664	1.788
.0425	33.52	1.485	1.563	1.659	1.777
<u>.0450</u>	<u>34.24</u>	<u>1.487</u>	<u>1.562</u>	<u>1.653</u>	<u>1.767</u>
.0475	34.96	1.489	1.560	1.648	1.756
.0500	35.68	1.490	1.559	1.643	1.745
.0525	36.40	1.491	1.558	1.638	1.735
.0550	37.12	1.492	1.556	1.633	1.725
.0575	37.84	1.494	1.555	1.628	1.715
.0600	38.56	1.495	1.553	1.622	1.705
.0625	39.28	1.495	1.551	1.617	1.695
.0650	40.00	1.496	1.550	1.612	1.685
.0675	40.72	1.497	1.548	1.607	1.676
.0700	41.43	1.498*	1.546	1.602	1.666
Effect of sub- optimization on the EPS		.8%	.3%	2.4%	5.0%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 5-10 year range

## GRANITE CITY STEEL

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0250	\$22.39	\$1.603	\$1.629	\$1.658	\$1.691
.0275	23.28	1.617	1.641	1.669	1.669
.0300	24.18	1.629	1.652	1.678	1.707
.0325	25.08	1.641	1.663	1.687	1.713
.0350	25.97	1.652	1.672	1.695	1.719
.0375	26.87	1.662	1.681	1.702	1.724
.0400	27.76	1.672	1.689	1.708	1.729
.0425	28.66	1.681	1.697	1.715	1.733
.0450	29.55	1.690	1.704	1.720	1.737
<u>.04625</u>	<u>30.00</u>	<u>1.694</u>	<u>1.708</u>	<u>1.722</u>	<u>1.738</u>
.0475	30.45	1.698	1.711	1.725	1.740
.0500	31.34	1.706	1.717	1.730	1.743
.0525	32.24	1.713*	1.723*	1.734*	1.746*
Effect of sub- optimization on the EPS		1.1%	.8%	.6%	.4%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 25-30 year range

E CITY STEEL

<u>EPS</u> <u>n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>	<u>EPS</u> <u>when n=25</u>	<u>EPS</u> <u>when n=30</u>
603	\$1.629	\$1.658	\$1.691		
617	1.641	1.669	1.669	\$1.728	\$1.769
629	1.652	1.678	1.707	1.733	1.771
641	1.663	1.687	1.713	1.738	1.773
652	1.672	1.695	1.719	1.742	1.774
662	1.681	1.702	1.724	1.746	1.775*
672	1.689	1.708	1.729	1.749	1.775*
681	1.697	1.715	1.733	1.751	1.775*
690	1.704	1.720	1.737	1.753	1.775*
<u>694</u>	<u>1.708</u>	<u>1.722</u>	<u>1.738</u>	1.755	1.774
698	1.711	1.725	1.740	<u>1.755</u>	<u>1.744</u>
706	1.717	1.730	1.743	1.756	1.773
713*	1.723*	1.734*	1.746*	1.757	1.772
				1.758*	1.770
.1%	.8%	.6%	.4%		
				.2%	.1%

from the date of  
 n occurs that  
 est rate/con-  
 tion selected  
 the optimum one . . . . . 25-30 year range

## W. T. GRANT

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0225	\$20.85	\$2.437	\$2.602	\$2.844	\$3.202*
.0250	21.87	2.449	2.610	2.847	3.194
.0275	22.89	2.460	2.618	2.849*	3.185
.0300	23.91	2.469	2.625	2.849*	3.174
.0325	24.94	2.478	2.630	2.849*	3.163
.0350	25.96	2.487	2.635	2.848	3.152
.0375	26.98	2.494	2.639	2.846	3.139
<u>.0400</u>	<u>28.00</u>	<u>2.501</u>	<u>2.643</u>	<u>2.843</u>	<u>3.127</u>
.0425	29.02	2.507	2.646	2.840	3.114
.0450	30.04	2.513*	2.648*	2.837	3.101

Effect of sub-  
optimization on  
the EPS

.5%      .2%      .2%      2.4%

The number of years from the date of  
issue until conversion occurs that  
would cause the interest rate/con-  
version ratio combination selected  
by the company to be the optimum one . . . . . 10-15 year range

W. T. GRANT

P	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
0.85	\$2.437	\$2.602	\$2.844	\$3.202*	3.729*
1.87	2.449	2.610	2.847	3.194	3.702
2.89	2.460	2.618	2.849*	3.185	3.674
3.91	2.469	2.625	2.849*	3.174	3.645
4.94	2.478	2.630	2.849*	3.163	3.616
5.96	2.487	2.635	2.848	3.152	3.586
6.98	2.494	2.639	2.846	3.139	3.557
<u>8.00</u>	<u>2.501</u>	<u>2.643</u>	<u>2.843</u>	<u>3.127</u>	<u>3.527</u>
9.02	2.507	2.646	2.840	3.114	3.498
0.04	2.513*	2.648*	2.837	3.101	3.469
b- on	.5%	.2%	.2%	2.4%	5.7%

f years from the date of conversion occurs that the interest rate/con- o combination selected ny to be the optimum one . . . . . 10-15 year range

## GREAT NORTHERN PAPER

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0125	\$43.73	\$5.044	\$5.154	\$5.303*	\$5.503*
.0150	44.79	5.052	5.159	5.302	5.494
.0175	45.86	5.059	5.163	5.301	5.486
.0200	46.92	5.066	5.167	5.300	5.477
.0225	47.98	5.072	5.170	5.299	5.469
.0250	49.05	5.078	5.173	5.297	5.460
.0275	50.11	5.084	5.176	5.296	5.451
.0300	51.18	5.089	5.179	5.294	5.443
.0325	52.24	5.095	5.181	5.292	5.434
.0350	53.31	5.100	5.183	5.290	5.426
.0375	54.37	5.104	5.185	5.287	5.417
.0400	55.44	5.109	5.187	5.285	5.409
<u>.0425</u>	<u>56.50</u>	<u>5.113</u>	<u>5.188</u>	<u>5.283</u>	<u>5.401</u>
.0450	57.56	6.117	5.190	5.280	5.392
.0475	58.63	5.121	5.191	5.277	5.384
.0500	59.69	5.125	5.192	5.275	5.376
.0525	60.76	5.128	5.193	5.272	5.368
.0550	61.82	5.131	5.194*	5.269	5.361
.0575	62.89	5.134*	5.194*	5.266	5.353

Effect of sub-  
optimization on  
the EPS

.6%      .1%      .4%      1.9%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 10-15 year range

GREAT NORTHERN PAPER

	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
73	\$5.044	\$5.154	\$5.303*	\$5.503*	\$5.772*
79	5.052	5.159	5.302	5.494	5.751
86	5.059	5.163	5.301	5.486	5.731
92	5.066	5.167	5.300	5.477	5.711
98	5.072	5.170	5.299	5.469	5.691
05	5.078	5.173	5.297	5.460	5.672
11	5.084	5.176	5.296	5.451	5.653
18	5.089	5.179	5.294	5.443	5.635
24	5.095	5.181	5.292	5.434	5.617
31	5.100	5.183	5.290	5.426	5.599
37	5.104	5.185	5.287	5.417	5.582
44	5.109	5.187	5.285	5.409	5.565
<u>50</u>	<u>5.113</u>	<u>5.188</u>	<u>5.283</u>	<u>5.401</u>	<u>5.548</u>
56	6.117	5.190	5.280	5.392	5.532
63	5.121	5.191	5.277	5.384	5.516
69	5.125	5.192	5.275	5.376	5.501
76	5.128	5.193	5.272	5.368	5.486
82	5.131	5.194*	5.269	5.361	5.472
89	5.134*	5.194*	5.266	5.353	5.457
on	.6%	.1%	.4%	1.9%	4.0%

years from the date of  
conversion occurs that would  
erest rate/conversion ratio  
elected by the company to be  
ne . . . . . 10-15 year range

## HESS OIL &amp; CHEMICAL (AMERADA-HESS)

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0350	\$18.38	\$2.421	\$2.513	\$2.634	\$2.792*
.0375	19.04	2.434	2.523	2.640	2.792*
.0400	19.69	2.445	2.532	2.645	2.791
.0425	20.35	2.456	2.541	2.650	2.790
<u>.0450</u>	<u>21.00</u>	<u>2.466</u>	<u>2.548</u>	<u>2.653</u>	<u>2.788</u>
.0475	21.65	2.475	2.555	2.657	2.785
.0500	22.31	2.484	2.561	2.659	2.783
.0525	22.96	2.492	2.567	2.661	2.779
.0550	23.62	2.500	2.573	2.663	2.776
.0575	24.27	2.508	2.578	2.664	2.772
.0600	24.93	2.515	2.582	2.665	2.768
.0625	25.58	2.521	2.586	2.666*	2.763
.0650	26.24	2.527	2.590	2.666*	2.759
.0675	26.89	2.533*	2.593*	2.666*	2.754

Effect of sub-  
optimization on  
the EPS

2.7%      1.8%      .5%      .2%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . 15-20 year range

## OUTLET

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0100	\$15.23	\$1.518	\$1.644	\$1.811*	\$2.031*
.0125	15.43	1.522	1.645*	1.806	2.017
.0150	15.62	1.525	1.645*	1.801	2.003
.0175	15.82	1.529	1.645*	1.795	1.990
.0200	16.01	1.532	1.645*	1.790	1.976
.0225	16.21	1.536	1.645*	1.785	1.963
.0250	16.40	1.539	1.645*	1.779	1.950
.0275	16.60	1.542	1.645*	1.774	1.937
.0300	16.79	1.545	1.644	1.769	1.925
.0325	16.99	1.548	1.644	1.764	1.913
.0350	17.19	1.551	1.644	1.758	1.900
.0375	17.38	1.554	1.643	1.753	1.889
.0400	17.58	1.556	1.643	1.748	1.877
.0425	17.77	1.559	1.642	1.743	1.865
.0450	17.97	1.561	1.641	1.738	1.854
.0475	18.16	1.564	1.641	1.733	1.843
.0500	18.36	1.566	1.640	1.728	1.832
.0525	18.55	1.568	1.639	1.723	1.822
<u>.0550</u>	<u>18.75</u>	<u>1.571</u>	<u>1.638</u>	<u>1.718</u>	<u>1.811</u>
.0575	18.95	1.573	1.637	1.713	1.801
.0600	19.14	1.575	1.636	1.708	1.791
.0625	19.34	1.577	1.635	1.703	1.781
.0650	19.53	1.579	1.634	1.698	1.771
.0675	19.73	1.581	1.633	1.693	1.762

## OUTLET

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0700	\$19.92	\$1.583	\$1.632	\$1.889	\$1.753
.0725	20.12	1.584	1.631	1.684	1.743
.0750	20.31	1.586	1.630	1.679	1.735
.0775	20.51	1.588*	1.629	1.675	1.726

Effect of sub-  
optimization on  
the EPS

1.1%      .4%      5.4%      12.1%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . 5-10 year range

## PAN AMERICAN WORLD AIRWAYS 1959

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0300	\$25.16	\$2.651	\$2.712	\$2.784	\$2.871
.0325	25.80	2.663	2.722	2.792	2.874
.0350	26.45	2.676	2.732	2.799	2.877
.0375	27.10	2.687	2.742	2.805	2.880
.0400	27.74	2.699	2.751	2.811	2.882
.0425	28.39	2.709	2.759	2.817	2.883
.0450	29.03	2.720	2.767	2.822	2.885
.0475	29.68	2.729	2.775	2.827	2.886
<u>.04875</u>	<u>30.00</u>	<u>2.734</u>	<u>2.779</u>	<u>2.829</u>	<u>2.886</u>
.0500	30.32	2.739	2.782	2.831	2.887
.0525	30.97	2.748	2.789	2.835	2.887
.0550	31.61	2.757	2.795	2.839	2.888*
.0575	32.36	2.765	2.801	2.842	2.888*
.0600	32.90	2.773	2.807	2.845	2.888*
.0625	33.55	2.781	2.813	2.848	2.887
.0650	34.20	2.788	2.818	2.851	2.887
.0675	34.84	2.795	2.823	2.853	2.887
.0700	35.49	2.802	2.828	2.856	2.886
.0725	36.13	2.808*	2.832*	2.858*	2.885

Effect of sub-  
optimization on  
the EPS

2.7%      1.9%      1.0%      .1%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . Answer Does Not Exist

## PAN AMERICAN WORLD AIRWAYS

1966

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0200	\$60.77	\$2.953	\$3.091	\$3.261*	\$3.469*
.0225	62.46	2.962	3.095	3.257	3.456
.0250	64.16	2.970	3.098	3.254	3.442
.0275	65.86	2.977	3.101	3.250	3.429
.0300	67.56	2.985	3.103	3.245	3.415
.0325	69.26	2.991	3.105	3.241	3.402
.0350	70.96	2.998	3.107	3.236	3.388
.0375	72.65	3.004	3.108	3.230	3.374
.0400	74.35	3.009	3.109*	3.225	3.360
.0425	76.05	3.014	3.109*	3.219	3.346
<u>.0450</u>	<u>77.75</u>	<u>3.019</u>	<u>3.109*</u>	<u>3.213</u>	<u>3.333</u>
.0475	79.45	3.023	3.109*	3.207	3.319
.0500	81.15	3.027	3.108	3.201	3.306
.0525	82.85	3.031	3.108	3.194	3.292
.0550	84.54	3.035	3.107	3.188	3.279
.0575	86.24	3.038	3.106	3.181	3.266
.0600	87.94	3.041*	3.105	3.175	3.253

Effect of sub-  
optimization on  
the EPS

.7%

-

1.5%

4.1%

The number of years from the date of  
issue until conversion occurs that  
would cause the interest rate/con-  
version ratio combination selected  
by the company to be the optimum one . . . . 10 years

## REEVES BROTHERS

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0200	\$30.99	\$ 3.188	\$3.394	\$3.665	\$4.023
.0225	32.36	3.216	3.417	3.681	4.027
.0250	33.74	3.242	3.439	3.695	4.029*
.0275	35.12	3.266	3.458	3.707	4.029*
.0300	36.49	3.289	3.476	3.717	4.027
.0325	37.87	3.310	3.492	3.725	4.023
.0350	39.25	3.329	3.506	3.732	4.018
.0375	40.62	3.347	3.519	3.737	4.012
<u>.0400</u>	<u>42.00</u>	<u>3.364</u>	<u>3.531</u>	<u>3.741</u>	<u>4.004</u>
.0425	43.38	3.380	3.542	3.744	3.996
.0450	44.75	3.395*	3.551*	3.746*	3.987

Effect of sub-  
optimization on  
the EPS

.9%            .6%            .1%            .6%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . .15-20 year range

REEVES BROTHERS

EP	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
0.99	\$ 3.188	\$3.394	\$3.665	\$4.023	\$4.495*
2.36	3.216	3.417	3.681	4.027	4.481
3.74	3.242	3.439	3.695	4.029*	4.464
5.12	3.266	3.458	3.707	4.029*	4.445
6.49	3.289	3.476	3.717	4.027	4.425
7.87	3.310	3.492	3.725	4.023	4.404
9.25	3.329	3.506	3.732	4.018	4.382
10.62	3.347	3.519	3.737	4.012	4.358
<u>12.00</u>	<u>3.364</u>	<u>3.531</u>	<u>3.741</u>	<u>4.004</u>	<u>4.334</u>
13.38	3.380	3.542	3.744	3.996	4.310
14.75	3.395*	3.551*	3.746*	3.987	4.285
sub- on on	.9%	.6%	.1%	.6%	3.7%

of years from the date of  
conversion occurs that  
the interest rate/con-  
ratio combination selected  
pany to be the optimum one . . . .15-20 year range

## REYNOLDS METALS

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0125	\$48.41	\$3.178	\$3.224	\$3.279*	\$3.346*
.0150	49.53	3.182	3.226	3.279*	3.343
.0175	50.65	3.187	3.229	3.279*	3.339
.0200	51.78	3.191	3.232	3.279*	3.336
.0225	52.90	3.195	3.234	3.279*	3.333
.0250	54.02	3.199	3.236	3.279*	3.329
.0275	55.14	3.203	3.238	3.278	3.326
.0300	56.27	3.206	3.239	3.278	3.322
.0325	57.39	3.209	3.241	3.277	3.319
.0350	58.51	3.213	3.242	3.277	3.315
.0375	59.63	3.216	3.244	3.276	3.312
.0400	60.76	3.218	3.245	3.275	3.309
.0425	61.88	3.221	3.246	3.274	3.305
<u>.0450</u>	<u>63.00</u>	<u>3.224</u>	<u>3.247</u>	<u>3.273</u>	<u>3.302</u>
.0475	64.12	3.226	3.248	3.272	3.298
.0500	65.24	3.228	3.249	3.271	3.295
.0525	66.37	3.231	3.249	3.270	3.292
.0550	67.49	3.233	3.250	3.268	3.288
.0575	68.61	3.235	3.250	3.267	3.285
.0600	69.73	3.237*	3.251*	3.266	3.282

Effect of sub-  
optimization on  
the EPS

.4%

.1%

.2%

1.3%

## REYNOLDS METALS

P	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
8.41	\$3.178	\$3.224	\$3.279*	\$3.346*	\$3.427*
9.53	3.182	3.226	3.279*	3.343	3.419
10.65	3.187	3.229	3.279*	3.339	3.411
11.78	3.191	3.232	3.279*	3.336	3.403
12.90	3.195	3.234	3.279*	3.333	3.396
14.02	3.199	3.236	3.279*	3.329	3.388
15.14	3.203	3.238	3.278	3.326	3.381
16.27	3.206	3.239	3.278	3.322	3.374
17.39	3.209	3.241	3.277	3.319	3.367
18.51	3.213	3.242	3.277	3.315	3.360
19.63	3.216	3.244	3.276	3.312	3.353
20.76	3.218	3.245	3.275	3.309	3.346
21.88	3.221	3.246	3.274	3.305	3.340
<u>23.00</u>	<u>3.224</u>	<u>3.247</u>	<u>3.273</u>	<u>3.302</u>	<u>3.334</u>
24.12	3.226	3.248	3.272	3.298	3.328
25.24	3.228	3.249	3.271	3.295	3.322
26.37	3.231	3.249	3.270	3.292	3.316
27.49	3.233	3.250	3.268	3.288	3.310
28.61	3.235	3.250	3.267	3.285	3.305
29.73	3.237*	3.251*	3.266	3.282	3.299
sub- n on	.4%	.1%	.2%	1.3%	2.8%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . .10-15 year range

## ROHR CORPORATION

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0175	\$18.69	\$2.180	\$2.264	\$2.372	\$2.511*
.0200	19.21	2.190	2.271	2.375	2.509
.0225	19.73	2.199	2.278	2.379	2.507
.0250	20.25	2.208	2.285	2.381	2.504
.0275	20.78	2.216	2.291	2.384	2.501
.0300	21.30	2.224	2.296	2.386	2.498
.0325	21.82	2.232	2.301	2.388	2.495
.0350	22.34	2.239	2.306	2.389	2.491
.0375	22.87	2.246	2.311	2.390	2.488
.0400	23.39	2.252	2.315	2.391	2.484
.0425	23.91	2.259	2.319	2.391	2.480
.0450	24.43	2.265	2.322	2.392*	2.476
.0475	24.96	2.270	2.326	2.392*	2.472
.0500	25.48	2.276	2.329	2.392*	2.467
<u>.0525</u>	<u>26.00</u>	<u>2.281</u>	<u>2.332</u>	<u>2.392*</u>	<u>2.463</u>
.0550	26.52	2.286	2.334	2.391	2.459
.0575	27.04	2.290*	2.337*	2.391	2.454

Effect of sub-  
optimization on  
the EPS

.4%      .2%      -      1.9%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . . 15 years

## SPARTANS INDUSTRIES

<u>i</u>	<u>cP</u>	<u>EPS</u> <u>when n=5</u>	<u>EPS</u> <u>when n=10</u>	<u>EPS</u> <u>when n=15</u>	<u>EPS</u> <u>when n=20</u>
.0475	\$36.58	\$2.602	\$2.683	\$2.778	\$2.889
<u>.0500</u>	<u>38.00</u>	<u>2.619</u>	<u>2.697</u>	<u>2.787</u>	<u>2.892</u>
.0525	39.42	2.635	2.709	2.795	2.894*
.0550	40.84	2.650	2.721	2.802	2.894*
.0575	42.25	2.664	2.731	2.808	2.894*
.0600	43.67	2.677	2.741	2.812	2.894*
.0625	45.09	2.689	2.749	2.817	2.892
.0650	46.51	2.700	2.757	2.820	2.890
.0675	47.93	2.711	2.764	2.823	2.887
.0700	49.35	2.721	2.770	2.825	2.884
.0725	50.76	2.730	2.776	2.826	2.881
.0750	52.18	2.739*	2.781*	2.827*	2.877
Effect of sub- optimization on the EPS		4.6%	3.1%	1.4%	.1%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . Answer does not exist

## STOKELY-VAN CAMP

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0250	\$25.87	\$2.485	\$2.567	\$2.668	\$2.789
.0275	26.51	2.497	2.577	2.673	2.790*
.0300	27.15	2.508	2.586	2.678	2.789
.0325	27.79	2.519	2.594	2.683	2.789
.0350	28.44	2.530	2.602	2.687	2.788
.0375	29.08	2.540	2.609	2.690	2.786
.0400	29.72	2.549	2.616	2.694	2.785
.0425	30.36	2.559	2.622	2.696	2.783
<u>.0450</u>	<u>31.00</u>	<u>2.567</u>	<u>2.628</u>	<u>2.699</u>	<u>2.781</u>
.0475	31.64	2.576	2.634	2.701	2.779
.0500	32.28	2.584	2.640	2.703	2.777
.0525	32.92	2.592	2.645	2.705	2.774
.0550	33.56	2.599	2.649	2.707	2.771
.0575	34.21	2.606	2.654	2.708	2.769
.0600	34.85	2.613	2.658	2.709	2.766
.0625	35.49	2.620	2.662	2.710	2.763
.0650	36.13	2.626	2.666	2.710	2.760
.0675	36.77	2.632	2.670	2.711*	2.756
.0700	37.41	2.638*	2.673*	2.711*	2.753
Effect of sub- optimization on the EPS		2.8%	1.7%	.5%	.3%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . .15-20 year range

## UNITED MERCHANTS AND MANUFACTURERS

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0225	\$25.62	\$3.740	\$3.816	\$3.910	\$4.023
.0250	26.86	3.774	3.848	3.937	4.046
.0275	28.09	3.805	3.877	3.963	4.057
.0300	29.32	3.834	3.903	3.986	4.085
.0325	30.55	3.861	3.927	4.006	4.101
.0350	31.79	3.886	3.950	4.025	4.115
.0375	33.02	3.909	3.970	4.043	4.128
<u>.0400</u>	<u>34.25</u>	<u>3.931</u>	<u>3.990</u>	<u>4.058</u>	<u>4.139</u>
.0425	35.48	3.951	4.007	4.073	4.148
.0450	36.71	3.970	4.024	4.086	4.157
.0475	37.95	3.988*	4.039*	4.097*	4.165*

Effect of sub-  
optimization on  
the EPS

1.4%      1.2%      1.0%      .6%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . Answer does not exist

## ED MERCHANTS AND MANUFACTURERS

	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20	<u>EPS</u> when n=25
5.62	\$3.740	\$3.816	\$3.910	\$4.023	\$4.162
5.86	3.774	3.848	3.937	4.046	4.179
6.09	3.805	3.877	3.963	4.057	4.192
6.32	3.834	3.903	3.986	4.085	4.204
6.55	3.861	3.927	4.006	4.101	4.213
6.79	3.886	3.950	4.025	4.115	4.221
7.02	3.909	3.970	4.043	4.128	4.228
<u>7.25</u>	<u>3.931</u>	<u>3.990</u>	<u>4.058</u>	<u>4.139</u>	<u>4.233</u>
7.48	3.951	4.007	4.073	4.148	4.237
7.71	3.970	4.024	4.086	4.157	4.240
7.95	3.988*	4.039*	4.097*	4.165*	4.242*
ab- on	1.4%	1.2%	1.0%	.6%	.2%

of years from the date of  
conversion occurs that  
the interest rate/con-  
o combination selected  
ny to be the optimum one . . . Answer does not exist

## VENDO

<u>i</u>	<u>cP</u>	<u>EPS</u> when n=5	<u>EPS</u> when n=10	<u>EPS</u> when n=15	<u>EPS</u> when n=20
.0200	\$38.28	\$1.113*	\$1.202*	\$1.327*	\$1.504*
.0225	39.20	1.113*	1.200	1.322	1.493
.0250	40.12	1.113*	1.198	1.316	1.481
.0275	41.04	1.113*	1.196	1.311	1.470
.0300	41.97	1.113*	1.194	1.305	1.459
.0325	42.89	1.113*	1.192	1.300	1.447
.0350	43.81	1.113*	1.189	1.294	1.437
.0375	44.73	1.113*	1.187	1.289	1.426
.0400	45.66	1.112	1.185	1.283	1.416
.0425	46.58	1.112	1.183	1.278	1.405
<u>.0450</u>	<u>47.50</u>	<u>1.112</u>	<u>1.181</u>	<u>1.273</u>	<u>1.395</u>
.0475	48.42	1.111	1.179	1.267	1.385
.0500	49.34	1.111	1.176	1.262	1.375
.0525	50.27	1.111	1.174	1.257	1.366
.0550	51.19	1.110	1.172	1.252	1.356
.0575	52.11	1.110	1.170	1.247	1.347
.0600	53.03	1.110	1.167	1.242	1.338
.0625	53.96	1.109	1.165	1.237	1.329
.0650	54.88	1.109	1.163	1.232	1.321
.0675	55.80	1.108	1.161	1.228	1.312
Effect of sub- optimization on the EPS		.1%	1.8%	4.3%	7.8%

The number of years from the date of issue until conversion occurs that would cause the interest rate/conversion ratio combination selected by the company to be the optimum one . . . . Less than five years

TABLE 25--The number of years from the date of issue until conversion occurs that would cause the interest/rate conversion ratio combination selected by the company to be the optimum one

<u>Company</u>	<u>Year of Issue</u>	<u>Rating</u>	<u>Optimum Conversion Period</u>
Air Reduction	1962	BBB	15-20 year range
Aurora	1965	B	10 years
Bobbie Brooks	1966	BB	10 years
Burlington	1966	BBB	10-15 year range
Champion P & F	1959	BB	10 years (elapsed)
Collins & Aikman	1966	BBB	5-10 year range
Commercial Solvents	1966	BB	5-10 year range
Copperweld Steel	1959	BB	5-10 year range (elapsed)
General Instruments	1965	BB	5-10 year range
Granite City Steel	1964	BB	25-30 year range
Grant	1965	BBB	10-15 year range
Great Northern Paper	1966	BB	10-15 year range
Hess Oil	1966	BBB	15-20 year range
Outlet	1966	B	5-10 year range
Pan American Airlines	1959	BB	Does not exist
Pan American Airlines	1966	BB	10 years
Reeves Brothers	1966	BB	15-20 year range
Reynolds Metals	1966	BB	10-15 year range
Rohr	1966	BB	15 years
Spartans	1965	B	Does not exist
Stokely-Van Camp	1962	BB	15-20 year range

<u>Company</u>	<u>Year of Issue</u>	<u>Rating</u>	<u>Optimum Conversion Period</u>
United Merch. & Manuf.	1965	BB	Does not exist
Vendo	1960	BB	0-5 year range (elapsed)

## CHAPTER IV

## THE INTEREST RATE CONVERSION PRICE TRADE-OFF

## Trade-Off Opportunities

In order to select the optimum interest rate and corresponding conversion ratio combination for a given convertible bond at a given point in time, it is necessary to know what potential combinations are available to the company issuing the bond. It is known that the actual combination chosen by the corporation was one available alternative. In order to determine what other alternatives were available, one must calculate what trade-off relationship existed between the conversion ratio and interest rate.<sup>1</sup> The percentage change in the conversion price that would have been necessitated by a one percent change in the actual interest rate when a convertible bond was issued will be referred to as the  $d$  value. This is the reciprocal of the  $F$  value in the maximization model and can be viewed as expressing the trade-off opportunity schedule for that bond.

$$d = \frac{\text{percentage change in cp}}{\text{actual change in } i}$$

$$F = \frac{\text{actual change in } i}{\text{percentage change in cp}}$$

---

<sup>1</sup>The mechanics used in calculating the trade-off relationship for each bond were described in Chapter II.

If the  $d$  value is higher for a bond with a quality rating of  $x$  at time period  $y$  than it is for a bond with a quality rating of  $x'$  at time interval  $y'$ , then this illustrates that in the case of the first bond the market put more value on the interest rate aspect of the convertible. The interest factor was relatively more valuable in the trade-off against the conversion price in the first example, while in the latter example the interest rate was a comparatively less expensive commodity.

#### Objectives

The primary objectives of the dissertation were discussed in Chapters II and III. A secondary objective is to determine whether any relevant characteristics were revealed from the trade-off data generated from the conducted case studies which would suggest the desirability of a future comprehensive study in that specific area. One possible characteristic is that for a higher rated bond the percentage increase in the conversion price for every one percent that a company is willing to raise its interest rate will be more than that of a lower rated bond. A second possible characteristic is that for convertible bonds issued in recent years the percentage increase in the conversion price for every one percent increase in the interest rate will be more than a bond of equivalent quality issued in the late 1950's or early 1960's.

An alphabetical listing of all of the bonds included in the study is shown in Table 1, including the year of issue,

the quality rating, and the d and F values for each bond.

TABLE 26.--Presentation of d and F values

<u>Company</u>	<u>Year of Issue</u>	<u>Rating</u>	<u>d</u>	<u>F</u>
Air Reduction	1962	BBB	14.16	.0706
Aurora	1965	B	14.49	.0690
Bobbie Brooks	1966	BB	8.49	.1178
Burlington	1966	BBB	12.76	.0784
Champion P & F	1959	BB	7.15	.1399
Collins and Aikman	1966	BBB	8.59	.1164
Commercial Solvents	1966	BB	7.28	.1374
Copperweld Steel	1959	BB	4.89	.2045
General Instruments	1965	BB	8.41	.1177
Granite City Steel	1964	BB	11.94	.0838
W. T. Grant	1965	BBB	14.59	.0685
Great Northern Paper	1966	BB	7.54	.1326
Hess Oil	1966	BBB	12.84	.0778
Outlet	1966	B	4.17	.2396
Pan American Airways	1959	BB	8.61	.1161
Pan American Airways	1966	BB	8.74	.1144
Reeves Brothers	1966	BB	13.11	.0763
Reynolds Metals	1966	BB	7.13	.1403
Rohr	1966	BB	8.04	.1244
Spartans	1965	B	14.93	.0670
Stokely-Van Camp	1962	BB	8.27	.1209
United Merchants and Manuf.	1965	BB	14.39	.0695
Vendo	1960	BB	7.77	.1286

### Bond Ratings

Before an attempt is made to draw conclusions about how the quality of the bond affects its trade-off opportunity schedule, it is advantageous to review the meaning of the bond quality ratings. The ratings used in this paper were those assigned by Standard and Poor's.<sup>2</sup> Bond rating agencies such as S & P provide the investor with their current opinions on the quality of most large, publicly held corporate and governmental bond issues. These rating agencies do not sell bonds, and their ratings are assigned by committees rather than by single individuals. This minimizes the possibility of personal bias or ulterior motives causing a bond to be given a higher or lower rating. In fact, these ratings are so widely accepted that government regulatory agencies utilize them in evaluating the safety of the securities held by banks and insurance companies.<sup>3</sup>

Bond ratings attempt to rank bonds in relation to their probability of default.<sup>4</sup> Bonds rated AAA are of the highest quality and have the lowest probability of default. "Double-A" bonds are also of a high quality but not quite as risk-free as triple-A bonds. Bonds rated A and BBB are generally considered to be of high to medium quality. Bonds not falling into these first four categories are considered to have an

---

<sup>2</sup>Standard and Poor's Bond Guides 1959-1966.

<sup>3</sup>Edward Zinbarg, "What's in a Rating?" Barrons May 4, 1964, p. 4.

<sup>4</sup>These ratings are not perfect but they are the best means available for evaluating the risk that is associated with various bonds.

element of risk associated with them; banks, for example, cannot buy any bond rated below triple-B.<sup>5</sup>

Braddock Hickman of the National Bureau of Economic Research made a study of corporate bonds sold between 1900-1943. He found that the agencies had been quite accurate in their ratings of bond issues. The highest rated bonds had the smallest percentage of default, while the lowest rated bonds had the highest percentage of default, approximately seven times as great as the highest rated bonds.<sup>6</sup>

TABLE 27.--Bond quality ratings as related to their rate of default

	<u>Rating Category</u> (composite of ratings of various agencies)	<u>Default Rate</u> (% of par value)
1=Highest=triple-A	1	6
9=Lowest=C	2	6
	3	13
	4	19
	5-9	42

Although the rating agencies accurately predicted the probability of default, the large investors who purchased a portfolio of well-diversified, higher-yielding bonds below the top grades would have had satisfactory results if they held the bonds through all corporate difficulties experienced

---

<sup>5</sup>Jerome B. Cohen and Edward D. Zinbarg, Investment Analysis and Portfolio Management (Richard D. Irwin, Illinois, 1967), p. 358-362.

<sup>6</sup>W. Braddock Hickman, Corporate Bond Quality and Investor Experience (National Bureau of Economic Research, New York, 1958) p. 10.

until the bonds were finally paid off. The yield on the entire portfolio after allowing for losses would have exceeded the yield on a high-grade portfolio.<sup>7</sup> However, one should not ignore the psychological dangers involved here because even large institutions will be tempted to sell bonds at a loss when the issuer encounters serious financial difficulty.<sup>8</sup>

#### Analysis of Trade-Off Opportunity Data

In analyzing the data that are presented in Table 26, 28 and 29, Figures 7 and 8, there are certain characteristics which can be observed.

#### Date of issue - its influence on the trade-off

First, the  $d$  value increases in successive years from 1959 through 1965 and then declines in 1966. Although this trend tends to exist in all of the classes of bonds studied, it is portrayed most clearly when one views the mean average of all of the bonds analyzed in the various years. The mean average  $d$  value for all bonds being analyzed by years rose in each successive year being studied from 1959 through 1965 and then declined in 1966 as shown in Figure 7 and Table 28. The mean  $d$  value rose from 6.88 in 1959 to 7.77 in 1960; 11.21 in 1962; 11.94 in 1964; 13.36 in 1965, and then declined to 8.97 in 1966. It is apparent that the interest factor

---

<sup>7</sup> Ibid. pp. 25-40.

<sup>8</sup> Douglas H. Bellemore and John C. Ritchie, Investments (South-Western Publishing Company, New York, 1969) p. 207.

became relatively more valuable each year from 1959 through 1965 as compared to the conversion price, and then declined in its relative value in 1966. The turnaround in 1966 could represent a new downward trend; however, it is more probable that the credit crunch of 1966 which caused interest rates to be higher than in any other period of time within the study was the reason for the turnaround.

As the interest rate that the investor is able to earn becomes a more abundant commodity, its relative values as compared to other commodities, such as the conversion ratio, will decline. The decline in the relative value of the interest rate as compared to the conversion ratio will cause a decline in the  $d$  value.

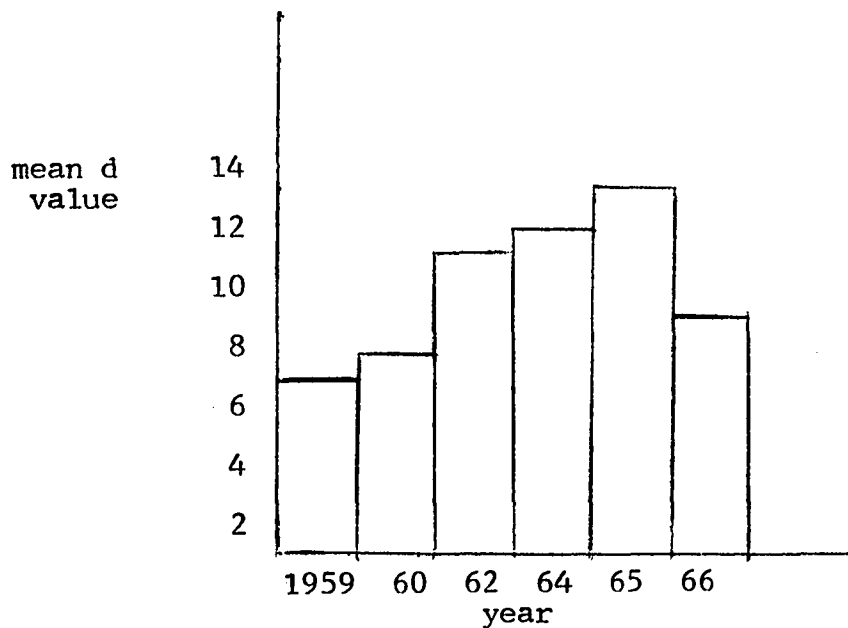


Fig. 7.--Mean average  $d$  value for all bonds.

TABLE 28.--Mean average d value  
for all bonds

<u>Year</u>	<u>all bonds mean d</u>
1959	6.88
1960	7.77
1962	11.21
1964	11.94
1965	13.36
1966	8.97

Quality of bonds-its influence on the trade-off

A second observation which can be made from the data compiled in the study is that the mean d value for BBB convertible bonds was substantially higher than the mean d value for BB convertible bonds in all three of the years that bonds with both of these ratings were analyzed. These data are shown in Figure 8 and Table 29.

TABLE 29.--The mean values of d for BB  
and BBB convertible bonds in  
the years specified

	<u>BB</u>	<u>BBB</u>
1962	8.27	14.16
1965	11.40	14.59
1966	8.62	11.40

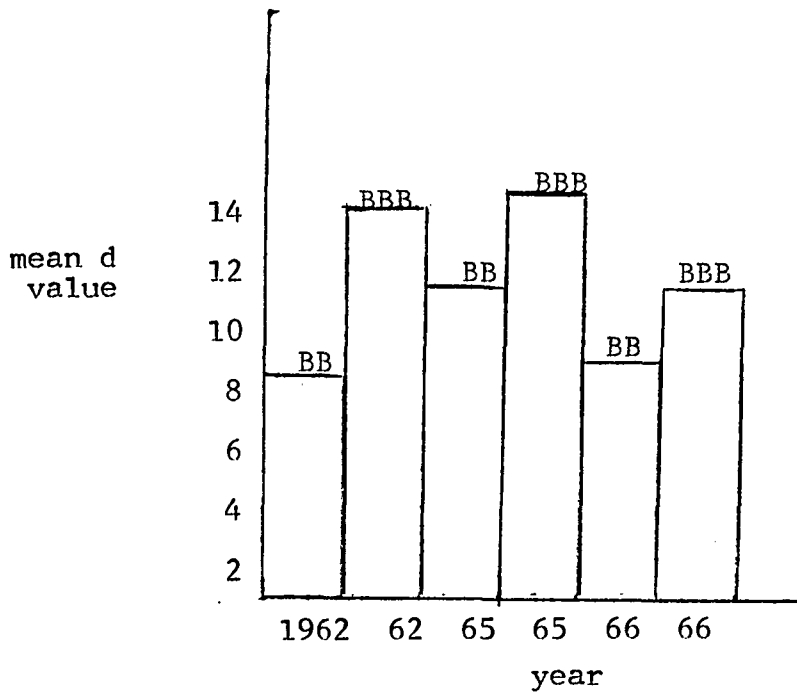


Fig. 8.--Mean values of d for BB and BBB convertible bonds in the years specified.

In 1962 the mean d value for double-B bonds was 8.27, while for triple-B bonds it was 14.16. In 1965 the mean d value for double-B bonds increased to 11.40, but the mean d value for triple-B bonds increased to 14.59. In 1966 the mean d value for double-B bonds decreased to 8.62 while mean d value for triple-B bonds decreased to 11.40.

Comparative analysis cannot meaningfully be made with B rated bonds due to the lack of available relevant information for these bonds.

The following analysis will explain why the  $d$  value was greater for triple-B convertible bonds than for double-B convertible bonds.

Triple-B bonds are often considered to be the lowest rated of the high quality, low risk bonds. For example, banks can only buy bonds that are rated triple-B or higher. When an investor purchases a convertible bond of triple-B quality rating he is getting a bond that promises relatively risk-free interest payments and redemption of the bond at maturity if the investor so desires.

One who purchases any convertible bond is accepting more risk and receiving a lower interest yield than if he had purchased a straight bond in the same company; therefore, he certainly is hoping for capital appreciation in his bond which would be caused by an increase in the conversion value. An investor who purchases a triple-B convertible bond, however, is placing a great deal of weight on the safety aspect of the bond that is related to the ability of the company to meet its interest payments.

In general, investors who purchase BBB convertible bonds put relatively more value on the interest factor and relatively less value on conversion factor than investors who purchase double-B convertible bonds, or convertibles of an even lower quality.

An investor who puts relatively high value on the interest yield and safety associated with BBB convertible bond will

demand a greater decrease in the conversion price of the convertible for a one percent decrease in the interest rate than an investor who invests in a lower quality bond and puts relatively more weight on the conversion value and relatively less weight on the interest yield and safety feature of the bond. The  $d$  value, therefore, was higher for triple-B convertible bonds than for double-B convertible bonds for the years analyzed in this dissertation.

Based on the trade-off data generated from the case studies in the paper, it appears that the  $d$  value is affected by both the quality rating of the bond and the year in which it is issued. Future research should be utilized to explore the validity and the relevance of these observations.

#### Empirical Data

In order to determine what  $d$  and  $F$  values exist for each convertible bond the following procedure was undertaken.

As an example, if a given BB rated bond was issued on June 23, 1966 with a seven percent interest rate, then all of the convertible bonds listed on the N. Y. S. E. on the date of issue, with a quality rating of BB and a market price no greater than \$1150 and no less than \$850, and an interest rate of at least four percent were taken as a sample for determining what trade-off exists between the interest rate and conversion ratio for that bond.<sup>9</sup> For each bond chosen in

---

<sup>9</sup>The reasons for selecting the sample in this manner were discussed in Chapter II.

this sample it was then necessary to calculate:

1. the yield to maturity and
2. the percentage decline that would be necessary in the conversion price in order to eliminate any premium that may exist on the bond.

A linear regression analysis is then used to determine what effect a one percent rise or decline in the interest rate will have on the conversion price of a bond of the specific quality rating at the specified date from which the sample was chosen. The linear regression will generate the d value and its reciprocal will be the F value.

For each of the 23 convertibles analyzed in this dissertation: the d value, the F value, and all of the relevant information needed to calculate these values are shown on the following pages.

TABLES 30-52.--F and d values for each bond

<u>Company</u>	<u>AIR REDUCTION</u>	<u>8-29-62</u>	<u>Premium</u>
	Rating BBB	d = 14.16 F = .0706	
American Distilling		.0398	.215
Baxter Laboratories		.0338	.447
Champion P & F		.0382	.461
Combustion Engineering		.0365	.160
Dresser Industries		.0465	.551
Eastern Stainless Steel		.0535	.503
Intern'l Minerals & Chem.		.0355	.181
Oxford Paper		.0375	.236

AURORA PLASTICS 10-27-65

Rating B d = 14.49  
F = .0690

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Automatic Canteen	.0380	.337
Baltimore & Ohio RR.	.0475	.558
Colorado Fuel & Iron	.0427	.325
Douglas Aircraft	.0320	.301

BOBBIE BROOKS 8-24-66

Rating BB d = 8.49  
F = .1178

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Armour	.0530	.236
Copperweld Steel	.0495	.200
Grace (W. R.)	.0505	.250
Grand Union	.0492	.148
Reynolds Metal	.0472	.221
Stevens	.0479	.177

BURLINGTON IND. 9-13-66  
 Rating BBB d = 12.76  
 F = .0784

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Allegheny Ludlum	.0410	.065
Dresser Industries	.0525	- .008
Eastern Stainless Steel	.0580	.383
Grant (W. T.)	.0458	.157
Macy	.0506	.135
Sinclair	.0482	.076
Stauffer Chemical	.0486	.285

CHAMPION P & F 1-15-59  
 Rating BBB d = 7.15  
 F = .1399

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Colorado Fuel & Iron	.0432	.210
Combustion Engineering	.0254	.108
Dresser Industries	.0325	.412
Grace	.0348	.165
Oxford Paper	.0377	.221
Vanadium Corp Amer	.0365	.341
Wheeling Steel Corp	.0280	.103

COLLINS & AIKMAN 6-21-66

Rating BBB      d = 8.59  
                          F = .1164

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Allegheny Ludlum	.0368	.138
American Distilling	.0518	.237
Continental Baking	.0484	.177
Eastern Stainless Steel	.0565	.345
Grant	.0338	.080
Libby, McNeil & Libby	.0405	.155
Macy	.0412	.240
Rockwell Standard	.0438	.195
Sinclair	.0440	.107
Stauffer Chemical	.0418	.256

COMMERCIAL SOLVENTS 6-23-66

Rating BB      d = 7.28  
                          F = .1374

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Armour	.0443	.296
Celanes	.0413	.240
Cluett Peabody	.0337	.060
Copperweld Steel	.0415	.168
Fansteel Met'l'gical	.0350	.016
General American Oil	.0400	.259
General Time	.0380	.242
Grace (W. R.)	.0425	.257

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Grand Union	.0432	.170
Granite City Steel	.0552	.143
Intern'l Minerals & Chem.	.0417	.235
Reynolds Metal	.0376	.185
Stokely-Van Camp	.0460	.129
Talcott	.0542	.376
Vendo	.0459	.330

COPPERWELD STEEL 12-16-59

Rating BB  
d = 4.89  
F = .2045

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Boeing	.0492	.302
Cer De Pas	.0510	.333
Food Fair	.0438	.210
General Amer. Oil	.0504	.308
Grand Union	.0322	.374
J. R. McDermott	.0555	.324
National Tea	.0318	- .020
Pan American Airlines	.0487	.225
Rohr Aircraft Corp	.0483	.140
Sieberling Rubber	.0528	.170

GENERAL INSTRUMENTS 12-3-65

Rating BB                    d = 8.41  
    F = .1177

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
American Mach & Found	.0475	.640
Armour	.0376	.305
Celanes	.0350	.241
Fansteel Met'l'fical	.0510	.381
Food Fair	.0405	.351
General Time	.0400	.339
Granite City Steel	.0444	.223
Hunt	.0480	.296
Stokely-Van Camp	.0400	.218
Vendo	.0350	.367

GRANITE CITY STEEL 12-8-64

Rating BB                    d = 11.94  
    F = .0838

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Burroughs Corp	.0410	.363
Copperweld Steel	.0395	.153
Food Fair	.0436	.292
General Amer. Oil	.0425	.232
General Time	.0468	.489
Hunt Foods	.0438	.340
Litton Industries	.0285	.166
Stokely-Van Camp	.0404	.305
Talcott	.0395	.332
Vornado	.0438	.192

GRANT W. T.            6-23-65  
 Rating BBB            d = 14.59  
                              F = .0685

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Allegheny Ludlum	.0379	.255
American Distilling	.0431	.266
Baxter Laboratories	.0328	.282
Continental Baking	.0355	.196
Dresser Industries	.0382	.247
Eastern Stainless Steel	.0462	.460
Libby, McNeil & Libby	.0375	.103
Sinclair	.0388	.257

GREAT NORTHERN PAPER    3-29-66  
 Rating BB            d = 7.54  
                              F = .1326

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Armour	.0379	.163
Celanes	.0411	.198
Food Fair	.0535	.304
General Amer. Oil	.0428	.135
General Telephone & Electronics	.0353	.223
General Time	.0416	.278
Grace (W.R.)	.0370	.259
Granite City Steel	.0472	.179
Grand Union	.0372	.020
Hunt Foods	.0512	.322

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Intern'l Minerals & Chem.	.0324	.195
Stokely-Van Camp	.0360	.091
Vendo	.0432	.318

HESS OIL

8-1-66

Rating BBB

d = 12.84

F = .0778

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Allegheny Ludlum	.0404	.171
American Distilling	.0535	.236
Continental Baking	.0443	.124
Dresser Industries	.0368	.022
Eastern Stainless Steel	.0565	.360
Grant	.0427	.080
Libby, McNeil & Libby	.0500	.078
Macy	.0436	.193
Rockwell Standard	.0474	.243
Sinclair	.0437	.052
Stauffer Chemical	.0449	.254

OUTLET CO 7-12-66  
 Rating B d = 4.17  
 F = .2396

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Baltimore & Ohio RR.	.0507	.619
Colorado Fuel & Iron	.0625	.354
Storer Broadcasting	.0419	.236

PAN AM. WORLD AIRWAYS 7-30-59

Rating BB d = 8.61  
 F = .1161

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Food Fair	.0355	.2063
Garrett	.0397	.1539
General Amer Oil	.0480	.3064
J. R. McDermott	.0507	.3604
Merritt Chapman	.0555	.0987
National Tea	.0277	.0063
Boeing	.0450	.3150
Douglas Aircraft	.0490	.4337

PAN AM                    8-10-66  
 Rating BB                 d = 8.74  
                                  F = .1144

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Armour	.0540	.247
Celanes	.0469	.222
Cluett Peabody	.0440	.031
Copperweld Steel	.0445	.153
Fansteel Met'l'gical	.0540	.085
General Amer. Oil	.0469	.144
General Telephone & Elec	.0384	.165
General Time	.0540	.252
Grace (W.R.)	.0460	.215
Grand Union	.0500	.122
Granite City Steel	.0554	.118
Intern'l Minerals & Chem	.0460	.218
International Silver	.0344	.052
Reynolds Metal	.0440	.190
Stevens	.0396	.049
Stokely-Van Camp	.0435	.037
Talcott	.0585	.363
Vendo	.0511	.354

REEVES BROTHERS 1-11-66  
 Rating BB d = 13.11  
 F = .0763

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Celanes	.0330	.187
Fansteel Met'l'rgical	.0430	.342
Food Fair	.0422	.308
General Amer Oil	.0390	.136
Granite City Steel	.0392	.207
Hunt	.0449	.341
Stokely-Van Camp	.0315	.122
Talcott	.0460	.393
Vendo	.0344	.351

REYNOLDS METALS 3-15-66  
 Rating BB d = 7.13  
 F = .1403

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Armour	.0390	.181
Celanes	.0422	.225
Copperweld Steel	.0403	.123
Fansteel Met'l'gical	.0439	.084
Food Fair	.0515	.288
General Amer Oil	.0467	.160
General Telephone & Elec	.0347	.128
General Time	.0421	.289
Grace (W.R.)	.0374	.225

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Granite City Steel	.0466	.175
Hunt Foods	.0505	.311
Intern'l Minerals & Chem	.0347	.182
Stokely-Van Camp	.0387	.132
Talcott	.0488	.344
Vendo	.0395	.290

ROHR AIRCRAFT

12-2-66

Rating BB

d = 8.04  
F = .1244

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
American Airlines	.0322	.129
Cluett Peabody	.0453	.154
Copperweld Steel	.0415	.193
General Amer Oil	.0471	.019
General Telephone & Elec	.0357	.172
General Time	.0570	.301
Grace (W.R.)	.0485	.302
Grand Union	.0500	.205
Intern'l Minerals & Chem	.0486	.212
International Silver	.0330	.053
Pan American Air	.0481	.285
Reynolds Metals	.0455	.222
Stokely-Van Camp	.0596	.188
Talcott	.0621	.377
Vendo	.0595	.418

SPARTANS INDUSTRIES 12-17-65

Rating B d = 14.93  
F = .0670

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
Baltimore & Ohio RR	.0482	.579
Colorado Fuel & Iron	.0498	.340
NAFI	.0435	- .003
Standard Packaging	.0645	.473

STOKELY-VAN CAMP 3-6-62

Rating BB d = 8.27  
F = .1209

<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
American Machine & Fdry	.0364	.480
Copperweld Steel	.0444	.322
Crowell Collier & Macmil	.0355	.268
Food Fair	.0290	.115
General American Oil	.0394	.125
General Time	.0395	.313
Mc Call	.0390	.225
National Tea	.0249	.080
Royal McBee	.0548	.647
Seiberling Rubber	.0635	.279
Vornado	.0435	.241



<u>Company</u>	<u>Yield to Maturity</u>	<u>Premium</u>
National Tea	.0348	.103
Olin Mathieson	.0450	.296
Pan American	.0506	.307
Philco Co.	.0353	.336
Rohr Aircraft	.0516	.244
Seiberling Rubber	.0604	.331
Smith Corona	.0488	.348
Royal McBee	.0536	.495

## CHAPTER V

## SUMMARY AND CONCLUSIONS

## Summary

The use of convertible debentures as a major source of capital has grown rapidly in recent years. However, possibly due to the fact that its popularity had mushroomed only in the late 1950's and in the 1960's, there had never been developed a systematic method for selecting the optimum interest rate and corresponding conversion ratio when a convertible bond was issued.

The optimum combination for each company is one that would maximize the earnings per share and, therefore, the price per share of the company's common stock without increasing the risk associated with the ownership of the stock. Consequently, this would maximize the wealth of those investors who are common shareholders on the date that the convertible bonds are issued.

A study conducted by Fred Weston and Eugene Brigham and a study conducted specifically for this paper both indicated that many corporate financial executives did not utilize a systematic, rational method of selecting the optimum interest rate and conversion ratio where they recommended the issuance and proceeded to issue convertible bonds. There

were some indications also that they were not cognizant of the various alternatives available to them.

In this dissertation a model was developed that would enable a company that is issuing convertible bonds to select the optimum interest rate and corresponding conversion ratio. The model is shown below.

$$\text{EPS} = \frac{(i-i_1 + F) (A + BQ)}{D (i-i_1 + F) + Fy} \quad (r)$$

where:

$$A = cp_1 x$$

$$B = cp_1 y$$

$$D = cp_1 s$$

$$Q = (1 + r - i + t)^n$$

x = assets owned by the company at the date the convertible bonds are issued

y = price of the bond times the number of bonds

r = anticipated return on assets

n = years to conversion

b = additional shares from conversion

(conversion ratio times the number of bonds)

i = coupon interest rate

t = annual tax savings from the interest payments  
expressed as a percentage of i

s = number of shares of common stock initially outstanding

$i_1$  = actual interest rate selected by the corporation

$cp_1$  = actual conversion price selected by the company

F =  $\frac{\text{absolute change in the interest rate}}{\text{percentage change in the conversion price}}$

Case studies were then conducted to determine whether any convertible bonds have sub-optimum interest rate/conversion ratio combinations.

All of the convertible bonds listed on the N. Y. S. E. on March 1, 1970 which were rated B, BB, or BBB, and were issued without the use of a rights offering in the years 1959 through 1966 were included in the study conducted for this dissertation. There were a total of 23 convertible bonds that met these qualifications.

For each of these bonds the model that was developed in the dissertation was used to generate a series of optimum interest rates and corresponding conversion ratios, in order to coincide with a series of potential conversion dates. The first of these dates was five years from the date of issue, and subsequent dates were at successive five-year intervals until the maturity date of the bonds.

The optimum interest rates and conversion ratios were compared to those actually chosen by each company and an analysis was made to determine to what degree, if any, the earnings per share for each company could have been increased at the successive alternative conversion dates if the optimum rather than the actual interest rate and conversion ratio were adopted.

Six companies, representing 26.09 percent of all of the companies analyzed, chose interest rate/conversion ratio combinations that were definitely sub-optimum. And it is probable that sub-optimum combinations were also chosen for some of the

other seventeen convertible bonds. In some cases this sub-optimization could affect the earnings per share by over ten percent.

If each of the companies that issue convertible bonds in the future would utilize the model developed in this dissertation, then it would be able to select the optimum interest rate and corresponding conversion ratio that would maximize the wealth of its common stockholders.

In order to select the optimum interest rate and corresponding conversion ratio for a given convertible bond, it is necessary to know what potential combinations were available to the issuing corporation. It is known that the actual combination chosen by the corporation was one available alternative. Using this as a starting point, it is possible to calculate what other alternatives were available if one knows the percentage change in the conversion price that would have been necessitated by a one percent change in the actual interest rate when the convertible bond was issued. This trade-off relationship is referred to as the d value.

$$d = \frac{\text{percentage change in cP}}{\text{actual change in i}}$$

As the d value increases, the market is treating the interest rate as a more valuable commodity and is demanding a greater increase in the conversion price for a given change in the interest rate.

For the 23 companies analyzed in the study it was observed

that the  $d$  value was consistently higher for BBB convertible bonds than for BB convertible bonds. Furthermore, the  $d$  value increased in each of the years studied from 1959 through 1965 and then declined sharply in 1966.

### Conclusions

There are three objectives that have been accomplished in the dissertation.

First, a model has been developed that can be utilized in selecting the optimum interest rate and corresponding conversion ratio for a given company issuing convertible bonds at a given point in time.

Second, it has been shown that a substantial percentage of those corporations that were analyzed in the dissertation chose sub-optimum interest rate/conversion ratio combinations when they issued convertible bonds. Based on these results it is not possible to draw conclusions as to the degree of sub-optimization that will exist in convertible bonds to be issued in the future. However, if the model developed in the dissertation is not utilized, there is no reason to assume that the corporate financial managers will come any closer to selecting the optimum interest rate/conversion ratio combinations in the future than they have in the past. If the model is utilized, then the optimum combinations can be selected for the convertible bonds that will be issued.

Third, it has been observed that for the convertible bonds studied in the dissertation, for every one-quarter of one percent that a company was willing to raise its interest

rate when it issued convertible bonds, the corresponding percentage increase in its conversion price that was acceptable to the market

- 1) was greater for the BBB convertible bonds than it was for the BB convertible bonds and
- 2) rose in each of the years studied from 1959 through 1965 and then declined in 1966.

Future research is necessary to thoroughly examine the relevance and validity of these two observations.

## BIBLIOGRAPHY

Books

- Archer, Stephen H. and D'Ambrosio, Charles A. Business Finance: Theory and Management. MacMillan and Company, New York, 1966.
- Barges, Alexander. The Effect of Capital Structure on the Cost of Capital. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1963.
- Bauman, W. Scott. Estimating the Present Value of Common Stocks by the Variable Rate Method. Bureau of Business Research, Michigan, 1964.
- Beach, E. F. Economic Models. John Wiley and Sons, New York, 1957.
- Bellèmore, Douglas H. and Ritchie, John C. Investments. South-Western Publishing Company, New York, 1969.
- Cohen, Jerome B. and Robbins, Sidney M. The Financial Manager. Harper and Row, New York, 1966.
- Cohen, Jerome B. and Zinbarg, Edward D. Investment Analysis and Portfolio Management. Richard D. Irwin Inc., Homewood Illinois, 1967.
- \_\_\_\_\_ Corporate Financing. Investment Dealers' Digest, 1951-1960, 1961-1963, 1964-1966.
- Dean, Joel. Managerial Economics. Prentice-Hall Inc., Englewood Cliffs, N. J., 1951.
- Dorfman, Robert. Samuelson, Paul A. and Solow, Robert M. Linear Programming and Economic Analysis. McGraw-Hill, New York, 1958.
- Durand, David. "The Cost of Debt & Equity Funds for Business: Trends & Problems of Measurement," Conference on Research in Business Finance. pp. 215-261. National Bureau of Economic Research, New York, 1952.

- Ezekiel, Mordecai. and Fox, Karl A. Methods of Correlation and Regression Analysis. John Wiley and Sons, New York, 1959.
- Graham, Benjamin. Dodd, David L. and Cottle, Sidney. Security Analysis. 4th Ed. McGraw-Hill, 1962.
- Guild, Samuel E. Stock Growth and Discount Tables. Financial Publishing Company, Boston, 1931.
- Guthman, Jerry G. and Dougall, Herbert E. Corporate Financial Policy. 4th Ed. Prentice-Hall, Englewood Cliffs, N. J. 1962.
- Hickman, W. Braddock. Corporate Bond Quality and Investor Experience. National Bureau of Economic Research, New York, 1958.
- \_\_\_\_\_ ISL Stock Price Index. New York, 1959 through 1969.
- Lerner, Eugene M. and Carleton, Willard T. A Theory of Financial Analysis. Harcourt, Brace and World Inc., New York, 1966.
- Lindsay, R. And Sametz, A. W. Financial Management: An Analytical Approach. Richard D. Irwin, Homewood, Illinois, 1963.
- Miller, David W. And Starr, Martin K. Executive Decisions and Operations Research. Prentice-Hall, Englewood Cliffs, N. J. 1960.
- \_\_\_\_\_ Moody's Manual. Moody's Investor Service, New York, 1958 through 1970.
- Pilcher, James C. Raising Capital With Convertible Securities. Ann Arbor Michigan Business Studies, Vol. XII No. 2, 1955.
- Robichek, Alexander A. and Myers, Stewart C. Optimal Financing Decisions. Prentice-Hall, Englewood Cliffs, N. J., 1965.
- Smillie, K. W. An Introduction to Regression and Correlation. Academic Press, New York, 1966.
- Soldofsky, R. M. and Murphy, James T. Growth Yields on Common Stocks: Theory and Tables. Bureau of Business and Economic Research, Iowa, 1964.

Solomon, Ezra. The Theory of Financial Management. Columbia University Press, New York, 1963.

---

Standard and Poor's Bond Guide.  
Standard and Poor's, New York 1959 through 1969.

Weston, J. Fred. and Brigham, Eugene F. Essentials of Managerial Finance. Holt, Rinehart, Winston, Inc. New York, 1968.

Weston, J. Fred. and Brigham, Eugene F. "Some Theoretical Aspects of Convertible Securities," in Readings: Essentials of Managerial Finance. by E.F. Brigham and R.B. Ricks. Holt, Rinehart, Winston, Inc. New York, 1968.

Williams, John B. The Theory of Investment Value. Harvard University Press, Cambridge Mass. 1938.

Periodicals

- Aly, Howard F. "Premium Method of Refunding," Financial Executive, Vol. 37. (December, 1969) pp. 24-26.
- Baumol, William J., Makiel, Burton G., and Quandt, Richard E. "The Valuation of Convertible Securities," Quarterly Journal of Economics, Vol. 80, No. 1 (February, 1966), pp. 48-59.
- Brewer, D. E. and Michaelson, J. B. "The Cost of Capital, Corporation Finance and the Theory of Investment: Comment," American Economic Review, Vol. 55, No. 3 (June, 1965), pp. 516-524.
- Brigham, Eugene F. "An Analysis of Convertible Debentures: Theory and Some Empirical Evidence," Journal of Finance, Vol. 21, (March 1966), pp. 33-54.
- Brigham, Eugene F. and Kawaja M. "Use of Convertible Debentures in Commercial Bank Financing" Bankers Magazine, Vol. 105, (Autumn 1967) pp. 26-33.
- Braman, K. L. "The Use of Convertible Subordinated Debentures by Industrial Firms 1949-59," Quarterly Review of Economics & Business, Vol. 3 (Spring, 1963), pp. 65-75.
- Butler, John A. "Consideration of the Income Spread in Purchase of Convertible Bonds; Formula for Determining Premium or Discount," Trusts and Estates, Vol. 107 (April, 1968) pp. 367-69.
- \_\_\_\_\_ "Cloud Over Convertible Debentures," Business Week, (October, 1967) pp. 143-44.
- \_\_\_\_\_ "Convertible Securities: The Parachute That Failed to Open," Forbes Vol. 104, (Sept. 19, 1969), pp. 30-31.
- \_\_\_\_\_ "The Cost of Capital in an Imperfect Market: A Reply to Madigliani and Miller," American Economic Review, Vol. 19 (June 1959), pp. 655-69.
- Crawford, Charles T. "Amortization of Conversion Feature Discount: What is the Proper Treatment?" Journal of Taxation, Vol. 32, (February 1970) pp. 102-105.

- Cretien, Paul D. "Convertible Bond Premiums as Predictors of Common Stock Price Changes," Financial Analysts Journal, Vol. 25, (November 1969), pp. 90-95.
- \_\_\_\_\_ "Discount Bonds; the Investment with the Guaranteed Gain," Business Management, Vol. 30, (April 1966), pp. 42-43.
- Durand, David. "State of the Finance Field: Further Comment," Journal of Finance, Vol. 23, (December 1968), pp. 851-857.
- Finn, Robert P. "Mergers and Convertibles Stimulate Wall Street," Commercial and Financial Chronical Vol. 206, (October 1967), p. 208.
- Fraine, Harold G. and Mills, Robert H. "Effects of Default and Credit Deterioration on Yields of Corporate Bonds," Journal of Finance, vol. 16, No. 3 (September 1961), pp. 423-34.
- Harris, J. T. "Comparison of Long-Term Deep Discount and Current Coupon Bonds," Financial Analysts Journal, Vol. 24, (July 1968) pp. 81-85.
- Hayes, Douglas A. "The Dimension of Analysis, A Critical Review," Financial Analysts Journal, Vol. 22 (Sept.-Oct., 1966) pp. 81-84.
- Homer, S. "Distortions Within Bond and Money Markets" Financial Analysts Journal, Vol. 24, (July 1968) pp. 77-79.
- Hunt, Pearson. "A Proposal for Precise Definitions of 'Trading on the Equity' and Leverage," Journal of Finance, Vol. 16 (September 1961), pp. 377-86.
- Innocenti, R. E. "Stock-Bond Split Decision for Pension Funds," Financial Analysts Journal, Vol. 25, (November 1969) pp. 97-101.
- \_\_\_\_\_ "Installment Reporting of Gain on Receipt of Bonds in Corporate Acquisition," Journal of Taxation, Vol. 30, (March 1969) pp. 198-99.
- Jacquette, F. L. "How Can Straight Debt Be Cheap When It Costs Ten Percent?" Bankers Magazine, Vol. 153, (Winter 1970) pp. 83-88.
- Jen, F. C. and Wert, J. E. "Effect of Call Risk on Corporate Bond Yields" Journal of Finance, Vol. 22, (December 1967), pp. 637-651.

- Johnson, R. E. "Term Structure of Corporate Bond Yields as a Function of Risk of Default," Journal of Finance, Vol. 22, (May 1967), pp. 313-350.
- Johnson, R. W. "Subordinated Debentures: Debt that Serves as Equity," Journal of Finance, Vol. 10, (March 1955), pp. 1-16.
- Kaplan, Mortimer. "Yields on Recently Issued Corporate Bonds; a New Index," Journal of Finance, Vol. 17, (March 1962), pp. 81-110.
- Kurtz, H. W. "Horseless Carriage Approach to Amortizing Bonds," Bankers Magazine, Vol. 152, (Autumn 1969), pp. 76-81.
- Lintner, John. "Optimal Dividends and Corporate Growth Under Uncertainty," The Quarterly Journal of Economics, Vol. 78, (February 1964) pp. 49-95.
- Mendes, L. "Convertible Debentures and Stock Options," Commercial and Financial Chronical, Vol. 206, (August 3, 1967), pp. 442-443.
- Miles, John F. "Formulas for Pricing Bonds and Their Impact on Prices" Financial Analysts Journal, Vol. 25, (July 1969), pp. 156-161.
- Modigliani, Franco. and Miller, Merton H. "The Cost of Capital, Corporation Finance, and the Theory of Investment," The American Economic Review, Vol. 48 (June 1958), pp. 261-99.
- Molodovsky, Nicholas. May, Catherine. and Chottiner, Sherman. "Common Stock Valuation: Theory and Tables," Financial Analysts Journal, Vol. 21, (March-April, 1965), pp. 104-112.
- \_\_\_\_\_ "Optimal Investment and Financing Policy" Journal of Finance Vol. 18 (May 1963), pp. 264-72.
- Parker, James E. "New Rules for Determining Earnings Per Share," Financial Analysts Journal, Vol. 26, (January-February, 1970) pp. 49-53.
- \_\_\_\_\_ "Peak Yield for Bond Investors," Financial World, Vol. 128, (November 15, 1967), p. 4.
- Pettway, R. H. and Weinraub, H. J. "Profitable Bond Trading Among Bonds of the Same Risk Class and Maturity" Financial Analysts Journal, Vol. 25, (November, 1969) pp. 125-128.

- Pringle, J. M. "Mortgage Market and its Relationship to Markets for Government, High-Grade Corporate and Municipal Bonds," Financial Analysts Journal, Vol. 22, (May 1966), pp. 105-106.
- Seligman, B. "Inverse Bond-Stock Yield," Magazine of Wall Street, Vol. 122, (April 27, 1968), p. 40.
- Schwartz, E. "Refunding Decision," Journal of Business, Vol. 40, (October 1967), pp. 448-49.
- Soldofsky, Robert M. and Miller, R. L. "Risk-Premium Curves for Different Classes of Long-Term Securities," Journal of Finance Vol. 24, (June 1969), pp. 30-42.
- Spurdle, John W. "New Subordinated Convertible Preferred Debenture With Warrants and Its Implications," Financial Executive Vol. 36, (August 1968), pp. 59-63.
- Traum, S. S. "Accounting and Tax Aspects of Issuing Convertible Debenture Bonds," New York CPA, Vol. 37, (December 1967), pp. 931-34.
- Weil, R. L. "Premium on Convertible Bonds," Journal of Finance Vol. 23, (June 1968), pp. 33-41.
- Weingartner, H. M. "Optimal Timing of Bond Refunding," Management Science, Vol. 13, (March 1967), pp. 511-524.
- Wiese, Robert F. "Investing for True Value," Barrons, (Sept. 8, 1930), pp. 5-6.
- Wendt, Paul F. "Current Growth Stock Valuation Methods," Financial Analysts Journal, Vol. 21, No. 2, (March-April 1965).
- Zinbarg, Edward. "What's in a Rating?" Barrons (May 4, 1964), p. 4.

#### Miscellaneous

- Jensen, James E. "A Pricing Model for the Convertible Debenture: A Selective Study." Unpublished Doctoral Dissertation, University of Pittsburgh, 1965.
- Questionnaire prepared specifically for this dissertation.  
New York, Winter 1969.

- Reisman, Arnold. Weston, J. Fred. and Buffa, Elwood. "Toward a Theory of Optimum Financing Mix," Working Paper No. 50, University of California, Los Angeles, Western Management Science Institution, August, 1964.
- Weston, Lewis. Underwriter with Goldman Sachs & Company, Personal interview, New York, January 3, 1969.
- Wipperfurth, Ronald F. "Earnings Variability, Financial Structure and the value of the firm," unpublished DBA dissertation, Stanford University, 1964.