A Multiple Discriminant Investigation Into the Nature of Firms Issuing Convertible Bonds.

Bruce Cale Payne

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CONVERTIBLE BONDS

A Dissertation

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in

The Department of Finance

by

Bruce Cale Payne
B.A., University of South Florida, 1967
M.B.A., University of South Florida, 1970
May, 1977
To the memory of my father

Courtney Raymond Payne
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ABSTRACT

Convertible bonds and the value of the premiums associated with convertible bonds have been favored topics in financial literature for many years. Most studies have attempted to find methods to establish the value of the securities to investors. There have been no studies concerning whether or not the value of firms that issue convertible bonds is determined, in any way, differently from firms that rely on other types of financing.

The major purpose of this study was to identify the characteristics of firms that issue convertible bonds in a given capital market situation. More specifically, the study was concerned with those variables that are indicators of the firms' risk-return tradeoff character. If differences do exist in the mean vectors of variables between firms that issue convertible bonds and firms that rely on other types of financing, then the two groups of firms are valued differently. That is, investors trade off different proxies for risk and return to determine the value of the firm.

An appropriate statistical method for a study of this nature is multiple discriminant analysis. The objective in the analysis was to
derive a discriminant function that could classify firms into apriori
groups on the basis of the selected variables.

Several important conclusions were forthcoming from the
analysis. In general, the firm that will attempt to achieve the
strategic advantages of convertible financing in a very tight capital
market, is a relatively large, well-known firm that has had a better
record of growth two years prior to issuing convertible bonds than
firms in general. The firm will not have as good a record of profit
or cash flows, and will offer less systematic, but more unsystematic
risk, than firms that do not issue convertible bonds. A major con-
clusion of this study is that the risk-return tradeoff character of the
two groups of firms is indeed different. The greater the indicators
of profitability, cash flows, and systematic risk, the more likely the
firm would be a non-convertible issuing firm. To the extent that
investors perceive profit and cash flows to be indicators of return and
safety in regard to accounting risk, and to the extent that they perceive
systematic risk as the relevant indicator of market risk they trade
off these factors to determine the value of the firm. The greater the
values for growth and unsystematic risk the more likely the firm was
to issue convertibles. To the extent that investors perceive growth
as an indicator of return and unsystematic risk as the relevant
indicator of market risk, they trade off these factors to determine
the value of the firm. It is argued that if markets are efficient and
investors are well diversified that the only relevant risk is systematic risk. Portfolio theory assumes that individual investors will diversify and consider the risk of a portfolio as a whole rather than each asset individually. There is very little empirical evidence indicating that people behave according to this assumption.

This study has resulted in a contribution toward the construction of a theory concerning the characteristics of firms that attempt to achieve the strategic advantages of convertible financing, and the differences in the risk-return tradeoff proxies of firms that issue convertible bonds and firms that rely on other types of financing. The theory has implications for financial managers and investors alike. It is offered as a plausible and logical explanation of observed phenomena.
CHAPTER I

INTRODUCTION

Statement of Purpose

The major purpose of this study will be to identify the characteristics of firms that issue convertible bonds in a given capital market situation. The basis for the identification of firms that issue these securities as opposed to firms that will not issue convertibles will be potential differences in selected financial variables. More specifically, the study is concerned with those variables that are indicators of the firms risk-return tradeoff character, and thus, how the firms are valued.

Lavely¹ and Frank and Weygandt² both discussed convertible bonds and certain financial ratios or characteristics of firms that issue convertible bonds. Lavely was interested in differences between firms


that issue convertibles and firms that issue bond-warrant packages
and the relative merits of each type of security. Frank and Weygandt
attempted to establish a model to predict the conversion of outstanding
convertible bonds into common stock. Both studies ignored the more
basic question concerning potential differences in variables that
indicate how the firm is valued. If there are differences in the
variables of these groups of firms then it seems reasonable that in a
given capital market situation, one could predict what firms would
issue convertibles on the basis of the defined variables. That is, if
there are advantages of financing strategy, as defined in Chapter II, to
be gained by issuing convertible securities, who will attempt to employ
this strategy? What are the characteristics of firms that issue
convertibles? If definite conclusions can be drawn concerning these
questions, the conclusions will have certain implications both for
issuing firms and potential investors. It is to this purpose that this
study is directed.

Plan of This Study

The characteristics of firms analyzed in this study are intended
to indicate how the firm is valued. That is, the variables will be
proxies for risk and return; there will also be a variable to measure
size. The point will be to see if there is any difference in how the two
groups of firms are valued. In order to start an inquiry into this
subject, it is first necessary to review theories of how investors value convertible bonds, and secondly, to review reasons given by practitioners for issuing convertibles. The purpose of Chapter II is to make the two reviews and to see if a consensus can be reached concerning the strategic advantages of issuing convertible bonds.

There is no reason to believe that the strategic advantages associated with convertible bonds remain static over time or exist to the same degree over time. In the latter half of the 1960's, convertible debentures made important gains in the market. They grew from four percent of all bond offerings in 1964 to a peak of twenty-one percent in 1967. Since 1967 was a peak year for convertible issues, it follows that many firms and investors were seeking whatever strategic advantages that are associated with convertible bonds. The purpose of Chapter III will be to review the capital market situation in 1967, and isolate that year as a time period on which to base this study.

The purpose of Chapter IV will be to choose a sample of firms to analyze, and to choose a profile of variables on which to base the analysis. The criteria for choosing variables will be potential differences between groups, their relevance in regard to how the value of the firm is determined, and the degree to which they have been discussed in the literature.

In Chapter V an extensive analysis is undertaken to answer the basic questions posed in this study. An appropriate statistical
method for a study of this nature is multiple discriminant analysis. The objective will be to derive a discriminant function that can classify firms into apriori groups on the basis of the selected variables. Before any general conclusions are drawn from the results of the tests, the test will be validated so that the proportion of firms classified correctly because of bias can be identified. There will also be a discussion of the effects of measurement error. The results of the analysis, the major conclusions derived from those results, and the implications of those conclusions for both firms and investors are discussed in great detail.

Chapter VI is a complete summary of the entire study. The conclusions are stated in more general terms and if there are questions raised as a result of the study, those questions will be stated clearly as possible fruitful areas for further study.

**Contribution**

It is possible that this study will result in a contribution toward the construction of a theory concerning the characteristics of firms that attempt to employ the strategic advantages of convertible bond financing. The characteristics will be chosen to reflect the risk-return tradeoff character of the two groups of firms. If it is found that there are significant differences in the variable profiles, it would indicate that the groups of firms are valued differently.
A new theory concerning how groups of firms are valued would have important implications for both firms and investors. Financial managers are constrained by the normative goal of the firm. The risk-return tradeoff entails a consideration of the firms’ cost of capital. It is incumbent on firms to offer their securities in the most valuable form. To the extent that firms succeed in this they move toward the achievement of their goal. There is no reason to believe that convertible bonds are, on the average, more valuable than other securities. The success of convertible offerings is primarily dependent on market receptivity. If firms were aware of what proxies for risk and return potential investors were trading off, it would be less difficult to gauge the market receptivity prior to issue.

The value of the possible new theory for investors is essentially the same as the implications for firms, except that it is viewed from a different perspective. Securities are valued by how the investor views the risk-return tradeoff character. As a result of this study more information will be available to investors to make that evaluation.
CHAPTER II

RATIONAL FOR THE EVALUATION AND USE OF CONVERTIBLE BONDS: THEORY AND PRACTICE

Much of what has been written concerning behavior in the capital markets has taken the positive approach to the study of finance. The positive approach is an attempt to explain behavior in the real world or to make predictions concerning behavior that has not yet been observed. The distinguishing characteristic of the positive approach is its treatment of the role of assumptions. In the positive approach the value of any model is judged by its ability to make predictions. The assumptions in the model do not have to conform to reality and most writers are of the opinion that the value of the theory or model is not diminished by the lack of reality of its assumptions. For example, Sharpe built his discussion of capital market theory on the usual set of assumptions, one of which is that all investors agree on predictions of expected returns, standard deviation of return, and correlation coefficients of rates of return. In the very

next chapter Sharpe relaxed this assumption and allowed disagree-
ment. The result was that the model was more realistic and the
implications were more general. He stated, "Its implications are
sufficiently general to be consistent with almost any observation. By
explaining everything, it explains nothing."² Haley and Schall write
that so far capital market theory has been concerned with only three
financing methods: (1) debt, (2) new shares of common stock, and
(3) retained earnings.³ They further state that an examination of
empirical capital markets would reveal, "an incredible mix of
financing instruments."⁴ There are different types of preferred
stock and even different classes of common stock. There are also
convertible bonds, mortgage bonds and capital notes. It is the view
of Haley and Schall that the proliferation of different types of
instruments is the result of the markets being subject to some
gross imperfection that creates the possibility for firms to offer their
securities in some "best, (most valuable) form."⁵

It will become clear in the following paragraphs that capital
market theory is concerned with more than the three methods of

²Ibid., p. 112.
³Charles W. Haley and Lawrence D. Schall, The Theory of
⁴Ibid.
⁵Ibid.
financing mentioned by Haley and Schall. In fact, the equilibrium option pricing theory, discussed later in this chapter, has implications so broad that it can be used to evaluate any combination of claims against assets. The point is that the value of the work of Sharpe and other writers is not diminished by assuming only three sources of financing.

The purpose of this chapter will be to examine why firms issue convertible securities. Are there instances where convertible bonds are the most strategically advantageous method of raising capital? If so, what determines their value? In general, this chapter will be developed along the following format: (1) a review of theoretical models for valuing convertible bonds, (2) a discussion of viewpoints of practitioners, and (3) a summary and some possible implications for this study.

**Theoretical Models for Valuing Convertible Bonds**

A discussion of theoretical models for valuing convertible bonds should follow the evolution of thought on valuation. The evolution of valuation models can be described in roughly three phases: first, the pre-capital asset pricing model (CAPM) phase may include all works that base ex-ante valuation on an expected rate of growth for the underlying common stock, resulting in probabilistic values. Secondly, the CAPM phase may include those works that treat convertible debentures--like their underlying
common shares—as components of a risky market portfolio. Finally, the equilibrium option pricing phase contains works that permit the quantification of the various factors that affect the value of an option. It cannot be overemphasized that although the abovementioned three phases seem to accurately reflect the evolution of thought concerning the valuation of convertible bonds, they in no way reflect the chronological order in which studies of valuation techniques have appeared in the journals. The following paragraphs contain examples illustrative of theoretical models representing each of the three evolutionary phases of thought.

Pre-CAPM Theories

One of the most widely read articles—as evidenced by its appearance in bibliographies—is Brigham's 1966 development and test of a theoretical framework for analyzing the nature of convertibles. Essentially, Brigham's position was that the ex-ante yield on a convertible is dependent on a set of variables that are subject to probability distributions, and that the yield itself, then, must be a random variable. The determinates of the yield are expected values of the probability distributions of the growth rate of the underlying common stock, the terminal value of the security

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and the number of years the security is outstanding. The unique characteristic of the probability distribution of ex-ante yields is that it has both upper and lower bounds. That is, the yield will not fall lower than the value of the security as a straight bond. The yield will also not exceed the point where the capital gains are the same for both the convertible and the underlying common stock. At this point the current yield on the bond declines vis à vis that on the common stock because dividends on growing stocks tend to rise, but the interest receipts remain fixed.

Brigham's article was preceded one month by an article similar in many respects. Baumol, Malkiel and Quandt (BMQ) developed a model that based the value of a convertible security on a subjective probability distribution of the future market value of the convertibles underlying common stock. The BMQ model represented the value of a convertible as a definite integral. The integral was the sum of all occurrences in which the bond value will exceed the stock value times the probability of each occurrence. The limits of the integral are the same as the bounds of Brigham's probability distribution. The lower limit was the value of the security when the growth rate of the underlying common stock was zero. The upper

limit was that point where the bond value was equal to the conversion value. One difference in the Brigham and the BMQ studies might be that the Brigham upper bound might actually be a small range depending in part on the dividend potential of the associated common stock.

The Brigham and BMQ studies are representative of pre-CAPM valuation theories. Almost without exception, one or both of the studies are included in all bibliographies of articles dealing with convertible bonds.

There are many other pre-CAPM studies. In general, their contributions are derived from addressing one or more problems involved in valuation. Three other noteworthy articles from the pre-CAPM phase that frequently appear in bibliographies are: (1) a 1968 article by Weil, Segall and Green. Their major finding was that the lower bound, or floor value of the bond was of negligible importance in determining the premium. Their conclusion was based on regression tests to explain the value of the premium. The floor variable was included as an independent variable, but its coefficient was not significantly different from zero. In addition, $R^2$ was only slightly smaller when the floor variable was omitted. It was not

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clear whether or not the contribution of the floor variable was actually explained by the other variables in the set; i.e., the degree of multicollinearity was not discussed. (2) Poensgen agreed that the ex-ante yield prior to expiration was a random variable. The vital difference between his model and the BMQ model was that the future straight bond value was also a random variable. In the BMQ model the straight bond value was constant, and was, in fact, the lower bound of the probability distribution of future values. Poensgen contended that since the future straight bond value was a random variable, its distribution of possible values would affect the distribution of possible ex-ante yields. He examined both the shape and dispersion of these distributions. Finally, Poensgen related future expected values to the present by a simple discounting procedure. He explicitly raised the problem of risk, but provided no guidelines for choosing an appropriate risk-adjusted discount rate. (3) Leibowitz asked a fundamental question: given the probability distribution of growth rates, how long does it take the convertible's current yield to recoup the "disadvantage" of the conversion premium? I.e., how long does it take the investor to "break even"? The Leibowitz


study is included here as an example of the pre-CAPM theories of value. The approach is the same as for the Brigham and BMQ studies, but the work was published in 1974. This is mentioned here to illustrate that contributions to the literature do not necessarily follow the three phases of the evolution of thought on valuation. The value or contribution of any of the theories or models is not diminished by being "out of phase." 

Theories in the Context of the CAPM

The CAPM phase includes all theories of valuation that treat convertible debentures as components of a risky market portfolio. In general, the expected value of a security is determined by estimating the expected return from the market portfolio and applying the beta of the security to this return. Frankle and Hawkins addressed the question: what beta should be used in computing the value of a convertible bond?\footnote{A. W. Frankle and C. A. Hawkins, "Beta Coefficients for Convertible Bonds," \textit{Journal of Finance}, 30 (March 1975), 207-210.} They were of the opinion that the changing relationship between the common stock conversion value and the straight bond value would give the resulting betas a high degree of non-stationarity. They derived a beta for convertible bonds based on the historical value of the underlying common stock beta and the current relationship between the common stock conversion value.
and the straight bond value. They stated that this method would reduce non-stationary difficulties to that inherent in the calculation of common stock betas. They concluded that betas for convertible bonds derived by their method would be less than that for the corresponding common stocks.

Walter and Que tested to see if convertible debentures were less responsive to the changing nature of the market than their underlying common stocks. They were of the opinion that the benefit of the bond value floor should be reflected in the convertible security's systematic risk. They compared the betas for a sample of convertible bonds with the betas for the corresponding common stocks. They found that the betas for the convertibles were less than those for the common stocks and thus concluded that the bond floor had a beneficial effect on systematic risk. They found that the significance of the floor characteristic varies directly with the volatility of the underlying stock. The later findings of the abovementioned Frankle and Hawkins study are thus consistent with the more comprehensive Walter and Que study.

**Equilibrium Option Pricing Theories**

Black and Scholes reasoned that if options are correctly priced in the market, it should not be possible to make sure profits by creating portfolios of long and short positions in options and their underlying stocks. Using this principle, they developed a model for determining the equilibrium value of an option. The model has theoretical importance for the valuation of any type of option, and it has particular importance for the valuation of convertible bonds, since the convertible feature is, in fact, an option. The Black and Scholes model is based on a number of strong assumptions. Given their assumptions, the equilibrium value of an option can be determined. If the market price of an option were to differ from that given by the model, a riskless hedged position could be established that would earn an amount in excess of the short-term rate assumed in the model. At this point arbitragers would enter the market and would borrow large sums of money at the short-term rate, establish hedged positions and earn an amount in excess of the short-term rate. This would continue until the buying or selling pressures on the stock and option drove their prices into equilibrium with each other.

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14 Ibid., p. 640.
other. The return on a fully hedged position would, once again, be the assumed short-term rate.

Merton extended the Black and Scholes model and showed that a similar type model could be derived using weaker assumptions. Specifically, the Black and Scholes model showed the value of an option to be affected by four factors: (1) the time to expiration, (2) the short term interest rate, (3) the variance rate of return on the common stock, and (4) the stock price. Merton showed the option price to depend on: (1) the short term interest rate, and (2) the total variance of the return on the common stock which he states is a stable number and can thus be estimated accurately from time series data. It is easy to see that with the weaker assumptions an empirical equilibrium price for options can be derived more confidently.

Any discussion of theories of valuation of convertible bonds would be incomplete without mentioning the work of Tennican. His primary objective was to determine how an investor should decide how much premium a particular convertible security is worth relative to its underlying value as a straight bond or relative to the value of the stock into which it might be


16Ibid., p. 161.
converted. The work was so comprehensive that it cannot be placed in any of the three phases of the evolution of thought.

Tennican's contribution, in part, consisted of reviewing all worthy theories of valuation and adding results from his own work. Tennican stated, "The option valuation problem is sufficiently complex that an analysis must steer between the Scylla of simplistic approaches to the problem and the Charybdis of full and rigorous approaches leading to intractable mathematical equations." He was, for the most part, successful in steering this path. The analysis did become somewhat complex, but many fundamental insights into the process of option valuation were conveyed in non-technical language. His book is thus, useable for academicians and practitioners with various degrees of interests and mathematical expertise.

The Use of Convertible Bonds: Viewpoints of Practitioners

In order to explain why firms use convertible bonds it will be necessary to borrow two concepts from Haley and Schall and discuss the existence of these securities within the framework of these two concepts. They identify two different but related components of


18 Ibid., p. 7.
financing decisions: (1) "Financing strategy will be used to refer to the choice of particular means of financing in the current period . . . " (2) "Financing policy refers to the question of what the long-run appropriate mix of financing should be." Financing strategy includes attempts to exploit timing and whatever gross imperfections the market is subject to that allow firms to offer their securities in some best (most valuable) form. If financing strategy explains the use of convertible bonds, the next logical question is what strategic advantages can possibly be gained by issuing convertible bonds.

The literature concerning convertible bonds offers some suggestions about why they might be good strategy at certain times and under certain circumstances. It will be useful, at this point, to consider the reasons why firms issue convertibles.

Since Haley and Schall identified financing strategy, it is appropriate to consider first the reasons they suggest for using convertible bonds. They suggest first, that issue costs are lower for convertible bonds than they are for common stock. Hence, if the firm were interested in issuing stock, it might issue convertible bonds to save on issue costs, expecting the securities to convert shortly. 20 This seems possible, but their second reason sounds

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19 Haley and Schall, pp. 215-216.

20 Ibid., p. 253.
like it might have a much greater impact on a firm's decision to issue convertibles. This is the concept of the delayed equity issue and is mentioned by several writers. They first assume heterogeneous expectations and suggest that, "now there may be very good reason for management to use convertibles." The situation is that management has investment opportunities that they believe to be highly profitable. Either the market is not aware of these opportunities or it is aware, but it is more pessimistic concerning the profitability of the projects. The price of the firm's stock will reflect the opinion of the market and not of management. The firm is assumed to have reached its capacity for long-term unconvertible debt and the flow of internal funds is not sufficient to support the proposed projects. In this case management would prefer to issue new shares of common stock, but the price of the new shares will reflect the market's more pessimistic view of the projects. The present share holders will not receive the full benefits of the investment opportunities. Haley and Schall suggest that now management should make a delayed equity issue. That is, issue convertible bonds with a conversion price approximating the value of the stock if the market agreed with management on the value of the investments. If the investment opportunities turn out as well as management predicted the market price of the stock will go up and the bonds can be converted. Thus, management was able to issue delayed equity
and the present shareholders received the benefit of the profitable investment opportunities. 21

In addition to his theory of valuation mentioned earlier in this chapter, Brigham suggested two reasons why firms would issue convertible securities. First, he states that "the firm desires equity capital and believes that convertibles are an expedient way of selling common stock," or secondly "the firm desires more debt and believes that adding the convertible feature will result in substantially lower interest costs." 22 In an effort to determine which of the above two reasons was predominant in his sample firm's decisions to issue convertibles, Brigham sent questionnaires to each of the 42 firms in his sample. Fifty-two percent of the firms in the sample responded. Of these, 73 percent indicated that they were interested in obtaining equity, and the remaining 27 percent stated that they were simply interested in "sweeting" a debt issue. It is interesting to note that Brigham's respondents each indicated that they had financing alternatives at reasonable costs. That is, they stated that they could have issued common stock at prices ranging from 2 to 5 percent below the market price and the straight debt alternative would have increased interest costs only 1/2 to

21 Ibid., pp. 253-254.
22 Brigham, p. 50.
1 percent. The point is that the firms indicated that they were in no way forced to use convertibles. If these firms were in no way forced to use convertibles, one can conclude either that the firms were in a position to take advantage of the best financing strategy package available, or that firms that respond to questionnaires do not like to admit that they were forced into some single alternative.

In a 1971 dissertation at the University of Iowa, Joseph A. Lavelly studied the comparative usage of convertible bonds and bond-warrant packages. Specifically, he sought to identify potential differences in certain financial ratios and characteristics of firms that employ each of the alternatives as financing strategy. Lavelly was interested in the nature and characteristics of each security and offered reasons why a firm might use convertible bonds as financing strategy. Again, one of the first reasons mentioned is the concept of "delayed equity." Like Brigham in his earlier work, Lavelly sent questionnaires to selected firms. Eleven respondents indicated that their goal was to increase equity, but on a delayed basis. Apparently they seemed to feel that a direct equity issue would have an adverse effect on earnings per share, but by issuing stock on a delayed basis, i.e., through a convertible bond, the investment projects financed through the issue would generate funds and by the time conversion occurred the earnings would have
increased enough to offset the fact that there would now be more shares to dilute those earnings. 23

The use of a conversion privilege as a "sweetner" to obtain lower interest rates on debt is well known in the world of finance. Purchasers feel that the conversion privilege is worth at least as much as the difference in interest on a straight bond and interest on a convertible. Recall that 27 percent of Brigham's respondents stated that they were primarily interested in obtaining debt and were simply using the convertible feature as a "sweetner." Lavely also asked his respondents to express their motive for issuing convertibles. He received 65 "useful" replies from firms that issued convertible debt. Executives of 22 of the firms or 34 percent, expressed the "sweetner for debt" strategy as their reason for issuing convertibles. 24

In a 1955 study Pilcher asked the presidents of 100 firms, which of the following played the more important role in their decision to issue convertibles: "the desire to sweeten the senior leverage issue, therefore making it more attractive to buyers, or


24 Ibid., p. 146.
the desire to raise common equity on a delayed basis? Twenty-five firms replied to Pilcher. Forty-seven of the respondents, or 63 percent, stated that their primary purpose was to issue equity on a delayed basis while 17 firms, or 23 percent, indicated the reason was to sweeten the security to obtain a lower interest charge.

The empirical studies by Brigham, Lavely and Pilcher seem to corroborate each other. That is, that the primary reason for issuing convertibles is to increase equity, and specifically to issue this new equity on a delayed basis. These studies also back up the theoretical contention by Haley and Schall that the firm might have some investment opportunities that the market is not aware of or if the market is aware, it is simply more pessimistic concerning the profitability of those projects. The second major reason, for issuing convertibles, uncovered in the empirical studies was that the convertible feature was used to "sweeten" a debt issue so as to obtain a lower interest rate. Twenty-three percent of Pilcher's respondents in 1955, twenty-seven percent of Brigham's respondents in 1963, and thirty-four percent of Lavely's respondents in 1970, gave this second reason as their major consideration in issuing convertibles. The empirical studies cited above are remarkably

consistent, and seem to answer the question first raised by Haley and Schall's definition of financing strategy: What strategic advantages can be gained by the use of convertibles? The first theoretical reason suggested by Haley and Schall: The firm might issue convertibles to save on issue costs was mentioned in none of the empirical studies. In fact, Brigham left open in his questionnaire a response entitled "other." That is, he was giving financial executives an opportunity to express reasons other than those suggested for issuing convertibles. Not one of his respondents suggested another reason.

If any conclusions are evident from the studies it is that the major advantage to be gained from the use of convertibles in financing strategy is the opportunity to sell equity for more than its current market value. The second major advantage, and of secondary importance, is the opportunity to sell debt securities at a lower interest rate than would otherwise be possible. The above conclusions seem to be oversimplified. It is logical to assume that the advantages to be gained by a firm at one point in time may be nonexistent at another point in time. It is conceivable that the mood of investors could change over time. In Haley and Schall's theoretical example, the market was more pessimistic concerning the profitability of the firm's project than was management. If over a period of time the mood of investors changes and moves more in conformity with that of management, then the market price of the shares will reflect this
change and the advantages to be gained from the strategy of "delayed equity" will be diminished. Similarly, if conditions in capital markets were to change drastically, the idea of "sweetening" a debt issue may take on more or less significance, depending on the direction of the change. For example, suppose for a moment that long term interest rates on industrial bonds of all grades are very high, and that capital for expansion is expensive from any source. In this case more firms may try the strategy of "sweetening debt" in an effort to avoid the high interest rates on straight bonds. The point is that what may be good strategy in one time period may not be good strategy in another time period. In order to discuss the characteristics of firms that might take advantage of the strategy available by issuing convertibles, a time period must be isolated. That is, the conditions in the capital markets should be identified and the strategic advantages of convertibles discussed in that context. The isolation of a period to study is the subject of the next chapter.

A discussion of why convertibles exist and what strategic advantages can be gained by using convertibles would hardly be complete without mentioning some ideas on which there have been no empirical studies. Brigham mentions two institutional factors that would seem to make convertibles attractive to investors. First, he states that there exists a group of investors who desire more
leverage than the margin requirements will allow. At the time Brigham wrote his article, convertible bonds could be purchased on a 10 percent margin while common stocks required a 70 percent margin. It was therefore, possible for high leverage investors to buy "delayed common stock" on a 10 percent margin. At the time of this writing, the margin requirements are exactly the same for both securities: 50 percent for common stock and 50 percent for convertibles. If there ever was an advantage in issuing common stock to appeal to high leverage investors, that advantage would no longer exist. This is discussed further in the next chapter. Brigham also suggested as a result of interviews and questionnaire responses that a number of institutional investors were restricted in their ability to hold common stocks. Management of some of these institutions apparently felt that it would be desirable to hold more common stock than was permitted by regulations. Convertible securities were perceived as a method of indirectly holding common stock. There was a great deal of speculation on whether or not the growth of institutions had, at that time, caused a shift to the right, in the supply curve of funds for convertibles. Brigham quotes W.S. Skelly as suggesting this and then asks, "Indeed, is it not possible that corporations could be oversold on the use of convertibles, thus

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26 Brigham, p. 53.

27 Ibid.
causing them to demand an excessive amount of funds through such issues and making the cost of convertible capital relatively more expensive than other types?" 28 Just as the elimination of differences in margin requirements neutralized the demand for convertibles by high leverage investors, better management and relaxation of some restrictions have tended to lessen the demand for convertibles by institutions. Soldofsky states, "The continuing liberalization of legal investments for life insurance companies and for state and local pension funds has probably diminished the force of this argument." 29 Certainly, institutions did play a great role during the time period chosen for study. One idea that cannot be discounted was mentioned by Lavely. He suggested that many financial analysts consider convertibles as equity and not as debt, which of course, they legally are. As long as investors and analysts perceive convertibles as equity, the debt capacity of the firm is not reduced. 30 In a time period, such as the one discussed in Chapter III it is conceivable that firms would issue convertibles in order to increase their perceived debt capacity.

28 Ibid.


30 Lavely, p. 156.
Summary and Implications For This Study

Early studies in capital market theory, such as that of Sharpe and Lintner, assumed only three methods of financing: (1) debt, (2) new shares of common stock, and (3) retained earnings. Haley and Schall asked why only three methods were assumed, when even a cursory glance at empirical markets revealed an incredible mix of instruments. The answer lay in the positive approach taken by the early writers. The distinguishing characteristic of this approach was that the value of their work was judged by its explanatory power and was in no way diminished by the lack of reality of its assumptions. Later studies such as Black-Scholes and Merton's work on the theory of rational option pricing are adequate to explain the value of all types of claims against the assets of a firm.

There has been a great deal written on the valuation of convertible bonds. For purposes of review, the theories were arbitrarily classified into three phases to reflect the evolution of thought on valuation. The three phases in no way reflect the chronological order in which the theories appeared in the journals, but the implications of the theory of equilibrium option pricing seem broad enough to indicate that a great deal of future work will take place in that phase.

If there are advantages of financing strategy to be gained by issuing convertible bonds, what are these advantages? There are
several empirical studies that have attempted to answer that question. Brigham, Lavelle and Pilcher all found, through questionnaires, that convertibles were most often issued to employ the strategy of "delayed equity." The second most frequent answer was the strategy of "sweetening debt." There are also institutional factors that might cause issues of convertible securities to be financially advantageous at certain points in time, but no empirical work has been done concerning those potential advantages. It was concluded that the relative value of any strategy cannot be determined without isolating that time period in which the strategy will be employed.

The implications, for this study, of the possible advantages of financing strategy are that they affect the value of the firm. The value of a firm is a function of its risk-return tradeoff character, and the financing decision has an impact on that tradeoff. The variables, introduced in Chapter IV, will give an indication of the risk-return character of each group in the sample. A possible contribution of this study then, is to identify potential differences in the risk-return tradeoff character between firms that issue convertible securities and firms that rely on other means of financing.

The theoretical models reviewed, in this chapter, are primarily concerned with the ex-ante yield to the investor given a certain degree of risk. Some of the risk associated with a firm is, however, not relevant to the investor, since this risk can be
diversified away by the choice of securities in his portfolio. Another possible contribution of this study is then, to identify potential differences, between groups, in the amount of risk that can be diversified away by investors.
CHAPTER III

A UNIQUE CAPITAL MARKET SITUATION AND
THE GROWTH OF CONVERTIBLE BONDS

The purpose of this chapter is to identify a unique, episodic time period in the history of recent capital markets on which to base this study. The chapter will be developed along the following general format: (1) A discussion of the events leading up to, and forming the background for the capital market situation in 1967, (2) A discussion of several reasons why firms were unwilling to postpone bond issues in the face of record high interest rates, and (3) the growth of the use of convertible bonds.

Background For A Unique Time Period

The year 1966 appeared to be the end of a boom that had lasted since 1961. Sales of manufacturing corporations increased a mere two hundredths of one percent over 1965. The year before had been considered more normal in these war years when sales had increased by ten and seven tenths percent. The demand for long

term funds is usually increased at the end of a boom period. One reason for this is that corporations commit themselves to capital projects in boom periods that depend, in part, on cash flows resulting from the high level of sales activity. When the cash flows from the boom period start to taper off, the project commitments still require funds. This particular period was characterized by the construction of new plants and equipment by heavy goods producers such as the air transport, aircraft construction, and heavy equipment industries. Total plant and equipment expenditures for manufacturing firms started to level off at a round 30 billion dollars per year in 1966, but that was still more than double the 1958-59 rate. Capital expenditures had increased every year since 1961, and corporate profits had increased every year since 1960. In addition, inventory accumulations were high at the time business started to slow down. In situations like this, one of the first alternatives for financial managers has been to turn to the banks for short term loans. This has the advantage of buying time for the firms. The financial managers can decide during this time what form their new permanent financing will take. One option resulting from such action would be to let the short term bank loans

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hold them over until business had taken an obvious downturn and then try the bond market at what should be lower post boom interest rates. By the middle of 1966 there was a great demand for short term bank loans. In the late summer interest rates on high quality corporate securities reached their highest level since 1929. See Figure 3-1. Although the loans at commercial banks were at an all time high, there was great demand for still more loans. The scarcity of funds was, in part, due to actions taken by the Federal Reserve Board to offset the pressures of demand-pull inflation. The restrictive measures were actually initiated around the end of 1965 and lasted until the fall of 1966. The money supply $M_1$ declined from April to October. It leveled off in early 1967 and started to increase. Before the leveling period, the credit restraint brought such severe pressures to the financial markets that it was referred to as the "Credit Crunch of 1966." The Federal Open Market Committee appeared to want a rather tight money market in 1966 but they did not want the credit crunch that resulted from their policy.

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FIGURE 3-1

LONG AND SHORT TERM INTEREST RATES 1930-1967

of restraint. One of the complications of the great demand for business loans was that the banks were liquidating great numbers of government securities to make the higher yield commercial and industrial loans. See Figures 3-2 and 3-3. For example, in the first eight months of 1966, bank loans had increased at an annual rate of twelve percent. But, bank lending to business had increased at an annual rate of twenty percent. The last thing the Federal Reserve wanted was a disorderly market condition for government securities, and this now seemed like a distinct possibility. In an effort to dissuade member banks from further expansion of commercial and industrial loans at the expense of government securities, the Board of Governors took an unusual action. They authorized a letter to all member banks that modified the conditions under which member banks could use the discount window. The essence of the letter was that bank lending to business was expanding at too rapid a rate. It condemned this rapid expansion, and promised more consideration at the discount window to banks that slowed down on such loans. This action nearly stopped the expansion of commercial and industrial loans. In the six month period from June 30, 1966 to


FIGURE 3-2

TREASURY SECURITIES HELD BY COMMERCIAL BANKS 1929-1967

FIGURE 3-3

COMMERCIAL AND INDUSTRIAL LOANS BY COMMERCIAL BANKS 1945-1967

December 31, 1966, commercial and industrial loans increased by a mere four percent. The letter was rescinded in December, but by the end of the year many firms were desperate for funds.

In the credit crunch of 1966 some firms turned immediately to the bond market instead of trying to compete for short term bank loans. There they found interest rates at historical highs. The highest grade corporate bonds were selling with a 5.13 percent coupon. This was the highest rate on comparable securities since 1929.\(^9\) Standard Oil of Indiana came to the bond market at the height of the 1966 credit crunch and paid six percent on triple A bonds. This was considered abnormally high at that time.\(^10\) One of the reasons that more firms did not go straight to the bond market in 1966 was that they felt that interest rates were too high and would surely come down in the near future. Even with the extraordinarily high interest rates the total bond offerings was a record 15.6 billion.\(^11\)

The end of the six year boom and the credit crunch of 1966 seemed to lay the groundwork for the capital market situation in 1967. It was the year 1967 that broke the records of the previous year both


\(^10\) Loomis, p. 122.

\(^11\) Ibid., p. 121.
In volume of bonds offered and interest rates applicable to those offerings. In fact, the year 1967 was so unique that the collective attitudes of both borrowers and lenders seemed to change. Carol Loomis wrote:

> When the time comes to write a history of the corporate bond market, 1967 may be remembered as the year when 50 million got to seem like small potatoes... it became obvious that an important change had taken place in attitudes toward borrowing. Debt had taken on some new class. In that great parade to the bond market there were corporations that had once rejected debt and were now ready to take it on; corporations that had always had debt and were ready to build it up; even corporations ready to build it up just so the new money could be passed on in dividends. 12

In early 1967 it appeared that firms that had taken short term bank loans during the credit crunch of 1966 to hold them over until lower long term rates were available had followed a winning strategy. The lower long term rates that they were waiting for did materialize in the early weeks of 1967. The decline was in part due to an easier monetary policy resulting in increased availability of funds at banks and other financial institutions. This policy seemed to relieve pressure in the long-term markets. Moreover, there was general anticipation of a further easing of monetary policy and this also seemed to contribute to the decline in long-term rates. 13Long term

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12Ibid.

13"Recent Credit and Monetary Developments," The Federal Reserve Bulletin 54 (February 1968): 112.
rates reached their 1967 lows in late February, but by this time there was a great pent-up demand for long-term funds. The relatively low rates were to be of short duration. Businesses and state and local governments issued record amounts of securities in the first half of 1967 and by July long-term rates were back to their 1966 highs. The corporations that did not go to the bond market in the first half of the year found themselves facing the highest rates since 1920. See Figure 3-1. Even with these high rates there were 22 billion dollars in corporate securities offered in 1967. The previous record was the aforementioned 15.6 billion in 1966.

Reasons for the Proliferation of Offerings

There were several major reasons why, even in the face of record high interest rates, firms were not inclined to postpone their ventures to the bond market. The first was that many corporations were beginning to feel a little uncomfortable about their liquidity positions. One source of financing their expansions during the boom was by reducing their cash and near-cash holdings. The decline in corporate liquidity is evidenced by the decline in cash and government securities from 38 percent of current liabilities in 1961 to 24 percent in 1967. 14 A second factor that contributed to the concern regarding corporate liquidity positions was a decline in internally generated

14"From Stocks to Bonds," p. 35.
funds. Profits on sales rose 15 percent per year from 1962 through the first two quarters of 1966. Starting in the third quarter of 1966 and continuing through 1967 sales weakened, and the flow of internal funds declined by 7 percent from the third quarter of 1966 to the second quarter of 1967. 15 Thus, corporations were faced with an increasing decline in internally generated funds and decreasing sources in the money and capital markets. Many firms met this situation by diverting to other uses funds that would have been used to build up the usual seasonal inventory of liquid assets. 16

A second reason why corporations were reluctant to postpone bond issues was the result of their experiences in 1966 with short-term bank loans. There appeared to be a general feeling among financial managers that there was a need for a reduced dependence on short-term bank financing. In close to two thirds of the big bond issues in 1967, at least part of the proceeds was used to retire short-term bank loans. 17

A significant reason for going to the bond market at a time when interest rates were at historical highs was that, by taking this action, the financial managers were arguing, implicitly, that they

16 Ibid., p. 1275.
17 Loomis, p. 123.
expected interest rates to go even higher in the future. They, therefore, reasoned that by locking up some long-term funds, their cost of funds would be less expensive than if they waited. Moreover, by locking up long-term funds they would accomplish their goal of becoming less dependent on bank loans. If the financial managers had been wrong about the future direction of long-term interest rates, then the big issues in 1967 would have been expensive indeed, especially since life insurance companies and other institutions had become increasingly insistent on having non-refundability clauses in the bond indenture. They were not wrong; long-term interest rates continued to climb. At the time of this writing, long-term rates have not returned to the 1967 levels. In addition to the feeling that the future path of long-term rates was upward, there was some concern about a coming "world capital shortage," in which the demand for funds would far exceed the supply. Many businessmen and brokers believed that this would result in an extended period of high interest rates. Some even suggested that the rates would go so high as to become politically intolerable and this would raise the possibility of government controls on borrowing. 18

18 Ibid., p. 124.
It is noteworthy that state and local governments were not very successful in bidding for funds in the market. Some postponed projects in the hope that there would be less competition for funds in the future. Moreover, most communities were forbidden by law to pay more than some ceiling rate for funds. Later, in order to compete many municipalities simply raised their ceilings or changed their laws.

It should also be noted that there seemed to be some change in the buying side of the market. The institutions, such as insurance companies, pension funds, and mutual funds still dominated the bond market. But, the life insurance companies had less money available in 1967 because of heavy forward commitments to firms during the 1966 credit crunch. The corporate pension funds were not satisfied with "performance" in the bond market and by the second quarter of 1967 they had practically dropped out. Some of this buying power was replaced by consumers. This particular group accelerated their purchases of corporate bonds to record levels in the second half of 1967. The reason for this increased participation by consumers seems obvious. If banks were paying five percent and high grade corporate bonds were exceeding six percent, the expected

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19 Ibid., p. 121.

disintermediation would, and did, take place. This process resulted in outflows of funds from savings banks and savings and loan associations. The slump in housing starts in both 1966 and 1967 was attributed to the reduced supply of funds for mortgages as a result of this disintermediation.\(^{21}\)

Another significant reason for so many bonds coming to the market in 1967 was the idea that firms had for many years grown more receptive to the idea of debt. One indication of this is a statistic reported annually by the Federal Trade Commission. It is the ratio of stockholders equity to total assets. The ratio had fallen for nine straight years, from 66.5 percent at the end of 1958 to 58.7 percent at the end of 1967.\(^{22}\) Firms seemed to be saying, implicitly, that interest rates are going to keep going higher and it is to our advantage to go to the market now. The memory of the credit crunch of 1966 was the motivating force behind many of the new issues in 1967. A typical winner was Union Carbide. They came to the market in February, and borrowed 250 million dollars at 5.3 percent. Textron did not enter the market until June; they cut their offering from 100 million to 50 million dollars to keep from having to pay six percent. They issued their 50 million at 5.95 percent. Later, Joseph B.

\(^{21}\)"From Stocks to Bonds," p. 36.

\(^{22}\)Loomis, p. 125.
Collinson, vice president for finance stated that "management has long since outgrown its prejudices against six percent." There not only seemed to be prejudices against high interest rates in issuing corporations, but also in the institutions that were in the market for bonds. In a 1966 study Hayes found that above some vaguely defined level of interest charges that the normal rules governing the supply and demand for capital do not apply. He reasoned that at a six and one-half percent interest rate would connote an acceptable risk for an institutional lender. However, a seven and one-half percent interest rate would infer an unacceptable amount of risk. He quoted one institutional investment officer as stating: "I wouldn't dare present a seven and one-half percent loan to my investment committee, even if I were convinced that it represented an acceptable risk." Hayes further stated that this attitude was typical of the other lenders with which he talked.

The Growth of the Use of Convertible Bonds

The great demand for funds following the end of the 1961-1966 boom thus created a paradox. Firms were willing to pay more for

23 Ibid., p. 124.

funds than the "accepted" ceiling, and lenders were unable to take advantage of it.\(^{25}\) It was at this time, and partially for this reason, that convertible bonds became a more significant instrument in the market.

It was stated earlier that total bond issues increased from 15.6 billion in 1966 to 22 billion in 1967, both records. A more significant, and surprising, statistic is that while regular bonds increased by 60 percent over 1966, convertible bonds increased by 129 percent.\(^{26}\) Some of the reasons for the new-found strength of convertibles were the same as those cited as reasons for the existence of the securities in Chapter II. There were some firms that wanted to borrow funds, but they did not want to pay the prevailing high interest rates. For example, R. C. A. issued 160 million in 4.5 percent convertibles in July. The interest rate differential between convertibles and straight bonds was about 1.25 percent for the firm.\(^{27}\) Both large and small companies seemed to be seeking a way to escape the high interest rates. Arlene Hershman wrote that many unseasoned companies could hardly raise funds in any other way.\(^{28}\) However, as in the case of R. C. A., another "blue

\(^{25}\) Ibid.

\(^{26}\) Loomis, p. 122.

\(^{27}\) Ibid., p. 124.

chip" company, Ralston Purina, floated a forty million dollar issue in late 1967. Ralston clearly had other alternatives, but their convertible issue carried a 4 7/8 percent coupon and a straight bond issue would have probably been around 6 5/8 percent.\textsuperscript{29} Ralph DeNunzio, executive vice president of Kidder, Peabody and company stated, "... Ralston expects the purchasers to turn their bonds to shares within two or three years at the most... one of Ralston's aims was to broaden their equity base."\textsuperscript{30}

Regardless of the reasons for so many convertible issues coming to the market, there would have been a great deal of difficulty in selling those issues had not some change taken place on the buying side. Prior to 1967 speculators could buy convertibles on a 10 percent margin. In mid-1967 the Federal Reserve Board felt that with the great proliferation of convertibles, speculation might get out of hand. They therefore, proposed that buyers put up 70 percent in cash rather than the ten percent as before. Later in the year they softened this proposal to the current rate of 50 percent. But the mere proposal seemed to shut off a great deal of credit to speculators. As the speculators dropped out of the convertible market, institutions moved in to take their place. For example, in the last quarter of

\textsuperscript{29} Ibid.
\textsuperscript{30} Ibid.
1967, John Hancock Life put one million or more into several convertible offerings. At the end of the year the company took three million of the General Telephone and Electronic issue. The Eaton and Howard mutual fund picked up issues of six different companies in the fourth quarter. An Eaton and Howard analyst stated, "We expect to place a greater emphasis on convertibles, if interest rates continue high and quality converts keep coming to the market."\(^{31}\)

The convertible market did take on some new class in 1967. On the issuing side both large and small companies came to the market with a record volume of convertibles. On the buying side calmer and more sober institutional investors took the place of the speculators. This in turn had an effect on interest rates. For example, Tenneco issued 50 million in straight debt at 6.5 percent in May. In November they issued 100 million in convertibles at 6.25 percent. R. E. McGee, senior vice president for finance suggested that had the Federal Reserve not stiffened its margin rules on convertibles, Tenneco might have gotten a rate of 5.25 percent.\(^{32}\)

Table 3-1 summarizes bond and stock financing by corporations from 1963 to 1970. Convertible debt issued for cash grew from 12 percent of all debt issued in 1966 to 21 percent of all debt issued in 1967. It also appears that debt, in general, became more

\(^{31}\)Ibid., p. 43.

\(^{32}\)Loomis, p. 125.
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acceptable as the 1961-1966 boom came to an end. The total proceeds from the sale of all debt grew from 79 percent of all securities issued in 1964 to 88 percent in 1967. And conversely, the proceeds from stock issues fell from 21 percent of all securities issued in 1964 to 12 percent in 1967. It should be noted that a greater percentage of convertible debt to total bond financing was issued in both 1968 and 1969 than in 1967. But in both cases more than half the issues were in connection with mergers. This flood of issues was short lived. Section 279 of the 1969 Tax Reform Act limited the deductibility of interest on large issues of convertibles used in acquisition. In 1968 convertibles used in acquisition accounted for 12 percent of total bond financing; in 1969 acquisition issues accounted for 10 percent. Since 1970 convertibles used as acquisition currency have never exceeded one percent.

1967 was and remains to this day, the year that record volumes of convertibles came to the market; it was the year that convertibles took on some new class. Not all corporations issued convertibles for the same reason. It seems that most of the reasons stated by researchers, in Chapter II, for the existence of convertibles were given as reasons, by executives, for the issues in 1967. In addition there were apparently some firms that simply wanted to rebuild liquidity at the end of the boom. Carol Loomis went so far as to suggest that some firms were inventories money because
of the fear of the "coming world capital shortage." Albert Esokait, the man who was for twenty-five years the chief bond analyst for Moody's Investors Service and the man who assigns bond quality ratings for Moody's, stated, "1967 was the roughest, toughest, year ever. The underwriters are physically and mentally exhausted, and so am I."  

It is for all these reasons, and the fact that 1967 was the most unique year for convertibles in capital market history, that 1967 is the time period chosen for this study.  

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33 Ibid., p. 124.

34 Ibid., p. 184.
 CHAPTER IV

SAMPLE AND VARIABLE SELECTION

A purpose of this study is to attempt to identify firms that will issue convertible bonds in a capital market situation such as that described in Chapter III. The basis for the identification of firms that will issue these securities as opposed to firms that do not will be potential differences in selected financial variables. If there are differences in the variables then it seems reasonable that given the capital market situation described in Chapter III, one could predict what firms would issue convertible securities on the basis of these variables. That is, if there are advantages of financing strategy, as defined in Chapter II, to be gained by issuing convertible securities, who will attempt to employ this strategy? What are the characteristics of firms that issue convertibles? Can firms, in fact, be classified as issuers or non-issuers on the basis of these characteristics? If it can be anticipated that in a market such as described, a supply of convertibles will be forthcoming from certain firms, financial managers and investors alike can make great use of that information in planning their own financing
or investment strategy. It is to this end that this study is directed.

The purpose of this chapter is twofold: first, two samples of firms will be selected for study. And secondly, variables will be selected for use in the model for analysis in Chapter V.

Sample Selection

The data source for this study is the well-known COMPSTAT tapes. The most common pitfall in comparing different financial variables and ratios of firms might be that internally generated information is not comparable among firms. That is, there is no set of standardized definitions to which all firms, in all industries adhere. One of the advantages of using data from COMPSTAT is that all data on the tapes was collected and written with standardized definitions. The variables used in this study are clearly defined later in this chapter and are comparable among firms.

A basic data set of 381 industrial firms was initially chosen from the tapes. The first order of business was to determine how many of the 381 firms had issued convertible bonds over the twenty year period from which the data was collected. As shown in Figure 4-1, seventy-five of the 381 firms issued convertibles. ¹ The

¹ It should be noted that although the data set includes the years 1953-1972, very little information was available for the year 1972. This is not considered critical since the year isolated for study is 1967.
FIGURE 4-1

CONVERTIBLE BOND ISSUES BY SEVENTY-FIVE FIRMS 1953-1972
most striking feature about Figure 4-1 is, of course, that twenty-five or exactly 33 1/3 percent of all firms in the sample that issued convertibles over the twenty year period issued in the year 1967. This finding is entirely consistent with all the events described in Chapter III and particularly the statements on convertible issues. In this sample the number of firms issuing convertibles increased from ten in 1966 to twenty-five in 1967 or an increase of 60 percent. This consistency and even a cursory glance at Figure 4-1 reinforces the decision to isolate 1967 as a time period in which to make this study.

Once the firms were identified that issued convertible bonds in 1967, they were grouped together for study and will hereinafter be referred to as that part of the sample comprising the test group. It is this group of firms whose characteristics will be studied to see whether or not they differ with firms that relied on other forms of financing, not only for 1967, but for the entire twenty year period. This latter group will hereinafter be referred to as the control group. If there is any bias in the sample groups, it is toward large size. Since all firms in the data set are listed, they may be relatively larger than firms in general. To

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2 Some of the firms in the test group had more than one convertible issue in the twenty year period. In each case, they were not included in the test group unless their most significant issue, in dollar amounts, was in 1967.
sum up, there are twenty-five firms that issued convertibles in 1967, and for comparison, there are twenty-five firms that relied on other forms of financing over the twenty year period. Later, in order to validate the model it will be necessary to select another, even larger, control group. 3

**Selection of Variables**

The criteria for choosing variables will be potential differences between groups, their relevance, and the degree to which they have been discussed in the literature. In addition, the chosen variables have to be available on a quarterly basis, and have a relatively low degree of correlation with each other. A basic truth concerning multiple discriminant analysis (MDA) is that the greater the degree of multicollinearity between variables, the weaker will be the conclusions derived from the model. This same problem exists in the more familiar multiple regression models.

Brigham's study, referred to in Chapter II, was concerned with large firms. There were only forty-two firms in Brigham's sample, but they accounted for 76 percent of the dollar value of all convertibles issued from 1961-1963. 4 On the other hand, Hayes

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3 Appendix A lists the twenty-five firms in the test group, the twenty-five firms in the control group, and the fifty firms used later to validate the model.

found that firms issuing convertible bonds "tended on the average, to be smaller than firms that borrow without such features." 5

Lavelly suggests that large size is sometimes correlated with financial soundness, and that investors will accept a convertible issue only from firms they judge qualitatively superior. 6 In the market described in Chapter III both large and small companies were coming to the market with convertible issues. Recall from Chapter III that there were "blue chip" issues such as R. C. A.'s 160 million and Ralston-Purina's 40 million. Recall also that one writer was of the opinion that many small unseasoned companies could hardly raise funds any other way. There seems to be no real consensus of opinion as to whether convertibles are a financing tool of the relatively small, more speculative companies, or whether the size of the firm is of no consequence in discriminating between issuers and non-issuers of convertibles. If there is a real difference in the relative sizes of firms, it will be useful in the construction of a theory concerning the nature of firms that issue


convertibles. For this reason, a measure of size will be one of the attributes studied.

Growth is directly related to the concept of delayed equity. In Chapter II various writers referred to the strategy of delayed equity as one of the principle reasons for the use of convertible bonds. In order for the concept of delayed equity to work, the price of a firm's common stock must be temporarily undervalued, such as in the simple case of earnings being temporarily depressed because of a strike. It would be foolhardy to issue new common stock in such a situation because more shares would have to be issued, for a given sum, than would be the case if the common was not depressed. Another situation might arise when a firm is developing a new product and the market price of their common shares reflects a more pessimistic view of the new product than that held by management. As in the previous example, if new equity were issued before the new product was marketed, present shareholders would not receive the benefit of the marginal value the new product would add to the firm. In both cases, earnings and the price of common is expected to rise in the future, and firms want to sell delayed equity at some future higher price. This strategy is entirely dependent on growth. Van Horne writes: "the convertible security is best suited for a growth company . . . . a company with prospects for little or no growth would be ill-advised to use
convertible securities as a method of financing. If inference is made from the replies to the Brigham and Lavelly questionnaires that delayed equity is the predominate reason for the existence of convertibles, then it might be expected that firms issuing convertibles would have a higher growth rate than other firms. If it can be shown that firms issuing convertibles do, in fact, have a greater growth rate than other firms, it would not only add credibility to Van Horne's statements, but would also contribute to the construction of a theory concerning the nature of firms that issue convertibles. For this reason, a variable will be included that will measure the rate of growth.

Most writers agree that the objective of financial managers should be to maximize the value of the firm to the present shareholders. This objective is accomplished by making decisions that affect the firm's risk-return character. Since the value of the firm is a function of its risk-return character, the next logical question is: Does the risk-return character differ in any way between firms that issue convertibles and firms that rely on other types of securities. If it can be shown that there is a real difference, it would contribute to the construction of a theory concerning the

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nature of firms that issue convertibles. For this reason a measure of profitability will be used in the analysis. A measure of risk is also needed for the analysis, but then, there are several types of risk. The model will contain a proxy for measuring business and financial risk derived from accounting data; it will also contain two measures of market risk, systematic and unsystematic.

In summary, there are six areas for comparison: (1) the size of the firm, (2) the rate of growth, (3) a measure of profitability, (4) a measure of business and financial risk, (5) a measure of systematic risk, and (6) a measure of unsystematic risk. The six variables chosen for the discriminant function are as follows:

\[ X_1 \] -- Net Sales is used to measure the size of the firm. Sales include gross sales and other operating revenue less discounts, returns, and allowances.

\[ X_2 \] -- Operating Profit Margin is used as a measure of profitability. It is defined as operating income after depreciation and amortization expressed as a percent of sales.

\[ X_3 \] -- Cash Flows Per Share is used as a proxy for business and financial risk. It is simply a relative indicator of the ability of firms to service fixed charges. It is defined as the sum of all cash available for common stock, depreciation and amortization and extraordinary items divided by the number of shares in existence at the end of the quarter.
$X_4$ -- Growth. Since size is to be measured in dollar sales, growth will be defined as the percentage change in dollar sales over a period of eight quarters. The most recent period of growth is relevant because the entire study is based on the particular capital market situation described in Chapter III.

$X_5$ -- Systematic Risk. Beta is used as a measure of systematic risk. Sharpe refers to it as the "diagonal model." In this study beta was determined by regressing the price relatives for each stock against the Standard and Poors 500 stock index.

$X_6$ -- Unsystematic Risk. The residual variance is a measure of unsystematic risk. In statistics it is referred to as the mean square error. In this study the unsystematic risk for each firm is determined by the residual variance of each firm's price relatives regressed against the Standard and Poors 500 stock index.

The final variable profile does not contain the most significant variables on a univariable basis. Moreover, the variables chosen may not be the best measures of those characteristics they purport to measure. Recall, however, the dilemma is to choose

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that combination of variables that not only adequately measures the attributes, but that also has a low degree of correlation among its variables and is available on a quarterly basis. This final variable profile is that desired combination. An intensive search of the literature failed to turn up any study that used market variables such as $X_5$ and $X_6$ in a discriminant model. The bibliography in this study contains a comprehensive list of studies using the application of MDA in finance. All those studies listed use variables generated from internal accounting data. This is the first known application of MDA in finance that makes use of market variables.

A final word is in order concerning the data used in the model. It was established in Chapter III that the firms used in the test group would be those firms that issued convertibles in 1967. It is conceivable that a firm could change in a great many of its characteristics from the beginning of the first quarter to the end of the fourth quarter. It was for this reason that annual data were not used. Annual data are attractive; there are a great deal of them, and variables are available that are good measures of the characteristics of firms. The objective of this study is, however, unattainable with annual data. An objective is to determine the characteristics of firms that issue convertible bonds. This dictates that those characteristics must be determined in the same quarter that the bonds were issued. Therefore, the observations for each firm in the test group were
taken from the same quarter in which that firm issued a convertible. There were twenty-five firms in the test group; one firm issued a bond in quarter one, two in quarter two, twelve in quarter three, and ten in quarter four. Data for the firm that issued in quarter one were taken from quarter one. Data for the two firms that issued in quarter two were taken from quarter two and so forth.

To sum up, two groups of firms were chosen from a basic data set. One group of firms, referred to as the test group, issued convertible securities in the year 1967. The other group, referred to as the control group, relied on other means of financing. In the next chapter another, larger, sample will be drawn to validate the model. In order to construct a theory regarding the nature of firms that issue convertible securities, it is necessary to identify variables or attributes that describe the nature of firms. These variables were chosen on the basis of their potential discriminating power, the degree to which they have been discussed in the literature, and their effect on the value of the firm. Chapter V is an analysis undertaken to determine whether or not the firms that issued convertibles can be identified on the basis of these variables.
CHAPTER V

ANALYSIS

This chapter is undertaken to determine whether or not firms that are prone to issue convertibles can be identified by differences in the characteristics of those firms and firms that rely on other means of financing. In general this chapter will be developed along the following format: (1) a short discussion of Multiple Discriminant Analysis (MDA) and why it is an appropriate statistical tool for this study, (2) an analysis of the model, and the results of the analysis presented objectively, (3) an objective interpretation of the results, (4) a validation of the basic test and the results of the validation, (5) a brief discussion of the effects of measurement error, and (6) conclusions and implications.

Multiple Discriminant Analysis

The question to be resolved is one of prediction or classification and the evaluation of the accuracy of that classification. More specifically, can firms be assigned on the basis of selected variables to one of two groups: (1) a group that will issue convertible securities, or (2) a group that will not issue convertible
MDA provides a procedure for assigning firms to predetermined groupings on the basis of variables or attributes whose values may depend on the group to which the unit actually belongs. The basic assumptions in the model are: (1) the variables on which the classifications are based are assumed to have multivariate normal distributions, and (2) the within group variances are assumed to be equal. The robustness of the test and the importance of these assumptions are discussed in the section on the test of hypothesis.

The use of MDA in studies in finance is well known, but relatively recent. One of the first applications of MDA in finance was by David Durand. He used it to evaluate the credit worthiness of used car loan applicants. More recently, it has been used to analyze common stock quality ratings, predict financially distressed property-liability insurance firms and predict the failure of small businesses. It seems, however, that the most fundamental question was posed by Altman. He asked, "Can we bridge the gap . . . between traditional ratio analysis and the more rigorous statistical techniques which have become popular among academicians in


2 A comprehensive list of studies using the application of MDA in finance is included in the bibliography.
recent years?"  He was asking whether or not, financial ratios, when analyzed in a multivariate framework would take on a greater statistical significance than the common techniques of sequential univariate comparisons. His results were positive and many subsequent studies using financial ratios and MDA cite his study as a justification for their use. Altman found that the most important advantage of MDA is that it can analyze the entire set of financial data for each firm simultaneously rather than sequentially. The importance of this will become apparent later in this chapter when the variables are evaluated on a univariate basis and compared with the results of the same variables evaluated on a multivariate basis. The studies referred to all had one thing in common. The groups, in which firms or other experimental units are classified, are nominally measured; i.e., good-bad, failing-nonfailing, likely to bankrupt-not likely to bankrupt, or in the case of bond quality ratings, ordinally measured. The predictive variables, on the other


hand, were all intervally measured. This study, as in the studies referred to, has nominally measured dependent variables and intervally measured predictive variables. I.e., firms will be classified as belonging to groups that will issue convertible bonds or groups that will not issue, on the basis of selected financial variables.

In summary linear discriminant analysis may be appropriate when the dependent variables are nominally measured and the predictive variables are intervally measured. MDA is then an appropriate model for the classification of firms in this study, and its use in studies in finance is well established.

**Tests and Results**

The computer program used in this study is the Biomed 04M Discriminant Analysis for two groups. The program defines a discriminant function of the form:

\[
(5-1) \quad Z_j = V_1 X_{1j} + V_2 X_{2j} + \ldots + V_n X_{nj}
\]

where:


\(X_{ij}\) is the jth company's value for the ith independent variable;
\(V_i\) is the discriminant coefficient for the ith variable;
\(Z_j\) is the jth individual's discriminant score.

The discriminant function derived from the data in this study is:

\[
(5-2) \quad Z_j = 0.00006X_1 - 0.00029X_2 - 0.00682X_3 + 0.05955X_4 - 0.02751X_5 + 1.34205X_6.
\]

The first logical question should be: Does this function have any power to discriminate? Of course, if there is no difference between the two groups, there is no way any function can separate them. If there is a real difference in the mean vectors of the two groups, then the discriminant function will be useful because it is based on an optimum method of separation. In order to test the hypothesis that there is a real difference in the two groups, it is assumed that the groups follow a multivariate normal distribution with equal covariance structures. The assumptions are not considered critical however, since the test is said to be robust. How much concern should there be about the reality of the assumptions? Cooley and Lohnes state:

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"very little, in our judgement . . . . and we do not know of any useful test for multivariate normality."\textsuperscript{8}

One of the output quantities of the Biomed 04M program is a Mahalanobis $D^2$ statistic. This statistic may be defined as, "a generalized distance between two groups, where each group is characterized by the same set of $n$ variables and the variance-covariance structure is the same for both groups."\textsuperscript{9} The $D^2$ statistic is transformed to the more familiar $F$ statistic; the $F$ statistic is then used to determine whether or not there is a significant distance between the two mean vectors.

The first test of hypothesis is a standard test of the significance of the $F$ (or transformed $D^2$) statistic to determine if there is a significant distance between the two mean vectors:

1. $H_0$: There is no significant difference between the mean vector of six variables from firms that issued convertible securities in 1967 and a random sample of firms that did not.


ii. Ha: The mean vector of six variables from firms that issued convertible securities in 1967 is not equal to the mean vector of firms that did not issue such securities.

iii. Assume that the variables follow a multivariate normal distribution, that the samples were randomly selected and the covariance structure is the same for both groups.

iv. The significance level is .05, and the test is a two-tailed $F$ test.

v. The $F$ statistic transformed from $D^2 = 3.75\cdot 6$ and 43 degrees of freedom.

vi. $3.75$ is greater than $F_{0.05} = 2.74$. Therefore, reject the null hypothesis and conclude that the mean vector of six variables from firms that issued convertible securities in 1967 is not equal to the mean vector of variables for firms that did not issue such securities.

Since the differences in the two groups are differences in the mean vectors it can be inferred that the two groups are not homogeneous and that the discriminant function in this case does, indeed, have the power to separate the two groups.
The procedure for classifying firms is relatively simple. The values of the six variables for each firm are substituted into equation (5-2). Thus, each firm in both groups receives a Z score. If a firm's Z value is greater than a defined critical value, the firm is classified in group one. And conversely, if a firm's Z score is less than the defined critical Z value, the firm is classified in group two. Since the two groups are heterogeneous, it is expected that all firms issuing convertibles will fall into one group and firms not issuing convertibles will fall into the other group. The variances of the two groups are equal, therefore the value halfway between the two group means can be defined as the critical value; it is the value that will minimize the overlap and the probability of misclassification between the two distributions. The values for the two distributions are illustrated in Table 5-1. The mean Z value for group one is .02518; the mean Z value for group two is -.01668, and the critical Z value is .00425. The zone of misclassification, for this study, is the range from Z = .03144 to Z = -.03997.

The results of this study are shown in Figure 5-1. Of the twenty-five firms in the test group, eighteen were classified correctly, and seven were misclassified. Of the twenty-five firms in the control group, twenty were classified correctly and five were misclassified.
TABLE 5-1

PARAMETERS OF THE GROUP DISTRIBUTIONS
OF Z VALUES

<table>
<thead>
<tr>
<th></th>
<th>Convertible Group</th>
<th>Non-Convertible Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Means</td>
<td>.02518</td>
<td>-.01668</td>
</tr>
<tr>
<td>Group Variances</td>
<td>.00097</td>
<td>.00077</td>
</tr>
</tbody>
</table>
FIGURE 5-1

INDIVIDUAL FIRM DISCRIMINANT SCORES

Firms Classified As Not Likely to Issue Convertibles | Firms Classified As Likely to Issue Convertibles

Non-Convertible Financing | Convertible Financing

CUT-OFF

.00425
Interpretation of the Results

The results in the previous section are explicit, but what does it all mean? In order to answer this question it will be necessary to pose three more questions:

1. Is there a significant difference in the mean vectors of variables for the two groups of firms?

2. How well did the discriminant function perform?

3. How well did the independent variables perform?

Question number one has already been answered. The conclusion of the F test in the previous section was that there is, indeed, a significant difference in the mean vector of variables for firms that issued convertibles in 1967 and firms that relied on other sources. This can only be interpreted to mean that the groups are heterogeneous and the discriminant function has the power to separate them. The fact that the discriminant function has the power to separate the two groups does not necessarily mean that it will separate them. And that raises the next question.

How well did the discriminant function perform? That is, what percentage of firms were classified correctly, and is that percentage significant? In a test of proportions, such as this, a chi-square test is appropriate:
i. Ho: There is no significant difference in the proportion of firms classified correctly, by the discriminant function, and that proportion that could be expected to be classified correctly by chance.

ii. Ha: The proportion classified correctly by the discriminant function is greater than that that could be expected by chance.

iii. Assume that the samples were drawn randomly from a multivariate normal distribution and that the covariance structure is the same for both groups.

iv. The significance level is .05, and the test is a chi-square test.

v. Seventy-two percent of the issuing firms were classified correctly. Chi-square = 13.84 \( \frac{c}{1. d.f.} \) \(^{10}\)

vi. 13.84 is greater than chi-square \( \frac{3.84}{.05 \, 1. d.f.} \). Therefore, reject the null hypothesis and conclude that the proportion classified correctly by the discriminant function is greater than that that could be expected by chance.

The answer to the second question is clear. The discriminant function is not only capable of separating the two groups, but it did, in fact separate them well.

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\(^{10}\) See Appendix B for the computation of the chi-square statistic.
The group means and t-tests for significant differences between group means are presented in Table 5-2. The test results provide an indication of the individual discriminating ability of the variables. An examination of Table 5-2 shows unsystematic risk, growth, and size to be significant at the .05 level. Systematic risk, cash flows per share and profitability are not significant discriminators when evaluated on a univariate basis. However, the univariate tests provide no indication of the relative contribution of the variables to the multiple discriminant function. Altman concluded that financial variables would take on greater statistical significance when evaluated in a multivariate framework than when evaluated sequentially. 11

The relative contribution of each variable may be obtained by adjusting the discriminant coefficients for differences in the units of measure of the original variables. This adjustment is made arithmetically, by multiplying the square root of the diagonal elements of the variance-covariance matrix for each variable times the discriminant coefficient of that variable. The product of this multiplication gives the relative contribution of each variable to the total discriminating power of the function. The adjusted coefficients are shown in Table 5-3. An examination of Table 5-3 shows

11 Altman, p. 609.
TABLE 5-2

VARIABLE MEANS AND TESTS OF SIGNIFICANT DIFFERENCES BETWEEN MEANS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test Group Mean</th>
<th>Control Group Mean</th>
<th>t-Value#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>193.09999</td>
<td>91.35599</td>
<td>2.081*</td>
</tr>
<tr>
<td>Profitability</td>
<td>9.40720</td>
<td>21.93440</td>
<td>-1.788</td>
</tr>
<tr>
<td>Cash Flow Per Share</td>
<td>1.00480</td>
<td>.84440</td>
<td>.459</td>
</tr>
<tr>
<td>Growth</td>
<td>.37312</td>
<td>.07604</td>
<td>2.554*</td>
</tr>
<tr>
<td>Systematic Risk</td>
<td>.45918</td>
<td>.78464</td>
<td>-1.408</td>
</tr>
<tr>
<td>Unsystematic Risk</td>
<td>.01040</td>
<td>.00536</td>
<td>2.694*</td>
</tr>
</tbody>
</table>

The variances for cash flows per share, growth and systematic risk were the same for both groups. They were thus, pooled and resulted in 48 degrees of freedom. The variances for size, profitability and unsystematic risk are not the same for both groups. They were thus, used separately and resulted in 24 degrees of freedom. The formulas used to compute the t-values are listed in Appendix C.

* Significant at the .05 level.
### Table 5-3

**Relative Contribution of the Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted Coefficient</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>0.01037</td>
<td>4</td>
</tr>
<tr>
<td>Profitability</td>
<td>-0.00721</td>
<td>5</td>
</tr>
<tr>
<td>Cash Flow Per Share</td>
<td>-0.00561</td>
<td>6</td>
</tr>
<tr>
<td>Growth</td>
<td>0.01822</td>
<td>2</td>
</tr>
<tr>
<td>Systematic Risk</td>
<td>-0.01329</td>
<td>3</td>
</tr>
<tr>
<td>Unsystematic Risk</td>
<td>0.01870</td>
<td>1</td>
</tr>
</tbody>
</table>
unsystematic risk and growth to be very close as the variable with the greatest contribution to the overall discriminating function. The arithmetic signs of the adjusted coefficients are important. The negative signs for profit, cash flows per share and systematic risk indicate that the greater a firm's values for these variables, the lower will be the firm's Z score, and the greater the probability that the firm will fall in the group that did not issue convertible bonds. Conversely, the positive signs for size, growth and unsystematic risk indicate that the greater a firm's values for these variables, the greater will be the firm's Z score, and the greater the probability that the firm will fall in the group that issued convertibles. The significance of the results is discussed later in the section concerning possible implications.

It is evident that the discriminant function had the power to separate the two heterogeneous groups in this study. Moreover, it not only had the power to separate the groups, but it did significantly separate them. In addition, some preliminary conclusions can be stated concerning the relative weight of the six variables used in the model. However, before any general conclusions can be drawn, it must be determined whether or not the model can be expected to work for any group of randomly drawn firms. This involves validating the model.
Validation of the Model

It was concluded, in the preceding section, that there was indeed a significant difference in the two groups under study. In MDA a statistical difference between two groups can result from three different sources:

(1) true differences between the groups,

(2) sampling errors,

(3) intensive search for the variables that work best in sample. 12

The objective in validating the test is to eliminate the possibility that the difference in the two groups is due to (2) or (3) above.

Sampling errors occur when a discriminant test is applied to the same sample of data that was used to derive the discriminant function. The discriminant "fit" to the data is the one that maximizes the predictive power of the function for the particular sample being studied. 13 If the underlying population is, in fact, homogeneous, but the sample means are somehow different due to errors in sampling or measurement, discriminant analysis will center on the


13 Ibid., p. 253.
differences in the samples. The result will be an upward bias that will show differences in populations that are not real. 14

Search bias is built into the model by the researcher. It occurs when the researcher tries every possible combination of variables in the model, and then uses that combination that shows the most discriminatory power. For example, there were sixteen variables available for use in this study. If instead of choosing the variables with the criteria described previously, every possible subset of the sixteen variables were tried in the model, and that subset that maximized the predictive power of the equation chosen, search bias would be present. Clearly, a validation procedure is needed that will detect both sampling errors and search bias.

Frank, Massy, and Morrison suggest that the preferred method for validation is the split sample approach. 15 The procedure consists of splitting the original sample into two subsamples: one to derive a discriminant function and the other for validation. Once the discriminant function is determined, it is used to classify the units of the validation sample into a group membership. The classification of the validation sample will be free of sampling errors or search bias. And since the validation sample is free of bias, the

14 Ibid., p. 254.
15 Ibid.
proportion of correct classifications will be less than that in the
analysis sample, by the amount of the original bias. 16

The validation procedure used in this study is a simple modi-
fication of the split sample approach. 17 In the original test, the null
hypothesis, that there was no significant difference between the mean
vector of six variables from firms that issued convertible securities
in 1967 and a random sample of firms that did not, was rejected. It
was concluded that the mean vector of variables for firms that
issued convertible securities was greater than that vector for firms
that did not. The MDA procedure then classified 72 percent of the
issuing firms into the correct group. Now this test is biased because
of sampling errors. That is, the discriminant function was applied
to the same two groups used to estimate the discriminant coefficients.
The validation procedure, in this case, involved gathering information
for fifty new firms. The discriminant coefficients derived from the
original sample were then multiplied by the values of the variables
for the fifty new firms. The objective is to see if the discriminant
function will discriminate as well, on any random sample of firms,
as it did on the original sample. It is expected that the proportion
of firms classified correctly in the validation sample will be less

16 Ibid.

17 The author gratefully acknowledges the advice of Dr. David
W. Smith of the Department of Experimental Statistics at Louisiana
State University, on the method of modifying the split sample approach.
than the original sample due to the systematic bias associated with sampling errors. The fact that the validation test is expected to classify a smaller proportion correctly is not important. The major question is will the proportion correctly classified by the validation test differ significantly from the original test. In other words, the difference in the proportions classified correctly by the two tests is due to bias. The objective is to see if this bias is significant. The validation test used in this study will also identify any bias that might be present due to intensive search. Recall that when the original sample was chosen, all firms that issued convertible bonds in 1967 were used to make up the test group. The control group was made up of firms that relied on other types of financing. Now since all firms that issued convertibles were used in the original test, there are only firms that did not use convertibles left in the data set. Fifty firms were chosen randomly from this group. It is expected that the Z values for all firms in this group will fall below the critical Z of .00425. More specifically, since the original test classified 72 percent of the firms correctly, it is expected that the validation test will classify a proportion of the new firms into group two, that is not significantly less than 72 percent. The test is:

i. **H₀**: \( p_2 = p_1 = .72 \). That is, there is no significant difference in the proportion of firms classified correctly in the analysis test and the proportion classified correctly in the validation test.
ii. Ha: \( p_2 \) is less than \( p_1 \). The proportion of firms classified correctly in the validation test is less than the proportion classified correctly in the analysis test.

iii. Since the firms will either fall in group one or group two, and there is one sample, the binomial test can be used to test for a significant difference in proportions.

iv. The significance level is .05, and the number of observations is 50.

v. The number of firms classified correctly in the analysis was 36 or 72 percent. The number classified correctly in the validation test was 32 or 64 percent.

vi. \[
\frac{32 - 50(.72)}{\sqrt{50(.72)(.28)}} = -1.26 \text{ is less than } t_{05} 1.645;
\]

therefore, accept the null hypothesis and conclude that there is no significant difference in the proportion of firms classified correctly in the analysis sample and that classified correctly in the validation sample.

It can also be concluded, as a result of the validation procedure, that while there was some bias in the original analysis, it was not
significant and the procedure will classify new firms as well as it did in the original analysis.

**Effects of Measurement Error**

The two errors described in the previous section are generally regarded as the most likely to bias a discriminant analysis and lead to a faulty conclusion. One other type of error is noteworthy, and that is, the errors that can result from measuring the values of the variables. This is known as the "errors-in-variables" problem and is discussed in most econometrics textbooks.

The variable profile used in this study includes four variables derived from internally generated accounting data; i.e., size, profitability, cash flow per share, and growth. The other two variables, systematic and unsystematic risk, were computed from market data. Thompson points out that accounting data can, in itself, be a source of error. The errors originate from different methods used to measure the same phenomena. For example, LIFO or FIFO can be used to evaluate inventories, average inventory or ending inventory can be used to calculate inventory turnover, and estimates are sometimes made from very small samples. 18 The accounting data used in this study were standardized so that each

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accounting variable measures what it purports to measure in exactly the same way for each firm. There is then, no measurement error in the accounting variables that would bias the analysis.

The market variables are quite another matter. Error did result in the measurement of individual firm's values for systematic risk (beta) and unsystematic risk (the residual variance). The errors in values for individual firms resulted from using monthly data over a two year period. Twenty-four monthly observations are not sufficient to obtain a good fit for the beta statistic. Moreover, the lack of a good fit resulted in a greater degree of residual variance. The important question is, how did the presence of these errors in the measurements for individual firms affect the discriminant analysis of the two groups?

A great deal of recent work has been concerned with obtaining more accurate estimates of the beta parameter. The studies have addressed both the problem of the non-stationary character of beta over time, and the problem of measurement error in values for individual firms as those errors affect analysis of groups of

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firms. The general method of "ironing out" non-stationarity and individual error is known as the "grouping" procedure. The basic idea is to use portfolios rather than individual securities to calculate betas on the grounds that the resulting estimates will be closer to their true values. The portfolio will average out, by cross-sectional collection, events peculiar to individual securities. 20 Hinich and Roll suggest also, that the cross section will smooth out changes in the model's parameters that are unique to individual firms. 21 In addition, Blume found that a large magnitude of residual variance may make the model inadequate to evaluate an individual firm, but that it is adequate for cross-sectional analysis. 22

The values for beta and the residual variance, in this study, were derived from a cross-section of firms. The total number of observations used to derive those values was six hundred for each group; i.e., twenty-five firms times twenty-four months. The discriminant coefficients for each of the two market variables thus resulted from twelve hundred observations. Moreover, an additional twelve hundred observations were necessary to complete the validation process in the preceding section. The errors in measurement for


21 Hinich and Roll, p. 44.

individual firms have, as Hinich and Roll said, been "smoothed out" by the cross-section grouping. The differences in the values of the variables for the two groups under study maintain their integrity and the errors in measurement had no effect on the results of the discriminant model.

Conclusions and Implications

Conclusions

Financing strategy, as defined in Chapter II, refers to the choice of particular means of financing in the current period. It includes attempts to exploit timing and whatever gross imperfections the market is subject to that allow firms to offer their securities in some best (most valuable) form. Obviously, advantages that exist in one time period may not exist in another. If there are gross imperfections that the market is subject to, as stated by Haley and Schall, these imperfections may change from one time period to the next. It was, therefore, necessary to isolate one time period on which to base this study, and it follows that the conclusions reached in this study are applicable to a money and capital market situation such as that described in Chapter III, and there is no reason to believe that the conclusions are so general that they are applicable to any time period.

There is no real consensus in the literature as to whether convertible financing is a tool of the relatively small, more
speculative firms or whether a firm has to be large and relatively well known to issue convertible bonds. In the preceding chapter, different writers were quoted as expressing both points of view. If there is a preponderance of folklore on one side or the other, it seems to lean toward that side that views the convertible issuing firm as relatively small with some potential for growth. The results of this study show something quite different, and may even be a bit surprising. The coefficient of the proxy for size is positive. This means that the larger the firm, the more likely it is to issue a convertible bond. A superficial conclusion, at this point, might be that firms that issue convertibles are relatively larger than firms that do not issue such securities. A closer study might reveal that in tight money and capital markets with interest rates at historical highs, any firm, regardless of size, will consider convertible bonds. R. C. A., Ralston-Purina, and Tenneco clearly had other financing alternatives, but chose the convertibles, either to escape the high interest rates or to add to their equity base. It is also conceivable that in such a market many unseasoned companies would have great difficulty obtaining funds any other way. It is a conclusion of this study then, that in a capital market situation such as that described in Chapter III, firms of all sizes will consider the convertible alternative. The actual issues, however, are more likely to come from the relatively well-known "blue-chip" companies such as the
aforementioned Ralston-Purina, R. C. A., and Tenneco. A primary reason for this seems to be that the market in general, and institutions in particular, have become more receptive to the idea of convertibles. In 1967 convertibles seemed to take on some new class, and to the extent that institutions were becoming more interested, the greater was the demand for "blue-chip" convertibles. This conclusion is in no way consistent with the idea that convertible bonds are primarily the tool of small speculative firms.

Most writers are of the opinion that firms that issue convertible securities will have some potential for growth. The concept of delayed equity is directly related to growth, and without growth this strategy will not work. The coefficient of the proxy for growth in Table 5-3 is positive indicating that the greater the rate of growth for a firm, the more likely the firm will be to issue convertibles. Moreover, the proxy for the rate of growth ranked second in contribution to the overall discriminant function. It is easy to come to a relatively strong conclusion that firms that issue convertibles experience a greater rate of growth twenty-four months prior to the date of issue than firms in general. It is not certain that this observed rate of growth is an indication of potential growth, but it is reasonable to conclude that this is indeed the case.

The other four variables were included in the model in an effort to determine whether or not the risk-return tradeoff character
differs in any way between the two groups of firms. There is a proxy for profitability, and since there are different types of risk, there are three proxies for risk.

The coefficient of the proxy for profitability is negative indicating the more profitable a firm, the more likely it will not issue convertible bonds. This is a reasonable conclusion. Firms that are very profitable are more likely to rely on internally generated funds than firms that are not so profitable. This conclusion was expected. Profitability is not, however, a measure of return to shareholders. It only has an influence on return. The relationship between profit and return is discussed further in the section on implications for investors.

One source of risk can be measured by accounting information. This is the risk that results from fixed charges, generally discussed in principles textbooks. The ability to service fixed charges is measured, on a relative basis, by cash flows per share. Table 5-3 shows cash flows per share to have a negative coefficient indicating that the greater a firm's cash flows per share the more likely it will not issue convertible securities. This conclusion was not unexpected. Recall from Chapter III that one of the reasons for issuing bonds in 1967 was to rebuild liquidity decimated by the end of the 1961-1965 boom and the 1966 credit crunch. This conclusion was also not unexpected because cash flows per share should be
highly positively correlated with profitability. To the extent that profitability and cash flows per share are correlated, the discriminant function is less efficient, but an examination of Table 5-3 indicates that profitability and cash flows per share rank fifth and sixth respectively in their contributions to the overall discriminant function. It is safe to conclude then, that the degree of correlation between the two lowest ranking variables probably had no harmful effect on the overall function.

Market risk is partitioned into its usual two components. Systematic risk was determined by computing the regression coefficient (beta) of the price relatives for each stock against the Standard and Poor's 500 stock index. Unsystematic risk is determined by the residual variance of the above regressions, and is measured by the mean square error.

The proxy for systematic risk in Table 5-3 is negative. This indicates that the greater the value of beta, the more likely the firm will fall into the group that does not issue convertibles. The mean beta for the test group, from Table 5-2, is .459; the mean beta for the control group is .785. A preliminary conclusion is that the group that did not issue convertibles has more systematic risk than the convertible group, but it has less systematic risk than the market. The convertible group, on the other hand, is less affected by the changing nature of the market than the non-convertible
group and may be attractive to investors because of their "defensive" nature. The preliminary conclusion is superficial. A more comprehensive conclusion regarding market risk and potential differences in the risk-return character of each group has to be postponed until unsystematic risk is considered.

Table 5-3 shows the proxy for unsystematic risk to be positive. This indicates that the greater the degree of unsystematic risk associated with a firm, the more likely the firm will be a convertible issuing firm. The proxy for unsystematic risk is also shown to rank first in relative contribution of the variables to the total discriminating power of the discriminant function. It is, therefore, safe to conclude strongly that firms that issue convertibles have a significantly greater degree of unsystematic risk associated with them than do firms that do not issue convertibles.

In summary, the major conclusions of this study thus far are that the firm that will attempt to employ the strategic advantages of convertible financing, in a capital market such as described in Chapter III is a relatively large, well-known firm that has had a better record of growth two years prior to issue than firms in general. The firm will not have as good a record of profit or cash flows two years prior to issue as firms in general, and will offer less systematic and more unsystematic risk than firms that do not issue convertible bonds.
The purpose of including indicators of risk and return in the model was to determine whether or not the risk-return tradeoff was in any way different between firms that issue convertibles and firms that rely on other types of financing. If there is a difference it means, of course, that the value of the firms is determined differently.

The major conclusion of this study is that the risk-return tradeoff character of the two groups of firms is indeed different. The greater the indicators of profitability, cash flows per share, and systematic risk, the more likely the firm would be a non-convertible issuing firm. To the extent that investors perceive profit and cash flows to be indicators of return and safety in regard to accounting risk, and to the extent that they perceive systematic risk as the relevant indicator of market risk they trade off these factors to determine the value of the firm. The greater the values for growth and unsystematic risk the more likely the firm was to issue convertibles. To the extent that investors perceive growth as an indicator of return, and to the extent that they perceive unsystematic risk as the relevant indicator of market risk, they trade off these variables to determine the value of the firm. It is argued that if markets are efficient and investors are well diversified that the only relevant risk is systematic risk.\textsuperscript{22} To the extent that

markets have imperfections and investors are not well diversified
unsystematic risk becomes important. Blume found that although
portfolio theory assumes that individual investors will diversify
and consider the risk of the portfolio as a whole rather than each
asset individually, there is very little empirical work indicating
that people do, in fact, behave according to the assumption.\(^\text{23}\)

This study has resulted in a contribution toward the con-
struction of a theory concerning (1) the characteristics of firms
that attempt to exploit the strategic advantages of convertible
financing, and (2) the differences in risk-return tradeoff proxies
of firms that issue convertibles and firms that rely on other
forms of financing. The fact that there are differences in the
risk-return tradeoff proxies indicate that the firms are valued
differently. The theory is offered as a plausible, and logical
explanation of observed phenomena. The next logical question
should be: what are the implications of the new theory?

**Implications for the Firm**

The implications of the newly constructed theory for firms
and financial managers are constrained by the normative goal for

the firm. The risk-return tradeoff entails a consideration of the firms cost of capital. It is incumbent on firms to offer their securities in the most valuable form. To the extent that firms succeed in this they move toward the achievement of their goal. There is no reason to believe that convertible bonds are, on the average, more valuable than other securities. The decision to use convertibles should be an attempt to take advantage of short-term financing strategy in a particular market situation. The strategic advantages of using convertibles, as well as a market situation in which the advantages would surely exist was discussed at great length in Chapter II. The success of the convertible offerings is primarily dependent on market receptivity. The newly offered theory suggests that investors who are interested in convertibles, trade off unsystematic risk and return in the form of growth. The implications of the theory are clear for firms that are seeking the strategic advantages of convertible financing. First, they should be aware that they are appealing to investors who can handle (by diversification) unsystematic risk. Secondly, since the theory suggests that the investors are looking for return in the form of growth, the firm that has potential for growth, as perceived by investors, will find a greater degree of market receptivity than firms that have little or no prospects for growth. In short, knowledge of potential investors risk-return tradeoff proxies provides the firm
with prior knowledge of who their investors will be. It follows
that if they know who their investors are likely to be, more
information will be available on which to base decisions of financing
strategy.

Implications for the Investor

The implications for investors are essentially the same as
the implications for firms, except that they are viewed from a
different perspective. Again, there is no reason to believe that
convertible bonds are, on the average, superior to other securities.
Their value, to the investor, is determined by how the investor
views the risk-return tradeoff character of the security. A great
deal has been written concerning how investors value this risk-
return tradeoff. Some of the theories of valuation were reviewed
in Chapter II and need not be reiterated here. The important
implication here is that the results of this study indicate that the
convertible issuing firms have a greater degree of unsystematic
risk than other firms. To the extent that investors feel they can
handle (by diversification) the greater degree of unsystematic risk,
associated with convertibles, the convertibles become more
attractive, especially since they have less systematic risk than
common stocks. Moreover, if investors feel that they can reduce
unsystematic risk and still have a chance for a capital gain via conversion, convertibles become attractive indeed. Just how attractive convertibles are to individual investors is well established in traditional wisdom. It is a function of whether or not the investor is willing to accept a lower interest income in return for the chance for a capital gain, and the marginal impact that the convertible will have on his total portfolio risk. To reiterate Blume's earlier position, whether or not investors actually behave according to traditional wisdom has not been established. The point is that now, as a result of this study, more information is available to investors.
CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

In this study a contribution is offered toward the construction of a theory concerning the nature of firms that seek the strategic advantages of convertible financing. More specifically, the questions were asked: If there are advantages of convertible financing in certain capital market situations, what are those advantages? And more importantly, are the characteristics of firms that issue convertible bonds significantly different from the characteristics of firms that rely on other types of financing? In order to start an inquiry into the answers of these questions, it was first necessary to review theories of how investors value convertible bonds, and secondly, to review reasons given by practitioners for issuing convertibles.

Theories of Valuation

A great deal has been written on the valuation of convertible securities. In this study, the review of theories of value reflects the apparent evolution of thought on valuation. The evolution of thought
can be described in roughly three phases: first, the pre-capital asset pricing model (CAPM) phase may include all works that base ex-ante valuation on an expected rate of growth for the underlying common stock, resulting in probabilistic values. Secondly, the CAPM phase may include those works that treat convertible debentures—like their underlying common shares—as components of a risky market portfolio. Finally, the equilibrium option pricing phase contains works that permit the quantification of the various factors that affect the value of an option. Chapter II contains examples of models that illustrate each of the three phases.

The Use of Convertible Bonds

The viewpoints of practitioners concerning the strategic advantages of convertible bonds seem to corroborate each other. The primary reason, given by financial executives, for issuing convertibles is to increase equity, and specifically to issue this new equity on a delayed basis. The viewpoints expressed by financial executives also seem to back up the theoretical contention that the firm might have some investment opportunities that the market is not aware of, or if the market is aware, it is simply more pessimistic concerning the profitability of those projects. In this case, the firm would issue convertible bonds with a conversion price approximating the value of the stock if the market agreed with management on the value of the
investments. If the investment opportunities turn out as well as management predicted the market price of the stock will go up and the bonds can be converted. Thus, management can issue delayed equity and the present shareholders receive the benefit of the profitable investment opportunities. The second major reason for issuing convertibles, uncovered in the empirical studies, was that the convertible feature was used to "sweeten" a debt issue so as to obtain a lower interest rate.

Several other reasons were suggested for issuing convertible bonds, such as using them as a method of saving on issue costs of common stock, and appealing to institutions that are restricted in their ability to hold common stock. No empirical studies have been undertaken to measure the magnitude of either of these strategies, but as the restrictions on institutions began to be relaxed in the late 1960's, the effects of this strategy would logically seem to diminish. On the other hand, as issue costs become more of a relevant factor, the effects of this strategy should become more important. One other suggestion, on which there is no empirical evidence, is that firms issue convertible debt in the hope that investors will perceive it as equity and this will in turn stretch the firm's debt capacity. Although these and other strategies may, in fact, be used at different times, the respondents to the empirical studies, reviewed in Chapter II, mentioned none of the more exotic reasons for using convertibles.
A Unique Time Period and The Growth of Convertible Bonds

Whatever may be the strategic advantages associated with issuing convertible bonds, there is no reason to believe that these advantages remain static over time, or whether they exist to the same degree at different points in time. In order to study the characteristics of firms that attempt to exploit the advantages associated with convertible financing, it was necessary to isolate one period in time on which to base this study.

Descriptive statistics and historical capital market literature reveal 1967 as a year so unique that the collective attitudes of both borrowers and lenders seemed to change. The great demand for funds following the 1961-1966 boom created a paradox. Firms were willing to pay more for funds than the "accepted" ceiling and lenders were unable to take advantage of it, partially because the higher rates connoted unacceptable risk to institutions. It was at this time, and partially for this reason, that convertible bonds became a more significant instrument in the market. In 1967 total bond issues increased by 60 percent over 1966, but convertible bonds increased by 129 percent. Some of the reasons for the new-found strength of the convertibles were the same as those cited as reasons for the existence of the securities in Chapter II. Some firms were trying to escape the record high interest rates and others were trying to build their equity base.
Regardless of the reasons for so many convertible securities coming to the market, there would have been a great deal of difficulty in selling those issues had not some change taken place on the buying side. Prior to 1967 speculators could buy convertibles on a 10 percent margin. In mid-1967 the Federal Reserve Board felt that with the great proliferation of convertibles, speculation might get out of hand. They, therefore, proposed that buyers put up 70 percent in cash rather than 10 percent as before. Later in the year they softened this proposal to the current rate of 50 percent. But the mere proposal seemed to cut off a great deal of credit to speculators. As the speculators dropped out of the convertible market, institutions moved in to take their place. As a result, it is said that convertibles took on some new class in 1967. On the issuing side both large and small companies came to the market with a record volume of convertibles. On the buying side calmer and more sober institutional investors took the place of speculators. This in turn created a greater demand for quality, convertibles from "blue chip" firms. 1967 was and remains the year that record volumes of good quality convertibles came to the market. Not all firms issued convertibles for the same reasons, but there is reason to believe that most firms in need of new funds in 1967 considered convertibles as an alternative.
Sample and Variable Selection

The sample used in this study was chosen from a basic data set of 381 firms. Seventy-five of the 381 firms issued convertibles over the twenty year period from which the data was collected. Of the seventy-five firms that issued convertibles over the twenty year period, twenty-five or 33 1/3 percent issued in the year 1967. This is entirely consistent with the capital market situation described in Chapter III, and reinforces the decision to isolate 1967 as a time period on which to base the study. All the firms in the data set that issued convertibles in 1967 were identified and grouped together. This group is referred to as the test group, and it is the characteristics of the test group that were under study. Twenty-five firms that did not issue convertibles were chosen from the same time period for comparison with the test group; this group is referred to as the control group. Later, in order to validate the model an additional fifty firms were chosen at random from the same time period.

The criteria for choosing variables was potential differences between groups, their relevance in regard to the value of the firm, and the degree to which they have been discussed in the literature. In addition, the chosen variables had to be available on a quarterly basis, and have a relatively low degree of correlation with each other. The final variable profile contained proxies for six areas for
comparison: (1) the size of the firm, (2) the rate of growth, (3) a measure of profitability, (4) a measure of business and financial risk, (5) a measure of systematic risk, and (6) a measure of unsystematic risk.

Analysis

The question to be resolved by the analysis was one of prediction or classification and the evaluation of the accuracy of that classification. The use of multiple discriminant analysis in studies in finance is well known. The bibliography contains a rather comprehensive list of such studies, and they all have one thing in common. The groups in which firms or other experimental units are classified, are nominally measured; the predictive variables, on the other hand, were all intervally measured. This study as in the studies referred to, has nominally measured dependent variables and intervally measured predictive variables. Multiple discriminant analysis is then an appropriate tool for the analysis in this study.

The major results of the analysis were interpreted by answering three questions:

(1) Is there a significant difference in the mean vectors of variables for the two groups of firms?

(2) How well did the discriminant function perform?

(3) How well did the independent variables perform?
The answer to question number one was found to be affirmative; there was indeed a significant difference in the mean vector of variables for the test group and the mean vector of variables for the control group. This was interpreted to mean that the groups are heterogeneous and the discriminant function has the power to separate them.

The fact that the discriminant function has the power to separate the two groups does not necessarily mean that it will separate them. This raised question number two above. The discriminant function performed very well; it classified seventy-two percent of the test group correctly. This was a significant proportion at the .05 level.

The relative contribution of each of the independent variables to the discriminant function is shown in Table 5-3. In order of their power to discriminate, the variables ranked: (1) unsystematic risk, (2) growth, (3) systematic risk, (4) size, (5) profitability, and (6) cash flows per share.

Before any general conclusions could be drawn, it was necessary to validate the model to eliminate any possibility that the difference in the two mean vectors was due to either sampling errors or search bias. The procedure used to validate the model was a simple modification of the split sample approach. The results of the validation test showed no significant bias in the analysis, and it was
thus concluded, that the discriminant function would classify new firms as well as it did the original sample.

The aforementioned two errors are generally regarded as the most likely to bias a discriminant analysis and lead to a faulty conclusion. One other type of error is noteworthy, and that is the errors that can result from measuring the values of the variables. The variables used in this study were derived from both internally generated accounting data and market data. Accounting data can, in itself, be a source of error. The errors originate from different methods used to measure the same phenomena. The accounting data used in this study was standardized so that each accounting variable measures what it purports to measure in exactly the same way for each firm. There is, then, no measurement error in the accounting data that would bias the analysis. Error did result in individual firms' values for systematic and unsystematic risk. The errors in the values for individual firms resulted from observing the price relatives for only twenty-four months prior to issue. The twenty-four observations were not adequate to produce "good fits" for the individual firm's beta statistics. The important question is how did the presence of these errors affect the discriminant analysis of the two groups? The general method of "ironing out" individual errors is known as the grouping procedure. The basic idea is to use portfolios rather than individual securities to calculate betas on the
grounds that the resulting estimates will be closer to their true values. It was also suggested that cross-sectional analysis will smooth out changes in the model that are unique to individual firms. The values for beta and the residual variance, in this study, were derived from a cross section of firms. The errors in measurement for individual firms have been "smoothed out" by cross-sectional grouping. The differences in the values of the variables for the two groups under study maintained their integrity and the errors in measurement had no effect on the discriminant model.

Conclusions

The conclusions of this study and the implications of those conclusions are discussed in great detail in Chapter V. In summary, the major conclusions are that the firm that will attempt to employ the strategic advantages of convertible financing in a capital market situation such as described in Chapter III is a relatively large, well-known firm that has had a better record of growth two years prior to issue than firms in general. The firm will not have as good a record of profit or cash flows two years prior to issue as firms in general, and will offer less systematic and more unsystematic risk than firms that do not issue convertible bonds.

The purpose of including indicators of risk and return in the model was to determine whether or not the value of the firms is
determined differently. The major conclusion of the study is that the 
风险-回报权衡特征的两个集团公司的风险不同。风险指标更大，盈利性，现金流
按股，和系统性风险，公司越可能为非可转换的发行公司。在某种程度上，投资者认为
利润和现金流是回报和安全的指标，考虑到会计风险，和考虑到他们认为系统性
风险作为市场风险的指标，他们权衡这些因素来确定公司的价值。风险越大，增长
和非系统性风险越有可能发行可转换债券。在某种程度上，投资者认为增长是
回报的指标，和考虑到他们认为非系统性风险是市场风险的指标，他们权衡
这些变量来确定公司的价值。据认为，如果市场是有效的，投资者是分散的，其
唯一相关风险是系统性风险。在某种程度上，市场有不完善，投资者是不分散的，
非系统性风险变得重要。据很少有限的实证工作
表明，投资者将分散考虑风险的组合，而不是每个资产的
单独。

This study has resulted in a contribution toward the construc-
tion of a theory concerning (1) the characteristics of firms that
attempt to exploit the strategic advantages of convertible financing,
and (2) the differences in the risk-return tradeoff proxies of firms that issue convertibles and firms that rely on other types of financing. The fact that there are differences in the risk-return tradeoff proxies indicate that the firms are valued differently. The theory is offered as a plausible, and logical explanation of observed phenomena.

In addition to the contribution toward the construction of a theory as described above, the value of the study lies not only in questions it answers, but also providing clear statements of questions that need answering. In this regard, there are two obvious and important questions that are potentially fruitful areas for further study. First, what happened to the discriminatory variables after issue? The objective in this study was to determine the nature of firms that issue convertible bonds. This dictated that the data be gathered at the time or prior to issue. The question remains: did the issue of convertible securities change the characteristics of the firm, and in particular the firm's risk-return tradeoff character? Secondly, if the propositions in the theory are true concerning differences in the risk-return tradeoff character of the two groups of firms, does this create a clientele effect and, if so, what types of investors are attracted to each group and why?
APPENDIX A

GROUPS OF FIRMS USED IN THE STUDY

Test Group

1. National Distillers and Chemical Corporation
2. Grolier Publishing Company
4. Baxter Laboratories Incorporated
5. Armstrong Rubber Company
6. Owens-Illinois Company
7. Penn-Dixie Industries
8. Howmet Corporation
9. Revere Copper Company
10. Trane Corporation
11. F.M.C. Corporation
12. Skil Corporation
13. Sunstrand Corporation
14. Black and Decker Company
15. Cooper Industries
16. Pitney Bowes
17. Radio Corporation of America
18. Admiral Corporation
19. Grumman Corporation
20. Lockheed Corporation
21. United Technologies
22. Cessna Corporation
23. Insilco Corporation
24. General Telephone Company
25. Signal Corporation
**Control Group**

1. Kennecott Copper Company  
2. Pullman Corporation  
3. Louisiana Land and Exploration  
4. Federal Paperboard Company  
5. Tootsie Roll Industries  
6. Diamond International Company  
7. Crown Zellerbach Corporation  
8. American Smelt and Refining  
9. Maytag Corporation  
10. Owens-Corning Fiberglass  
11. Simmons Corporation  
12. Republic Steel Corporation  
13. Zenith Radio Corporation  
14. Rockwell Corporation  
15. Inmont Corporation  
16. Time Incorporated  
17. American Chain and Cable Company  
18. Babcock and Wilcox  
19. St. Joe Minerals Corporation  
20. International Nickel of Canada  
21. Eli Lilly Corporation  
22. Simplicity Pattern Company  
23. Anhauser Busch Incorporated  
24. Stewart-Warner Company  
25. Globe-Union Corporation
Validation Group

1. American Crystal
2. Shell Oil Company
3. Polaroid Corporation
4. Emhart Corporation
5. Proctor Gamble Company
6. Halliburton Company
7. National Gypsum Company
8. Graniteville Company
9. Howard Johnson Company
10. Carter-Wallace Company
11. Keebler Corporation
12. Kellogg Company
13. Gulf Oil Corporation
14. Dupont (E I) De Nemours
15. General Motors Corporation
16. Jones Laughlin Steel Company
17. Johns-Manville Company
18. Standard Brands Incorporated
19. First National Stores
20. Bucyrus-Erie Company
21. Phelps Dodge Company
22. Minnesota Mining and Manufacturing Company
23. Mobile Oil Company
24. Stanley Works
25. Outboard Marine Company
26. McGraw Edison Company
27. Bayuk Cigars Incorporated
28. Moore Corporation
29. Unilever N. V.
30. U. S. Steel Corporation
31. Timken Company
32. Cincinnati Milacron
33. Texasgulf Incorporated
34. Winn-Dixie Stores
35. Acme Markets
36. Hudson Bay and Refining
37. Square D Company
38. Beckman Instruments
39. Trans-Union Company
40. Alpha Portland Industries
41. Wrigley (WM) Jr. Company
42. Gerber Products
43. Exxon Corporation
44. Allied Chemical Corporation
45. Koppers Corporation
46. Thiokol Corporation
47. Skelly Oil Company
48. Joy Manufacturing Company
49. Caterpillar Tractor Company
50. International Business Machines
APPENDIX B

CALCULATION OF THE CHI SQUARE STATISTIC

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
<th>Non-issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>(18 - 12.5)^2/12.5</td>
<td>(5 - 12.5)^2/12.5</td>
</tr>
<tr>
<td></td>
<td>2.42</td>
<td>4.5</td>
</tr>
<tr>
<td>Non-Issue</td>
<td>(7 - 12.5)^2/12.5</td>
<td>(20 - 12.5)^2/12.5</td>
</tr>
<tr>
<td></td>
<td>2.42</td>
<td>4.5</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i} \]

where:  
- \( O_i \) = observed number of cases in \( i \)th category
- \( E_i \) = expected number of cases in \( i \)th category under Ho

\( k \Sigma \) directs one to sum over all \( k \) categories

\( \chi^2 = 13.84 > \chi^2_{0.05} = 3.84 \) c 1 d.f.

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APPENDIX C

FORMULAS FOR CALCULATING THE t-STATISTICS
AND THEIR DEGREES OF FREEDOM

For populations that are normally distributed and have equal observations, but unequal variances, the t statistic

\[ t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \]

follows approximately the Student's t-distribution with \((n - 1)\) degrees of freedom.

For populations that are normally distributed, have equal observations, and equal variances, the t-statistic

\[ t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{2s_p^2}{n}}} \]

follows approximately the Student's t-distribution with \(2(n - 1)\) degrees of freedom, and where:

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\[ \bar{x}_1 = \text{the mean sample of Group 1} \]
\[ \bar{x}_2 = \text{the mean sample of Group 2} \]
\[ s^2_1 = \text{the variance of Group 1} \]
\[ s^2_2 = \text{the variance of Group 2} \]
\[ n = \text{the number of observations in one group} \]
\[ s^2_p = \text{the sum of squares of the first group plus the sum of squares of the second group divided by } 2(n - 1) \]
\[ \text{degrees of freedom.} \]
BIBLIOGRAPHY

Books


Articles in Journals or Magazines


**Unpublished Materials**


VITA

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