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STUDY OF THE ACCOUNTING CLASSIFICATION OF CONVERTIBLE SECURITIES: A MARKET ANALYSIS

BY

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THESIS

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Chapter I

INTRODUCTION

"The role of financial reporting in the economy is to provide information that is useful in making business and economic decisions ... ."[1] This recent statement is one in a long line of normative assertions that financial disclosures should provide relevant information to decision-makers in a market setting. A particular type of decision-maker is the investor. Financial disclosures are of value to a present or potential investor for the purpose of determining his unique investment portfolio.

In making the portfolio decision, market participants must choose from an assortment of investment instruments including stocks, bonds and convertible securities. The particular instrument of interest in this study is the convertible security.[2] This research considers the financial accounting disclosures relevant to the present or potential convertible security investor.

Background

The balance sheet classification of debt and equity provides information relevant to portfolio construction.[3] Traditionally, the distinction between debt and equity has been specified by contractual differences. In FASB No. 15, debt securities are defined as follows:[4]

> In this statement, a receivable or payable (collectively referred to as debt) represents a contractual obligation to pay money on demand or on fixed or determinable prices... .

Clearly, debt securities are defined based upon their contractual attributes. In FASB No. 12, equity securities are defined as follows:

> Equity security encompasses any instrument representing ownership shares (e.g., common, preferred, and other capital stock), or the right to acquire (e.g., warrants, rights, and call options) ownership shares in an enterprise at fixed or determinable prices.

Again, equity securities are defined based upon their contractual attributes. This classification procedure maintains a consistency of disclosure based upon contractual idiosyncracies (form over substance).

Because of the standard setting body's propensity to classify securities based upon contractual attributes, convertible bonds are classified entirely as debt. In APB Opinion No. 14, the Board asserts "that no portion of the proceeds from the issuance of the types of convertible debt securities described in paragraph 3 (debt securities which are convertible into common stock of the issuer or an affiliated company at a specified price at the option of the holder) should be accounted for as attributable to the conversion feature."[6] Convertible bonds are classified in the same manner as nonconvertible bonds. In similar fashion, convertible preferred stocks are classified entirely as an equity security. The balance sheet disclosure for a convertible security is determined by the legal form of the instrument.

In APB Opinion No. 15, the Accounting Principles Board focused its attention on the conversion feature of convertible securities. In this opinion,"the board concluded that a convertible security should be classified as a common stock equivalent at the time of issuance if, based on its market price, it has a cash yield of less than 66 2/3% of the current bank prime interest rate."[7,8] Once a convertible security is characterized as a common stock equivalent, the computation of primary earnings per share treats a dilutive convertible security as if the instrument is an equity security.[9] In contrast to balance sheet presentation, convertible securities are classified by a market based criterion for the primary earnings per share computation.

The inconsistency of financial statement disclosures is apparent when one compares the classification schemes of APB Opinions Nos. 14 and 15. The identical security may be presented in financial statement disclosures based on two different classification schemes.

From an investor's point of view, classification by contractual form provides limited information. The firm's capital structure is dictated by the legal form of the security. Classification by a market-based criterion can introduce the market's assessment of a convertible security into financial statement disclosures. In a market-based classification scheme, the firm's capital structure can be linked to the market's evaluation of a security's debt or equity characteristics. Since this research focuses on financial disclosures of relevance to convertible security investors, a market-based classification scheme is a concern of this research project.

Theoretical Considerations

Careful consideration of the investment-consumption decision has led to modern portfolio theory. Portfolio theory provides a general structure for the evaluation of risky investments. According to portfolio theory, a security's total risk can be partitioned into systematic and unsystematic risk. From the works of Sharpe (1964), Lintner (1965) and Mossin (1966), the diversification of an investment portfolio leads to the elimination of unsystematic risk. Thus, systematic risk is central to the evaluation of any risky security in an investor's portfolio.

Since systematic risk is a major element in portfolio construction, estimation of the "true" systematic risk of any security is necessary for practical implementation of portfolio theory. In Sharpe (1964), Lintner

(1965) and Mossin (1966), portfolio theory is developed as a single period model. In order to estimate the systematic risk of a security, parameter stationarity is generally assumed across time periods. Identification of the "true" systematic risk is dependent upon the validity of intertemporal parameter stationarity. The issue of stationarity is discussed at length in Chapter II.

For a convertible security, estimation of systematic risk poses unique problems. The theoretical literature on convertible security valuation establishes two distinct aspects of a convertible security's price. In general, a convertible security is a complex combination of two economic resources, straight debt value and the value assigned to the conversion privilege. Straight debt value is the market price which would be assigned to an equivalent debt security that does not possess a conversion privilege.[10] The value assigned to the conversion privilege is the market price of the right to convert the investment instrument into common equity shares. Hence, the observable market price of the convertible security is a combination of the straight debt value and a premium paid for the conversion privilege.[11]

From these two aspects, two distinct return generating processes can be identified. A change in the straight debt value over time creates a debt return generating process. In addition, changes in the value assigned to the conversion privilege establish an equity return generating process.[12] Hence, the systematic risk of a convertible security is a composite relation that results from the market's assessed evaluation of the relative dominance of the debt and equity return generating processes.

Since an objective of financial disclosure is to provide information of value in portfolio construction, the type of disclosure must be considered in relation to the systematic risk of a particular security. At least two types of disclosures may be of interest to convertible security investors. First, accounting risk measures (traditional financial statement ratios) can be constructed from financial statements. In Chapter II, previous empirical research studies will link accounting risk measures with equity security systematic risk. If a convertible security's return generating process is dominated by equity characteristics, accounting risk measures may provide information of value in assessing a convertible security's systematic risk. Second, interest rate risk measures (interest rate elasticity, coupon, maturity and duration) can be constructed from available financial disclosures and market data. Also in Chapter II, interest rate risk measures will be related to debt security systematic risk. If a convertible security's return generating process is dominated by debt characteristics, interest rate risk measures may provide information of value in assessing a convertible security's systematic risk. Thus, the type of financial disclosures of value in portfolio construction may be dependent upon the market's assessment of the relative dominance of equity and debt characteristics of convertible securities.

Purpose

One purpose of this research project is to develop and empirically test standards of convertible security classification that are related to convertible security systematic risk. To accomplish this purpose, research will provide evidence concerning how accounting and interest rate risk measures relate to market risk measures of convertible securities. An alternative market-based classification scheme will be compared to the traditional contractual form classification scheme. If accounting risk measures are found to have stronger relationships with systematic risk estimates after use of the market-based classification scheme, this study can be used to suggest a change from contractual form to market-based classification of convertible securities.

A second purpose of this research project is to test the appropriateness of the assumption of systematic risk stability for convertible securities. In order to relate financial disclosures to a systematic risk parameter, an estimate of the convertible security systematic risk must be obtained. Measurement error of a convertible security's systematic risk may lead to suboptimal investment decisions. To the extent that the "true" systematic risk is unstable, an investment portfolio's "true" market risk may deviate from the portfolio's estimated market risk. This measurement error can lead to portfolio selection decisions which are not consistent with expected utility maximization.

NOTES

[1] Professional Accounting Standards (Chicago, Illinois: Commerce Clearing House Inc., 1981): 3031.

[2] "A convertible security is a bond or a share of preferred stock that can be converted at the option of the holder into common stock of the same corporation." James C. Van Horne, Financial Management and Policy (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1974): 366.

[3] This statement is shown analytically in Bowman (1979). R. G. Bowman, "The Theoretical Relationship Between Systematic Risk and Financial (Accounting) Variables," Journal of Finance 33, (May, 1979): 617.

[4] Professional Accounting Standards (Chicago, Illinois: Commerce Clearing House Inc., 1979), 3: 9722.

[5] Ibid., p. 9391.

[6] Ibid., p. 9974.

[7] Ibid., p. 7953.

[8] FASB Statement 55 has changed the bank prime interest rate to Moody's Aa average yield to maturity.

[9] With respect to fully-diluted earnings per share, APB Opinion No. 15 treats all dilutive convertible securities as if these instruments are equity securities.

[10] This "equivalent" debt security would possess identical contractual arrangements as the convertible debt security. The differentiating factor would be the lack of a conversion feature.

[11] The term premium is used in this context to merely denote an excess of market price above straight debt value.

[12] This equity return generating process should be distinguished from the return generating process associated with the common stock of the firm. This process is concerned with the return on the conversion privilege.

Chapter II

LITERATURE REVIEW

In the following sections, four major areas of recent research related to the main concerns of this study are reviewed. First, the issue of structural change in the systematic risk of convertible securities is suggested from convertible security valuation theory and empirically-based studies. Next, cross-sectional correlation studies are reviewed to suggest empirical links between accounting risk measures and the systematic risk measure of equity securities. Third, debt oriented studies are reviewed to suggest empirical links between interest rate risk measures and the systematic risk measure of debt securities. Finally, a number of accounting research studies are reviewed to suggest the importance of conversion value/call price as a debt-equity differentiating device.

Structural Change in the Market Model's Parameters

Portfolio analysis formulates the investment problem as the maximization of expected return for a given level of risk. It should be noted that both expected returns and risk are unobservable. The solution of the practical problem of portfolio construction requires an estimate of the risk and expected return of a portfolio. Measurement error in the estimate of risk can lead to suboptimal (in the expected utility sense) investment decisions. Thus, an appropriate measure of the systematic risk of investment securities is necessary to permit expected utility maximization for investors.

The following sections concentrate on the structural stability of the systematic risk estimate of convertible securities. To the extent that convertible securities' systematic risk parameters change, the "true" portfolio risk may differ from an estimate of the portfolio's risk that does not allow for structural change. This measurement error can lead to suboptimal investment decisions. To motivate this structural stability issue, a review of convertible security valuation theory will focus on the composite valuation of these securities. With this composite valuation established, the causes of structural change will be reviewed.

Traditional Convertible Security Valuation Theory

The suggestion of structural change in the underlying return generation process finds its roots in traditional convertible security valuation theory. This theory includes Brigham (1966), Baumol, Malkiel and Quandt (1966), Poensgen (1965, 1966), Frankle and Hawkins (1975), Ingersoll (1977a, 1977b), and Brennan and Schwartz (1977, 1980).

An early model of convertible security valuation was provided in Brigham (1966). This model is presented in Figure I. The curve MC_t is the market value of a convertible security. The segment BX represents the straight debt value of the convertible security. The curve XM' is the conversion value of the convertible security. The vertical distance between MC_t and BXM' is a graphical description of the premium associated with the conversion feature. It should be noted that Brigham's (1966) model is a static representation of a convertible security's value. In addition, the valuation of the convertible security (as shown) is dependent upon a presumption of equity growth over time. This equity growth can be seen as the increase in XM' over time. Despite the limitations of a static model and a presumption of equity growth, the market price of a convertible security is shown as a composite of straight debt value and equity value. The relative weight of straight debt value and equity value is left unspecified in Brigham's (1966) model.

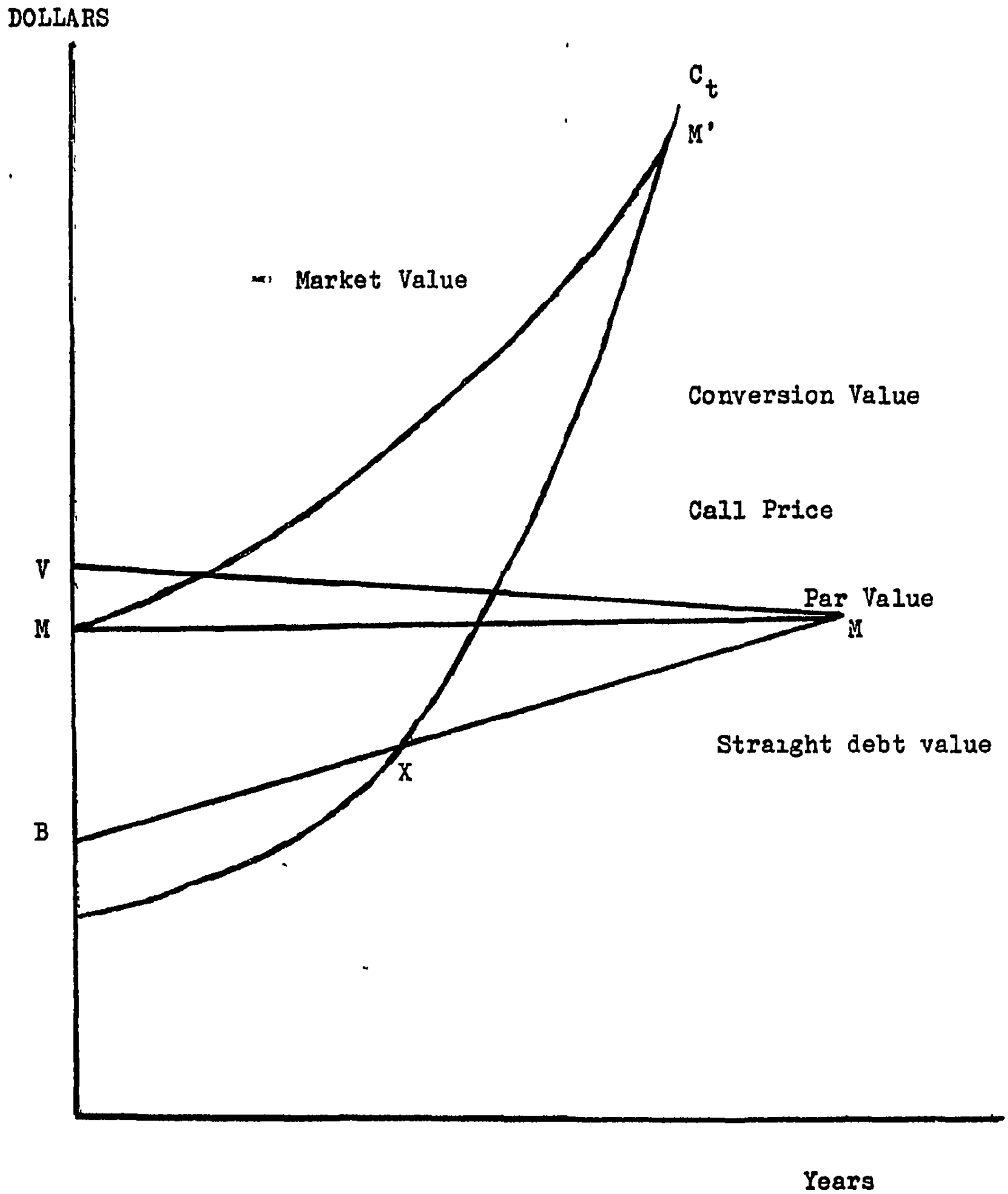

Figure 1. Hypothetical Model of a Convertible Bond (Brigham, 1966, p. 37)

BXM = the straight debt value;
MM = the par value;
VM = the call price;
MC_t = the market value;

XM' = the conversion value;
BXC_tM = the critical region.

For more explicit representations of this interaction, Baumol, Malkiel and Quandt (1966) present the following model:[1]

$$C = \max\,(C_s, C_b)$$

where: $$C_s = PS + \int_0^{\bar{B}/PS} f(i,t_o)\,[\bar{B} - i(t)\,PS]\,di(t) \quad (1)$$

$$C_b = \bar{B} + \int_{\bar{B}/PS}^{\infty} f(i,t_o)\,[i(t)\,PS - \bar{B}]\,di(t) \quad (2)$$

C_s = the value of the convertible as stock with debt guarantee;
C_b = the value of the convertible as debt with premium for the equity feature;
C = value of the convertible; B = bond equivalent; S = number of equity securities issued upon conversion; P = price of the equity security at present; $i(t)$ = price-relative at date t; $f(i, t_o)$ = subjective probability assessment of $i(t)$ at t_o.

Equation (1) specifies that C_s is composed of two values. PS is the conversion value of the convertible security. The second term illustrates the insurance value of the debt character of the convertible security for subjective probability assessments of the price-relative between 0 and $\bar{B}/PS$ at the end of time horizon t. Equation (2) states that C_b is a combination of two values. $\bar{B}$ is the straight debt value of the convertible security. The second term is the value assigned to the conversion feature for subjective probability assessments of the price-relative being between $\bar{B}/PS$ and ∞ at the end of time horizon t. This model separates the interaction between debt and equity attributes in the valuation of convertible securities.

Baumol, Malkiel and Quandt (1966) then extend this model by introducing the <u>ex ante</u> notion that the convertible securityholder is interested in the future conversion value of the convertible security as follows:[2,3]

$$C = \int_0^{\infty} i(t)PS\ f(i,t_0)\ di(t) + \int_0^{\bar{B}/PS} f(i,t_0)\ [\bar{B} - i(t)\ PS]\ di(t) \quad (3)$$

where: The symbols are the same as in (1) and (2) above.

In this model, the first term represents the conversion value in all possible states of the price-relative from 0 to ∞. Again, the second term represents the insurance value of the debt characteristic. Thus, Baumol, Malkiel and Quandt's (1966) model explicitly presents the interaction of debt and equity characteristics in the valuation of convertible securities.

In both Brigham (1966) and Baumol, Malkiel and Quandt (1966), the bond's straight debt value was treated as exogenously determined. A more robust model of the valuation of convertible securities can be obtained by introducing the stochastic nature of interest rate changes.

The random characterization of the straight debt value is explicitly considered in valuation models proposed by Poensgen (1965). As a general model, Poensgen (1965) suggests:[4]

$$E\ (p) = \int_0^{\infty} [y \int_0^{y} h(x|y)\ dx + \int_y^{\infty} x\ h(x|y)dx]g(y)dy \quad (4)$$

where: $E(p)$ = expected price of the convertible security; y = the straight debt value; $h(x|y)$ = the conditional probability that x will result for a particular bond value y; x = the stock price of the convertible security; $g(y)$ = the probability of occurrence of the bond value y (unconditional); $h(x,y) = h(x|y)\ g(y)$;

Poensgen's model captures the random nature of bond prices by integrating the debt value and conversion value over all possible states of straight-debt value, y. In this manner, Poensgen illustrates the interrelationship of the debt and conversion value of the convertible security in the dynamic environment of interest rate changes.

Poensgen (1965) synthesizes the models of Baumol, Malkiel and Quandt (1966) by illustrating that the following equations for convertible securities are logically equivalent:

$$E(p) = \int_0^\infty \left[y \int_0^y h(x|y)dx + \int_y^\infty x\, h(x,y)dx\right] g(y) \quad (4')$$

$$E(p) = \int_0^\infty \left[\int_0^\infty x\, h(x,y)dx + \int_0^y (y-x)h(x,y)dx\right] dy \quad (5)$$

expected stock value — value of floor guarantee

$$E(p) = \int_0^\infty y\, g(y)dy + \int_0^\infty \int_y^\infty (x-y)\, h(x,y)dx\, dy \quad (6)$$

expected straight debt value — expected value of the conversion option

where: The symbols are the same as (4).

Equation (5) specifies that the value of the convertible security is the expected stock price plus the value attached to the floor guarantee for a stochastic straight debt value, y. This formulation is identical to Baumol, Malkiel and Quandt's (1966) model (equation 3) except for the assumption by Poensgen (1965) that y is a random variable. In the same fashion equation (6) of Poensgen (1965) mirrors Baumol, Malkiel and Quandt's equation (2) with straight-debt value as a random variable.

Poensgen's (1965) article presents two additional assertions germane to the present research. First, it is empirically shown that there was no statistically significant correlation between bond yield variability and stock prices.[5] Then, Poensgen (1965) analytically reduces equation (6) to:

$$E(p) = \int_0^\infty y\, g(y)\, dy + \int_y^\infty (x-y)f(x)dx \quad (6')$$

where: The symbols are the same as (4) and f(x) is the probability density function of x.

In this equation, Poensgen (1965) has reduced the value of a convertible security to the value of straight debt plus the value of a warrant with exercise price y.

Poensgen (1965) also shows that the distribution of stock prices, x, is truncated on the left by the straight debt value (in his notation, a constant a). This assumption suggests that an investor receives some straight-debt value, a, for states of nature where the conversion value of the convertible security drops below a. Hence, Poensgen (1965) simplifies the empirical analysis of convertible securities by assuming that the first term of equation (6) is a constant.

Prior to Frankle and Hawkins' (1975) study, the link between the CAPM and a convertible security's beta had not been explored. The authors derived the following relationship between the beta of a convertible security and the beta of the underlying common stock:

$$\text{beta} = \rho \frac{\sigma_x}{\sigma_m} \left[1 - \Phi\left(\frac{a}{\sigma_m}\right)\right] \qquad (7)$$

where: beta ≡ the beta of a convertible security; ρ ≡ correlation coefficient between x and m; x ≡ return on the common stock; m ≡ the return on the market (value-weighted composite portfolio of all risky securities); Φ = the cumulative normal function;

The important implication of (7) is that "the beta of a convertible security is less than or equal to that of its underlying common stock."[6] Further, the equity beta establishes an upper bound for the convertible security's beta.

The next major advance in convertible security valuation theory evolved from option pricing theory. Brennan and Schwartz (1977, 1980) and Ingersoll (1977a, 1977b) address convertible security valuation by noting that the value of a contingent claim is the solution of a boundary value problem.[7] Brennan and Schwartz (1977, 1980) use a dynamic programming algorithm to numerically approximate the value of a convertible security. In contrast, Ingersoll (1977) concentrates on developing closed-form solutions to particular contractual configurations of convertible securities. In both sets of articles, the valuation of the convertible security is dependent upon assumed market conditions and a hypothesized return process for the value of the firm.

In Brennan and Schwartz (1977), the authors prove that:[8,9,10]

> Lemma 2. The firm's optimal call strategy is to call the bond as soon as its value if it is not called is equal to the call price.

This result implies that an optimal call strategy from the firm's point of view requires a call to occur when the conversion value/call price ratio is one.

In addition to pointing out the optimal call strategy of a firm issuing convertible securities, Brennan and Schwartz (1977) emphasize the relationship between firm value and the value of a convertible security. They show through numerical approximation that low firm value leads directly to a low valuation of convertible securities. This result contrasts with the earlier assumption by Brigham (1966), Baumol, Malkiel and Quandt (1966), Poensgen (1965), (in his empirical work) and Frankle and Hawkins (1975) that there exists a constant straight debt value for a convertible security. Thus, the Brennan and Schwartz (1977) valuation methodology emphasizes the importance of the random nature of the straight debt value in convertible security valuation.[11]

Ingersoll (1977) concentrates on the derivation of closed-form solutions for particular convertible securities. He proves:[12]

$$G(V,T;B,o,\gamma) = F(V,T;B,o) + W(\gamma V,T;B) \qquad (8)$$

$$H(V,T) = F(V,T;B,o) + W(\gamma V,T;B) + Z^2(r-p)/\sigma^2 \left[F(\gamma V,T;B',o) - F(\gamma V';T;B'/\gamma,o)\right] \qquad (9)$$

Notation: $G(V,T;B,o,\gamma) \equiv$ convertible security's value (V) at t with balloon payment B at maturity, o coupon payments, γ per cent of equity given at conversion; $F(.) \equiv$ the market value of straight debt (o coupon payment); $W(.) \equiv$ the warrant value (γV) proportional market value of the firm; $Z \equiv K(T)/\gamma V$ [$K(T) \equiv$ call price of the security]; $B' \equiv Be^{(r-p)T}$; $V' \equiv V e^{(p-r)T}$; $\overline{V} = \overline{V(T)}$ the optimal call point;

Equation (8) asserts that the value of a convertible security is the sum of the value of a straight debt security and the value of a warrant. It should be noted that cash distributions have been excluded from the warrant, bond and convertible securities in Ingersoll's model which is a rather restrictive case. Yet, the important result is that the convertible security's value is directly linked to a straight debt value and a warrant value.

In sum, traditional convertible security theory suggests that two market values (debt and warrant) combine to create the market value observed for a convertible security. Over time, fluctuations in these component values create two return generating processes. The return processes identified are the debt process and warrant (equity) process.[13] A link between the two return generating processes is the market's valuation of the underlying equity security. An intertemporal change in the equity market value suggests a structural change in the weights assigned to the debt and warrant components of the value. Since the return generating processes (debt and warrant) possess different systematic risk characteristics, a change in market value of the underlying security will imply a shift in the weights assigned to the separate debt and warrant generating processes. This change in weights suggests that a structural shift in the systematic risk component of the convertible security will be observable.

Determinants of Structural Change - Systematic Risk

Two major theoretical determinants of structural change of equity systematic risk parameters have been identified. First, Hamada (1969) showed that a direct relationship exists between the capital structure of an entity and its systematic risk characteristic. As the debt-equity ratio increases, the systematic risk parameter will increase. In addition, Bowman (1979) establishes a direct theoretical relationship between "a firm's systematic risk and the firm's leverage and accounting beta."[14] Bowman also shows "that systematic risk is not theoretically related (directly) to the earnings variability, dividends, size or growth of a firm."[15] These theoretical results suggest that capital structure changes result in systematic risk changes for equity securities.

A second determinant of structural change of systematic risk coefficients is related to the operating risk of the firm. Lev (1974) shows that an increase in a firm's operating risk will lead to an increase in equity systematic risk. Thus, operating risk is an element in systematic risk assessment for equity securities.

Since a convertible security is a composite of debt and a warrant (equity security), financial and operating risk will be related to the systematic risk estimate of the convertible security. It should be noted that little work has been done to date relating financial and operating activities to the systematic risk characteristic of debt or convertible securities. A major purpose of this research project is to empirically assess the degree of structural change in a convertible security's return generating process.[16]

Empirical Tests of Structural Change

Three empirically based studies will be used to illustrate the empirical tests that can be performed to detect shifts in the parameters of a return generating process. First, Kon and Jen (1978) utilize the switching regression technique to detect changes in the systematic risk and performance of mutual fund portfolios. Based on their tests, Kon and Jen (1978) conclude that there was "substantial risk level nonstationarity in mutual fund portfolios whether in the context of SLM (Sharpe, Lintner and Mossin) or Black capital asset pricing models."[17] These results suggest that OLS estimation techniques may lead to model misspecification for structurally changing return generating processes.

Lee, Shick and Jen (1977) also use the switching regression technique in evaluating structural changes in the market model parameters of merging firms. Again, the authors met with some success in detecting structural shifts in the return generating process. A dummy variable switching regression technique was developed and utilized to detect structural shifts in α_i and β_i. These switching regression techniques employed by Lee, Shick and Jen (1977) can be used to detect changes in parameter values when the point of shift is unknown _a priori_.

A third empirical study concerned with structural stability of regression coefficients is by Collins and Simonds (1979). The authors used the Chow (1960) ANCOVA test, moving regressions of Brown, Durbin and Evans (1975), and Quandt's (1958) maximum likelihood estimators to determine the extent and timing of changes in relative risk associated with the required SEC line-of-business disclosures. Again, the authors employ switching regression techniques to determine whether a significant shift in regression parameters has occurred. Once a shift has been detected, the location of the switch can be approximated using Quandt's maximum likelihood estimator or the Brown, Durbin and Evans technique.

Combining the theoretical arguments concerning convertible security valuation with the empirical technique of switching regression, the switching regression methodology can be employed to establish whether a structural change in systematic risk has taken place. If a switch is signaled, Quandt's (1958) maximum likelihood estimator can be utilized to approximate the point of switch. In addition, if the investigator is capable of specifying the switch point as a result of theoretical considerations, the Chow (1960) ANCOVA test can be applied to assess the significance of structural change. Switching regression provides abundant tests of the theoretical assertions related to the convertible security return generation process.

Cross-Sectional Studies Relating Accounting Risk Measures and Systematic Risk of Equity Securities

After considering the stability of the market model parameters, the issue of which accounting risk measures to be considered as candidates for risk evaluation of a firm's convertible and equity securities becomes crucial. This consideration can be addressed by briefly reviewing a number of empirical accounting research studies that addressed the relationship between accounting risk measures and the systematic risk of equity securities.

Beaver, Kettler and Scholes (1970) investigated the relationship between accounting risk measures and equity security's systematic risk by correlation analysis (see Table 1). Their major conclusions suggested that earnings variability, payout and the accounting beta are highly related to a firm's systematic risk. Next, Beaver and Manegold (1975) concentrated upon the relationship of accounting betas (variously defined) to the market beta. Again, accounting betas were found to be significantly related to the market's systematic risk measure. In a third study, Thompson (1976) evaluated the relationship between numerous accounting risk measures and the equity's systematic risk characteristic, β_i (see Table 2). The variables which Thompson found to be most significantly related to the common stock's systematic risk coefficient were a dividend factor, an earnings multiple factor (P/E), an earnings factor, an operating income factor, an asset growth factor and a leverage factor (D/E). Also, Thompson (1976) found that the covariate form of the information variable was the most highly related to the systematic risk of the equity security. These three studies suggest the existence of relationships between accounting risk measures and the market determined risk measure for equity securities.

In the realm of preferred stocks, two empirical studies by Bildersee (1975) and Smith (1979) suggest additional accounting risk measures of interest. Bildersee (1975) investigated the relationship between numerous accounting risk measures and the systematic risk of a firm's equity and preferred stock securities. Table 3 lists the accounting risk measures (and other variables) used in that study. Bildersee (1975) found the largest correlations between equity systematic risk and his proxies for leverage, efficiency (sales/equity), and variability of earnings.

Finally, Smith (1979) studied the relationship of various accounting risk measures with the systematic risk of preferred stocks. A list of the variables employed in Smith (1979) is presented in Table 4. Smith (1979) found total assets and sales growth to be the most important operating risk variables. In the leverage category (Table 4) , the inverse of the times interest earned and the inverse of the times preferred dividends earned ratios were significantly related to the preferred stock systematic risk. Finally, the bid-ask spread and the volume/issue size variables proved significantly related to the systematic risk of the preferred stock in a number of models proposed by Smith. Thus, Smith's (1979) findings suggest that variables from the size, growth, leverage and marketability categories are related to the systematic risk measure of preferred stock.

In the context of the present study, these articles suggest a number of considerations. There exists empirical evidence of correlation between accounting risk measures and the systematic risk of equity securities. In addition, these studies suggest a sample of accounting risk measures of interest in this analysis. With these considerations, this work will investigate the relationships between accounting risk measures (to be defined subsequently) and the systematic risk measure, β_1, for convertible securities and their underlying equity securities.

Two major objectives of performing this cross-sectional analysis can be identified. First, this study will attempt to identify cross-sectional relationships which can be used to explain changes in systematic risk over time. To the extent that these relationships exist, the empirical determinants of systematic risk can be identified. Second, this study will attempt to extract relevant variables which can be used in prediction of systematic risk in future periods.

Cross-Sectional Studies Relating Interest Rate Risk Measures and Systematic Risk of Debt Securities

In this section, four research papers are reviewed with the intent of noting relationships between interest rate risk measures and a debt security's systematic risk. These papers are Fisher (1959), Reilly and Joehnk (1976), Boquist, Racette, and Schlarbaum (1975), and Urwitz (1977).

In Fisher's classic (1959) article, the dependent variable of interest was the risk premium on a straight debt security (yield on the bond less the pure rate of interest). The independent variables which possessed the largest explanatory power were earnings variability, period of solvency, equity/debt ratio and the bonds outstanding. In each case, the independent variable is an accounting measure.

Reilly and Joehnk (1976) were concerned with the relationship of bond ratings to the systematic risk of straight bond issues. The rationale for their research was suggested along the following lines. Accounting risk measures have been found to be related to the systematic risk of equity securities.[18] Also, accounting risk measures have been found to be related to bond ratings. Thus, the authors hypothesized that there is a significant association between the market determined systematic risk and bond ratings. But, the authors found that, "the results derived from an examination of the association between market risk measures and bond ratings did not consistently support the hypothesis" (Reilly and Joehnk, 1976). A possible implication of this result suggests that for straight debt securities the relationship between accounting risk measures and systematic risk measures will be relatively low and inconsistent. Extrapolating this result to convertible securities, convertible instruments which are evaluated as debt securities are hypothesized to manifest a relatively low and inconsistent relationship between accounting risk measures and the systematic risk of that security.

In addition to the lack of support for their hypothesized relationship, Reilly and Joehnk (1976) suggested that macroeconomic variables could be the source of differences in the straight debt systematic risk measure. One variable of particular interest is the duration of a bond security.[19]

In "Duration and Risk Assessment for Bonds and Common Stocks", Boquist, Racette and Schlarbaum (1975) derive an explicit relationship between bond beta's and duration.

They show: $$\beta_{it} = \frac{-D_{it}\rho(d\tilde{r}_{it},\tilde{R}_{mt})\sigma(dr_{it})}{\sigma(\tilde{R}_{mt})}$$

where: D_{it} = the duration of security i at time t; $d\tilde{r}_{it}$ = the change in yield to maturity; $\tilde{R}_{mt}$ = the return on the market;

This functional form illustrates the direct relationship between duration and the beta of a straight debt security. This analytic result was supported by the empirical results of Urwitz (1978).

Urwitz (1978) establishes that duration of the bond issue, the common stock residual error, and the common stock beta are highly related to bond betas.[20] The primary conclusion of Urwitz's work emphasizes the "importance of the term structure risk as being the major determinant of corporate bond risk".[21] This suggests that the underlying financial structure and operating activities of the firm appear to be significantly less crucial than the duration of the bond issue. The variables suggested by Urwitz (1978) include interest rate elasticity, duration, coupon payments and maturity. A major goal of this study is to extend knowledge of the relationship between the proxies for interest rate risk (above) and the systematic risk of convertible securities.

In sum, the variables which empirically have been shown to be related to systematic risk are quite different depending upon the type of security in question. Accounting risk measures have been shown to be most highly correlated with the systematic risk of equity securities. Interest rate risk measures have been suggested as possessing a high degree of correlation with the systematic risk measure of debt securities. For convertible securities that are valued as equity instruments, a high degree of association between accounting risk measures and the systematic risk estimate is postulated. For convertible securities that are valued as debt instruments, a more powerful relationship between interest rate risk measures and the systematic risk estimate is postulated. With these implications of equity and debt security research, the next major task is to specify that range of price where a convertible security reacts as a debt security as opposed to an equity security.

Convertible Securities - Conversion Value/Call Price

Three conversion prediction studies were undertaken by Frank and Weygandt (1971a), Frank and Weygandt (1971b) and Frank and Kroncke (1974). In Frank and Weygandt (1971a), the authors utilize the conversion value/call price ratio to predict conversions of convertible bonds.[22] This success of conversion value/call price in predicting conversion prompted a subsequent conversion prediction study by Frank and Weygandt (1971b). In this study, the authors employed multiple discriminant analysis to develop a convertible bond prediction model. The most dominant variable was shown to be conversion value/call price. Following the previous conversion prediction studies, Frank and Kroncke (1974) found conversion value/call price to be a highly discriminatory variable when predicting conversion. Although the present research is not addressing prediction of conversion, the fact that conversion value/call price was a reliable predictor of conversion suggests that this statistic can be employed to differentiate between convertible securities which possess equity characteristics.[23] Thus, the conversion value/call price statistic permits a convenient and objective measure of the aggregate market's evaluation of the convertible security's equity or debt status.

Summary

Throughout this literature review, the major purpose has been to dichotomize convertible securities into debt and equity components. Convertible security valuation theory suggests a dual nature of the hybrid security. Next, switching regression studies illustrate a methodology for detecting structural shifts in the return generating processes. The final sections suggest empirical links between accounting and interest rate risk measures and systematic risk characteristics of equity and debt securities. Again, these empirical relationships permit the testing of partitions of convertible securities. Finally, the conversion prediction studies suggest that the conversion value/call price statistic can be utilized to partition convertible securities into debt and equity categories.

NOTES

1 William J. Baumol, Burton G. Malkiel and Richard E. Quandt," The Valuation of Convertible Securities", The Quarterly Journal of Economics 80, (Spring, 1966):49-50.

2 Ibid., p. 50.

3 This model includes both (1) and (2) in Baumol, Malkiel and Quandt's previous model for ex ante conversion values. This result is made explicit in Baumol, Malkiel and Quandt (1966).

4 Otto Poensgen, "The Valuation of Convertible Bonds, Part 1", The Industrial Management Review 7, (Fall, 1965): 80.

5 It should be noted that Poensgen's empirical work covered the period 1946-1963. After eliminating a time trend from fluctuations of bond yields and stock prices over this period, Poensgen (1965) found no statistically significant correlation between bond yield variability and stock prices. This result may not be descriptive of the post-1963 period. The increase in variability of bond yields in the latter 1970's may not be uncorrelated with common stock prices. Thus, Poensgen's (1965) reduction of equation (6) to equation (6') may not be appropriate in the 1970's and early 1980's.

6 A. W. Frankle and C. A. Hawkins, "Beta Coefficients for Convertible Bonds", Journal of Finance 15, (March, 1975): 209.

7 In this case, the contingent claim must be priced such that an arbitrage profit cannot be obtained based upon the market price of the underlying equity security.

8 This result is prominently developed in Ingersoll (1977a). It is attributed to Brennan and Schwartz (1977) merely for convenience of exposition. Ingersoll (1977a) independently developed this same result.

9 M. J. Brennan and E. S. Schwartz, "Convertible Bonds: Valuation and Optimal Strategies for Call and Conversion", The Journal of Finance 32,(December, 1977): 1703.

10 This result is based upon two assumptions of Brennan and Schwartz (1977). First, they assume that "each party, firm and investor, pursues an optimal strategy and expects the other party to do the same."(page 1701) Second, "the aggregate market value of the firm's securities, V(t) is assumed to be determined exogenously and by the Modigliani-Miller theorem to be independent of the particular call and conversion strategies followed." Ibid., p. 1701.

11 A following article by Brennan and Schwartz (1980) utilizes the identical dynamic programming approach to valuing convertible securities. In this later paper, the authors allow explicitly for uncertainty about future interest rates.

[12] J. Ingersoll, "A Contingent-Claims Valuation of Convertible Securities," Journal of Financial Economics 4, (May, 1977): 307.

[13] In subsequent sections, the return generating process is referred to as the "equity" return generating process. The author's intent is to dichotomize between debt and equity. This does not suggest that the return generating process is identical with the return generating process of a common stockholder of the firm in question. In general, it is suggested in Frankle and Hawkins (1975) that "the beta of a convertible bond is less than or equal to that of its underlying common stock" (p. 209).

[14] R. G. Bowman, "The Theoretical Relationship Between Systematic Risk and Financial (Accounting) Variables," Journal of Finance 34 (May, 1979):617.

[15] In order to arrive at Bowman's theoretical result, he makes the following restrictive assumptions:

(1) All investors are single-period, risk-averse maximizers of the expected utility of terminal wealth.
(2) They find it possible to make their optimal portfolio decisions solely on the basis of the mean and standard deviation of the probability distributions of terminal wealth associated with the various portfolios.
(3) They all have the same decision horizon, and over this period the mean and standard deviation of the probability distributions exist.
(4) They have homogeneous expectations regarding the mean and standard deviation of the probability distributions.
(5) There are perfect capital markets.

Thus, the theoretical results of Bowman (1979) are based upon quite restrictive assumptions. Ibid., p. 618.

[16] An area of future research interest will be concerned with the microeconomic and macroeconomic determinants of debt systematic risk characteristics. In addition, the development of microeconomic and macroeconomic variables which explain convertible security systematic risk parameters will be addressed in subsequent work.

[17] S. J. Kon and F. C. Jen, "Estimation of Time-Varying Systematic Risk and Performance for Mutual Fund Portfolios: An Application of Switching Regression," Journal of Finance 33, (May, 1979): 451-472.

[18] The authors use the terminology corporate variables rather than accounting risk measures.

[19] "Duration is simply a weighted average maturity stated in present value terms." (Reilly and Sidhu, 1979, p. 8).

[20] Correlation coefficient's absolute values were greater than .6 in all cases.

[21] G. Urwitz, On the Pricing of Corporate Bonds: The Risk Return Relationship, (Carnegie-Mellon Unversity, 1977): 83.

[22] The success rate for predictions made one year in advance was 92% where conversion took place and 80% where conversion did not take place.

[23] This statement must be considered in light of Brennan and Schwartz's (1977) and Ingersoll's (1977) arguments.

Chapter III

HYPOTHESIS DEVELOPMENT AND RESEARCH METHODOLOGY

This chapter develops methodology for exploring the two classes of hypotheses of interest. First, the issue of structural change in the estimate of the market model's parameters will be studied in the convertible security's market context. This endeavor relies exclusively upon financial markets' return data. Upon resolution of this stability issue, the second research avenue investigates the relationship of accounting risk measures (and interest rate risk measures) with the convertible security's systematic risk estimates.

Hypotheses Related to Parameter Stability

In the previous chapter, the structural stability of the convertible security return generating process was considered. It was suggested that structural change could result from financial and operating leverage considerations. In addition, the convertible security valuation literature suggests that market price, premium over bond value and conversion value/call price are attributes which can be used in a market based classification of convertible securities. The following sections will state the research hypotheses concerning the structural change issue.

The structural change issue is concerned with the stability of the parameters of the market model as applied to convertible security returns. The null hypothesis of the structural change issue can be stated as follows:

H_o: The parameters of the market model are constant for all orderings of the independent variable (R_m) and dependent variable (R_i).

This null hypothesis suggests that a linear model is descriptive of the relationship between the return on the market (R_m) and the return on a particular convertible security (R_i). In addition, the null hypothesis states that the parameters of the linear model (the intercept and slope) do not change. Finally, the hypothesis asserts that the ordering of the observations does not introduce identifiable parameter instabilities.

The alternative hypotheses concerning structural stability of the convertible security return generating process are stated below. They are:

H_A^1: The parameters of the market model are <u>not</u> constant for the calendar ordering (time) of the independent variable (R_m) and dependent variable (R_i).

H_A^2: The parameters of the market model are <u>not</u> constant for the convertible security market price ordering of the independent variable (R_m) and dependent variable (R_i).

H_A^3: The parameters of the market model are <u>not</u> constant for the premium over bond value ordering of the independent variable (R_m) and dependent variable (R_i).

H_A^4: The parameters of the market model are <u>not</u> constant for the conversion value/call price ordering of the independent variable (R_m) and the dependent variable (R_i).

Each of these four alternative hypotheses asserts that the parameters are <u>not</u> constant for a particular ordering of coordinates. The four alternative hypotheses differ based upon the ordering mechanism employed. In each case, the independent and dependent variable set of observations is rank ordered by an exogenously determined variable. The tests for structural stability are applied to the reorganized information. The ordering mechanisms employ convertible security valuation theory results to increase the power of the tests of structural change.

The basic model of interest in this investigation is the market model. The market model can be presented as:

H_o: $R_{it} = a_i + b_i R_{mt} + U_{it}$;

where: R_{it} = the return in period t on security i;

R_{mt} = the return in period t on the "market";

a_i, b_i = the regression coefficients;

$U_{it} \sim N(o, \sigma^2_i)$

The alternative hypothesis suggests possible structural change of the form:

H_a: $R_{it} = a_{1i} + b_{1i} R_{mt} + U_{1it} \quad t \in I_1$

$R_{it} = a_{2i} + b_{2i} R_{mt} + U_{2it} \quad t \in I_2$

where: I_1 = regime 1, I_2 = regime 2;

$a_{1i}, a_{2i}, b_{1i}, b_{2i}$ = the regression coefficients
$a_{1i} \neq a_{2i}$ or $b_{1i} \neq b_{2i}$;

$U_{kit} \sim N(o, \sigma_{ki}^2)$ $k = 1,2$;

Thus, the null hypothesis asserts that the market model holds for all observations, N. The alternative hypothesis contends that two linear relationships are descriptive of the convertible security return generating function.

Switching Regression

The structural stability issue is addressed with a collection of statistical methodologies termed switching regression. This work employs three tests of parameter stability: Quandt's (1958) maximum likelihood ratio test, Farley, Hinich and McGuire's (1970) F-test and Chow's (1960) ANCOVA test. As a formalization of the tests of the null hypotheses outlined above, a brief discussion of the three tests will be undertaken.

Quandt's (1958) Test

Quandt's (1958) maximum likelihood ratio test is a general test of the change in coefficients of a linear relationship. The null hypothesis for Quandt's (1958) test is:

$$H_o: \; y = a + bx \; \forall (x,y) \qquad (1)$$

The alternative hypothesis for the test is:[1]

$$H_a:\ y = a_1 + b_1 x \ \{\forall (x_i, y_i) \text{ such that } i < i^*\} \quad (2a)$$

$$y = a_2 + b_2 x \ \{\forall (x_i, y_i) \text{ such that } i \geq i^*\} \quad (2b)$$

That is, Quandt's (1958) test compares a single linear function with two separate linear functions partitioned at an a priori unspecified point of separation i*.

Quandt's (1958) test can be developed as follows:[2]

$$H_0:\ y = a + bx + u \quad \text{where: } u \sim N(o, \sigma^2) \quad (3)$$

$$H_a:\ y = a_1 + b_1 x + u_1 \ \{\forall (x_i, y_i) \text{ such that } i < i^*\} \quad (4a)$$

$$y = a_2 + b_2 x + u_2 \ \{\forall (x_i, y_i) \text{ such that } i \geq i^*\} \quad (4b)$$

$$\text{where : } u_k \sim N(o, \sigma_k^2) \ k = 1,2;$$

Utilizing the assumption of independent and identically distributed error terms, Quandt creates a maximum likelihood estimate of "the point at which the system switches from one regime to the other" as follows:[3,4]

$$L(t) = -T \log \sqrt{2\pi} - t \log \hat{\sigma}_1 - (T-t) \log \hat{\sigma}_2 - \frac{T}{2} \quad (5)$$

where: T = the total number of observations;

t = the number of observations in the "regime" defined by equation 4a; $\hat{\sigma}_k$ = the estimate of the standard deviation in "regime" k;

For each possible t separating regime 1 from regime 2, equation (5) is evaluated. Then, the maximum maximorum of the set of L(t)'s is selected as the most likely point of switch from regime (1) to regime (2).

Once the most likely point of switch is identified, a maximum likelihood ratio test is employed to determine the stability of the coefficients of the linear regression. Quandt presents the test statistic as follows:[5]

$$\lambda = \frac{\hat{\sigma}_1^{\,t}\ \hat{\sigma}_2^{\,T-t}}{\hat{\sigma}^{\,T}} \qquad (6)$$

where: the notation is identical to equation (5)'s ;

Upon computation of λ, the test statistic $-2\ln\lambda$ is approximately distributed as a Chi-square distribution with n-m degrees of freedom where n is the dimensionality of the unrestricted maximum of the likelihood function and m is the dimensionality of the likelihood function restricted by the null hypothesis.[6] Quandt's method provides a test to address the issue of structural stability of regression coefficients. In addition, Quandt's method provides an estimate, i*, of the point of separation between two linear relationships.

Farley, Hinich and McGuire's (1970) Test

Farley, Hinich and McGuire's (1970) test models the shift of a linear model's slope coefficient as follows:[7]

$$y = a + b_1 x + b_2 Z_i\,(i^*) \qquad i = 1, \ldots, n \quad (7)$$

where : $Z_i\,(i^*) = \begin{cases} 0 & i < i^*, \\ x_i & i \geq i^*; \end{cases}$

This model projects a discrete change in the slope coefficient at an a priori unknown switch point, i*. It should be noted that the intercept term, a, remains fixed in regime (1) and regime (2) (regime (1): $i < i^*$; regime (2): $i \geq i^*$).

The statistically testable form of this model is as follows:[8]

$$y_t = a + (b_1 + \delta t)\, x_t + U_t \qquad (8)$$

where : $U \sim N(o, \sigma^2)$;

$t = \frac{1}{n}, \frac{2}{n}, \quad \ldots, 1$;

n = the number of observations;

δ = the shift of b_1 on average over n observations;

The model attempts to test for a discrete shift in slope at an unknown point a priori by asserting that there is a uniform probability that a shift could occur at any of the n observations. With this assertion of uniform probability of shift, the independent variable $Z_i(i^*)$ is replaced by an averaged x_t. That is, each independent variable observation ranging from 1 to N is multiplied by the cumulative uniform probability density function to obtain an estimate of $Z_i(i^*)$.

The Farley, Hinich and McGuire test compares equation (8) with a model which constrains δ in equation (8) to be equal to zero. The test statistic is as follows:[9]

$$R_n = \frac{SSE_o - SSE}{SSE}$$

where: SSE_o = the sum of squared errors with δ constrained to zero in equation (8); SSE = the sum of squared errors from Equation (8);

Upon computation of R_n, the test statistic is $F = [(N-2p)/p]\, R_n$. This F statistic is distributed as an $F_{p,n-2p}$ distribution. Upon rejection of the null hypothesis, the structural stationarity of the linear model can be rejected.

Chow's (1960) Test

The last test of structural change to be utilized in this research is Chow's (1960) ANCOVA test. This test requires an a priori specification of the switch point i*. The null hypothesis for the test is:

$$H_o: y = a + bx \quad \forall \quad (x,y) \qquad (9)$$

The alternative hypothesis is:[10]

$$H_a: y = a_1 + b_1x \ \{\forall(x_i,y_i) \text{ such that } i < i^* : i^* \text{ is known a priori}\} \quad (10a)$$
$$y = a_2 + b_2x \ \{\forall(x_i,y_i) \text{ such that } i \geq i^* : i^* \text{ is known a priori}\} \quad (10b)$$

The test compares a single linear function with a piecewise linear function with the separation point known a priori.

The statistically testable form of the model is shown as follows:[11]

$$H_o: y = a + bx + u \quad \text{where: } u \sim N(o,\sigma^2) \qquad (11)$$
$$H_a: y = a_1 + b_1x + u_1 \ \{\forall(x_i,y_i) \text{ such that } i<i^*; i^* \text{ is known a priori}\} (12a)$$
$$y = a_2 + b_2x + u_2 \ \{\forall(x_i,y_i) \text{ such that } i \geq i^*; i^* \text{ is known a priori}\} (12b)$$
$$\text{where: } u_k \sim N(o,\sigma_k^2) \ k = 1,2;$$

Chow (1960) develops the following F-statistic to test equation (11) versus equations (12a) and (12b):

$$S_n = \frac{SSE_o - SSE_1 - SSE_2}{SSE_1 + SSE_2} \qquad (13)$$

$$F = [(n - 2p)/p]\ S_n \qquad (14)$$

where: SSE_0 = the sum of squared errors under H_0;

SSE_1 = the sum of squared errors under (12a);

SSE_2 = the sum of squared errors under (12b);

n = the number of observations;

p = the number of independent variables;

It should be emphasized that the Chow test requires an a priori assertion concerning the switch point from regime (1) (12a) to regime (2) (12b).

Ordering of Observations

The previous three tests of structural stability of a linear model are concerned with testing coefficient differences between two regimes. It is necessary to assert a criteria for placing particular (x,y) coordinates in specifically designated regimes. Four methods of ordering (x,y) coordinates are investigated in this work. The four methods of ordering (x,y) coordinates are based upon the exogenous variables, time, price of the convertible security, premium above the straight bond value and conversion value/call price ratio of the convertible security. A one-to-one function is established relating each of the ordering criteria with the (x,y) coordinates. Once ordering has been accomplished on each of the four criteria, the (x,y) coordinates are reordered in conformity with the one-to-one function previously established. Given each of the four criteria, the switching regression methodology can be implemented to detect structural change.

The four exogenous orderings are introduced in this work to investigate various aspects of convertible security valuation theory. The introduction of ordering by time merely reflects a natural calendar ordering. The ordering of (x,y) coordinates by price of the convertible security is suggested since the higher a convertible security's price, the larger the value assigned to the option to convert, all other parameters held constant.[12] The third ordering mechanism attempts to order the (x,y) coordinates by the premium above straight debt value since the greater the premium above straight debt value, the greater the value assigned to the option to convert, all other parameters held constant.[13] The third ordering differs from the second ordering since straight bond value is permitted to vary intertemporally in the third ordering. Finally, the fourth ordering is based upon the conversion value/call price ratio, since the higher a conversion value/call price ratio the greater the proportion of the convertible security's value that is composed of the value attached to the option to convert the security into common stock.[14] In sum, the later three ordering criteria attempt to reassign the (x,y) coordinates to accentuate the power of the tests of structural change.

Accounting Risk Measures (Interest Rate Risk Measures) and Their Relationship to the Systematic Risk of Convertible Securities

The second segment of this research project addresses the association between accounting risk measures (and interest rate risk measures) and the systematic risk of convertible securities. First, the accounting risk measures and interest rate risk measures employed in this study are developed. Second, the issue of classification of convertible securities is addressed. Next, the systematic risk measures to be investigated are presented. Finally, the statistical methodology employed to detect differential relationships is illustrated.

Accounting Risk Measures

The accounting risk measures employed in this research are a practical compromise to accounting data availability. In general, the minimum disclosure requirements of APB Opinion No.28 (Interim Financial Reporting) are concerned with income statement related amounts. Table 5 of Appendix A presents those minimum requirements. The reporting standards adopted as of December 31, 1973 limit the universe of potential accounting risk measures to income related data. In addition, the quarterly data base available on the Compustat tapes includes only income statement measures. A listing of the quarterly data available on Compustat is presented in Table 6 of Appendix A. Both the minimum reporting requirements and the Compustat data availability must be considered as constraints on the accounting risk measures to be used in this study.

In the process of developing a listing of accounting risk measures of interest, the reviewed studies (see Chapter II) suggest that there exist relationships between accounting risk measures and the systematic risk of common stocks and preferred stocks. From the studies presented, proxies for leverage, profitability, dividend payout, size and marketability appear to possess the highest probabilities of being related to the systematic risk of convertible securities. As a means of arriving at a final list of accounting risk measures to be used in this dissertation, two factor analysis studies will yield "empirically based classifications of financial ratios."[16]

In their 1973 article, Pinches, Mingo and Caruthers (1973) used factor analysis to reduce a large number of financial ratios to seven factors. These factors are labeled by Pinches, Mingo and Caruthers (1973) as: (1) Return on Investment; (2) Capital Intensiveness; (3) Inventory Intensiveness; (4) Financial Leverage; (5) Receivables Intensiveness; (6) Short-term Liquidity; (7) Cash Position. In their paper, the information content inherent in numerous accounting risk measures was implied by the use of factor analytic techniques.

A replication of Pinches, Mingo and Caruthers' (1973) study was performed in Johnson (1979). Johnson (1979) found the seven factors suggested in Pinches, Mingo and Caruthers (1973). This result suggests that the data inherent in the accounting measures considered can be condensed into seven factors.

Of the seven factors suggested, short-term liquidity, receivable intensiveness, cash position and inventory intensiveness are balance sheet measures. The quarterly data to be used in this research does not permit creation of proxies for these factors. On the other hand, measures for return on investment, financial leverage and capital intensiveness can be obtained from the available data.

The accounting risk measures of interest are listed in Table 7 of Appendix A. These variables are intended to proxy return on investment, financial leverage and capital intensiveness. Four other accounting risk measures are considered. First, the dividend payout ratio has been shown to be related to equity systematic risk (see Chapter 2 for discussion). Second, the marketability features of convertible securities may prove to be related to their systematic risk since risky assets are not infinitely divisible and transactions costs do exist. In addition, a theoretical argument for considering marketability of risky assets can be found in Levy (1978). Third, growth has traditionally been hypothesized as a relevant variable in equity security valuation (i.e., Gordon's (1962) model). Finally, size has been empirically related to the systematic risk of equity securities (Thompson (1976)).

Interest Rate Risk Measures

Chapter 2 suggested the use of measures of interest rate fluctuation to identify securities dominated by debt characteristics. From the empirical and theoretical literature, a number of interest rate risk measures have been selected. The interest rate risk variables of concern in this research are those statistics which have been found to be significantly related to the straight debt β. The particular interest rate risk measures to be empirically tested are presented in Table 8 of Appendix A. Coupon and maturity have been found empirically to be related to the systematic risk characteristic of debt securities by Urwitz (1977). In the case of convertible preferred stocks, maturity is an undefined concept. Thus, convertible preferred stock interest rate risk measures will be confined to coupon and not maturity. Next, interest elasticity has been shown to be analytically related to debt beta's by Urwitz (1977). Again, interest elasticity is non-trivially defined only for convertible bonds. Thus, convertible preferred stocks will be eliminated from consideration with respect to interest elasticity. Finally, duration has been shown by Boquist, Racette and Schlarbaum (1975) to be analytically related to debt systematic risks. In the case of convertible preferred stocks, it will be assumed that the security has an infinite life.[17] Given this assumption of a perpetual annuity, convertible preferred stock duration becomes a defined concept. Thus, the interest rate risk measures considered in this work are coupon, maturity, interest elasticity and duration.

Classification of Convertible Securities

A number of accounting risk measures crucially depend upon the classification of the convertible security and its interest or dividend payments.[18] In Chapter 2, the empirical and theoretical literature on convertible securities points to the importance of conversion value/call price (CV/CP) to differentiate securities which are dominated by equity characteristics from those securities which are dominated by debt characteristics. Two recent analytical works by Brennan and Schwartz (1977) and Ingersoll (1977) relate the CV/CP statistic to the equity character of convertible securities.[19] Their analytical results suggest that a convertible security snould be called when its market price equals its call price. Hence, a convertible security with a market price relatively close to or above its call price would be hypothesized to be dominated by equity characteristics.[20] In parallel fashion, convertible securities with market price significantly below its call price would be hypothesized to be dominated by debt characteristics. Thus, the two ends of the spectrum of conversion value/call price range from equity dominated securities to debt dominated securities. This research will test the use of an alternative classification technique that is more consistent with convertible security market reactions than the traditional convertible security classification.

Since an intermediate group may be priced based on both debt and equity characteristics, the following three-way classification will be examined:

Grouping	Expected Market Characteristic
"high" CV/CP (upper quartile)	Reacts as a good dominated by equity characteristics.
"intermediate" CV/CP (middle two quartiles)	Reacts as a good influenced by equity and debt characteristics;
"low" CV/CP (lower quartile)	Reacts as a good dominated by debt characteristics;

The market-based criterion suggests the following accounting treatment:

	"HIGH" CV/CP	"INTERMEDIATE" CV/CP	"LOW" CV/CP
Conv. bond	I (1) Categorized as an equity security	II Proportionate equity and debt characterization	III (1) Categorized as a debt security
	(2) Interest payments categorized as a distribution of stockholder's equity; (dividends)		(2) Interest payments categorized as a fixed expense of doing business (interest expense)
Conv. pref. stock	IV (1) Categorized as an equity security	V Proportionate equity and debt characterization	VI (1) Categorized as a debt security
	(2) Distribution is categorized as a distribution of stockholder's equity		(2) Distribution is categorized as a fixed expense of doing business (interest expense)

The major changes from traditional convertible security classification are found in I and VI above. In I, a convertible bond is reclassified as an equivalent equity security. In VI, a convertible preferred stock is reclassified as an equivalent debt security. In II and V above, the difficulty of separating a convertible security's debt and equity characteristics is portrayed. In III and IV, traditional convertible security classification is maintained. Thus, a market-based accounting classification scheme is proposed to suggest adjustments to published financial reports.

The Dependent Variable of the Cross-Sectional Analysis - Convertible Security BETA

With respect to the convertible securities of interest in this work, at least two measures of systematic risk are readily available. First, an overall beta can be computed under the null hypothesis of the market model.

This statistic assumes a static linear model throughout the test period. On the other hand, the switching regression methodology yields estimates of two separate betas dependent upon the regime specification. Thus, dependent variable specification may differ depending upon the particular regime in effect. In this cross-sectional analysis, the dependent variable will be the systematic risk characteristic from the switching regression to the extent that the null hypothesis has been rejected in the switching regression. If the null hypothesis of no structural change can not be rejected, the dependent variable will be the systematic risk characteristic from the total regression. In addition to the convertible security systematic risk measure, the underlying equity security's beta will be considered as the dependent variable for cross-sectional analysis purposes.[21] In this case, the systematic risk of the common stock is the regression coefficient of the market model over the test period. This final dependent variable permits a comparison of the cross-sectional results of convertible securities and their underlying common stocks.

Cross-Sectional Analysis - Accounting Risk Measures (Interest Rate Risk Measures) and Convertible Security Systematic Risk

Given the previous specification of dependent and independent variables of interest, a series of empirical tests are performed to detect differential relationships between the independent variable (accounting and interest rate risk measures, variously defined) and the dependent variable (systematic risk of the convertible security or the underlying equity). The testing methodology utilizes the Chow (1960) ANCOVA test to detect structural change. Thus, a single linear relationship will be tested against the alternative of two linear relationships with the partition point known *a priori*. The form of the test is:

$$H_o: \beta \text{ conv.} = a_j + b_j (ARM_j^{\,t}) + u_j \text{ where: } u_j \sim N(o,\sigma^2) \quad (17)$$

$$H_a: \beta_1 \text{ conv.} = a_{1j} + b_{1j} (ARM_j^{\,t}) + u_{1j} \quad (18a)$$

$$\beta_2 \text{ conv.} = a_{2j} + b_{2j} (ARM_j^{\,t}) + u_{2j} \quad (18b)$$

where: $u_{kj} \sim (o, \sigma_k^2)$ $k=1,2;$

$ARM_j^{\,t}$ = the j^{th} accounting risk measure in its traditional financial statement form;

β conv. = the systematic risk of the convertible security; (see The Dependent Variable of the Cross-Sectional Analysis - Convertible Security BETA)

β_k conv. = the systematic risk of the convertible security in regime k; k = 1,2;

In contrast to the previous longitudinal use of the Chow (1960) ANCOVA test, this use of the test will focus on the cross-sectional differences in the linear relationship between two partitions of the convertible securities. The test will be performed by comparing the "high" CV/CP convertible securities with the "low" CV/CP convertible securities. This procedure eliminates the "intermediate" CV/CP convertible securities. In this manner, an *a priori* point of separation can be theoretically specified.

In parallel fashion, the next use of the Chow test will employ interest rate risk measures as the independent variable and the systematic risk of the convertible security as the dependent variable. The form of this test is:

$$H_o: \beta \text{ conv.} = a_j + b_j (IRRM_j) + u_j \quad \text{where: } u_j \sim N(o,\sigma^2) \qquad (19)$$

$$H_a: \beta_1 \text{ conv.} = a_{1j} + b_{1j} (IRRM_j) + u_{1j} \qquad (20a)$$

$$\beta_2 \text{ conv.} = a_{2j} + b_{2j} (IRRM_j) + u_{2j} \qquad (20b)$$

where: $u_{kj} \sim N(o,\sigma_k^2)$ $k = 1,2;$

$IRRM_j$ = the j^{th} interest rate risk measure;

β conv.= the systematic risk of the convertible security;

β_k conv.= the systematic risk of the convertible security in regime k;

k = 1,2;

Symmetrically, this use of the test will compare an overall linear relationship with separate linear relationships for the "low" and "high" CV/CP convertible security groups.

The previous two implementations of the Chow test employed the systematic risk of the convertible security as the dependent variable. For comparative purposes, the previous two tests will be run using the underlying equity beta as the dependent variable. Again, these tests will compare a single linear model with a pair of linear models with the point of separation known.

The intermediate CV/CP securities can be hypothesized to exhibit fewer equity security traits as the CV/CP ratio declines. As the CV/CP ratio is reduced, the intermediate CV/CP securities can be expected to exhibit greater debt security traits. As an attempt to test these assertions, the following two hypotheses will be tested on the intermediate CV/CP group of convertible securities:

(1) $H_o^{(1)}$: There exists no relationship between the rankings of convertible securities by conversion value/call price statistic and the rankings of securities by R^2 of accounting risk measures and systematic risk.

(2) $H_o^{(2)}$: There exists no relationship between the rankings of convertible securities by conversion value/call price and the rankings of securities by R^2 of interest rate risk measures and systematic risk.[22]

The R^2's relating accounting risk measures and the systematic risk coefficient are developed by longitudinally regressing the accounting risk measures and the beta coefficients for convertible securities (see the Dependent Variable Section) which remain in the "intermediate" CV/CP group over the test period. A similar procedure is followed for the interest rate risk measures. These two tests will give an indication of the extent of the relationship of the CV/CP statistic to the hypothesized interaction of equity and debt characteristics of convertible securities.

The final test analysis implements the market classification scheme for convertible securities. In this test, the adjusted accounting risk measures will be regressed with the convertible security's systematic risk characteristic for the "high" conversion value/call price group and the "low" conversion value/call price group. The R^2 resulting from the adjusted regression will be tested for significant differences from the R^2 of the traditional regression for the sample period utilizing a dependent sample t-test.[23] This test is designed to empirically address the consistency of the proposed classification scheme with the information set which is used by the market to determine β_i.

The previous tests are designed to consider the cross-sectional relationships between accounting risk measures (interest rate risk measures) and the systematic risk of convertible securities. To the extent that a differential effect is detectable in these cross-sectional relationships, the characterization of the distinction between debt and equity in the empirical setting of the convertible security's market will be enhanced. Thus, the objective of these tests is to add evidence concerning the distinction between debt and equity.

Summary

This chapter has presented the research methodology to be employed in this work. The first set of hypotheses are concerned with the structural stability of the market model's parameters. Four ordering criteria: time; price; premium of price above bond value; and CV/CP are justified. Three tests of structural stability are introduced. Together, this leads to twelve separate tests of structural stability of the sample of convertible bonds and convertible preferred stocks. The second set of hypotheses addresses the issue of cross-sectional relationships between the accounting risk measures (and interest rate risk measures) and the systematic risk measure of convertible securities. The later tests are concerned with the empirical differentiation between debt and equity. The two avenues of endeavor are intended to view convertible securities from a micro-orientation (structural stability issue) and a macro-orientation (composite market-reporting perspective).

NOTES

[1] R.E. Quandt, "The Estimation of the Parameters of Linear Regression System Obeying Two Separate Regimes", Journal of American Statistical Association 63, (December, 1958): 874.

[2] Ibid.

[3] Ibid.

[4] Ibid., p. 875.

[5] Ibid., p. 876.

[6] The test statistic "is an acceptable approximation to the (Chi square) distribution "for large T. In this research, T will be in excess of 200. Thus, the Chi square test statistic should be an "acceptable approximation".

[7] J. V. Farley, M. Hinich and T. W. McGuire, "Some Comparisons of Tests for a Shift in the Slopes of a Multivariate Time Series Model", Journal of Econometrics 3, (1975): 299.

[8] Ibid., p. 301.

[9] Ibid.

[10] G. Chow, "Tests of Equality between Subsets of Coefficients in Two Linear Regressions", Econometrica 28, (July, 1960): 595.

[11] Ibid.

[12] This assertion can be readily seen in Brigham's (1966) model. As value (V) rises the value attached to the option to convert (vertical distance between M M' and B M) increases.

[13] This assertion can be readily seen by considering Brigham's (1966) model over time. The line segment B M can be adjusted periodically by interest rate changes. Thus, the value attached to the option to convert (as in 12 above) would change by the difference between market value and a random straight debt value.

[14] Again, this assertion can be readily seen in Brigham's (1966) model. As the value of the convertible security increases, the conversion value/call price ratio moves from below one to above one. These assertions footnotes 12,13. and 14 can be analytically shown as in Ingersoll (1977). Yet, the graphical representation captures the essence of the argument without adding needless complexity.

15 Farley, Hinich and McGuire's (1970) test maintains a constant intercept and error variance. The null and alternative hypotheses are exactly the null and alternative hypotheses presented under Farley, Hinich and McGuire (1970) (previous section) with x replaced by R_m and y replaced by R_i. Similarly, Chow's (1960) test will be as previously presented with x replaced by R_m and y replaced by R_i. Quandt's (1958) test gives the nature of the null and alternative hypotheses. Thus, Farley, Hinich and McGuire (1970) and Chow (1960) could be similarly presented.

16 G. E. Pinches, K. A. Mingo and J. K. Caruthers, "The Stability of Financial Patterns in Industrial Organizations", Journal of Finance 27, (March, 1973): 395.

17 The assumption of infinite life of the convertible preferred stock is relevant in this context since the ultimate objective of this research is to differentiate convertible securities with debt characteristics from those convertibles with equity characteristics. A convertible security with an infinite life would never obtain common shareholder status. Thus, an infinite life would be consistent with the market's evaluation that the convertible security possessed debt characteristics.

18 Interest expense and dividends are directly related to the classification of convertible securities.

19 Theorem IV. If the perfect markets, Modigliani-Miller Theorem, no call notice, and the flat term structure assumption are valid, then the optimal call strategy for a convertible is to call when the firm value $V = \overline{V(i)} = K(i)/(\gamma)$ ($K(i)$ = call price; γ = the ratio of the number of common shares to be issued upon conversion divided by the number of shares outstanding). (Ingersoll, 1977).

20 The concept suggested is intended to juxtapose relatively high priced convertible securities with relatively low priced convertible securities. When a convertible security's CV/CP exceeds 1, the convertible security will exhibit equity dominated characteristics. When a convertible security's CV/CP is significantly below 1, the convertible security will exhibit debt dominated characteristics.

21 The use of the term "underlying equity security" refers to the common stock which will be given to the convertible securityholder in the event of conversion.

22 The null hypotheses will be tested by utilizing Spearman's Rank Correlation Coefficient. (Glass and Stanley, 1970, p. 316)

23 The dependent sample t-test can be specified as:

$$H_0 : \mu 1 - \mu 2 = 0 \quad H_a: \mu 1 - \mu 2 \neq 0; \quad \text{where:} \quad \mu 1 = R^2$$

from the adjusted accounting risk measures regression with the systematic risk of the convertible security; $\mu 2 = R^2$ from the traditional accounting risk measures regression with the systematic risk of the convertible security; (Glass and Stanley, 1970, p.298)

Chapter IV

STRUCTURAL STABILITY OF THE MARKET MODEL APPLIED TO CONVERTIBLE SECURITY RETURNS

This chapter presents the results of stability tests as applied to convertible securities' systematic risk measures. The first section explains the procedures used to measure the return on the market. Next, the convertible security data collection process is reviewed. The subsequent sections present the results of the switching regression methodology where the (x,y) coordinates are ordered by time, price, premium over bond value, and conversion value/call price. Comparisons and contrasts of the results using these different orderings follow. Finally, implications of the results are discussed.

Proxy for the Return on the Market

The capital asset pricing model implies a linear relationship between the expected return on the market portfolio and the expected return on any risky security. Traditionally, the *ex ante* returns of the theoretical model have been proxied by the *ex post* observable returns on a variety of stock market indices. However, the theoretical literature supports the use of a broadly based market-valued index to proxy the return on the market. Articles by Roll (1977, 1978 and 1979) and Mayers and Rice (1979) suggest that "we do know the attributes of a good market portfolio proxy for testing the theory - it should be a value-weighted index which includes as many assets as possible."[1] In general, the use of a broadly represented value-weighted index is in conformity with the capital asset pricing theory. Empirical evidence for the use of a value-weighted composite index is provided by Smith (1980). The author states:

> The multi-security index appears to provide a better specified model for bond and preferred stock returns than any of the single security indexes tested; however, for the common stock sample and the multiple security sample the Fisher Index provided the better market specification.[2]

In the present study the need for representation of non-equity securities in the market index is particularly acute due to the debt characteristics of convertible securities.

In an effort to develop a broadly based value-weighted index, weekly returns and market values for U.S. government bonds, Standard and Poor's High Grade bonds, and equity securities were assembled. The weekly returns for the U.S. government bonds and Standard and Poor's High Grade bonds were constructed after obtaining average yields and weekly prices from the Standard and Poor's Security Price Index Record. The market value of U.S. treasury bills, notes and bonds are found on a monthly basis in the Federal Reserve Bulletin. In order to obtain weekly market values, monthly changes in market value were assumed to have occurred uniformly throughout the period. The market values for corporate bonds were proxied by the market values published on a yearly basis in the NYSE Fact Book. Then, monthly bond values were estimated by adjusting yearly bond market values for new bond issues obtained from the Federal Reserve Bulletin, "New Security Issues". Weekly bond market values were constructed by averaging the market value change on a weekly basis. Finally, equity security returns and market values were obtained from the CRSP Daily Returns Tape. Then, weekly returns and market values were created. Utilizing these market values and security returns, a value-weighted composite market index was constructed.

The results of constructing a value-weighted composite index can be compared to the value-weighted CRSP index (equity securities only). For the 1976-79 period, a comparison of indices is shown in Table 4-1.

TABLE 4-1 Comparison of a Composite Value-Weighted Index With The CRSP Value-Weighted Index

	Composite Index	CRSP Index
Mean	.0014012	.0024058
Standard Deviation	.0098916	.0170808
Minimum Return	-.0408271	-.0709000
Maximum Return	.0277747	.0497000

It should be noted that the average return and the standard deviation of the composite index are less than the average return and standard deviation of the pure equity index. The composite index has a smaller range of observations than the CRSP index. Thus, the introduction of debt securities results in an index that is less variable than the CRSP index.

Convertible Security Sample Selection Process

Sample selection followed a two-step process. First, the population of convertible securities was defined to be those convertible securities which were outstanding from 1976 through 1979, inclusive.[3,4] This criterion yields 347 convertible bonds and 154 convertible preferred stocks. At this stage, one hundred convertible bonds and one hundred convertible preferred stocks were randomly selected. The second step required each of the previously selected securities to be readily available in the data collection sources. For convertible bonds, four convertible bonds were not listed in the Commercial and Financial Chronicle for the time period selected.[5] Eight convertible preferred stocks were not available on the Media General Tape.[6] Thus, the final samples contain 96 convertible bonds and 92 convertible preferred stocks.

Dependent Variable - Convertible Security Returns

Once the samples of convertible bonds and convertible preferred stocks were established, weekly price and volume data were assembled for each type of security. For convertible bonds, weekly price and volume data were hand collected from the Commercial and Financial Chronicle. For convertible preferred stock, weekly price and volume data were constructed by extracting the appropriate end of week price and total of the week's volume from the Media General Tape of daily prices and volumes. Upon collection of the weekly prices, weekly returns were created. These weekly returns are the dependent variables in each of the switching regression tests.

Switching Regression Results

The switching regression results are presented in the four following sections dependent upon the (R_i, R_m) ordering mechanism specified. In each section results are presented for the Quandt (1958), Farley, Hinich and McGuire (1970) and Chow (1960) ANCOVA designs. The first section reports the results of calendar time ordering of the returns. The second section reviews the outcomes of the three testing methodologies for the ordering of returns based upon price of the convertible bonds and preferred stocks. The next section presents results for the ordering based on premium above straight bond value. Finally, the conversion value/call price ordering procedure results are reviewed.

Time Ordering: Convertible Bonds and Convertible Preferred Stock

Quandt's (1958) Test - Time Ordering

Quandt's test assumes the null hypothesis of a single linear relationship covering all observations is true. The alternative hypothesis asserts the existence of two piece-wise linear relationships. Upon examining Quandt's (1958) $-2\ln\lambda$ statistic, the following results are evident:

TABLE 4-2 Quandt Test - Time Ordering

α - level	N	$10\% \geq \alpha > 5\%$	$5\% \geq \alpha > 1\%$	$1\% \geq \alpha$
Conv. Bonds	96	95	90	87
Conv. Pref.	92	86	81	68

At the conventional α-level of 5%, the null hypothesis is rejected in 93.75% (88.04%) of the observations for convertible bonds (preferred stocks) in the sample. These results suggest a high level of non-stationarity in the market model parameters utilizing time as the ordering mechanism.

Given this level of non-stationarity, the statistical significance of each linear relationship (overall regression, regime (1)'s regression and regime (2)'s regression) becomes important. With the objective of assessing the statistical significance of each regression, the following F-test results are obtained:

TABLE 4-3 Statistical Significance of Identified Regressions - Quandt Test - Time Ordering

α - level	N	$10\% \geq \alpha > 5\%$	$5\% \geq \alpha > 1\%$	$1\% \geq \alpha$
Conv. Bonds:				
OVERALL	96	66	60	39
Regime(1)	96	62	50	29
Regime(2)	96	28	19	7
Regime (1) and Regime (2)		18	9	3
Conv. Pref.:				
OVERALL	92	42	33	21
Regime(1)	92	41	33	18
Regime(2)	92	10	5	3
Regime (1) and Regime (2)		3	0	0

The regressions which include all observations (overall regression) are statistically significant in 62.5% (35.4%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. Moving to the regressions of regime (1), these regressions are statistically significant in 52.08% (35.9%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. For the regime (2) linear models, these regressions are statistically significant in 19.79% (5.4%) of the cases for convertible bonds (preferred stocks) at the 5% α-level.

The explanatory power of the regression equations developed in Quandt's test is shown in Table 4-4.

TABLE 4-4 Explanatory Power (R^2) of Overall Regressions and Piece-Wise Regressions - Time Ordering

α-level[+]	N	10% ≥ α	5% ≥ α	1% ≥ α
Convertible bonds:				
Overall	.037	.037	.036	.035
Piece-wise[7,8]	.062	.062	.061	.061
Convertible Preferred Stocks:				
Overall	.020	.019	.019	.020
Piece-wise[7,8]	.043	.042	.042	.041

[+] The α-level refers to the prespecified rejection rate for Quandt's test. The average explanatory power is computed only for those securities rejecting Quandt's test at the specified α-level.

The explanatory power uniformly increases for the two regime specification.[9] The two regime specification leads to a greater relative increase in the explanatory power for the convertible preferred stock sample (115%) compared to the convertible bond sample (67.6%). This comparison suggests that a two regime specification provides a more descriptive model for convertible preferred stock returns compared to convertible bond returns. In absolute terms, the increase in explanatory power for the convertible bonds (.025) and the convertible preferred stocks (.023) are approximately equal. In either case, the increase of explanatory power in excess of 2% can be considered significant in relation to the magnitudes of the explanatory powers of the single regime market models. In sum, the increase in explanatory power of the piece-wise regression suggests that the two regime specification dominates the single regime specification for time ordering.[10]

The regressions of the Quandt (1958) test exhibit the following systematic risk estimates:[11]

TABLE 4-5 Comparative Systematic Risk Statistics - Time Ordering

	Regime (1)	Regime (2)	Overall
Convertible Bonds:			
Average Beta-Estimate	.384	.466	.410
Standard Deviation of Beta-Estimate	.457	.610	.287
Inter-Quartile Range:			
Beta-25% Fractile	.105	.096	.236
Beta-75% Fractile	.605	.700	.524
Convertible Preferred Stocks:			
Average Beta-Estimate	.267	.275	.326
Standard Deviation of Beta-Estimate	.765	.396	.277
InterQuartile Range:			
Beta-25% Fractile	- .020	.039	.100
Beta-75% Fractile	.410	.432	.384

Table 4-5 illustrates that the average betas of convertible bonds and convertible preferred stocks were substantially below 1. The results show that, on average, convertible securities exhibit less systematic risk than the market portfolio. From the interquartile range statistics and the standard deviation estimates, the dispersion of systematic risk estimates increases by allowing a two regime model compared to a single regime model.[12]

Farley, Hinich and McGuire's (1970) Method - Time Ordering

The second empirical test of structural stability of the market model to be discussed is Farley, Hinich and McGuire's (1970) method (hereafter, FHM). Two outcomes of the test are presented. First, the method utilizes an F-test of an augmented linear model.[13] The results of this F-test are as follows:

TABLE 4-6 Farley, Hinich and McGuire's F-test - Time Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv.Bonds	96	9	6	2
Conv.Pref.	92	4	1	1

The FHM (1970) F-test leads to a rejection of the null hypothesis in 6.25% (1%) of the cases for convertible bonds (preferred stocks) at the α-level of 5%. The second measure of interest in utilizing the FHM method is the t-test of the coefficient of the second variable in the augmented linear relationship. The coefficient of the second variable is found to be significantly different from zero (α-5% level) in 12 (5) cases out of 96 (92) observations for convertible bonds (preferred stock). This limited set of rejections of the two null hypotheses suggest less structural instability as compared with the results of the Quandt test.

Chow's (1960) ANCOVA Test - Time Ordering

The final test of structural stability to be discussed is Chow's (1960) ANCOVA test. With an a priori assertion of structural shift at the mid-point of the time series, testing of this null hypothesis reveals:

TABLE 4-7 Chow's ANCOVA Test - Time Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv.Bonds	96	15	5	2
Conv.Pref.	92	11	5	1

These results suggest rejection of the null hypothesis in 5.21% (5.43%) of the convertible bonds (preferred stock) for an α-level of 5%. These results suggest limited structural instability for the time sequence.

Time Ordering - Summary

The time ordering of convertible securities met with limited rejection of the null hypothesis utilizing FHM's (1970) method and Chow's (1960) ANCOVA test. For the FHM and Chow test, the rejection rate of the null hypothesis did not greatly exceed the α-level specified. Quandt's (1958) test rejects the null hypothesis at a high level. For the Quandt test, the comparison of overall and piece-wise explanatory powers suggests that a two regime specification is more descriptive than a single regime specification. Thus, the ordering of convertible security returns based upon calendar time provides some evidence of structural instability.

Price Ordering: Convertible Bonds and Convertible Preferred Stocks

Quandt's (1958) Test - Price Ordering

With the ordering mechanism of convertible security price, Quandt's test reveals the following results:

TABLE 4-8 Quandt Test Results - Price Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv. Bonds	96	93	93	87
Conv. Pref.	92	84	79	69

For an α-level of 5%, the Quandt test rejects the null hypothesis in 96.88% (85.87%) of the cases for convertible bonds (preferred stocks) when the ordering mechanism is price of the convertible security. Again, a high level of non-stationarity is detected utilizing Quandt's test.

With this level of non-stationarity, the particular linear regression segments are analyzed for statistical significance. The following F-test results are obtained:

TABLE 4-9 Statistical Significance of Identified Regressions - Quandt Test - Price Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv. Bonds:				
OVERALL	96	62	56	34
Regime (1)	96	56	48	28
Regime (2)	96	16	10	7
Regime(1) and Regime(2)		9	7	4
Conv. Pref.:				
OVERALL	92	40	32	13
Regime (1)	92	39	31	12
Regime (2)	92	40	32	13
Regime(1) and Regime(2)		17	12	2

The regressions which include all observations are statistically significant in 58.3% (34.8%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. The regime (1) regressions were statistically significant for 50.0% (33.7%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. The regime (2) regressions were statistically significant for 10.4% (34.8%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. Constraining regime (1) and regime (2) regressions to a 5% α-level of significance, the intersection of these statistically significant regression models occurred in 7.3% (13.04%) of the cases for an α-level of 5%.

The explanatory power of the regression equations developed in Quandt's test are presented in Table 4-10. (See Notes 7,8.).

TABLE 4-10 Explanatory Power (R^2) of Overall Regressions and Piece-Wise Regressions - Price Ordering

α-level+	N	10% ≥ α	5% ≥ α	1% ≥ α
Convertible bonds:				
Overall	.030	.030	.030	.030
Piece-wise	.077	.078	.078	.079
Convertible Preferred Stocks:				
Overall	.024	.022	.021	.021
Piece-wise	.076	.076	.075	.077

+ The α-level refers to the prespecified rejection rate for Quandt's test. The average explanatory power is computed only for those securities rejecting Quandt's test at the specified α-level.

Again, the explanatory power increases for the two regime specification compared to a single regime restriction. The two regime specification leads to a greater relative increase in the explanatory power for the convertible preferred stock sample (216%) compared to the convertible bond sample (156%). In absolute terms, the increase in explanatory power for the convertible bonds (.047) and the convertible preferred stocks (.052) are approximately equal. An increase of more than 4% for the explanatory power can be considered significant in this case. Comparing the price and time ordering, the increases in explanatory power for price ordering are approximately double the increases in explanatory power for time ordering. Consequently, the increase in explanatory power suggests that the two regime model describes the convertible security returns for price ordering (see Note 10).

The Quandt test reveals the following systematic risk estimates: (See Note 11.)[14]

TABLE 4-11 Comparative Systematic Risk Statistics - Price Ordering

	Regime (1)	Regime (2)	Overall
Convertible Bonds:			
Average Beta-Estimate	.396	.393	.380
Standard Deviation of Beta-Estimate	.648	.664	.285
Inter-Quartile Range:			
Beta-25% Fractile	.150	.035	.176
Beta-75% Fractile	.547	.771	.507
Convertible Preferred Stocks:			
Average Beta-Estimate	.505	.084	.415
Standard Deviation of Beta-Estimate	.969	.966	.541
Inter-Quartile Range:			
Beta-25% Fractile	.197	- .221	.196
Beta-75% Fractile	.658	.338	.487

The average betas of convertible bonds and convertible preferred stocks were below the market's beta of 1. Again, the average betas of convertible bonds and convertible preferred stocks are less risky than the market portfolio.[15] In addition, the variability statistics reported in Table 4-11 suggest that the systematic risk estimates are more disperse in a two regime environment compared to a single regime environment. (See Note 12.)

Farley, Hinich and McGuire's (1970) Method - Price Ordering

Farley, Hinich and McGuire's (1970) test results will be reviewed considering two measures. The following F-test results are presented:

TABLE 4-12 Farley, Hinich and McGuire's F-test - Price Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv. Bonds	96	8	5	2
Conv. Pref.	92	8	2	0

The FHM (1970) F-test leads to a rejection of the null hypothesis in 5.21% (2.17%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. The second test of interest considers the significance of β_2. The t-test for the coefficient of the second variable in the augmented design is statistically significant at an α-level of 5% in 12 (12) out of 96 (92) observations for convertible bonds (preferred stocks). (See Note 13.)

Chow's (1960) ANCOVA Test - Price Ordering

Chow's test is performed assuming a structural shift occurs at the mid-point of the series of (x,y) coordinates when ordering the return coordinates by convertible security price. This ordering process inherently adjusts the mid-point to be the median of the prices of the convertible security under consideration. The results are presented in Table 4-13 below.

TABLE 4-13 Chow's ANCOVA Test - Price Ordering

α-level	N	10% $\geq \alpha >$ 5%	5% $\geq \alpha >$ 1%	1% $\geq \alpha$
Conv. Bonds	96	39	29	10
Conv. Pref.	92	34	22	3

The results of Chow's (1960) ANCOVA test reject the null hypothesis of no structural change in 30.2% (23.9%) of the cases for convertible bonds (preferred stocks) under convertible security price ordering at the 5% α-level.

Price Ordering - Summary

The price ordering mechanism permits greater instability detection than the time ordering mechanism. With respect to Quandt's method, price ordering leads to numerous rejections of the null hypothesis. As in the time ordering mechanism, FHM's method detects structural change in relatively few cases compared to Quandt's method. The most significant difference between time ordering and price ordering is detected when utilizing the Chow ANCOVA test. Implementing the test on price ordered convertible securities increased the rejections of the null hypothesis dramatically. Thus, price ordering facilitates an increase in rejections of the tests of structural stability compared to time ordering.

Premium over Straight Bond Value: Convertible Bonds and Convertible Preferred Stocks

Quandt's (1958) Test - Premium over Straight Bond Value

Utilizing the ordering mechanism premium over straight bond value, Quandt's test suggests the following results:[16]

TABLE 4-14 Quandt Test - Premium over Straight Bond Value Ordering

α-level	N	$10\% \geq \alpha > 5\%$	$5\% \geq \alpha > 1\%$	$1\% \geq \alpha$
Conv. Bonds	76	76	76	71
Conv. Pref.	70	66	62	56

For an α-level of 5%, the test rejects the null hypothesis in 100% (88.57%) of the cases for convertible bonds (preferred stocks). As in the previous ordering mechanisms, stationarity of the regression coefficients is rejected in a large percentage of the observations.

Turning to the statistical significance of the regression models, the following F-test results are presented:

TABLE 4-15 Statistical Significance of Identified Regressions - Quandt - Premium Over Straight Bond Value Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv. Bonds:				
OVERALL	76	53	47	29
Regime (1)	76	51	45	30
Regime (2)	76	15	8	3
Regime(1) and Regime (2)	76	12	3	20
Conv. Pref.:				
OVERALL	70	42	35	20
Regime (1)	70	44	36	18
Regime (2)	70	28	23	17
Regime (1) and Regime (2)	70	19	12	2

The linear regressions including all observations are statistically significant in 61.84% (50%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. Regime (1) regressions were statistically significant for 59.2% (51.43%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. Regime (2) regressions were statistically significant for 10.53% (32.86%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. By imposing a constraint of 5% α-level significance of the regime (1) and (2) regressions, 4% (17.14%) of the convertible bonds (preferred stocks) were statistically significant.

Explanatory powers from the regression equations of Quandt's test are presented in Table 4-16. (See Notes 7,8.)

TABLE 4-16 Explanatory Power (R^2) of Overall Regressions and Piece-Wise Regressions - Premium Over Straight Bond Value Ordering

α-level+	N	10% ≥ α	5% ≥ α	1% ≥ α
Convertible Bonds:				
Overall	.034	.034	.034	.034
Piece-Wise	.042	.042	.042	.042
Convertible Preferred Stocks:				
Overall	.034	.035	.035	.036
Piece-Wise	.083	.092	.089	.087

+ The α-level refers to the prespecified rejection rate for Quandt's test. The average explanatory power is computed only for those securities rejecting Quandt's test at the specified α-level.

The explanatory powers of the piece-wise regressions exceed the explanatory powers of the overall regressions. The two regime specification leads to a significantly greater relative increase in the explanatory power for the convertible preferred stock sample (144%) compared to the convertible bond sample (24%). This comparison suggests that a two regime specification provides a more descriptive model for convertible preferred stock returns compared to convertible bond returns. In absolute terms, the increase in explanatory power for the convertible bonds (.008) is significantly less than the increase in explanatory power for the convertible preferred stocks (.049). In both absolute and relative terms, the two regime specification only dominates the single regime specification for convertible preferred stocks. (See Note 10.)

The Quandt regressions allow the comparison of systematic risk estimates in Table 4-17. (See Note 11.)[17]

TABLE 4-17 Comparative Systematic Risk Statistics - Premium Over Straight Bond Value Ordering

	Regime (1)	Regime (2)	Overall
Convertible Bonds:			
Average Beta-Estimate	.376	.389	.393
Standard Deviation of Beta-Estimate	.526	.623	.266
Inter-Quartile Range:			
Beta -25% Fractile	.150	.092	.222
Beta -75% Fractile	.522	.717	.511
Convertible Preferred Stocks:			
Average Beta-Estimate	.425	.175	.413
Standard Deviation of Beta-Estimate	.470	1.290	.307
Inter-Quartile Range:			
Beta -25% Fractile	.170	- .125	.213
Beta -75% Fractile	.718	.530	.538

The results of Table 4-17 suggest that the average systematic risk estimates are less than the systematic risk of the market portfolio. Again, the use of a two regime specification permits greater variability in systematic risk estimates than a single regime specification. (See Note 12.)

Farley, Hinich and McGuire's (1970) Method - Premium over Straight Bond Value

The FHM (1970) F-test results are presented in Table 4-18.

TABLE 4-18 Farley, Hinich and McGuire's F-test - Premium Over Straight Bond Value Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv. Bonds	76	6	4	2
Conv. Pref.	70	10	5	3

The FHM (1970) F-test leads to a rejection of the null hypothesis in 5.26% (7.14%) of the cases for convertible bonds (preferred stocks) at the 5%

α-level. The second test of statistical significance of the augmented model considers differences of β_2 from zero. The t-test for the coefficient of the second variable in the augmented design is statistically significant at an α-level of 5% in 9 (12) cases out of 76 (70) observations for convertible bonds (preferred stocks). (See Note 13.)

Chow's (1960) ANCOVA Test - Premium over Straight Bond Value

The results of Chow's (1960) ANCOVA test based on premium over straight bond value ordering are as follows:

TABLE 4-19 Chow's ANCOVA Test - Premium Over Straight Bond Value Ordering

α-level	N	$10\% \geq \alpha > 5\%$	$5\% \geq \alpha > 1\%$	$1\% \geq \alpha$
Conv. Bonds	76	32	23	9
Conv. Pref.	70	23	17	9

Chow's test rejects the null hypothesis of no structural change in 30.3% (24.3%) of the cases for convertible bonds (preferred stocks) for the ordering mechanism, premium over straight bond value.

Premium above Bond Value - Summary

As in previous ordering schemes, Quandt's test indicated substantial structural instability in the market model. In addition, FHM's (1970) test detected more instability for this ordering mechanism than the time or price ordering. Finally, the Chow test results detect structural instability for a large percentage of convertible bonds and preferred stocks. In sum, the ordering mechanism, premium over bond value, shows a higher degree of structural instability for each of the three test procedures than does the time or price ordering.

Conversion Value/Call Price Ordering: Convertible Bonds and Convertible Preferred Stocks

Quandt's Test - Conversion Value/Call Price

Quandt's test results for the ordering mechanism, conversion value/call price, are presented in Table 4-20 below.[19]

TABLE 4-20 Quandt Test Results - Conversion Value/Call Price Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv. Bonds	91	90	87	71
Conv. Pref.	88	76	72	58

At the α-level of 5%, the null hypothesis is rejected in 95.6% (81.8%) of the observations for convertible bonds (preferred stocks) in the sample. As in the previous ordering mechanism, a high level of parameter non-stationarity was detected.

The statistical significance of the linear models specified is presented in Table 4-21.

TABLE 4-21 Statistical Significance of Identified Regressions - Quandt Test - Conversion Value/Call Price Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv. Bonds:				
OVERALL	91	58	52	30
Regime (1)	91	52	44	24
Regime (2)	91	12	9	7
Regime(1) and Regime(2)		6	4	3
Conv. Pref.:				
OVERALL	88	39	31	16
Regime (1)	88	36	27	11
Regime (2)	88	27	25	22
Regime(1) and Regime(2)		9	8	2

The overall regressions are statistically significant in 57.14% (35.23%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. The linear regression models of regime (1) are statistically significant for 48.35% (30.68%) of the cases for convertible bonds (preferred stocks) at the 5% α-level. Regime (2) linear models are statistically significant for 9.89% (28.41%) of the cases for convertible bonds (preferred stocks) at the 5% α-level.

The explanatory power of the regression equations developed in Quandt's test are shown in Table 4-22. (See Notes 7,8.)

TABLE 4-22 Explanatory Power (R^2) of Overall Regressions and Piece-Wise Regressions - Conversion Value/Call Price Ordering

α-level+	N	10% ≥ α	5% ≥ α	1% ≥ α
Convertible Bonds:				
Overall	.028	.028	.028	.026
Piece-Wise	.054	.054	.053	.051
Convertible Preferred Stocks:				
Overall	.029	.030	.028	.030
Piece-Wise	.057	.056	.055	.052

+ The α-level refers to the prespecified rejection rate for Quandt's test. The average explanatory power is computed only for those securities rejecting Quandt's test at the specified α-level.

As in all previous ordering mechanisms, the average explanatory powers of the combined piece-wise regressions exceed the average explanatory powers of the overall regressions. The two regime specification leads to a comparable relative increase in the explanatory power for the convertible bond sample (93%) and the convertible preferred stock sample (97%). In absolute terms, the increase in explanatory power for the convertible bonds (.026) and the convertible preferred stocks (.028) are approximately equal. The increase in explanatory power in excess of 2.5% can be considered significant in this case. Again, the increase in explanatory power suggests the dominance of a two regime specification. (See Note 10.)

The regression equations of the Quandt test allow comparisons of the following systematic risk estimates: (See Note 11.)

TABLE 4-23 Comparative Systematic Risk Statistics - Conversion Value/ Call Price Ordering

	Regime (1)	Regime (2)	Overall
Convertible Bonds:			
Average Beta-Estimate	.199	.431	.350
Standard Deviation of Beta-Estimate	.785	.676	.248
Inter-Quartile Range:			
Beta -25% Fractile	.061	.178	.185
Beta -75% Fractile	.441	.732	.510
Convertible Preferred Stocks:			
Average Beta-Estimate	.082	.305	.310
Standard Deviation of Beta-Estimate	.882	1.410	.474
Inter-Quartile Range:			
Beta -25% Fractile	-.115	.123	.172
Beta -75% Fractile	.471	.709	.536

Table 4-23 suggests that the convertible bond and convertible preferred stock systematic risk estimates are substantially below one. In addition, the average beta estimate increases moving from regime (1) to regime (2). The variability of the systematic risk estimate is greater for the two regime specification compared to the single regime specification. (See Note 12.)

Farley, Hinich and McGuire's (1970) Method - Conversion Value/Call Price

For the conversion value/call price ordering, FHM's (1970) F-test results are reported in Table 4-24.

TABLE 4-24 Farley, Hinich and McGuire's F-test - Conversion Value/Call Price Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv.Bonds	91	8	4	1
Conv.Pref.	88	6	4	2

The FHM (1970) F-test rejects the null hypothesis in 4.39% (4.55%) of the cases for convertible bonds (preferred stocks) at the α-level of 5%. In addition, a t-test to determine the statistical significance of the β_2 coefficient was performed. The t-test for the coefficient of the second variable in the augmented design is statistically significant at an α-level of 5% in 13 (10) cases out of 91 (88) observations for convertible bonds (preferred stocks). (See Note 13.)

Chow's (1960) ANCOVA Test - Conversion Value/Call Price

The results of the test for conversion value/call price ordering are presented as follows:

TABLE 4-25 Chow's ANCOVA Test - Conversion Value/Call Price Ordering

α-level	N	10% ≥ α > 5%	5% ≥ α > 1%	1% ≥ α
Conv.Bonds	91	10	3	0
Conv.Pref.	88	13	8	1

The Chow test rejects the null hypothesis of no structural change in 3.29% (9.09%) of the cases for convertible bonds (preferred stock) utilizing conversion value/call price ordering at the 5% α-level.

Conversion Value/Call Price - Summary

As in all previous ordering mechanisms, Quandt's (1958) test showed strong indications of structural instability. FHM's (1970) test detected less structural instability for the conversion value/call price ordering than for the premium above bond value ordering mechanism. Chow's (1960) ANCOVA test performed at a lower rejection rate (of the null hypothesis) for the conversion value/call price ordering than the premium over straight bond ordering mechanism.

Comparisons and Contrasts - Results of Time, Price, Premium over Bond Value and Conversion Value/Call Price Ordering

Quandt's (1958) Test

For all four ordering mechanisms, the Quandt (1958) test detects rejection of the null hypothesis for a large percentage of convertible securities. This is clearly shown in Table 4-26.

TABLE 4-26 Comparative Quandt Test Results - Rejection Rates and Sample Sizes

Ordering Mechanism	Convertible Bonds	Convertible Preferred Stocks
Time	93.75% (96)	88.04% (92)
Price	96.88% (96)	85.87% (92)
Premium Over Bond Value	100.00% (76)	88.57% (70)
Conversion Value/ Call Price	95.60% (91)	81.08% (88)

The ordering mechanism which produces the largest percentage of null hypothesis rejections is premium over bond value. In sum, each of the ordering mechanisms reveals acute instability in the return generating processes of the convertible securities sampled.

A final set of descriptive statistics can be generated from the Quandt test. Each identified switch point is associated with a market price. The average market prices for the identified switch points are presented in Table 4-27 for the convertible bond sample.

TABLE 4-27 Average Market Price and Standard Deviation for the Quandt Test Identified Switch Point - Convertible Bonds

	Mean Price+	Standard Deviation
Time Ordering	82.146	29.883
Price Ordering	81.284	28.236
Premium Over Bond Value Ordering	77.633	16.344
Conversion Value/Call Price Ordering	77.990	17.997

+ The mean price of the convertible bond at the switch point is expressed as a percent of a $1,000 bond.

The market price is approximately 80% of a $1,000 bond at the switch point for all orderings. In future research on a different convertible bond sample, the $800 market price can be used as the point of switch for the Chow (1960) ANCOVA test.

In similar fashion Table 4-28 presents the average market price/call price for the convertible preferred stock sample.

TABLE 4-28 Average Market Price/Call Price And Standard Deviation at the Quandt Test Identified Switch Point - Convertible Preferred Stocks

	Mean Market Price/Call Price+	Standard Deviation
Time Ordering	69.279	27.515
Price Ordering	69.600	25.300
Premium Over Bond Value Ordering	64.800	23.800
Conversion Value/Call Price Ordering	65.400	20.500

+ The average market price/call price of the convertible preferred stock at the switch point is expressed as a percentage. The market price has been deflated by the call price due to the wide range of convertible preferred stock call prices in the sample.

The market price/call price is approximately 67% for the four orderings at the identified switch point. Again, an a priori point of switch can be identified at a market price/call price equal to .67. From Tables 4-27 and 4-28, empirically testable assertions can be identified. Future research can identify the point of switch for the Chow (1960) ANCOVA test based on the results of Tables 4-27 and 4-28.

Farley, Hinich and McGuire's (1970) Method

The comparative results of FHM's (1970) test are presented in Table 4-29.

TABLE 4-29 Comparative Farley, Hinich and McGuire Results - Rejection Rates

Ordering Mechanism	Convertible Bonds	Convertible Preferred Stocks
Time	6.25%	1.06%
Price	5.21%	2.17%
Premium over Bond Value	5.26%	7.14%
Conversion Value/ Call Price	4.40%	4.55%

From Table 4-29, it is evident that FHM's (1970) test did not reject the null hypothesis of no structural change at the 5% α-level. Two explanations of these results are readily available. First, the return generating process of convertible securities may be structurally stable over all observations. This explanation appears unlikely. The Quandt test rejects the null hypothesis of structural stationarity in excess of 80% of the cases. The Chow test rejects the null hypothesis of structural stability in excess of 20% of the cases for the price and premium over bond value orderings. Thus, the Quandt and Chow test results suggest the existence of structural instability.

The second explanation is concerned with the assumptions of FHM's (1970) test. FHM's test assumes that a switch point is equally likely at all observations. The testable augmented model is derived from this assumption. In the case of a convertible security, the assumption of an equally likely switch point for all observations may not model the return generating process in an appropriate manner. For instance, a convertible security which is priced as a substitute good for an equivalent debt would not have the same probability of switching from a debt dominated return generating process to an equity return generating process as a convertible security which has equally weighted debt and equity characteristics. Further research into the use of competing assumptions with the FHM (1970) technique appears warranted.[19]

Chow's (1960) ANCOVA Test

The comparative results of Chow's (1960) ANCOVA test are presented in Table 4-30.

TABLE 4-30 Comparative Chow Test Results - Rejection Rates

Ordering Mechanism	Convertible Bonds	Convertible Preferred Stocks
Time	5.21%	5.43%
Price	30.21%	23.91%
Premium Over Bond Value	30.26%	24.29%
Conversion Value/ Call Price	3.30%	9.09%

From these results, time and conversion value/call price ordering provide less indication of structural instability than the price and premium over bond value ordering mechanisms. The price and premium over bond value orderings suggests that the assertion of structural stability of a linear model's parameters is suspect for convertible securities.

Summary

As discussed in Chapter III, convertible security valuation theory suggests potential structural instability for the orderings: price, premium over bond value, and conversion value/call price. Unlike the FHM test, the Quandt and Chow tests do not assume a uniform probability distribution. Thus, they appear to be more appropriate means for detecting this potential structural instability. Using the Quandt test, instability was evident in all orderings. The results are similar employing the Chow test for the orderings price and premium over bond value. (See Note 20.)

NOTES

[1] Richard Roll, "A Reply to Mayers and Rice," Journal of Financial Economics 7, (1979): 394.

[2] David Smith, "A Test of Alternative Proxies for the Return on the Market Portfolio," Faculty Working Paper - University of Kansas, (1981): 6.

[3] This process involved listing those convertible securities which were outstanding at 12/31/79 and deleting those convertible securities which were not available at 1/1/76. The source of the 12/31/79 listing was Value Line Convertible Security Survey. The listing at 1/1/76 was found in the Moody's Bond Record.

[4] The period 1976-1979 was utilized in this study due to data availability on the Media General Tape for convertible preferred stocks.

[5] The four convertible bonds were issued by companies which merged with other companies during the four-year period. Their exclusion from the sample attempts to eliminate this uncontrolled variable.

[6] The loss of 8 observations is due to the construction of the Media General Tape. The tape utilized in this research was revised as of 9/30/80. Thus, the eight securities eliminated from the sample were not outstanding as of 9/30/80. Between 1/1/80 and 9/30/80, these securities were redeemed or converted.

[7] The piece-wise explanatory power is a measure of the R-squareds from the regime (1) and regime (2) linear regressions. The measure combines the sum-of-squared errors for each regression (appropriately weighted). This combined sum-of-squared errors is used to develop the descriptive statistic, piece-wise explanatory power, in the same manner as a traditional r-squared statistic. It should be noted that these results are not exactly comparable. Yet, the intent is to give an estimate of the increase in explanatory power associated with the flexibility of a two regime market model as opposed to a single regime market model. The piece-wise r-squared was computed as:

$$r^2\ (p.w.) = 1 - \frac{N}{N-2} \left[\frac{\Sigma\ (e_{i1})^2 + \Sigma\ (e_{i2})^2}{\Sigma\ (y_{i1}')^2 + \Sigma\ (y_{i2}')^2} \right]$$

where: e_{ik} = the error of observation i in regime k;

y'_{ik} = the deviation of the dependent variable of observation i in regime k;

N = The total number of observations;

k = 1, 2.

[8] The reader should keep in mind the fact that these regressions are run with weekly data. Thus, the R-squareds for the market model are expected to be relatively low compared to studies utilizing monthly data. The large amount of noise in the weekly data assures relatively low explanatory power.

[9] This result is not surprising. Since the Quandt test permits the regime specification to be determined endogenously, the explanatory power of the two regime specification will generally exceed the explanatory power of a single regime model.

[10] The information reported in Table 4-4 is intended to be descriptive. No statistical tests have been performed on the data. Thus, the subjective evaluations (i.e., "dominates") must be considered with caution. Future research will explore the necessary and sufficient differences in explanatory power to detect significantly different return processes. A simulation of various return processes and switch points may reveal cutoff points for differences in explanatory power.

[11] The average beta estimates in Table 4-5 reveals a rather interesting result. For convertible preferred stocks, the average beta exceeds the regime (1) and regime (2) betas. This result can be explained since the mean values of the regime (1), regime (2) and overall independent and dependent variables are not the same. Thus, the covariance and variance terms are not the same for the three regressions. With appropriate combination of covariances and variances, the results obtained are reasonable. For instance, the four observations below illustrate this result:

Observation	X	Y
1	0	1
2	10	5
3	1	2
4	11	6

If regime (1) includes observations 1 and 2, the estimates of systematic risk are:

$$\hat{\beta}_1 = .40, \ \hat{\beta}_2 = .40, \ \hat{\beta}_T = .406.$$

That is, the total beta exceeds the beta for regime (1) and regime (2).

[12] The increased dispersion may be the result of two circumstances. First, the Quandt test identifies the two regimes by splitting the 208 observations between regime (1) and regime (2). The split may identify as few as 10 observations with regime (1) and 198 observations with regime (2). With only 10 observations in regime (1), the beta estimate will be more responsive to an "outlier" in the sample compared to an estimate from a larger sample (i.e., 208 observations). A second possible explanation of the observed increase in dispersion of betas concerns the stationarity issue. If the alternative hypothesis (structural change) is true, the overall beta will be a complex combination of the regime (1) and regime (2) beta (see footnote 9). For a particular convertible security over time, a substantial change in systematic risk from regime (1) to regime (2) will tend to be averaged in the overall beta estimate. Since substantially changing betas may expand the range of observed betas in each regime, the increased dispersion of systematic risk estimates may be consistent with the alternative hypothesis. Due to the joint hypotheses, no definitive assertion can be made concerning the increased dispersion.

13 The term augmented linear model refers to Farley, Hinich and McGuire's use of a second independent variable which is a nonlinear transformation of the first independent variable.

14 A comparison of Table 4-5 and Table 4-11 reveals that the average overall betas are not the same. The difference arises due to the ordering mechanism. To order by price, the security must trade on Friday. This is not a necessary condition for the time ordering. Thus, fewer observations are included in the price ordering than the time ordering. The difference in observations leads directly to a different estimate of beta.

15 "Less risky" is used in the systematic risk sense.

16 A straight bond equivalent was not available in Moody's Bond Record for 20 convertible bonds and 22 convertible preferred stocks. Thus, results span those convertible securities which have straight bond equivalent values specified in Moody's Bond Record.

17 The overall beta estimates differ from previous estimates for two reasons. First, the number of convertible bonds and convertible preferred stocks in the premium over bond value ordering is less than previous ordering mechanisms (see footnote 16). In addition, the weekly premium over bond value was required to reorder the convertible security. If the premium over bond value was not available, the (x,y) observation was deleted. The loss of observations results in different estimates of beta compared to previous orderings.

18 Five convertible bonds and four convertible preferred stocks did not have equity security price data available on the Media General Tape. Thus, these five convertible bonds and four convertible preferred stocks cannot be reordered by conversion value/call price.

19 For instance, the assumption of an equally likely switch can be utilized over a relevant range. This technique would eliminate those (x,y) coordinates where the probability of switch is extremely low. A second alternative approach would change the equally likely assertion. An exponential distribution would add greater probability to latter (x,y) coordinates. In addition, earlier (x,y) coordinates would receive less probability assigned to their estimate as the potential switch point. Clearly, a great deal of econometric work remains to be done with Farley, Hinich and McGuire's (1970) technique.

20 The conversion value/call price rejection rate for convertible bonds is approximately the 5% α-level. This result may be due to the arbitrary point selected for separation of regime (1) and regime (2). Subsequent research using a prespecified conversion value/call price ratio on a new sample may resolve this problem.

Chapter V

CROSS-SECTIONAL RELATIONSHIPS - ACCOUNTING RISK MEASURES (INTEREST RATE RISK MEASURES) AND THE SYSTEMATIC RISK ESTIMATE OF CONVERTIBLE SECURITIES

In the following sections, the cross-sectional relationships of various independent variables (accounting risk measures and interest rate risk measures) to systematic risk estimates of convertible securities will be considered. Three tests are presented relating the risk measures to the systematic risk measures of convertible securities. The first set of results compares "high" and "low" conversion value/call price convertible securities.[1] The second set of tests considers the middle conversion value/call price convertible securities. The final test compares accounting risk measures before and after adjustment based on a market oriented classification scheme.

These three cross-sectional tests will yield insights into relationships which can be used to explain changes in systematic risk over time. Upon identifying the cross-sectional relationships, this study will identify relevant variables which can be used in the prediction of systematic risk.

Chow (1960) ANCOVA Test - Low Versus High Conversion Value/Call Price Securities

In order to perform the first cross-sectional tests, the sample of convertible securities will be partitioned into three groups. These three partitions of convertible securities are distinguished by quartile rankings of the conversion value/call price statistic.[2] The upper quartile of the conversion value/call price ranked convertible securities is hypothesized to exhibit equity dominated characteristics. On the other hand, the lower quartile of the conversion value/call price ordered convertible securities is hypothesized to exhibit debt dominated characteristics. The remaining quartiles of the conversion value/call price ordered securities are hypothesized to exhibit both equity and debt characteristics.

Ordering the Convertible Securities by Conversion Value/Call Price

In order to partition the set of convertible securities into quartiles, the average conversion value/call price statistic for each quarter from 1976 through 1979 was constructed. Upon creation of the average quarterly conversion value/call price, the convertible bonds and convertible preferred stocks were ordered by this ratio. Next, the convertible securities were grouped based upon the top, bottom and two middle quartiles for the sixteen quarters from 1976 through 1979. For illustrative purposes, the conversion value/call price statistics for the fourth quarter of 1979 are shown in Tables 11, 12 and 13 of Appendix A. Generally, "high" conversion value/call price securities exceed one. "Low" conversion value/call price securities are below .43. The "middle" quartile conversion value/call price securities span the remaining ratios from .43 through approximately one.

Independent Variables - Accounting Risk Measures and Interest Rate Risk Measures

The independent variables to be utilized in the Chow (1960) ANCOVA test are drawn from two groups. The first group of measures are variables from quarterly accounting disclosures. The following accounting risk measures are computed from the quarterly disclosures of the firms in the convertible security sample:

TABLE 5-1

Accounting Risk Measures

I. Return on Investment:

(1) Earnings before interest and taxes/Sales;

(2) Earnings/Sales;

(3) Earnings before interest and taxes/Total Assets;[3]

(4) Earnings/Total Assets;

II. Financial Leverage:

(5) Earnings before interest and taxes/Interest Expense;

III. Capital Intensiveness:

(6) Sales/Total Assets;

IV. Dividend Stability:

(7) Dividends/Earnings;

V. Marketability:

(8) Number of equity shares traded/number of equity shares outstanding;

(9) Number of convertible securities traded;

VI. Growth:

(10) $Sales_{t+1}/Sales_{t}$;

VII. Size:

(11) Ln (total assets);

The second group of measures are concerned with interest rate risk. The following interest rate risk measures are computed (when possible) for the convertible securities in the sample:[4]

TABLE 5-2

Interest Rate Risk Measures
(1) Interest Rate Elasticity;
(2) Duration;
(3) Coupon;
(4) Maturity Date;

Each of these independent variables from Table 5-1 and 5-2 were utilized in a set of Chow (1960) ANCOVA tests.

Dependent Variable - (Equity Beta Estimate and Convertible Security Beta Estimate)

Three dependent variables were used in the Chow (1960) ANCOVA test. First, an estimate of the equity security's systematic risk was developed by regressing the equity security's return and the CRSP value - weighted index (daily returns) for each quarter from 1976 through 1979. A second dependent variable is defined as the systematic risk estimate for the convertible security from the entire four year period. This systematic risk estimate is the result of regressing the convertible security's return and the value-weighted composite market index from 1976 through 1979, inclusive.[5] The third dependent variable considered in the Chow (1960) ANCOVA test is the systematic risk estimate from the time ordered Quandt (1958) test (See Chapter IV).[6] The Quandt (1958) estimate of the systematic risk of the convertible security is dependent upon the regime specification for a particular quarter between 1976 and 1979.

Chow (1960) ANCOVA test - Equity Beta Estimates (Dependent Variable)

The Chow (1960) ANCOVA test considers the issue of structural change in a linear process with the point of structural change known a priori. Cross-sectional tests of structural instability have been constructed by separating the groups of interest by quartile rankings of their convertible security's conversion value/call price statistic. First, the results of the Chow (1960) ANCOVA test utilizing accounting risk measures as the independent variables are presented. Next, the results of the Chow (1960) ANCOVA test considering interest rate risk measures as independent variables are considered. Finally, a summary of these test results are presented.

The results of the Chow (1960) ANCOVA test of structural change relating accounting risk measures and the systematic risk estimate for equity securities are presented in Table 5-3.

TABLE 5-3 Chow Test Results: Accounting Risk Measures and Equity Beta

Accounting Risk Measure	Rejection Rate H_o*	Percentage** $R^2(1)>R^2(2)$	Average*** $R^2(1)$	Average*** $R^2(2)$
(1) (Earnings before interest and taxes)/Sales;	12.5%	56.25%	.032	.029
(2) Earnings/Sales;	25.00%	56.25%	.024	.019
(3) (Earnings before interest and taxes)/ Total Assets;	18.75%	68.75%	.029	.024
(4) Earnings/Total Assets	18.75%	50.00%	.017	.026
(5) (Earnings before interest and taxes)/ Interest Expense;	12.50%	56.25%	.019	.030
(6) Sales/Total Assets;	37.5%	25.00%	.014	.045
(7) Dividends/Earnings;	25.00%	56.25%	.074	.060
(8) Number of equity shares traded/ number of equity shares outstanding;	31.25%	43.75%	.133	.184
(9) Number of convertibles traded;	25.00%	25.00%	.014	.065
(10) Sales $_{t+1}$;	13.33%	60.00%	.009	.012
(11) Ln (Total Assets);	25.00%	37.5%	.002	.084

* - This column presents the rejection rate of the null hypothesis at an α-level of 5% for the 16 quarters of this study.

** - This column compares the r-squared in regime (1) ($R^2(1)$) with the r-squared in regime (2) ($R^2(2)$);

*** - Columns (3) and (4) indicate the average r-squareds in regime (1) and regime (2).

As in Chapter IV, the ordering of (x,y) coordinates defines the regime (1) and regime (2) specification. With respect to the Chow (1960) ANCOVA test reported, regime (1) (x,y) coordinates are the accounting risk measures (x's) and systematic risk estimate (y) for the equity securities of the lowest quartile conversion value/call price convertible securities of the sample. On the other hand, the equity securities of the largest quartile conversion value/call price (CV/CP) securities yield the accounting risk measures (x's) and the systematic risk estimate (y) for the regime (2) specifications.

A perusal of the rejection rates of the null hypotheses reveals a consistent rejection of the null hypothesis at rates exceeding the 5% α-level. In eight cases, the number of quarterly rejections supports the overall alternative hypothesis at the 5% α-level. [7] Thus, the empirical evidence suggests structural instability for the cross-sectionally hypothesized relationships.

The results presented in the 16 tests of cross-sectional stability must be interpreted with caution. For each measure, the independent variable (accounting risk measure and interest rate risk measure) may not be independent from quarter to quarter. In addition, the dependent variable may not be independent from quarter to quarter. The sixteen observations of the Chow (1960) ANCOVA test may not be independent. Thus, a rejection rate of 3 observations out of 16 may not be sufficient evidence to reject the null hypothesis at the 5% α-level.

In the process of reviewing the results of comparative r-squareds from regime (1) to regime (2), six out of eleven cases suggest that the percentage of r-squareds in regime (1) exceed the percentage of r-squareds in regime (2). On the other hand, the average r-squared for regime (2) exceeds the average r-squared for regime (1) in seven out of eleven cases. Thus, a mixed result was obtained. Number of equity shares traded/number of equity shares outstanding and Dividends/Earnings produced the highest explanatory powers of the linear relationships. The r-squareds for these linear models span a large range from .002 to .184. In sum, the explanatory power of the linear relationship is not consistently larger for the "low" or "high" CV/CP partitioned equity securities.[8]

The results of the Chow (1960) ANCOVA test of structural change relating interest rate risk measures and the systematic risk estimate for equity securities are presented in Table 5-4.

TABLE 5-4 Chow Test Results: Interest Rate Risk Measures and Equity Beta

Interest Rate Risk Measure	Rejection Rate H_o*	Percentage** $R^2(1)>R^2(2)$	Average*** $R^2(1)$	Average*** $R^2(2)$
(1) Interest Rate Elasticity;	0.00%	45.45%	.030	.045
(2) Duration;	25.00%	37.5%	.016	.044
(3) Coupon;	6.25%	43.75%	.018	.038
(4) Maturity Date;	6.25%	14.29%	.028	.085

* - This column presents the rejection rate of the null hypothesis at an α-level of 5% for the 16 quarters of this study.

** - This column compares the r-squared in regime (1) ($R^2(1)$) with the r-squared in regime (2) ($R^2(2)$);

*** - Column's (3) and (4) indicate the average r-squareds in regime (1) and regime (2);

For the interest rate risk measures considered, the rejection rates do not significantly deviate from the α-level of 5%. A notable exception to this low rejection rate is found with duration. Duration exhibits a higher level of structural instability in this cross-sectional analysis than the other interest rate risk measures.[9]

The percentage of r-squareds suggest the regime (2) linear models have more explanatory power than the regime (1) linear models. Yet, columns (3) and (4) illustrate the relatively low explanatory power of all linear models constructed. Thus, the comparative explanatory power reveals very little economic insight into the relationship of interest rate risk measures and equity security systematic risk estimates.

In summary, these cross-sectional stability tests differ significantly with the choice of independent variable. With respect to accounting risk measures, structural instability is detected in eight out of eleven cases at levels in excess of the traditional 5% α-level. On the other hand, structural instability is rarely detected for the interest rate risk measure independent variables.

Chow (1960) ANCOVA Test - Convertible Security Beta Estimates (Entire Four Year Period)

Chow (1960) ANCOVA test results relating accounting risk measures (and interest rate risk measures) to the systematic risk estimate developed over the entire four year period are reviewed in three parts. First, the results of the Chow (1960) ANCOVA test utilizing accounting risk measures as the independent variables are presented. Second, the use of interest rate risk measures as the independent variables is considered. Finally, the results of the Chow (1960) ANCOVA test utilizing these two classes of risk measures are compared and contrasted.

The Chow (1960) ANCOVA test of structural change results relating accounting risk measures and the systematic risk estimate for convertible securities are presented in Table 5-5.

TABLE 5-5 Chow Test Results: Accounting Risk Measures and Convertible Beta (Four Year Estimate)

Accounting Risk Measure	Rejection Rate H_o*	Percentage** $R^2(1)>R^2(2)$	Average*** $R^2(1)$	Average*** $R^2(2)$
(1) (Earnings before interest and taxes)/Sales;	0.00%	68.75%	.018	.011
(2) Earnings/Sales;	0.00%	50.00%	.024	.019
(3) (Earnings before interest and taxes)/Total Assets;	18.75%	43.75%	.025	.047
(4) Earnings/Total Assets;	0.00%	50.00%	.027	.024
(5) (Earnings before interest and taxes)/Interest Expense;	12.5%	25.00%	.035	.058
(6) Sales/Total Assets;	6.25%	18.75%	.018	.052
(7) Dividends/Earnings;	18.75%	43.75%	.116	.055
(8) Number of equity shares traded/ number of equity shares outstanding;	0.00%	43.75%	.016	.014
(9) Number of convertible securities traded;	18.75%	37.50%	.010	.070
(10) $Sales_{t+1}/Sales_t$	20.00%	46.67%	.025	.058
(11) Ln (Total Assets);	0.00%	56.25%	.017	.016

* - This column presents the rejection rate of the null hypothesis at an α-level of 5% for the 16 quarters of this study.

** - This column compares the r-squared in regime (1) ($R^2(1)$) with the r-squared in regime (2) ($R^2(2)$);

*** - Column's (3) and (4) indicate the average r-squareds in regime (1) and regime (2).

A review of the rejection rates of the null hypothesis yields a mixed result. Four out of eleven accounting risk measures reject the null hypothesis of cross-sectional stability. Moving to the second column of Table 5-5, two cases out of eleven suggest that the explanatory power (r-squared) of the regime (1) linear model exceeds the explanatory power (r-squared) of the regime (2) linear model. When considering only those accounting risk measures which reject the null hypothesis of structural stability at levels in excess of 5%, four out of four cases suggest the explanatory power (r-squared) of the regime (2) linear model exceeds the explanatory power (r-squared) of the regime (1) linear model. Similar results are obtained considering the average r-squareds for each accounting risk measure. For all accounting risk measures considered, six out of eleven accounting risk measures possess average r-squareds of the regime (1) linear model in excess of the average r-squareds of the regime (2) linear model. Restricting consideration to those accounting risk measures which exhibit structural instability at the 5% α-level yields three out of four cases of the r-squareds of regime (2) linear models exceeding the r-squareds of the regime (1) linear model. In general, the explanatory power of the regime (2) linear models exceeds the explanatory power of the regime (1) linear models for those accounting risk measures exhibiting cross-sectional structural instability.

The comparative explanatory power issue becomes important when consideration is given to the ordering mechanism employed in this Chow (1960) ANCOVA test. Regime (1) is specified by convertible securities possessing the lowest quartile conversion value/call price statistics. Regime (2) is specified by the highest quartile conversion value/call price convertible securities. Thus, the relationship between accounting risk measure and systematic risk estimate is larger for "high" conversion value/call price classified convertible securities compared to "low" conversion value/call price convertible securities. This result is consistent with the empirical observations (see Chapter III) which link accounting risk measures with equity security systematic risk estimates.

In similar fashion, the Chow (1960) ANCOVA test of structural change results relating interest rate risk measures and the systematic risk estimate for convertible securities are presented in Table 5-6.

TABLE 5-6 Chow Test Results: Interest Rate Risk Measures and Convertible Beta - Four Year Estimate

Interest Rate Risk Measures	Rejection Rate H_0*	Percentage** $R^2(1)>R^2(2)$	Average*** $R^2(1)$	Average*** $R^2(2)$
(1) Interest Rate Elasticity;	87.50%	75.00%	.131	.081
(2) Duration;	6.25%	6.25%	.010	.058
(3) Coupon;	0.00%	0.00%	.002	.056
(4) Maturity Date;	12.50%	68.75%	.090	.049

* - This column presents the rejection rate of the null hypothesis at an α-level of 5% for the 16 quarters of this study.

** - This column compares the r-squared in regime (1) ($R^2(1)$) with the r-squared in regime (2) ($R^2(2)$);

*** - Column's (3) and (4) indicate the average r-squareds in regime (1) and regime (2);

Duration, coupon and maturity date do not reject the null hypothesis of structural stability at the 5% α-level or below. On the other hand, interest rate elasticity rejects the stability hypothesis at rates in excess of 5%.

A comparison of explanatory powers reveals an important relationship. For interest rate elasticity, the explanatory power (r-squared) of regime (1) exceeds the explanatory power (r-squared) of regime (2) for the percentage of r-squareds and the average r-squareds. Thus, the lowest quartile conversion value/call price convertible security interest rate risk measures exhibit a larger explanatory power of the systematic risk estimate compared to the highest quartile conversion value/call price convertible security group. This result is consistent with the empirical observation that interest rate risk measures are related to debt securities systematic risk estimates (see Chapter III).

The results of the Chow (1960) ANCOVA test of structural change reveals a striking contrast. The "high" conversion value/call price convertible securities exhibit a greater explanatory power from the linear relationship compared to the "low" conversion value/call price convertible securities for accounting risk measures.[10] Conversely, the "low" conversion value/call price convertible securities exhibit the largest explanatory power compared to the "high" conversion value/call price convertible securities for interest rate risk measures.

Chow (1960) ANCOVA Test - Convertible Security Beta Estimates (Quandt Test-Time Ordering)

The third set of cross-sectional tests of structural stability are presented in three sections. First, the Chow (1960) ANCOVA test results relating accounting risk measures and the systematic risk estimate of the convertible security (Quandt's (1958) estimate-time ordering) are presented. Next, the Chow (1960) ANCOVA test results relating interest rate risk measures and the systematic risk estimate of the convertible security (Quandt's (1958) estimate-time ordering) are offered. Finally, this section concludes with a summary of the Chow (1960) ANCOVA results comparing the linear relationships of accounting risk measures and interest rate risk measures as independent variables.

The Chow (1960) ANCOVA test results of the relationship of accounting risk measures and the systematic risk estimate of the convertible securities (from Quandt's (1958) test by time ordering) are presented in Table 5-7.

TABLE 5-7 Chow Test Results: Accounting Risk Measures and Convertible Security Beta

Accounting Risk Measure	Rejection Rate H_o*	Percentage** $R^2(1)>R^2(2)$	Average*** $R^2(1)$	Average*** $R^2(2)$
(1) (Earnings before interest and taxes)/Sales;	12.50%	31.25%	.017	.025
(2) Earnings/Sales;	6.25%	56.25%	.021	.024
(3) (Earnings before interest and taxes)/Total Assets;	12.50%	18.75%	.017	.056
(4) Earnings/Total Assets;	12.50%	37.50%	.019	.030
(5) (Earnings before interest and taxes)/Interest Expense;	12.50%	37.50%	.023	.049
(6) Sales/Total Assets;	18.75%	31.25%	.009	.050
(7) Dividends/Earnings;	25.00%	50.00%	.153	.068
(8) Number of equity shares traded/number of equity shares outstanding;	12.50%	43.75%	.016	.065
(9) Number of convertible securities traded;	25.00%	37.50%	.014	.065
(10) $Sales_{t+1}/Sales_t$;	13.33%	33.33%	.014	.052
(11) Ln (Total Assets);	6.25%	50.00%	.014	.021

* - This column presents the rejection rate of the null hypothesis at an α-level of 5% for the 16 quarters of this study.

** - This column compares the r-squared in regime (1)($R^2(1)$) with the r-squared in regime (2)($R^2(2)$);

*** - Column's (3) and (4) indicate the averaged r-squareds in regime (1) and regime (2).

The rejection rate column of Table 5-7 reveals three out of eleven cross-sectional relationships reject the null hypothesis of cross-sectional stability at rates in excess of the 5% α-level.

The comparative explanatory power of regime (1) and (2) linear models yields insight into the cross-sectional relationships. The percentage of r-squareds of regime (2) linear models exceed the percentage of r-squareds of regime (1) linear models in eight out of eleven cases. Comparing average r-squareds, ten out of eleven of the average r-squareds of regime (2) exceed the average r-squareds of regime (1). Thus, the accounting risk measures exhibit a higher degree of relationship to the systematic risk estimate of the convertible securities for "high" conversion value/call price classified convertible securities than for "low" conversion value/call price convertible securities.

The results of the Chow (1960) ANCOVA test of the structural relationship of interest rate risk measures and the systematic risk estimate for convertible securities (Quandt (1958) - time ordering) are presented in Table 5-8.

TABLE 5-8 Chow Test Results: Interest Rate Risk Measures and Convertible Security Beta

Interest Rate Risk Measure	Rejection Rate H_0:*	Percentage** $R^2(1)>R^2(2)$	Average*** $R^2(1)$	Average*** $R^2(2)$
(1) Interest Rate Elasticity;	56.25%	68.75%	.122	.024
(2) Duration;	37.50%	18.75%	.019	.075
(3) Coupon;	6.25%	18.75%	.012	.058
(4) Maturity Date;	31.25%	75.00%	.089	.010

* - This column presents the rejection rate of the null hypothesis at an α-level of 5% for the 16 quarters of this study.

** - This column compares the r-squared in regime (1)($R^2(1)$) with the r-squared in regime (2)($R^2(2)$);

*** - Column's (3) and (4) indicate the average r-squareds in regime (1) and regime (2);

The rejection rates of table 5-8 illustrate the cross-sectional structural instability detected by the Chow (1960) ANCOVA test. Three out of the four cases reject the null hypothesis at rejection rates in excess of the α-level of 5%.

The relative explanatory power of the linear models in each regime yield indications of the nature of the relationship between interest rate risk measures and the systematic risk of convertible securities. For two of the four interest rate risk measures, the regime (1) linear model's explanatory power (r-squared) exceeds the regime (2) linear model's explanatory power (r-squared). Of the remaining two interest rate risk measures, one of the two cases did not exhibit cross-sectional instability. Identical results were obtained utilizing average r-squareds from regime (1) and regime (2). These results suggest that for two of the three cases exhibiting structural instability the "low" conversion value/call price security's interest rate risk measures are more highly related to their systematic risk estimate than the "high" conversion value/call price securities.

As in the case of convertible security systematic risk estimate for the four year period, the relationship between the independent variable (accounting risk measure or interest rate risk measure) and the dependent variable (convertible security systematic risk estimate) relies upon the classification of the convertible instrument. For "high" conversion value/call price convertible securities, accounting risk measures exhibit a stronger relationship to systematic risk estimates than "low" conversion value/call price convertible securities.[11] On the other hand, the "low" conversion value/call price securities present a somewhat stronger relationship between the interest rate risk measures and the systematic risk estimates than the "high" conversion value/call price securities.[12] These results are consistent with empirical observations of relationships between accounting risk measures (interest rate risk measures) and systematic risk estimates of equity (debt) securities (see Chapter III).

In the previous sections, the Chow (1960) ANCOVA test considered the piece-wise linear relationship of accounting risk measures and the systematic risk estimate of convertible securities for "high" and "low" conversion value/call price partitioned securities. In general, accounting risk measures were found to be more closely related to "high" conversion value/call price security systematic risk estimates than "low" conversion value/call price security systematic risk estimates.[13] Symmetrically, interest rate risk measures were found to be more closely related to "low" conversion value/call price security systematic risk estimates than "high" conversion value/call price security systematic risk estimates. Given the relationships detected at the extremes of the conversion value/call price partition, the next logical step requires investigation of the convertible securities comprising the middle quartiles of the conversion value/call price partition.

Spearman's Rank-Correlation Coefficient Test on the Middle Quartiles of the Conversion Value/Call Price Partitioned Convertible Securities

The following set of tests consider the rank ordering of convertible securities by conversion value/call price compared to the rank ordering by explanatory power (r-squared) of the longitudinal relationship between accounting risk measures (and interest rate risk measures) and the convertible security's systematic risk estimate. Utilizing the Spearman's Rank-Correlation methodology, the middle quartiles of the conversion value/call price partitioned securities can be investigated to detect the deterioration of the relationship between accounting risk measures (and interest rate risk measures) and the systematic risk estimate of the convertible securities.

The Spearman's Rank-Correlation Coefficient Test follows a four step procedure in this case. First, a linear relationship is created for each security regressing a particular accounting risk measure (or interest rate risk measure) and the systematic risk estimate of the convertible security for the sixteen quarters from 1976 through 1979.[14] Next, the securities were rank ordered by the r-squareds derived in the previous step. Third, the securities were rank ordered by the conversion value/call price statistic. Finally, the Spearman Rank-Correlation Coefficient Test was computed.

The results of Spearman's Rank-Correlation Coefficient Test are presented in Table 5-9.[15]

TABLE 5-9 Spearman Rank Correlation Test

Measures	Spearman's Rank Correlation Coefficient	t-Statistic*	Degrees of Freedom
Earnings before interest and taxes/Sales	.0701	.5667	65
Earnings/Sales	-.0586	-.4738	65
Earnings before interest and taxes/Total Assets	.0453	.3652	65
Earnings/Total Assets	.0512	.4133	65
Earnings before interest and taxes/Interest Expense	-.1068	-.8565	65
Sales/Total Assets	.0346	.2791	65
Dividends/Earnings	.0629	.5081	65
Number of Shares traded/ Number of Shares outstanding	.0018	.0145	65
Natural logarithm of Total Assets	.0193	.1558	65
$Sales_{t+1}/Sales_t$	-.1457	-1.188	65
Interest Rate Elasticity	-.3131	-1.580	25
Duration	.2313	1.698	65

* - The critical value of the t distribution with 65(25) degrees of freedom is 2.00 (2.069)

It can be seen in Table 5-9 that the null hypothesis of no relationship between rankings cannot be rejected in any of the cases at the conventional 5% α-level. In seven of the ten cases for accounting risk measures, the Spearman rank correlation is positive. For the interest rate risk measures one of the two measures is positive. In sum, the Spearman rank correlation coefficient tests did not detect a clear relationship between the explanatory power of the linear model constructed and the conversion value/call price statistic.

A final set of tests is presented which alter the classification of the convertible security and its cash payment dependent upon a market-oriented classification scheme. For those securities classified in the "high" and "low" conversion value/call price partitions, the accounting risk measures have been adjusted as described in Chapter III. The explanatory power (r-squareds) resulting from cross-sectional regressions are derived before and after adjustment of specific accounting risk measures. Then, a dependent sample t-test is performed to consider the consistency of the proposed classification scheme with the information set which is used by the market to determine β_i.

The results of the dependent sample t-test of the explanatory power (r-squareds) before and after adjustment for the proposed classification scheme are presented in Table 5-10.

TABLE 5-10 Dependent Sample T-test

Accounting Risk Measure	t-Statistic	Degrees of Freedom	R^2(before)	R^2(after)
Earnings/Sales	-1.790**	31	.023	.041
Earnings/Total Assets	2.872*	31	.025	.021
Earnings before interest and taxes/Interest Expense	-4.085*	31	.036	.074
Number of shares traded/ Number of shares outstanding	-1.548	31	.024	.044

** - statistically significant for a two-tailed test at the 10% α-level.

* - statistically significant for a two-tailed test at the 5% α-level.

The above results reject the null hypothesis of no difference in explanatory power in two out of four cases at the 5% α-level. On the other hand, three of the four cases lead to t-statistics which are negative. Turning to the specific accounting risk measures, earnings/total assets yields a positive t-statistic. Thus in this case, the imposition of the market based classification scheme tended to reduce the explanatory power of the linear relationships. Yet, the absolute size of the average explanatory power before (.025) and after (.021) adjustment suggests that rejection of the null hypothesis lacks economic importance.[16] Turning to the three other accounting risk measures, the t-statistics are indicative of increases in the explanatory power of the linear relationships. The accounting risk measure which illustrates the largest change in explanatory power (r-squared) is the proxy for leverage, earnings before interest and taxes/interest expense. Since leverage has been theoretically shown to be related to the systematic risk of equity securities, this rejection takes on added importance. Thus, the dependent sample t-test suggests that the linear relationship between three out of the four accounting risk measures and the systematic risk estimate of the convertible security will be enhanced by utilization of the market-based classification scheme.[17]

The results presented for the adjusted accounting risk measures must be interpreted with caution. First, the accounting risk measures may not be independent from quarter to quarter. In addition, the systematic risk estimate is not independent from quarter to quarter. Thus, the explanatory power derived from the linear relationship between the accounting risk measure and the systematic risk estimate may not be independent. Since the t-test requires independence for each drawing of the dependent observations (in this case 2 observations per drawing), the results of the statistical test must be interpreted with care.

Summary - Cross-Sectional Relationships

Three specific areas of inquiry were considered in this chapter. First, the sample was partitioned into three classes of convertible securities. The "high" conversion value/call price convertible securities were found to possess more powerful linear relationships between selected accounting risk measures and systematic risk estimates than "low" conversion value/call price convertible securities. On the other hand, "low" conversion value/call price convertible securities were found to possess more powerful linear relationships between selected interest rate risk measures and systematic risk estimates than "high" conversion value/call price convertible securities.[18] The second set of empirical tests of this chapter are concerned with longitudinal relationships of the central quartiles of the conversion value/call price ordering. The null hypothesis of random orderings was not rejected for any of the accounting risk measures or interest rate risk measures. Thus, deterioration or appreciation of the linear relationship between accounting risk measures (interest rate risk measures) and the systematic risk estimate for convertible securities of the central conversion value/call price quartiles can not be asserted from the present results. Finally, the adjustment of selected accounting risk measures by a market oriented classification scheme generally increased the explanatory power of the linear relationship under consideration.[19]

NOTES

1 This study will propose three dependent variables of interest. They are the underlying equity security's beta, the convertible security's beta (4-year estimate), and the convertible security's beta (Quandt estimate). Although the equity security beta may appear to be unrelated to the debt-equity issue, the relationships of the independent variables (ARM's and IRRM's) with the equity security's beta allow a reference point for the subsequent convertible security tests.

2 Quartile rankings were employed since a theoretical cut-off point for the "low" conversion value/call price group is not available. For the "high" conversion value/call price group, the theoretical cut-off point would be one (see Ingersoll (1977a) and Brennan and Schwartz (1977)). From Tables 11 and 12 (of Appendix A), the partition of "high" conversion value/call price approximates a lower bound of one.

3 Total assets were determined on a quarterly basis by adjusting previous total assets by an adjusted quarterly earnings. The difference between the change in total assets and the earnings for the total of the four quarters (deflated by dividends) was assumed to change uniformly through the period. This process yields a proxy for the total assets at each quarter.

4 As pointed out in Chapter III, maturity date and interest rate elasticity are not available for convertible preferred stocks. In addition, duration for convertible preferred stocks utilizes the assumption of an infinite life.

5 The value-weighted composite index utilized in this section of this research project is the index described in Chapter IV. These estimates are obtained based upon weekly data.

6 The Quandt (1958) switching regression methodology identifies the week of structural change. Thus, the quarters prior to the switch week are assigned the estimate of beta derived for regime (1). The quarters after the switch week are assigned the beta for regime (2). The quarter which contains the switch week is assigned the beta for regime (1) or regime (2) based upon the greater number of weeks represented.

7 The null hypothesis must be rejected in at least three cases out of sixteen to be considered a rejection at the 5% α-level. If we assume a binomial distribution with probability of rejection equal to 5% and probability of non-rejection equal to 95%, the following results are obtained:

Prob (at least one rejection in 16 trials) = .56
Prob (at least two rejections in 16 trials) = .19
Prob (at least three rejections in 16 trials) = .04;

when three or more rejections are observed in 16 trials, the null hypothesis has been rejected at the 5% α-level. It should be noted that this analysis assumes an independence of drawings with replacement. In the present research, the repetition of the 16 Chow tests may not be independent. Thus, all results must be considered with extreme caution.

8 This result should not be totally unexpected. Chapter III's review of the accounting risk measure literature suggests that accounting measures are related to equity security systematic risk measures. In the tests performed, relationships between accounting risk measures and systematic risk measures of equity securities were considered. Although the equity securities were classified by an exogenous variable, conversion value/call price of the convertible security, the relationship between the accounting risk measures and the systematic risk estimate of the equity security need not be disturbed.

9 It is quite understandable that interest rate elasticity, coupon and maturity date do not change from low conversion value/call price classified equity securities to high conversion value/call price classified equity securities. These interest rate risk measures have not been linked to equity systematic risk empirically or analytically. Thus, no difference in relationship is not surprising. On the other hand, analytical relationships between equity security systematic risk and duration have been shown (Hopewell and Kaufman (1973)). Thus, the structural change detected for duration is consistent with available analytical results.

10 This summary only considers those accounting risk measures and interest rate risk measures which reject the null hypothesis of cross-sectional stability of the linear model.

11 The systematic risk estimate is for the convertible security not the underlying equity security.

12 Here, the relationship is true for two of the three cross-sectional tests which exhibited structural instability.

13 This statement must be tempered by the realization that the explanatory power of the linear relationships are extremely low. Yet, the consistency of evidence suggests the general assertions being presented.

14 The systematic risk estimate is derived from the Quandt (1958) test with ordering mechanism-time. It should be noted that the only securities considered in this portion of the study rejected the null hypothesis of the Quandt (1958) test.

15 Coupon and Maturity cannot be utilized in this research methodology. These interest rate risk measures do not change. Thus, a linear relationship with a systematic risk estimate can not be computed. In addition, the degrees of freedom are less for interest rate elasticity due to the problem of computing interest rate elasticity for an infinite life security.

16 The standard error of the estimate becomes extremely small for this t-statistic. This permits the rejection of the null hypothesis for this relatively small difference in absolute terms.

17 The term enhanced is utilized to suggest an increase in explanatory power (r-squared).

18 This statement is not precisely true due to the relationships detected for duration.

19 "Generally" is defined in this case as three out of four cases. In addition, the positive t-statistic for the fourth case is related to a minimal increase in explanatory power.

Chapter VI

CONCLUSIONS, LIMITATIONS AND EXTENSIONS

The final chapter of this work is organized under three subdivisions. First, conclusions based upon the theoretical and empirical results of this research are offered. Next, the limitations of this research project are explored. The final section of this work reveals potential extensions of this endeavor.

Conclusions

The conclusions of this work are divided into two sections. First, assertions are made based upon the results of the switching regression methodology. Then, propositions are addressed based upon the results of the cross-sectional analysis.

The objective of utilizing the switching regression methodology was to identify structural instability in a linear relationship. In the literature review, two return generating processes were posited. One hypothesis concerning the shift from a debt return generating function to a warrant return generating function is the assumption of uniform change over the range of observations. Farley, Hinich and McGuire's (1970) test assumes a uniform probability distribution of change over the sequence of observations. The results for this test for four orderings of the two samples of convertible securities consistently failed to reject the null hypothesis of structural stability. These results suggest that the hypothesized uniform probability of change was a misspecification of the model of the convertible security return generation process.[1] Hence, the notion that a convertible security's systematic risk adjusts in a uniform manner over a particular sequencing of data points has not been shown empirically.

The switching regression methodology employed in this work utilized four ordering mechanisms, time, price, premium over bond value and conversion value/call price. Ordering by premium over bond value provided the most powerful permutation of coordinates for rejecting the null hypothesis of structural stability.[2] In the realm of financial accounting disclosure, these results suggest that two variables of interest with respect to convertible security evaluation are premium over bond value and conversion value/call price.

The most significant conclusion from the results of the switching regression methodology is concerned with the statistical issue of stability of the linear model. From the results of Quandt (1958) and Chow (1960), structural stability of the linear process has been rejected in a substantial percentage of observations. This suggests that estimates of the systematic risk of convertible securities may be misspecified for linear models that assume a stationary process. Hence, the observed nonstationarity of the systematic risk of convertible securities must be considered in estimating the beta of these contingent claim securities.[3]

The three major sets of cross-sectional tests embodied in Chapter V suggest a number of considerations. Selected accounting risk measures have been shown to be related to the upper quartile conversion value/call price partitioned convertible security's systematic risk estimate. On the other hand, the interest rate risk measures have been shown to be related to the lower quartile conversion value/call price partitioned convertible security's systematic risk estimate. It has been posited that accounting risk measures have been shown to be related to equity security systematic risk estimates (see Chapter II). In addition, interest rate risk measures have been shown to be related to debt security systematic risk estimates (see Chapter II). The results of the cross-sectional tests between accounting risk measures and "high" conversion value/call price convertible securities suggest that this partition of convertible securities may possess equity characteristics in the market place. On the other hand, the "low" conversion value/call price convertible security relationship to interest rate risk measures suggests that this subset of convertible securities displays debt characteristics. Thus, the level of the statistic conversion value/call price is indicative of the type of relationship observed.

Finally, the market-oriented classification test (see Chapter V) suggests potential for reconsideration of the requirements of APB Opinion Nos. 14 and 15. As a result of the dependent sample t-test, explanatory power was found to be statistically different before and after the reclassification of the convertible securities. This result suggests that a market-oriented classification scheme may be more consistent with the information set which establishes estimates of the systematic risk of convertible securities than traditional legal distinctions.[4] To the extent that accounting risk measures are presented as indicators of the systematic risk estimate of convertible securities, a policy making board (such as the FASB) may reconsider the dictates of APB Opinion Nos. 14 and 15 in favor of a more market-oriented approach to convertible security classification.

Limitations

This work suffers from at least two general limitations. Security specific elements of this research design are one source of limitations. Pure econometric considerations are a second source of limitations. These restrictions will be addressed in the following discussion.

In the realm of security specific limitations, the first major concern revolves around the time period selected. Comparing the sample period 1976-1979 with the later 1960's suggests that the sample period lacked the intensive growth in market price found in the later 1960's. A priori, the lack of growth of equity market prices during 1976-1979 suggests a period in which few convertible securities would exhibit dramatic changes. Thus, the time period selected restricts the likelihood of observing the event of interest: structural change of a convertible security.

A second limitation inherent in the security specification is the nonsynchronous trading problem.[5] The nonsynchronous trading problem arises in two measures in this research design. Since convertible securities trade at a relatively low volume, the estimate of the weekly return for the convertible security suffers from measurement error.[6] The second form of the nonsynchronous trading problem arises in the estimate of the return on the market. The value-weighted market index constructed for this research project suffers from measurement error. The securities composing the CRSP value-weighted index are not continuously traded. Thus, the quoted price of a security at the close of a week (in this case) are estimates of the market's assessed evaluation of the market price at that time. This limitation is equally relevant with respect to the returns on government and corporate debt. In sum, the two primary inputs to the switching regression methodology suffer from nonsynchronous trading problems.[7]

A final security specific limitation can be found in the traditional survivorship bias. In this work, survivorship bias has two major effects. First, the equity securities which survive on the stock exchange may not be a random selection due to merger activities and bankruptcy actions in various segments of the market place. Thus, structural aspects of the stock exchanges limit the generalizability of the results. A unique survivorship bias is inherent in the sample selection process. It should be noted that at conversion the convertible security disappears as a priced security on the stock exchange. Thus, the convertible securities which were outstanding at 1/1/76 and 12/31/79 will exclude any securities which were converted during this period. These excluded securities may have produced the most powerful effects. An example of this effect will be instructive. At the beginning of the test period, market expectations could be of the form such that the convertible security had a low assessed probability assigned to ultimate conversion. Through a change in the market price of the underlying equity security, this convertible security could be converted prior to the end of the test period. At conversion, the security reacts as a substitute good for the equity securities obtained. To the extent that the return generating process changes from debt to warrant for these securities, the present test is less powerful due to the exclusion of this group of securities.

The cross-sectional tests of Chapter V are limited by the possible dependence of results across time. The methodology employed assumes that each test is an independent drawing from a binomial distribution. The tests may not be independent for two reasons. First, the estimates of the dependent variable (various systematic risk estimates) are correlated longitudinally. Second, the independent variables (various accounting and interest rate risk measures) may be dependent in a time series of observations. Thus, the α-level derived from the binomial distribution may be misspecified.

Two strictly econometric restrictions must be considered. First, this study suffers from the classic econometric problem of errors-in-variables. The errors-in-variables problem exists in the switching regression tests and the cross-sectional analysis. The observations of the return on security i and the value-weighted return on the market are proxies for the economic variable. This estimation process introduces errors in parametric computation. Thus, the noise inherent in the observation of returns translates into variability in the estimate of parameters of the market model. Specifically, the estimate of the systematic risk parameter suffers from the errors-in-variables problem. In the cross-sectional analysis, the estimate of the systematic risk of the convertible security is utilized as the dependent variable. Thus, the cross-sectional analysis suffers from the errors-in-variables problem. In addition, the independent variables of the cross-sectional analysis are subject to the errors-in-variables problem. Since accounting measures can be considered random variables, the realization of an accounting risk measure can only proxy the economic measure of interest. Again, the estimate of the parameters of the cross-sectional analysis will be subject to the noise inherent in the observation of the accounting risk measure. In sum, the errors-in-variables problem exists in the switching regression methodology and the cross-sectional tests.

The final econometric limitation concerns model specification. This research has considered the market model as an appropriate specification of the return generating process. To the extent that the market model is misspecified (i.e., omitted variables), the conclusions of this work may be inappropriate. In essence, the switching regression tests are a joint test of structural stability and the validity of the market model.[8]

However, the econometric problems considered are not unique to the present study. Measurement of a random variable leads to measurement error. This suggests that measurement error should always be a consideration in econometric analysis. In the same vein, the market model has been employed by numerous researchers in finance and accounting. Although model misspecification may be present, this model misspecification is equally apparent in similar research conducted in this realm. In an effort to address these econometric problems, the following section suggests two paths for future research.

Extensions

Two extensions to this empirical study are suggested by concern for model misspecification. First, Farley, Hinich and McGuire's (1970) model will be extended to consider alternatives to the uniform probability of structural change assumption. In addition, the arbitrage pricing theory will be considered.

The small percentage of rejection of the null hypothesis utilizing Farley, Hinich and McGuire's (1970) technique suggests that the assumption of uniform probability of change of the systematic risk estimate may not be descriptively valid. An alternative assumption concerning the probability distribution seems to be an appropriate extension. This extension may lead to a more descriptively valid model of the convertible security return generation process.

A much more extensive effort is possible employing the arbitrage pricing model.[9] The substance of the theoretical arguments have assumed the existence of two processes, the debt and warrant return generating processes. It has been assumed that market participants are influenced by two considerations; returns from equity securities and returns from debt securities. In this work, these two types of investment instruments are aggregated into the market return. A security's relationship of return to the aggregate market return is considered to be a relevant statistic for decision making purposes. On the other hand, a disaggregated set of measures may suggest a more descriptive model of the return generating process for contingent claims such as the convertible security.

The assertion of separate debt and equity return generating processes suggests the use of a two factor model to describe returns of a convertible security. Since a two factor model (debt and equity factors) has been analytically derived, the relative influence of the debt and equity factor can be obtained in a time series framework.[10] The simple comparison of beta estimates will reveal the relative strength of the debt or equity factor on the security's total return. This relative strength of the debt and equity factor could be utilized to suggest a partition of the convertible security's value between debt and equity with appropriate adjustments for interest payments and distributions. Within this two factor model, the same issues of structural stability become important. Given a classification scheme based upon relative beta weights, the two factor model could be continually adjusted. In this fashion, the arbitrage pricing model could be employed to extend the work of this dissertation.

NOTES

[1] It is necessary that some form of the market model must be appropriate in order to arrive at the assertion made at this point. It is quite possible that the misspecification of the market model is sufficient to render all conclusions of this work irrelevant. Yet, the consistency of results from the switching regression and cross-sectional tests suggest that some form of the market model captures a portion of the economic essence of a convertible security.

[2] This is true for both Quandt (1958) and Chow (1960).

[3] From the results of the switching regression, at least two external pieces of data may be utilized to infer the nature of the systematic risk stability. Premium over bond value and conversion value/call price may be employed to partition convertible securities into stable and unstable systematic risk groups. This is an area which may lead to further research with an investor decision making orientation.

[4] This statement must be tempered by the one case of a positive t statistic (see Chapter V for discussion). In addition, careful consideration of the limitations of this research project (next section) reveal the scope of this conclusion. The author's intent is simply to recognize a potential for reexamination of the dictates of APB Opinion Nos. 14 and 15. This does not imply a necessity of change to the classification scheme embodied in this research.

[5] The nonsynchronous trading problem arises since securities are not continuously traded. At any moment in time, the last reported trade may differ from the price which would equate supply and demand presently.

[6] Occasionally, the convertible security simply does not trade. In cases where trading sporatically did not occur, a simple average price was introduced. Where trading did not occur for long periods, these data points were eliminated from the switching regression methodology.

[7] The nonsynchronous trading problem leads to ordinary least squares estimates of alpha and beta that are biased and inconsistent. (M. Scholes and J. Williams, "Estimating Betas from Nonsynchronous Data", Journal of Financial Economics 5, (December, 1977): 310). To the extent that the bias is uniform over the two regime specification, the switching regression results are not directly affected. On the other hand, the inconsistency of the alpha and beta estimators will tend to increase Type I errors.

[8] This suggests that the results obtained (structural instability) may be a result of model misspecification.

[9] An obvious limitation of the arbitrage pricing model is the lack of theoretical support for specific factors in the model. Future research will be directed toward developing theoretical support for specific factors.

[10] Bernell Stone has decomposed the CAPM into a two factor model.

APPENDIX A

TABLE A-1 LIST OF THE ACCOUNTING RISK MEASURES USED BY BEAVER, KETTLER AND SCHOLES (1970)

1. Dividend Payout ≡ *common dividends/earnings available for common* stockholders;

2. Growth Rate ≡ $\ln\left(\frac{A_t}{A_{t-1}}\right)$; (A ≡ total assets)

3. Leverage ≡ total liabilities/total assets;

4. Liquidity ≡ current assets/current liabilities;

5. Asset size ≡ $\ln(A_t)$;

6. Variability in earnings ≡ standard deviation of income available for common stockholders to market value of common stock outstanding;

7. Covariability in earnings ≡ covariance of the earnings-price ratio with an "economy-wide average of earnings-price as the independent variable" (p.663)

Beaver W.H. Kettler P., and Scholes, Myron. "The Association Between Market Determined and Accounting Determined Risk Measures," The Accounting Review, 45 (October, 1970), pp. 654-682.

TABLE A-2 LIST OF ACCOUNTING RISK MEASURES USED BY THOMPSON (1976)

(1) "The model" $\equiv \dfrac{\text{cov}(\tilde{d}_i,\tilde{d}_m) + \text{cov}(\tilde{e}_i,\tilde{e}_m) + \text{cov}(\tilde{k}_i,\tilde{k}_m)}{\sigma^2(\tilde{d}_m) + \sigma^2(\tilde{e}_m) + \sigma_2{}^2(\tilde{k}_m)}$;

(2) Dividend $\beta \equiv \dfrac{\text{cov}(\tilde{d}_i,\tilde{d}_m)}{\sigma^2(\tilde{d}_m)}$;

(3) Earnings $\beta \equiv \dfrac{\text{cov}(\tilde{e}_i,\tilde{e}_m)}{\sigma^2(\tilde{e}_m)}$;

(4) Earnings Multiple $\beta \equiv \dfrac{\text{cov}(\tilde{k}_i,\tilde{k}_m)}{\sigma^2(\tilde{k}_m)}$;

(5) Earnings Yield $\beta \equiv \dfrac{\text{cov}(Y_i,Y_m)}{\sigma^2(Y_m)}$;

(6) Operating Income $\beta \equiv \dfrac{\text{cov}(x_i,x_m)}{\sigma^2(x_m)}$; $x_i \equiv$ operating income;

(7) Sales $\beta \equiv \dfrac{\text{cov}(x_i,x_m)}{\sigma^2(x_m)}$; $x_i \equiv$ sales;

(8) Total Debt to total assets $\beta \equiv \dfrac{\text{cov}(x_i,x_m)}{\sigma^2(x_m)}$; $x_i \equiv \dfrac{\text{total debt}}{\text{total assets}}$;

(9) Cash flow to total debt $\beta \equiv \dfrac{\text{cov}(x_i,x_m)}{\sigma^2(x_m)}$; $x_i \equiv \dfrac{\text{cash flow}}{\text{total debt}}$;

(10) Pretax interest coverage $\beta \equiv \dfrac{\text{cov}(x_i,x_m)}{\sigma^2(x_m)}$; $x_i \equiv$ pretax interest coverage;

(11) Current ratio $\beta \equiv \dfrac{\text{cov}(x_i,x_m)}{\sigma^2(x_m)}$; $x_i \equiv \dfrac{\text{current assets}}{\text{current liabilities}}$;

TABLE A-2 (Continued)

(12) Working capital total assets $\beta \equiv \frac{\mathrm{cov}(x_i, x_m)}{\sigma^2(x_m)}$; $x_i \equiv \frac{\text{working capital}}{\text{total assets}}$;

(13) Cash and receivables to expenditures for operations $\beta \equiv \frac{\mathrm{cov}(x_i, x_m)}{\sigma^2(x_m)}$;

$x_i \equiv \frac{\text{cash and receivables}}{\text{expenditures}}$;

(14) Dividend variance;

(15) Earnings variance;

(16) Earnings multiple variance;

(17) Earnings yield variance;

(18) Operating income variance;

(19) Sales variance;

(20) Total debt to total assets variance;

(21) Cash flow to total debt variance;

(22) Pretax interest coverage variance;

(23) Current ratio variance;

(24) Working capital to total assets variance;

(25) Cash and receivables to expenditures for operations variance;

(26) Dividend payout, measured as the mean of the annual dividends to earnings ratio;

(27) Dividend payout, measured as the ratio of the 9-year sum of dividends to the 9-year sum of earnings;

(28) Growth in assets (regressing ln of the data series on time);

(29) Growth in earnings (regressing ln of the data series on time);

(30) Growth in sales (regressing ln of the data series on time);

(31) Growth, measured as the mean of asset growth, earnings, growth, and sales growth;

TABLE A-2 (Continued)

(32) Ratio of investment to earnings, measured as the ratio of the 9-year change in assets to the 9-year sum of earnings;

(33) Return on investment, measured as the ratio of the 9-year change in earnings to the 9-year change in assets;

(34) Market volume, measured as the mean on the natural logs of the market value of common stock traded annually ($ millions);

(35) Mean of the annual ratios of total debt to total assets;

(36) Mean of the annual ratios of cash flow to total debt;

(37) Mean of the annual pretax interest coverage ratios;

(38) Mean of the annual current ratios;

(39) Mean of the annual ratios of working captial to total assets;

(40) Mean of the annual ratios of cash and receivables to expenditures for operations;

(41) Size, measure as the mean of the natural logs of total assets ($10 millions);

(42) Size, measured as the mean of the natural logs of total earnings ($ millions);

(43) Size, measured as the mean of the natural logs of total sales ($10 millions);

Thompson, Donald J. II. "Sources of Systematic Risk in Common Stocks," <u>The Journal of Business</u>, 49, pp. 173-188.

TABLE A-3 LIST OF ACCOUNTING RISK MEASURES BY BILDERSEE (1970)

1. Profitability ≡ net income available for common/common equity;
2. Leverage ≡ debt/equity;
3. Leverage (preferred stock) ≡ preferred stock/common equity;
4. Liquidity ≡ current assets/current liabilities;
5. Efficiency ≡ sales/common equity;
6. Coverage ≡ cash flow/debt plus preferred;
7. Growth rate of the firm ≡ geometric average of the annual growth of the assets of the firm;
8. Variability in earnings ≡ standard deviation of the price-earnings ratio;
9. Covariability in earnings ≡ covariance of the earnings-price ratio with an average earnings-price ratio for a sample of "1916 firms" (Bildersee, 1975, p. 84).

Bildersee J. "The Association Between Market-Determined Measures of Risk and Alternative Measures of Risk," The Accounting Review, 50 (January, 1975), pp. 81-98.

TABLE A-4 LIST OF ACCOUNTING RISK MEASURES USED BY SMITH (1979)

(1) Profitability:

(a) Sales/Total Assets;
(b) Operating Income/Total Assets;
(c) Operating Income/Sales;
(d) Net Income/Sales;

(2) Variability:

(a) Standard deviation of Operating Income/Sales;
(b) Standard deviation of Operating Income/Total Assets;
(c) Operating Income/Sales - Beta;

(3) Size:

Natural log of total assets;

(4) Industry:

Industry dummy;

(5) Growth:

$Sales_{t+1}/Sales$ = quarterly sales growth;

(6) Debt Leverage:

$$\text{Inverse of Times interest earned} = \frac{\text{Interest}}{\text{Income before Interest and Taxes}};$$

(7) Common Stock Leverage:

$$\text{Inverse of Times Preferred Dividends Earned} = \frac{\text{Preferred Dividends}}{\text{Income after Interest and Taxes}};$$

(8) Marketability:

(a) Spread between bid and ask price;
(b) Quarterly Volume;
(c) Quarterly Volume/Issue Size;
(d) Issue Size.

TABLE A-5 MINIMUM DISCLOSURE REQUIREMENTS OF APB OPINION NO. 28 (INTERIM REPORTING)

(1) Sales or gross revenues, provision for income taxes, extraordinary items (including related income tax effects), cumulative effect of a change in accounting principles or practices, and net income;

(2) Primary and fully diluted earnings per share data for each period presented, determined in accordance with the provisions of APB Opinion No. 15, Earnings per Share.

(3) Seasonal revenue, costs or expenses (paragraph 18).

(4) Significant changes in estimates or provisions for income taxes (paragraph 19).

(5) Disposal of a segment of a business and extraordinary, unusual or infrequently occurring items (paragraph 21).

(6) Contingent items (paragraph 22).

(7) Changes in accounting principles or estimates (paragraph's 23-29).

(8) Significant changes in financial position (paragraph 33).

[Source: APB Opinion No. 28, *Financial Accounting Standards Orginial Pronouncements as of July 1, 1979*, p. 356.]

TABLE A-6 COMPUSTAT QUARTERLY DISCLOSURES

(1) Net Sales;

(2) Depreciation and Amortization;

(3) Income Taxes (Total);

(4) Earnings per share - including extraordinary items and discontinued operations - fully diluted;

(5) Income before extaordinary items and discontinued operations;

(6) Earnings per share - excluding extraordinary items and discontinued operations - fully diluted;

(7) Available for common after adjustments for common stock equivalents;

(8) Earnings per share (primary) - including extraordinary items and discontinued operations;

(9) End of month price (1st, 2nd, and 3rd) month of the quarter;

(10) Common shares used to calculate primary earnings per share;

(11) Dividends per share;

(12) An adjustment factor;

(13) Common shares traded;

(14) Earnings per share (primary) - excluding extraordinary items and discontinued operations;

(15) Indicated annual dividend;

(16) Operating income before depreciation;

(17) Interest expense;

(18) Pretax income;

(19) Preferred dividends;

(20) Available for common before adjustments for common stock equivalents;

(21) Extraordinary items and discontinued operations;

(22) Earnings per share - excluding extraordinary items and discontinued operations - 12 month moving average;

(23) Common shares used to calculate 12 month moving average earnings per share;

(24) Report date of quarterly earnings per share.

TABLE A-7 LIST OF ACCOUNTING RISK MEASURES TO BE USED IN THIS STUDY

I. Return on Investment:

(1) EBIT/SALES; (Compustat (21-5)/2)
* (2) EARNINGS/SALES; (Compustat (8-26)/2)
(3) EBIT/Total Assets; (Compustat (21-5)/Total Assets)
* (4) EARNINGS/Total Assets; (Compustat (8-26)/Total Assets)

II. Financial leverage:

* (1) Interest coverage = $\frac{\text{EBIT}}{\text{INTEREST}}$; (Compustat (21-5)/22)

III. Capital Intensiveness:

(1) Sales/Total Assets; (Compustat 2/Total Assets)

IV. Dividend Stability:

(1) Dividend payout: Dividends/EARNINGS; (Compustat 16/(8-26)# of shares o/s)

V. Marketability:

* (1) Marketability of common shares: $\frac{\text{\# of shares traded}}{\text{\# of shares o/s}}$; (Compustat 18/# of shares o/s)

(2) Liquidity grade (market value of convertible bonds traded per week);

VI. Growth:

(1) $\text{Sales}_{t+1}/\text{Sales}$; (Compustat $2_{t+1}/2_t$)

VII. Size:

(1) Ln (Total Assets);

* - These accounting risk variables will be different depending on the classification of the convertible security and its cash flow.

TABLE A-8 LIST OF INTEREST RATE RISK MEASURES TO BE USED IN THIS STUDY

(1) Interest Elasticity Proxy: $\frac{\Delta P}{\Delta y} \cdot \frac{y}{P}$

where: P ≡ price of the security
Y ≡ yield to maturity
ΔP ≡ change in price
Δy ≡ change in yield to maturity;

(2) Duration: $$d \equiv \frac{\sum_{t=1}^{N} \frac{t(c)}{(1+y)^t} + \frac{NPV}{(1+y)^N}}{\sum_{t=1}^{N} \frac{c}{(1+y)^t} + \frac{FV}{(1+y)^N}}$$

where:
c ≡ coupon payments;
FV. ≡ face value;
y ≡ yield to maturity;
NPV. ≡ net present value;
N ≡ number of periods the security is outstanding;

(3) Maturity: m;

(4) Coupon Payments: c.

TABLE A-9 LIST OF THE CONVERTIBLE BONDS

1. Alexander's Inc. - 5.5 S 96
2. Allegheny Ludlum Steel - 4.0 S 81
3. Allied Stores Corp. - 4.5 S 92
4. Aluminum Co. of America - 5.25 S 91
5. American Hoist and Derrick Co. - 4.75 S 92
6. American Hoist and Derrick Co. - 5.5 S 93
7. Amfac Inc. -5.25 S 94
8. Armstrong Rubber Co. - 4.5 S 87
9. Ashland Oil Inc. - 4.75 S 93
10. Avco Corp. - 5.5 S 93
11. Baxter (Travenol) Laboratories - 4.375 S 91
12. Berkey Photo Inc. - 5.75 S 81
13. Bobbie Brooks, Inc. - 5.25 S 81
14. Brunswick Corp. - 4.5 S 81
15. Castle and Cooke Inc. -5.375 S 94
16. Cessna Aircraft - 3.875 S 92
17. Chris-Craft Industries, Inc. - 6 S 89
18. City Investing Co. - 7.5 S 90
19. Computer Sciences Corp. - 6.0 S 94
20. Cooper Laboratories, Inc. - 4.5 S 92
21. Cooper Laboratories, Inc. - 7.5 S 91
22. Crane Co. - 5.0 S 93
23. DPF, Inc. - 5.5 S 87
24. Di Giorgio Corp. - 5.75 S 93

TABLE A-9 (Continued)

25. Diversified Industries, Inc. - 5.875 S 93

26. Fairchild Industries Inc. - 4.375 S 92

27. Farah Mfg. Co. - 5.0 S 94

28. Fedders Corp. - 5.0 S 96

29. Fischback and Moore, Inc. - 4.75 S 97

30. Foremost Dairies Inc. - 5.5 S 80

31. Foremost-McKesson Inc. - 6.0 S 94

32. General Instrument Corp. - 4.25 S 85

33. General Instrument Corp. - 5.0 S 92

34. Giddings and Lewis Inc. - 4.625 S 87

35. Grace (W.R.) and Co. - 4.25 S 90

36. Great Northern Nekoosa, Corp. - 4.25 S 91

37. Green Giant Co. - 4.25 S 92

38. Gulf and Western Industries, Inc. - 5.5 S 93

39. Hammermill Paper Co. - 5.0 S 94

40. Heublein Inc. - 4.5 S 97

41. International Minerals and Chemical Corp. - 4.0 S 91

42. International Silver Co. - 5.0 S 93

43. IPCO Hospital Supply Corp. - 5.25 S 89

44. Kirsch Co. - 6.0 S 95

45. Litton Ind. Inc. - 3.5 S 87

46. MacDonald (E.F.) Co. - 6.0 S 89

47. Maryland Cup Corp. - 5.125 S 94

48. Mohawk Data Sciences - 5.5 S 94

49. National Can Corp. - 5.0 S 93

50. National Distillers and Chemical Corp. - 4.5 S 92

TABLE A-9 (Continued)

51. North American Phillips Corp. - 4.0 S 92

52. Oak Industries, Inc. - 4.375 S 87

53. Oneida Ltd. - 5.5 S 88

54. Owens-Illinois, Inc. - 4.5 S 92

55. Parker-Hannifin Corp. - 4.05 S 92

56. Penn-Dixie Cement Corp. - 5.0 S 82

57. Pennzoil Co. - 5.25 S 96

58. Pepsico, Inc. - 4.75 S 96

59. Pfizer, Inc. - 4.0 S 97

60. Revere Copper and Brass, Inc. - 5.5 S 92

61. Rockwell Intl. Corp. - 4.25 S 91

62. St. Regis Paper Co. - 4.875 S 97

63. Standex Intl. Corp. 5.0 S 87

64. Stokely-Van Camp, Inc. - 4.25 S 82

65. Storer Broadcasting Co. - 4.5 S 86

66. Sundstrand Corp. - 5.0 S 93

67. Sunshine Mining Co. - 6.5 S 89

68. Tesorro Petroleum Corp. - 5.25 S 89

69. Texfi Industries, Inc. - 4.75 S 96

70. Union Corp. - 6.0 S 88

71. United Brands Co. - 5.5 S 94

72. Vendo Co. - 4.5 S 80

73. White Motor Corp. - 5.25 S 93

74. Wickes Corp. - 5.125 S 94

75. Wometco Enterprises, Inc. - 5.5 S 94

76. Wyly Corp. - 7.25 S 95

77. Xerox Corp. - 6.0 S 95

TABLE A-9 (Continued)

78. Zapata Corp. -4.75 S 88

79. Zayre Corp. - 5.75 S 94

80. Zurn Industries, Inc. - 5.75 S 94

81. Aeronca, Inc. - 5.75 S 82

82. Condec Corp. - 5.0 S 93

83. DPF, Inc. - 5.75 S 87

84. Duro-Test Corp. - 5.75 S 92

85. Fischer and Porter Co. - 5.5 S 87

86. Greyhound Computer Corp. - 6.0 S 86

87. Grow Chemical Corp. - 5.25 S 87

88. Instrument Systems Corp. - 7.0 S 91

89. Lundy Electronics and Systems, Inc. - 6.5 S 88

90. McCullock Oil Corp. - 5.0 S 97

91. National Kinney Corp. - 5.25 S 97

92. O K C Corp. - 5.75 S 88

93. Phoenix Steel Corp. - 6.0 S 87

94. Ryan Homes, Inc. - 6.0 S 91

95. Trans-Lux Corp. - 5.0 S 87

96. Vernitron Corp. - 5.75 S 82

97. Work Wear Corp. - 4.75 S 85

TABLE A-10 LIST OF THE CONVERTIBLE PREFERRED STOCK

1. Amstar PF 2.65
2. Arcata Corp. PF 2.00
3. Avnet PF 2.50
4. Avnet PF 1.00
5. Beatrice Foods PF 4.00
6. Dayco Corporation PF 4.25
7. Di Giorgio Corp. PF .88
8. Eaton Corporation PF 1.19
9. Gulf Resources PF .20A
10. Ideal Basic PF 4.75
11. Kaiser Aluminum 59 PF 4.75
12. Kaiser Aluminum 66 PF 4.75
13. Kaiser Aluminum PF 4.12
14. Koehring Co. PF 2.75
15. Lehigh Valley Ind. PF 1.50
16. Lfe Corp. PF .60
17. Lone Star Inds. PF 4.50
18. Monsanto PF 2.75
19. Pennwalt Corp. PF 2.50
20. Purex Industries PF 1.35
21. Questor Corp. PF 2.00
22. Rapid-American PF 3.00
23. Rapid-American PF 2.25
24. Rexnord PF 2.36

TABLE A-10 (Continued)

25. Scovill Inc. PF 2.50

26. Warnaco PF 1.50

27. Witco Chemical PF 2.65

28. Zapata Corp. PF 2.00

29. Pratt and Lambert PF 2.25

30. Pratt-Read PF .66

31. Chromalloy Pf 5.00

32. Colt Indus. PF 1.60

33. Cooper Tire and Rubber PF 1.25

34. Kidde Inc. PF 4.00 B

35. Mead Corporation PF 2.80 A

36. Ogden Corp. PF 1.87

37. Sherwin-Williams PF 4.40

38. Talley Inds. PF 1.00 B

39. Zale Corp. PF .80

40. Altec Corp. PF .80

41. Ruddick Corp. PF .56

42. Bangor Punta PF 2.00

43. Ethyl PF 2.40

44. Federal Paper Brd. PF 1.20

45. International Telephone PF 4.00 H

46. Interpace Corp. PF 5.00

47. National Can PF 1.50

48. Newmont Mining Cp. PF 4.50

49. Sperry and Hutchinson PF 3.00

50. Allegheny Ludlum PF 3.00

TABLE A-10 (Continued)

51. Amerada Hess PF 3.50

52. Atlantic Richfield PF 2.80

53. Bristol-Myers PF 2.00

54. Bunker Ramo Cp. PF 1.50

55. Champion International PF 1.20

56. City Investing PF 2.00 B

57. Cluett, Peabody PF 1.00

58. Coastal Corp. PF 1.19

59. Consolidated Fds. PF 4.50

60. Dart Industries PF 2.00

61. Electronic Mem. PF 1.00

62. FMC Corp PF 2.25

63. Foremost-McKesson PF 1.80

64. General Instrument PF 3.0

65. Gulf Resources PF 1.30 B

66. Ingersoll-Rand PF 2.35

67. Insilco PF 1.25 A

68. International Telephone PF 4.50 I

69. International Telephone PF 4.00 K

79. International Telephone PF 2.25 N

71. International Telephone PF 5.00 O

72. Kaiser Cement PF 1.37

73. Katy Industries PF 1.46

74. Lear Siegler PF 2.25

75. Occidental Pete PF 4.00

76. Owens-Illinois PF 4.75

77. Pennwalt Corp. PF 1.60

TABLE A-10 (Continued)

78. Philips Inds. PF 1.00

79. RCA Corp. PF 4.00

80. Reynolds Metals PF 4.50

81. Sheller-Globe PF 1.35

82. Sun Company Inc. PF 2.25

83. Sundstrand Corp. PF 3.50

84. Sybron Corp. PF 2.40

85. Textron PF 2.08

86. Textron PF 1.40

87. TRW PF 4.40

88. United St. Gypsum PF 1.80

89. Woolworth PF 2.20

90. Bergen Brunswig PF 1.15

91. Susquehanna Corp. PF 1.00

92. Occidental Pete PF 2.16

TABLE A-11 "HIGH" AND "LOW" PARTITIONED CONVERTIBLE BONDS

UPPER QUARTILE-CONVERTIBLE BONDS (CV/CP) COMPANY NAME	CV/CP	LOWER QUARTILE-CONVERTIBLE BONDS (CV/CP) COMPANY NAME	CV/CP
SUNDSTRAND CORP.	.9524	TEXFI IND.	.0656
TESORO PETROLEUM	.9940	FEDDERS CORP.	.0680
AM. HOIST/DERR.	1.0121	FARAH MANUF.	.0902
COOPER LABS. INC.	1.0399	VENDO CO.	.1041
CITY INVESTING	1.0456	WHITE MOTOR CORP.	.1130
NATL. DIST./CHEM	1.0609	BOBBIE BROOKS INC.	.1283
ZAPATA CORP.	1.0619	MOHAWK DATA SCIENCES	.1511
ALLIED STORES	1.0736	LUNDY ELECT.	.1604
ASHLAND OIL	1.1242	INSTRUMENT SYSTEMS	.1673
PEPSICO INC.	1.1542	IPCO CORP.	.1791
BAXTER TRAV. LABS	1.2190	BERKEY PHOTO INC.	.1833
STORER BROADCASTING	1.2734	DIVERSIFIED IND.	.1833
WOMETCO ENTERPRISES	1.2856	UNITED BRANDS	.1888
AMERICAN HOIST/DERR.	1.2925	ALEXANDER'S INC.	.2001
PENNZOIL COMPANY	1.3001	PENN-DIXIE INDS.	.2173
INTL. MINERALS/CHEM.	1.3475	DPF INC.	.2214
FOREMOST-MCKESSON	1.4277	NATIONAL KINNEY CORP.	.2382
CESSNA AIRCRAFT	1.5953	ZAYRE CORP.	.2714
OAK INDUSTRIES	1.6153	BRUNSWICK CORP.	.2741
GENERAL INSTRUMENT	1.6383	REVERE COPPER/BRASS	.2852
STANDEX INTL.	2.0232	INSILCO CORP.	.2978
CRANE CO.	2.5283	AERONCA INC.	.3116
OKC CORP.	3.7183	WICKES CO.	.3240

TABLE A-12 "HIGH" AND "LOW" PARTITIONED CONVERTIBLE PREFERRED STOCKS

UPPER QUARTILE-CONVERTIBLE PREFERRED STOCKS (CV/CP) COMPANY NAME	CV/CP	LOWER QUARTILE-CONVERTIBLE PREFERRED STOCKS (CV/CP) COMPANY NAME	CV/CP
SUNDSTRAND CORP.	.9327	ALTEC CORP.	.0449
IDEAL BASIC IND.	.9479	SUSQUEHANNA CORP.	.1059
LONE STAR IND.	.9834	ELECTRONIC MEM. & MAG.	.1135
OGDEN CORP.	1.0070	INTERPACE CORP.	.1518
BEATRICE FOODS CO.	1.0355	PHILIPS IND. INC.	.1684
CHAMPION INTL.	1.0777	TALLEY IND.	.1812
MEAD CORP.	1.0885	QUESTOR CORP.	.2758
AMSTAR CORP.	1.0904	CLUETT, PEABODY/CO.	.2891
REXNORD INC.	1.1256	AMERADA HESS CORP.	.3062
LEAR SIEGLER INC.	1.1368	SPERRY & HUTCHINSON	.3541
AVNET INC.**	1.1503	I.T.T.	.3555
NATIONAL CAN CORP.	1.1636	PRATT-READ CORP.	.3588
FOREMOST-MCKESSON	1.1851	LEHIGH VALLEY IND.	.3778
RAPID-AMERICAN CORP.	1.2429	SYBRON CORP.	.3800
ZAPATA CORP.	1.2759	I.T.T.*	.3808
AVNET INC.	1.3804	COOPER TIRE & RUBBER	.3865
FEDERAL PAPER BD.	1.4156	ZALE CORP.	.4038
WITCO CHEMICAL CORP.	1.4743	I.T.T.*	.4071
KIDDE INC.	1.5842	SHERWIN-WILLIAMS CO.	.4075
EATON CHEMICAL	1.5951	I.T.T.*	.4221

* Only the first I.T.T. security was utilized in the cross-sectional analysis.

** Only the largest CV/CP AVNET security was utilized in the cross-sectional analysis.

TABLE A-13 CENTRAL QUARTILES CONVERSION VALUE/CALL PRICE PARTITIONED CONVERTIBLE SECURITIES

PREFERRED STOCKS COMPANY NAME	CV/CP	BONDS COMPANY NAME	CV/CP
BERGEN BRUNSWIG	.4274	ARMSTRONG RUBBER CO.	.3552
WARNACO INC.	.4400	REVERE COPPER & BRASS	.3895
PENNWALT CORP.	.4432	HEUBLEIN INC.	.4013
I.T.T.	.4727	FISCHBACK CORP.	.4173
RCA	.4810	TRANS-LUX CORP.	.4225
GULF RES. & CHEM.	.4823	AVCO CORP.	.4306
SHELLER-GLOBE	.4893	SUNSHINE MINING CO.	.4327
KOEHRING	.5051	PHOENIX STEEL CORP.	.4373
TEXTRON, INC.	.5085	DPF INCORP.	.4382
BUNKER RAMO CORP.	.5109	VERNITRON CORP.	.4680
LFE CORP.	.5315	UNION CORP.	.4854
DI GIORGIO CORP.	.5422	HAMMERMILL PAPER CO.	.4882
PRATT & LAMBERT, INC.	.5480	AMFAC INC.	.4924
CONS. FOODS	.5563	KIRSH CO.	.5005
TEXTRON, INC.	.5595	FISHER & PORTER CO.	.5059
GEN. INSTRUMENT	.5820	COOPER LABS, INC.	.5133
OWENS-ILL. INC.	.5888	CONDEC INC.	.5315
PENNWALT CORP.	.5908	NORTH AM. PHILIPS	.5801
INSILCO CORP.	.5913	ONEIDA LMTD.	.5843
SUN COMPANY	.5960	COMPUTER SCIENCES	.5879
PUREX IND.	.6034	DI GIORGIO	.6005
RAPID-AMERICAN	.6243	ZURN IND.	.6106
ALLEGHENY LUDLUM	.6261	GRACE, W.R.	.6442
FMC	.6264	GREAT NORTHERN NEK.	.6465

TABLE A-13 (Continued)

PREFERRED STOCKS COMPANY NAME	CV/CP	BONDS COMPANY NAME	CV/CP
REYNOLDS METAL	.6415	OWENS ILLINOIS	.6536
INGERSOLL-RAND CO.	.6550	XEROX CORP.	.6566
BANGOR PUNTA CORP.	.6622	RYAN HOMES	.6582
KAISER ALUMINUM & CHEM.	.6637	GIDDINGS & LEWIS	.6599
KAISER CEMENT	.6725	MACDONALD, E.F.	.6671
CITY INVESTING CO.	.7006	MARYLAND CUP CORP.	.6672
RUDDICK CORP.	.7242	DURO TEST CORP.	.6742
KAISER ALUMINUM & CHEM.	.7253	GROW GROUP INC.	.6866
BRISTOL-MYERS CO.	.7356	GENERAL INSTRU.	.6881
KAISER ALUMINUM & CHEM.	.7535	NATIONAL CAN CORP.	.7120
DAYCO CORP.	.7547	PILLSBURY CO.	.7151
GULF RES. & CHEM.	.7718	ALLEGHENY LUDLUM	.7213
DART IND.	.7752	CASTLE & COOKE	.7329
SCOVILL INC.	.7809	PFIZER INC.	.7691
OCC. PETROLEUM	.7814	GULF & WESTERN	.7718
TRW INC.	.7883	STOKELY-VAN CAMP CORP.	.8052
ARCATA CORP.	.7970	PARKER HANNIFIN	.8177
U.S. GYPSUM	.8015	LITTON IND.	.8219
CHROMALLOY AM. CORP.	.8212	FOREMOST-MCKESSON	.8544
WOOLWORTH, F.W.	.8223	CHRIS-CRAFT IND.	.9774
ATLANTIC RICHFIELD	.8310	FAIRCHILD IND.	.9006
KATY IND.	.8678	ALCOA	.9294
COLT IND.	.8700	ST. REGIS PAPER	.9483

TABLE A-13 (continued)

PREFERRED STOCKS COMPANY NAME	CV/CP
MONSANTO CO.	.8871
ETHYL CORP.	.8926
COASTAL CORP.	.9040
NEWMONT MINING CORP.	.9132

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