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THE LEVERAGE CHANGING CONSEQUENCES OF CONVERTIBLE DEBT FINANCING

by

Vahan Janjigian

Dissertation submitted to the Faculty of the

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

General Business (Finance)

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May, 1985
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THE LEVERAGE CHANGING CONSEQUENCES OF CONVERTIBLE DEBT FINANCING

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Vahan Janjigian

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Finance

(ABSTRACT)

Dann and Mikkelson (1984) report that the common stockholders of firms issuing convertible debt realize significantly negative returns upon the announcement of such financing. They further state that this observation is not consistent with the leverage hypothesis nor with the new financing models of Myers and Majluf (1984) and Miller and Rock (1982).

This study also documents negative returns to the stockholders of convertible debt issuing firms on the announcement date. However, Dann and Mikkelson's assumption that the issuance of convertible debt increases financial leverage is questioned.

A new convertible bond valuation model is proposed which valuates a convertible bond as the sum of its market perceived equity and straight debt components. Convertible bond rates of return are regressed on common stock and straight debt rates of return to demonstrate that convertible bonds have a large and significant equity

component; often large enough to cause leverage decreasing changes to the issuing firm's capital structure. Furthermore, the perceived change in leverage is shown to be significant in explaining the announcement period excess returns realized by the stockholders of convertible issuing firms. In this way, negative announcement period excess returns are shown to be consistent with the leverage hypothesis. In addition, the results support the new financing model developed by Myers and Majluf.

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INTRODUCTION

During different time periods, convertible bond financing has been a popular means of raising capital. Broman (1963) documents the the use of convertible bonds by corporations during the decade 1949-59. Although most offerings during this period were less than $10 million in size, the number of issues outstanding at the end of 1959 stood at 182 as compared to only 3 at the end of 1949. As reported in Chapter V, the issuance of convertible debt has continued to be an important source of outside financing for U.S. corporations.

A convertible bond is a hybrid security having characteristics of both debt and equity. Like a straight bond, a convertible bond provides the purchaser regularly paid coupons. But unlike a straight bond, the purchaser of the convertible has the right to exchange the bond for a stated number of shares of the underlying firm's common stock. The number of shares for which the convertible may be exchanged is referred to as the conversion ratio and this ratio may change during the life of the bond. The right to convert the bond is usually effective immediately upon issue.

In exchange for the conversion privilege the firm maintains the right to call the bond. The right to call is often employable within months after issue. The bondholder's option to convert has value as does the firm's right to issue a call. These features must be weighed when valuating a convertible bond. Furthermore, convertible bonds are often subordinate to straight bonds. As a result, rating services often grade these bonds below the straight bond issues of the same corporation. However, the coupon rates on convertibles are usually less than those on comparable straight bonds. This is usually attributed to the conversion feature.

There are two major issues in convertible debt financing which have not been resolved by financial economists. The first concerns the optimal call policy of the firm and the second concerns the leverage impact of convertible debt issuance.

The theoretical research on an optimal call policy has generally concluded that firms should call their convertible bonds as soon as their value in conversion rises to and equals their call price. Although there appears to be some agreement on this optimal call policy, the empirical evidence unambiguously suggests that firms often wait until the conversion value exceeds the call price by a substantial amount before issuing a call. Attempts to reconcile the deviation of actual from the theoretical call policy are the focus of continuing research in the area.

A second major issue, and the one with which this dissertation is concerned, is to explain the negative abnormal returns earned by the common stockholders of convertible debt issuing firms on the announcement date of such an offering. Dann and Mikkelson (1984) recently attempted to explain these negative returns but were unable to do so in terms compatible with accepted financial theory.

Since a convertible bond is a hybrid security, there is no a priori reason to believe that the straight debt characteristic of the bond dominates its equity characteristic. In this dissertation, the critical assumption made by Dann and Mikkelson that convertible debt issuance has a leverage increasing impact on the firm's capital structure is questioned.

Although for accounting purposes convertible bonds are categorized as debt, the market may believe that their issuance has a leverage decreasing effect upon the firm's capital structure. It is not uncommon for convertible bonds to be converted within a few short years following issuance, even though they would not otherwise mature for two or three decades. In this case, therefore, the market perceives the equity component as dominating, and the issuance of the convertible bond will be perceived to reduce leverage.

In order to test whether the debt or equity component is the dominant one, a new convertible bond valuation model is developed. Unlike conventional models which valuate convertible bonds as straight debt plus an option, this new model develops the convertible bond's value as the sum of its perceived straight debt and equity values.

An econometric form of the model is then developed which permits estimating the proportion of the bond perceived by the market to be equity. Once obtained, this estimate will be used to determine the leverage impact of the announcement of convertible issuance and, in turn, to realign the negative returns observed by Dann and Mikkelson with the leverage hypothesis.

In the following chapter some of the more pertinent literature is reviewed. The third chapter discusses the convertible bond valuation model. Chapter IV discusses the econometric specification of the valuation model, how it will be estimated, and the expected relationship between the leverage changing effect of convertible debt issuance and announcement period excess returns. Chapter V describes the data and how grouping of the data is accomplished. Empirical results are also found in Chapter V. Summary and concluding remarks are found in Chapter VI.

Chapter II

A REVIEW OF THE CONVERTIBLE BOND LITERATURE

2.1 INTRODUCTION

This chapter reviews some of the major literature which is divided into three categories. First, convertible bond valuation models are examined; these range from Brigham's (1966) early model to the more recent models of Ingersoll (1977a) and Brennan and Schwartz (1977) which rely on option pricing techniques developed by Black and Scholes (1973) and Merton (1973). Next we turn to the actual issuance of convertible debt, where the reasons most often given to explain the use of convertible debt financing are examined and the empirical literature documenting the issuance effect upon the firm's outstanding common shares is reviewed. Finally, we look at the call of convertible bonds. Studies which determine an optimal call policy for the firm and studies which conclude that an optimal call policy is indeterminate are reviewed, and then the empirical literature documenting the valuation effect of convertible call on common stock prices is examined.

2.2 THE VALUATION OF CONVERTIBLE BONDS

A convertible bond is like a straight bond with an option attached which entitles the holder of the convertible to convert the bond into a specified number of shares of the firm's common stock. If the bond is never converted then, ex-post, it behaves just like an otherwise straight bond. Another important feature of convertible bonds is that they are callable at the discretion of the issuer. During the last two decades several authors, including Brigham (1966), Baumol, Malkiel, and Quandt (1966), Ingersoll (1977a), and Brennan and Schwartz (1977), have derived convertible bond valuation models.

2.2.1 Brigham

Brigham (1966) provides one of the earliest models of the market value of a callable convertible bond. Brigham assumes that the firm's initial stock price, S_o, grows at a constant rate, g, that the convertible bond pays annual interest of I dollars, that the bond may always be converted into a fixed number of shares, N, and that the bond will pay a principal of F dollars in T years if it is not converted during its life. Brigham describes the bond as having a conversion value as well as a straight debt value.

To obtain his market valuation equation, recognize that the conversion value at time t, CV_t, is given by

$$CV_t = S_o(1 + g)^t N, \tag{2.1}$$

and the time t straight debt value, B_t, of the convertible bond is given by

$$B_t = \sum_{j=1}^{T-t} I/(1+r)^j + F/(1+r)^{(T-t)}, \tag{2.2}$$

where r is the required rate of return on equivalent risk, non-convertible debt. Thus, the conversion value is simply the value of the common stock obtained upon conversion, while the bond value is the present value of the convertible's coupons and return of principal.

The maximum of the conversion value or the straight debt value forms the bond value floor, as shown in Figure 1 by segment BXC_t, and this equals the minimum possible market value of the convertible bond.[1] The market value of the convertible bond cannot fall below its conversion value, segment CXC_t in Figure 1 otherwise, arbitrage profits could

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[1] Figure 1 is taken from Brigham (1966), page 37.

be earned by investors who will buy the bonds and immediately convert them. Additionally, since a convertible bond is like a straight bond plus an option, it must be worth at least as much as its straight bond value, segment BXF. But Brigham argues that the market value, segment $FF'C_t$, exceeds the floor for two reasons: (1) investors will pay a premium for the conversion privilege, and (2) the conversion privilege provides some protection against sharp declines in common stock prices, thereby allowing investors to reduce risk exposure.

Eventually, the convertible bond will expire in one of three ways. The bond may be called before maturity, in which case bondholders can either redeem it for the call price or convert it into common stock. Expiration through conversion may also occur voluntarily. Finally, in the absence of a call or conversion, the bond will mature, at which time the bondholder receives the principal. Letting TV_L denote the applicable expiration value of the convertible bond, where the market fully expects the convertible to expire L years from time t=0 (and at no other time), the expected market value of the bond at time t is given by

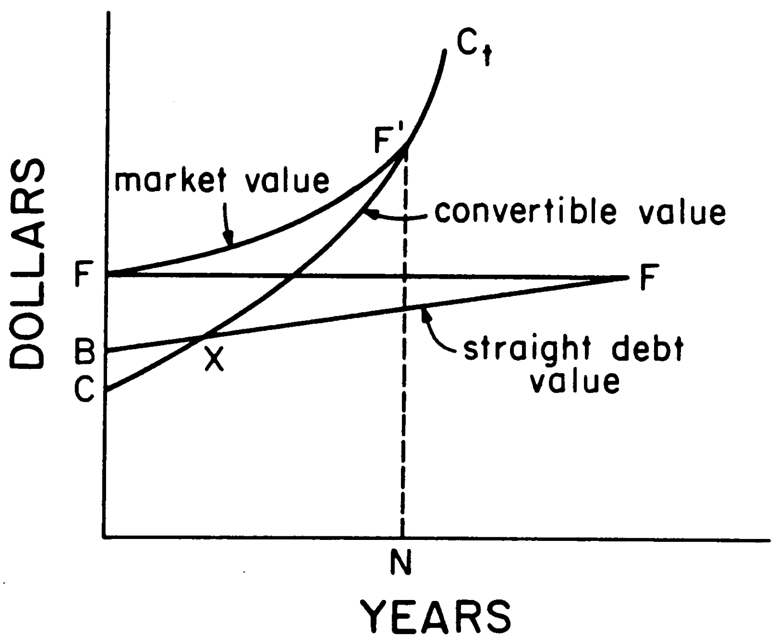

Figure 1: Brigham's Convertible Bond Valuation Model

$$M = \sum_{j=1}^{L-t} I/(1+k)^j + TV_L/(1+k)^{L-t}. \qquad (2.3)$$

In (2.3), k is the internal rate of return on the investment. Note that when L=T, the market expects that expiration will occur at the bond's maturity.

Over time, as the stock price increases, the market value of the convertible bond approaches its conversion value for three reasons. First, when a call is issued, convertible bondholders can accept the call price or convert their bonds. If the conversion value exceeds the call price, rational bondholders will convert rather than redeem their bonds upon call. Since the firm may be expected to issue a call at any time once conversion value exceeds call price, investors will not pay a large premium above conversion value for the bond since the premium will be lost immediately upon call. Second, at higher common stock prices the likelihood of default on the bond decreases. Therefore, as the stock price increases over time, investors are less willing to pay large premiums for the reduced risk exposure provided by the conversion privilege. Third, it is not uncommon for the dividends on the stock of a firm whose stock price is increasing to increase as well, however, the coupon payments on the convertible bond remain fixed. This results in a decrease in the current yield on the bond relative to the dividend yield. This further serves to reduce the gap between market value and conversion value since investors will not pay large premiums for a lower yielding investment.

2.2.2 Baumol, Malkiel, and Quandt

Baumol, Malkiel, and Quandt (1966) present a model in which the convertible's market value is the maximum of one of two values: (1) its value if converted plus its value as insurance against losses due to severe common stock price declines, or (2) its value as a straight bond plus a call option on the common stock.

The authors argue that a convertible bond must currently sell for at least as much as its value if currently converted, SN, where S is the market price per share of common stock and N is the number of shares obtainable upon conversion, plus its value as insurance, π.

$$C \geq SN + \pi, \qquad (2.4)$$

where C is the current convertible bond value. The insurance value, π, is given by

$$\pi = \int_{0}^{B/SN} f(i,t_o)[B-i(t)SN]di(t), \qquad (2.5)$$

where B denotes the straight bond value of the convertible, i(t) is the price relative of one share of stock at time t, or a future value factor, and $f(i,t_o)$ is a density function describing the subjective probabilities formed at time t_o of different stock prices occurring at some future time.

The convertible bond must also sell for at least as much as a straight bond plus a call option on the common stock,

$$C \geq B + O, \qquad (2.6)$$

where O is the value of the call option and is given by

$$O = \int_{B/SN}^{\infty} f(i,t_o)[i(t)SN-B]di(t). \qquad (2.7)$$

Therefore, the value of the convertible bond, as described by BMQ, is equal to the maximum of its value as equity plus insurance or its value as a straight bond plus a call option. This can be written as

$$C = \mathrm{Max}(SN+\pi,\ B+O). \tag{2.8}$$

2.2.3 Ingersoll, and Brennan and Schwartz

Ingersoll (1977a) and Brennan and Schwartz (1977) separately develop a model for the valuation of convertible bonds which relies on the assumptions employed by Black and Scholes (1973) and Merton (1973) in their option pricing models.

Assuming perfect markets, a constant conversion ratio, and no dividend payments to the common stock, Ingersoll shows that the value of a callable convertible bond is given by the solution to the partial differential equation as described by Merton (1973) subject to the following boundary conditions: (1) the value of the convertible cannot fall below zero, (2) when the bonds are called, bondholders receive the call price, and (3) at maturity, the bonds are worth the minimum of either the promised repayment or the value of the firm. In Figure 2 the market value of the convertible bond is given by the curved line joining points

A and B. K represents the convertible's call price and γ is the fraction of the firm for which the convertible may be exchanged.[2] Ingersoll's model requires that the convertible's market value be contained within triangle AOB because of arbitrage. If, for example, the market value of the convertible falls below segment AB, the bond's conversion value, arbitrage profits can be earned by investors who buy the bond and immediately convert it.

The Brennan and Schwartz model is derived under the perfect markets assumption as well. They arrive at the same partial differential equation as does Ingersoll but they rely on numerical search methods to provide a solution to the equation. Unlike Ingersoll's model, the Brennan and Schwartz model allows discrete coupon payments to the bonds as well as discrete dividend payments to the common stock.

Option pricing techniques developed by Black and Scholes and Merton have allowed the valuation of convertible bonds to advance to the model developed by Ingersoll and Brennan and Schwartz. While this model does not require the estimation of a terminal value as does Brigham's, we will

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[2] To derive his equation, Ingersoll first determines an optimal call policy for the firm as explained later in this chapter. This policy dictates that firms call convertible bonds as soon as their value in conversion reaches the call price. For this reason, Figure 2 does not display a value for the convertible where firm value exceeds K/γ.

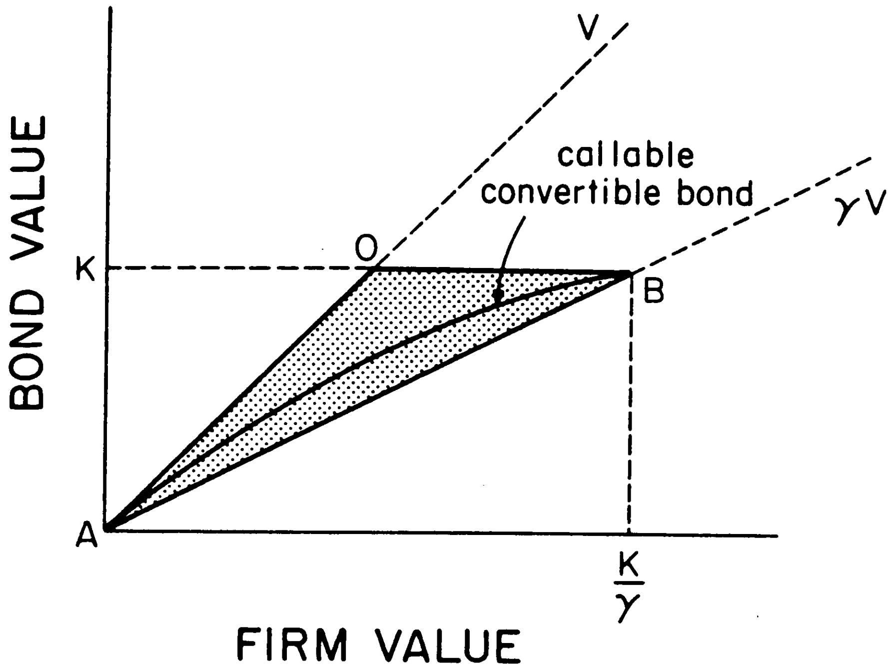

Figure 2: Ingersoll-Brennan and Schwartz Convertible Bond Valuation Model

see in Chapter III that it too cannot be used to display the convertible bond's value as the sum of its market perceived straight debt and equity values.

2.3 THE ISSUANCE OF CONVERTIBLE DEBT

In this section we examine some of the more popular reasons proposed to explain why corporations issue convertible debt. After examining these arguments we turn to the analysis of the effect of convertible debt issuance upon common stock prices.

2.3.1 Why Do Firms Issue Convertible Debt?

Numerous reasons have been proposed to explain why U.S. firms use convertible debt financing. These include the desire to raise capital on a delayed equity basis, the desire to "sweeten" an otherwise straight debt issue, the desire to eliminate agency problems associated with straight debt issues, the desire to attract reluctant investors, and the desire to overcome problems of information asymmetry.

Suppose the managers of a firm believe that the price of the firm's common stock will rise above its current market price. This belief may be based upon information not available to the market. Suppose also that capital financing is needed and that the managers prefer to raise this financing through an equity offering. However, if managers sell equity they may have to sell it for less than its worth, based upon their superior information. Convertible debt provides the opportunity to raise equity capital immediately on a delayed basis. The firm can make a convertible debt offering with a stated conversion price somewhere above the current market price of the common stock and once the market price rises above the conversion price, it can call the convertible bonds, forcing conversion of the convertible debt into equity.

The coupon rate on convertible debt is usually less than on otherwise similar straight debt. This reduced interest expense is another reason often given for the use of convertible debt financing. In this way the conversion feature acts as a sweetener by inducing investors to accept smaller coupon payments in exchange for the option to convert the bonds. In addition, firms considered relatively risky by the market may find that investors are more willing to purchase their debt at reasonable coupon rates if this conversion feature is included, thus ensuring sale of the entire debt offering.

There are three empirical studies that provide some evidence about the reasonableness of the delayed equity financing and sweetener motives for issuing convertible bonds. Indirect evidence for the delayed equity financing motive is provided by Broman (1963) who studies 68 convertible subordinated bond issues each over $10 million in issue size and each listed in Moody's Industrial Manual between 1949 and 1959. Time to maturity ranges from 12 years to 30 years with 82% of the bonds maturing between 20 and 25 years. As of March 1962, 20 bonds, or almost 30% of the sample had already been called. Of the 17 bonds issued prior to 1956 only seven had not been called, and four of these 7 had less than 50% of the original issue still outstanding, indicating a large degree of voluntary conversion of the bonds. This systematic pattern of early conversion lends support to the delayed equity hypothesis.

In a second study, Brigham (1966), using a questionnaire, tries to determine the motives of 42 firms which issued convertible debt between 1961 and 1963. These firms accounted for 76% of the total value of all convertible bonds issued during this period. Brigham received responses from 22 firms. The questionnaire apparently forced the respondents to choose between a desire to obtain equity financing and a desire to obtain debt financing as the primary motive for making a convertible offering. Sixteen of the 22 firms chose equity financing as the reason why they issued convertibles. Managers in all but one of these firms believed their stock price would increase over time and that a convertible debt issue allowed them to sell equity at a higher than prevailing market per share price. Only six of the 22 responding firms chose debt financing as the primary motive for issuing a convertible. These firms believed that the conversion feature sweetened an otherwise straight bond offering.

A second questionnaire study, conducted by Hoffmeister (1977), gives additional insight into the reasons firms issue convertible debt. Of 69 firms surveyed, Hoffmeister obtained 53 useable responses, all from firms which issued convertible debt between June 1970 and June 1972. Hoffmeister's questionnaire allowed the respondents six choices to indicate why they issued convertible debt. They were also allowed to indicate other reasons that were not stated on the questionnaire. In addition, the questionnaire asked the respondents to rank their choices from first to third. Seventy percent of the firms selected "the desire to delay an equity offering" as their first, second or third choice. Fifty-eight percent selected "a desire to reduce interest expense" as one of their top three choices. Finally 26% of the firms selected "a desire to enhance a difficult issue to sell."

It is well known that stockholders and bondholders have conflicting interests.[3] Stockholders may prefer, for example, that the firm engage in relatively risky investments which promise a greater probability of higher payoffs. Bondholders, on the other hand, will prefer safer investments promising smaller but less risky returns, ceteris paribus.

A third motive for issuing convertible bonds has been suggested by Jensen and Meckling (1976), who argue that the addition of the conversion feature to otherwise straight debt may be one way to reduce agency costs associated with debt. If, prior to a new bond offering, bondholders believed that the issuing firm's investment policy could be subsequently changed to favor stockholders at their expense, then an ex-ante loss in firm value can occur. To mitigate this loss, an agency cost, Jensen and Meckling have suggested that managers could instead issue convertible debt thereby permitting bondholders to convert their bonds and become stockholders themselves if management subsequently switches to a riskier asset structure. Jensen and Meckling believe that debt instruments having conversion features will be found more often in firms in which the transfer of wealth from debtholders is otherwise relatively easy to

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[3] see Galai and Masulis (1976).

accomplish.

Mikkelson (1980) argues that if one purpose of the conversion feature is to frustrate efforts to transfer wealth from bondholders to stockholders, then the elimination of convertible bonds through issuance of calls should result in a decrease in the market value of outstanding straight debt and an increase in the market value of outstanding equity because wealth transfers will no longer be shared with convertible bondholders. Mikkelson empirically tests the agency cost argument for the use of convertible bonds by examining the returns to 26 straight debt and 113 equity issues of firms which called their outstanding convertible bonds. He was unable to document any significant change in the value of the outstanding straight debt of these firms. However, contrary to his expectations, he found that stock prices of call issuing firms react in a significantly negative manner upon the announcement of the call. Mikkelson's evidence does not support the agency cost motivation for the issuance of convertible bonds.[4]

Brennan and Schwartz (1982) also lend support to this agency cost argument for the use of convertible debt. They believe that because of their hybrid nature, convertible

[4] Convertible bond calls are more fully discussed later in this chapter.

bonds are not strongly affected by firm risk. For example, if a firm adopts a relatively risky investment policy, the equity portion of the convertible bond becomes more valuable while the straight debt portion decreases in value. These effects tend to offset one another to some degree. The result is that there is little change in the overall value of the convertible bond and convertible bondholders are protected to some degree from attempts to expropriate wealth from one class of security holders to another. Therefore, Brennan and Schwartz predict that ". . . convertibles are most likely to be used by companies which the market perceives as risky, whose risk is hard to assess, and whose investment policy is hard to predict."[5] To provide supporting evidence, they cite Mikkelson (1980) who shows that convertibles are frequently issued by firms with a high degree of financial leverage, one proxy for firm risk.

Although the above arguments are the most commonly given reasons for the use of convertible debt, they are not the only reasons. For example, Brealey and Myers (1984) state that since convertible bonds are usually issued by small and more risky firms, the reason for their use may be to attract investors who would otherwise be reluctant to purchase the straight debt of such firms. A more recent justification for

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[5] Brennan and Schwartz (1982) p. 106.

the use of convertible debt financing comes from Giammarino and Neave (1984) who present a model which assumes asymmetric information regarding project risk. In their model, bond markets may fail because firms cannot sell bonds on terms they consider favorable. Giammarino and Neave believe that the use of convertible bonds can restore stability to bond markets.

2.3.2 Common Stock Price Reactions to the Announcement and Issuance of Convertible Debt

The managers of a firm acting to maximize common shareholder wealth will be interested in knowing exactly what effect new financing has on the outstanding shares. Proponents of the capital structure irrelevance theory believe this issue is moot. However, many scholars believe that capital structure does matter and that when a firm engages in new financing it is releasing valuable information to the market.

This section reviews the findings of Dann and Mikkelson (1984) who recently investigated the reaction of common stock prices to the announcement of issue and actual issuance of convertible debt. This study represents the most comprehensive analysis of the valuation effects of convertible debt financing to date. The authors conclude that their findings are not consistent with existing capital structure theory nor with the recent developments in the new financing literature.

2.3.2.1 The Dann and Mikkelson Study

Dann and Mikkelson (1984) examine common stock price reactions to the announcements of 132 convertible debt offerings made between 1970 and 1979. They required that the underlying firms be listed on CRSP. In addition, they excluded issues for which no announcement could be found in the Wall Street Journal. Using the market model they calculated predicted returns for the equity and compared these to the actual returns. Dann and Mikkelson found an average two day announcement period prediction error of -2.31% which is significantly different from zero at the .01 level. This finding clearly indicates that the announcement of a convertible debt offering has a significantly negative impact on the firm's equity.

Since all of the terms of the issue are not made public until the issuance date, Dann and Mikkelson also tested for stock price reactions using the issuance date as the event date. The sample size reduced to 129 since two announced issues were canceled and one was changed to a non-convertible issue. The authors measured an average two day prediction error of -1.54% which is also significantly different from zero at the .01 level. This issue date effect indicates that not all of the impact of a convertible debt issue is impounded in the stock price at the announcement of the issue.

For comparison purposes, the authors isolated a sample of straight debt issues using the same criteria as for the convertibles. Testing for common stock price reactions to the announcement and issuance of straight debt offerings, they observed an average two day prediction error around the announcement date of -.37%. Although negative, it is not significantly different from zero at the .05 level. The average two day prediction error around the issuance date was found to be .08% which is not significantly different from zero at the .01 level but is significant at the .05 level. In comparing the convertible sample to the straight debt sample Dann and Mikkelson conclude that there are significant differences between the average two day prediction errors around the announcement dates as well as around the issuance dates.

In an attempt to explain their findings, Dann and Mikkelson consider three theories relating stock price reactions to financing changes. In particular they consider information contained in leverage changing financings, information contained in any new financing, and finally, the underpricing of new issues. They reject all of the above as explanations for their results.

A leverage increasing capital structure change may convey good news to the market about the firm. For example, assuming perfect markets and asymmetric information, Ross (1977) develops a model in which a leverage increasing capital structure change is one way that the firm can signal positive information to the market. There are several studies on capital structure changes that are consistent with this hypothesis. These studies are summarized in Table 1 which is an extension of Dann and Mikkelson's Table 9.[6] Dann and Mikkelson's study is one of only a few in Table 1 for which the sign on the leverage change is not consistent with the sign on the announcement period return. This is the case for both convertible and straight bonds, however, recall that the announcement period return for straight bonds is not significant at the .05 level.

Dann and Mikkelson believe that even though a convertible debt issue may contain a large equity component, its value is not large enough to dominate the debt component and therefore the issue is probably leverage increasing. To support this view, they cite evidence presented by King (1984), that the debt portion of outstanding convertible

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[6] Dann and Mikkelson (1984) p. 173.

TABLE 1

Average Common Stock Price Announcement Period Returns by Type of Capital Structure Change

Author and Type of capital structure change	Sign of leverage change	2-day announcement period return
Masulis (1978)		
Exchange Offers:		
Common stock for debt	-	-7.44%
Debt for common stock	+	+10.52
Common stock for preferred	-	-2.29
Preferred stock for common	+	+5.78
Preferred stock for debt	-	-14.29
Debt for preferred stock	+	+2.13
Mikkelson (1981)		
Conversion of debt to common	-	-2.13
Conversion of preferred to common	-	-0.36
McConnell and Schlarbaum (1981)		
Income bonds exchanged for preferred	+	+2.18
Dann (1981)		
Repurchase of common	+	+15.41
Masulis (1980)		
Repurchase of common	+	+16.35
Vermaelen (1981)		
Repurchase of common	+	+14.14
Korwar (1982)		
Issuance of common	-	-2.48

TABLE 1

Average Common Stock Price Announcement Period Returns by Type of Capital Structure Change (continued)

Author and Type of capital structure change	Sign of leverage change	2-day announcement period return
Hess and Bhagat (1984)		
Issuance of common		
Industrial firms	-	-3.95
Public utilities	-	-1.00
Asquith and Mullins (1984)		
Issuance of common		
Industrial firms	-	-3.0
Public utilities	-	-0.9
Masulis and Korwar (1985)		
Issuance of common		
Industrial firms	-	-3.22
Public utilities	-	-0.74
Mikkelson and Partch (1985)		
Issuance of common	-	-4.46
Issuance of straight debt	+	+0.06
Issuance of convertible	+	-1.39
Issuance of preferred stock	+	+1.53
Eckbo		
Issuance of convertible debt	+	-1.25
Issuance of straight debt	+	-0.06
Dann and Mikkelson (1984)		
Issuance of convertible debt	+	-2.31
Issuance of straight debt	+	-0.37

issues dominates the equity portion. King reaches this conclusion after applying the Brennan and Schwartz convertible bond valuation model to a sample of 103 convertible bonds. First he calculates the bond values according to the model and compares these theoretical values to the actual market values. He concludes that the Brennan and Schwartz model accurately estimates the market values of the bonds. Next he calculates bond values again using the same model but this time he drives the conversion ratio to zero. The resulting value is what King calls the straight debt value of the convertible bond. The difference between the market value of the bond and the straight debt value of the bond, as determined by the Brennan and Schwartz model, is what he calls the equity value of the conversion feature. Since, on average, he observes that the equity value is only 18.4% of the market value, King concludes that the debt portion of the bond dominates the equity portion.[7]

If the issuance of convertible debt is leverage increasing, as Dann and Mikkelson propose, then the negative announcement period returns they document are certainly paradoxical in light of the noted studies. Significantly negative common stock price reactions to leverage increasing

[7] A criticism of King's methodology is found in Chapter III. Chapter IV includes an explanation of how a convertible bond may reduce leverage even if its debt portion is dominant.

capital structure changes are inconsistent with the leverage hypothesis.

Recently, Myers and Majluf (1984) and Miller and Rock (1982) have suggested that new financing, either equity or debt, will have a negative impact on common stock prices. In addition to assuming otherwise perfect markets, Myers and Majluf also assume that the firm's managers have earnings information not available to investors, that the managers act in the best interests of the old or existing stockholders, and that these stockholders do not readjust their portfolios as a result of financing or investment decisions made by the managers.

Under these assumptions, they develop a model which predicts that there may be times when positive NPV projects which require new financing will be rejected even though the value of the firm would increase if the project were adopted because the average value of existing stockholders' shares will decrease. They extend the model by considering the effects of issuing debt on the value of existing shares. Myers and Majluf claim that because debt is a safer instrument than equity, raising outside capital for new investment purposes by issuing debt results in a smaller loss to existing stockholders than if the same amount of capital were raised through an equity issue.

Miller and Rock also present a model in which new financing is considered bad news, and they also assume asymmetric information. Basically, new financing signals to the market that actual earnings are less than anticipated by the market, hence, bad news. However, unlike the Myers and Majluf model, the Miller and Rock model does not predict a dominance of one form of new financing over another. Debt and equity financing equally signal bad news to the market.

To test the hypothesis that new financing affects common stock prices in a negative manner, Dann and Mikkelson divide their sample of convertible debt announcements into two subsamples; the first containing those issues representing new financing and the second containing those issues representing refinancing of existing debt. Only the former sample represents new financing, however, they find that both subsamples exhibit significantly negative returns to stockholders. Since the Myers and Majluf and Miller and Rock models predict negative returns only for new financings, Dann and Mikkelson conclude that the new financing as bad news hypothesis does not explain their findings.

Finally, Dann and Mikkelson consider new issue underpricing as a possible explanation for the negative returns they observe. If new issues are underpriced to enhance their salability, an unreported flotation cost is incurred in the form of a wealth transfer from current stockholders to purchasers of the new issue. To test for the presence of underpricing, Dann and Mikkelson compare the stock price reactions to public convertible debt offerings with the stock price reactions to convertible debt offerings made on a rights basis. Assuming that stockholders exercise their rights, underpricing will not be an important factor in a rights offering since the new issue is being sold to present stockholders. However, because Dann and Mikkelson find that announcement period returns are significantly negative for public offerings as well as for rights offerings, they conclude that underpricing also does not provide a fully consistent explanation for their findings.

Since the Dann and Mikkelson study is one of only a few cited which is not consistent with the leverage hypothesis, it appears that perhaps the issuance of convertible debt has a leverage decreasing effect upon capital structure. Investors may believe that the equity portion of the convertible bond is large enough to decrease leverage.

2.4 THE CALL OF CONVERTIBLE DEBT

Another important convertible debt financing issue is whether or not it matters when a convertible bond is called. This section reviews studies aimed at determining if an optimal call policy exists. In addition, we examine the effect of convertible debt calls upon common stock prices.

2.4.1 Determining an Optimal Call Policy

Once the firm has issued the callable convertible bond, the question arises, is there an optimal time to call or force conversion of the bond or should it be allowed to continue to maturity? There are several recent investigations of this issue.

2.4.1.1 Optimal Policy

In developing an optimal call policy, Ingersoll (1977a) assumes that the only securities in the firm's capital structure are equity and convertible debt, that markets are perfect, that managers act to maximize common stockholder wealth, and that there is no call notice period. He shows that the optimal call policy is to call as soon as the value of the bond in conversion reaches to and equals the call price. He does this by forming two portfolios and comparing their current values. Using arbitrage arguments, he shows that the current value of the first portfolio, which contains the entire convertible bond issue, must exceed the current value of the second portfolio, which is composed of securities obtainable upon conversion of the convertible bond. Any delay in call results in a transfer of wealth from common stockholders to convertible bondholders in an amount equal to the difference between the bond's market value and its conversion value.

Brennan and Schwartz (1977) reach a conclusion identical to Ingersoll's. They argue that the firm's managers should act to maximize the value of the common stock, or what amounts to the same thing, minimize the value of the convertible bonds. They prove that the value of the convertible bond is minimized if the firm issues a call as soon as the bond's value if not called is identical to its value if called. This occurs when the bond's value reaches to and equals the call price.

The Ingersoll-Brennan and Schwartz model dictates that the firm call the bonds at K/γ. Therefore, in this model, the value of the convertible bond can never exceed its call price as indicated in Figure 3.

2.4.1.2 Indeterminate Policies

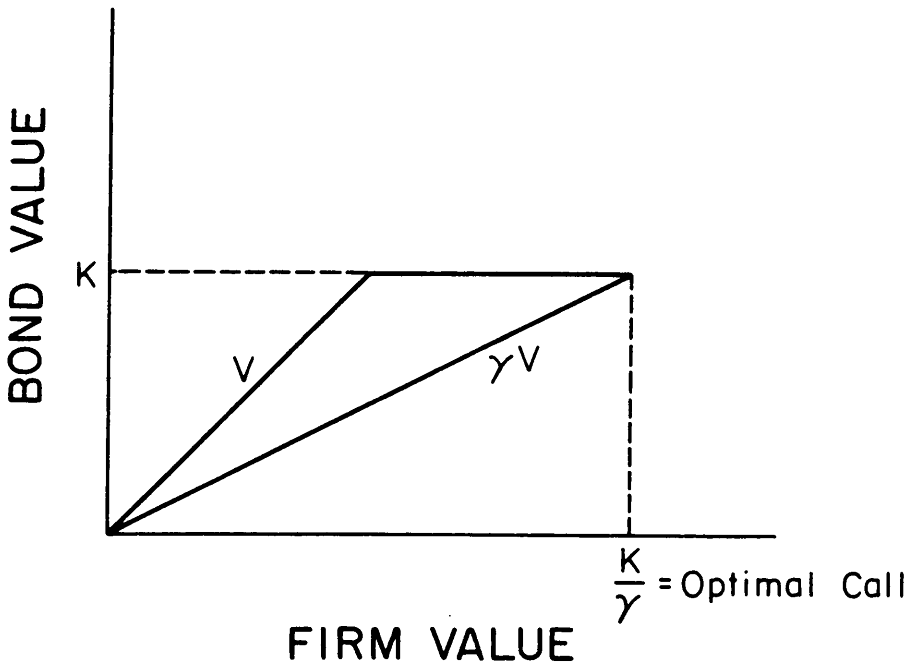

Figure 3: Ingersoll-Brennan and Schwartz Optimal Call Policy

Two recent studies develop models in which the Ingersoll-Brennan and Schwartz optimal call policy no longer holds. Harris and Raviv (1984) present a sequential signalling model in which the firm's managers, again acting to maximize common stockholder wealth, may optimally delay issuing a call of the convertible bonds. In their model, the firm's managers receive private information at discrete points in time. Investors try to guess what this information is by observing the actions of the firm. Managers make their call decisions based upon this information and upon how they believe the market will interpret it. Harris and Raviv show that a call is perceived as bad news and that passing up the opportunity to call signals good news. Their model not only explains why firms may delay calling past the Ingersoll-Brennan and Schwartz optimum, but it also predicts negative common stock price reactions to the announcement of convertible debt calls.

The second study by Constantinides and Grundy (1983) shows that it is not necessarily suboptimal for a firm to refrain from calling its convertible bonds if the conversion value exceeds the call price, so long as the market value equals the conversion value. That is, if $C=\gamma V$ when $\gamma V>K$, then the firm is indifferent to calling the bonds. However, a call should be issued if $C>\gamma V$ when $\gamma V>K$. Constantindes and Grundy show that if the firm's value follows a discontinuous sample path, then the conversion value can jump above the call price (without ever having equaled it), after which the convertible's market value will equal the conversion value. In such a situation the firm is indifferent to calling the bonds. This concept is easier understood by examining Figure 4. Suppose firm value jumps from V_1 to V_2 without ever having equaled K/γ. At V_2 the convertible's conversion value exceeds the call price. Constantinides and Grundy argue that the convertible bond may be so far in the money (i.e. the conversion price exceeds the market price of the common stock) that for all practical purposes the probability of conversion is equal to one. The market value of the convertible bond, C, will equal the conversion value, γV, and the firm is indifferent to calling.

The Constantinides and Grundy model can also be modified to predict negative common stock price reactions to the announcement of convertible debt calls; if it is assumed that conversion entails a cost and that managers have access to information before investors do, then a call signals bad news to the market.

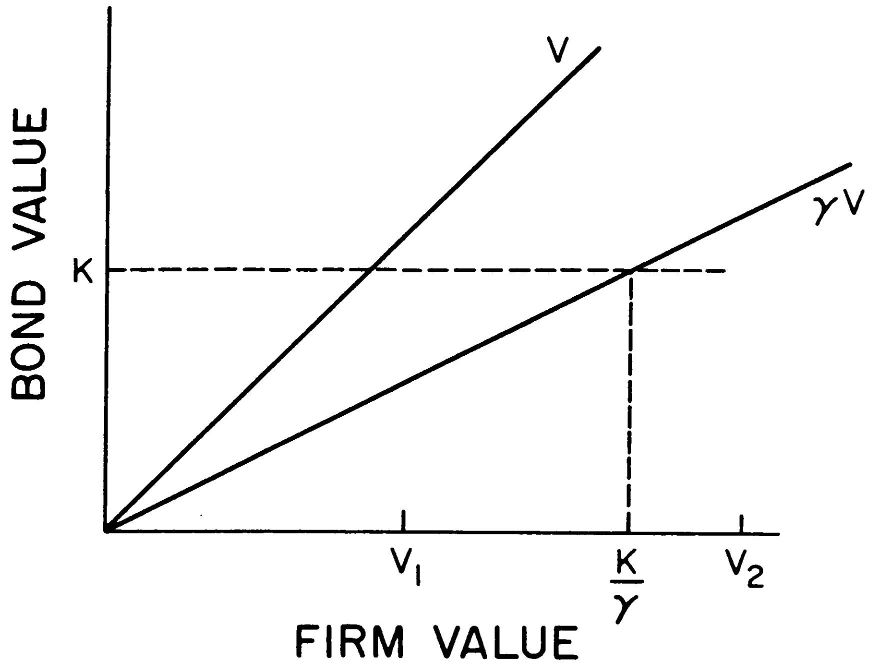

Figure 4: Constantinides and Grundy's Indeterminate Call Policy

2.4.2 Empirical Evidence Against an Optimal Call Policy

The empirical evidence on the call policies of U.S. firms clearly indicates that firms do not follow the optimal call policy derived by Ingersoll and Brennan and Schwartz.

Brigham (1966) finds that firms often wait to call the bonds until the conversion value exceeds the call price by some substantial amount. Almost half the bonds in his sample had not been called even though the conversion value exceeded the call price by at least 20%. A survey of firms found that some had no plans to force conversion by calling.

In a second study, Ingersoll (1977b) examines 179 convertible bond calls between 1968-75. He finds that the median firm delayed calling the bonds until the conversion value exceeded the call price by 43.9%, an amount significantly beyond the theoretical point of optimal call.

In an attempt to explain deviations from this optimum call policy, Ingersoll examines the effects of relaxing some of the assumptions used to develop his optimal call policy. He investigates relaxing the assumptions of no call notice period and no underwriting costs as possible explanations for deviations from the optimum in reality. However, he determines that with a positive call notice period and positive underwriting costs the effect upon the theoretical optimal call policy, as originally derived, is not sufficiently large enough to account for the call policies followed by actual firms.

2.4.3 Common Stock Price Reactions to the Announcement of Convertible Debt Calls

2.4.3.1 Various Theories

The call of a convertible bond may have a positive or a negative effect upon the underlying firm's common stock. Or it may have no effect at all. This section discusses some of the theories proposed to justify the expectation of each of these effects.

In his development of the firm's optimal call policy, Ingersoll (1977a) shows that the market value of a convertible bond exceeds its conversion value (see Figure 2). This difference between market value and conversion value, the convertible's premium, is what convertible bondholders would gain from stockholders if the firm delays issuing a call past the Ingersoll-Brennan and Schwartz point of optimal call. If this premium truly exists when the firm's value exceeds the point of optimal call, positive common stock price returns should be observed in reaction to a call announcement since stockholders will then capture the premium.

There are counter arguments predicting negative returns to common stockholders upon the call announcement. For example, Mikkelson (1981) argues that stock prices may react negatively to a call announcement because of tax effects. When bonds are converted the firm loses tax deductions in the form of interest payments. Miller (1977), in his presidential address, argues that there is no optimal capital structure for any firm in particular. In equilibrium, the corporate bond rate is grossed up to reflect the personal tax disadvantage of debt, so that any loss of corporate tax shields due to reduced leverage is exactly offset by personal savings on coupon income. Thus, within the context of Miller's theory, convertible debt calls would have no impact on common stock prices. However, in their extension of Miller's model, DeAngelo and Masulis (1980) demonstrate that a firm specific capital structure does exist and is due to the presence of tax shield substitutes for debt, as well as possible bankruptcy costs. If the firm's existing capital structure is already at the optimum, the DeAngelo and Masulis model predicts negative stock price reactions to convertible debt calls. On the other hand, a call should result in positive equity returns if it moves the firm to a new optimum.

Regardless of whether capital structure matters, Ingersoll (1977b) argues that interest expense tax shields, lost because of a call, can be recaptured by issuing more debt, especially if transactions costs are assumed to be zero. In this case, a call should have no effect upon common stock returns.

Mikkelson (1981) also proposes an increase in the number of shares outstanding as another reason for expecting negative common stock returns in reaction to convertible debt calls. An increase in the number of shares outstanding may decrease the stock price by causing an over supply of shares if the demand for these shares is not infinitely elastic.

2.4.3.2 Empirical Evidence

In contrast to the findings of most investigations, Bacon and Winn (1969) find slightly positive common stock price reactions to the announcement of 83 convertible bond calls issued between 1958 and 1967. Although not statistically significant, this result is consistent with the notion that stockholders capture the convertible bond's premium. The authors propose two explanations for their findings. First, since the amount of outstanding debt is reduced upon conversion of the bonds, the equity's risk is also reduced. Therefore, investors may be willing to pay more for the firm's common stock. But this is contrary to the findings of Galai and Masulis (1976), who show that the value of common stock increases as its risk increases. Second, calls may be fully anticipated by the market. If so, a call is not a surprise and common stock prices do not react significantly to it.

Another examination on the effect of a call on the firm's outstanding equity is provided by Alexander and Stover (1980) who study common stock price reactions to the announcement of 161 convertible debt and preferred stock calls which occurred between 1963 and 1975. All of the firms in their sample are listed on the New York Sock Exchange.

Beginning in 1969, the Accounting Principles Board Opinion 15 (APB O 15) required that a firm's earnings be reported on a fully diluted basis. Alexander and Stover divide their sample into pre and post APB O 15 subsamples in order to determine the effect of the Opinion, if any, on common stock price reactions to convertible debt calls. They find that for the entire sample, the Cumulative Average Residuals (CARs) increase consistently during the months prior to call announcements, but during the months after call announcements, CARs decline. The CARs during the pre-call announcement period are found to be significantly different from the CARs during the post-call announcement period for the entire sample, as well as for the pre-APB O 15 and post-APB O 15 subsamples. Moreover, the pre-call announcement CARs for the pre-APB O 15 subsample are not found to be significantly different from the pre-call announcement CARs for the post-APB O 15 subsample. However, significant differences are found between the subsamples' CARs during the post-call announcement period. The post-APB O 15 subsample's CARS decline at a faster rate following call announcements than do the pre-APB O 15 subsample's CARs. It appears that the reporting of earnings on a fully diluted basis does not prevent stock prices from declining any more than they did before reporting was required. Ironically, APB O 15 seems to have resulted in sharper common stock price declines during the post-call announcement period.

Mikkelson (1981) studies a sample of convertible debt calls by firms listed in Moody's Industrial, Transportation, or Public Utility Manuals, which occurred between 1963 and 1978, whose call announcements appeared in the Wall Street Journal, which were listed on CRSP, and for whom the announcement date conversion value exceeded the call price. price. His final sample contains 113 calls represented by 99 firms. Using the same criteria as above, he identifies 57 convertible preferred stock calls during the same period.

For convertible debt, Mikkelson finds that the call announcement unadjusted average common stock returns are negative and significantly different from the unadjusted average common stock returns for the comparison period.

However, for the convertible preferred stock, Mikkelson is unable to document any significant differences between the announcement period's unadjusted common stock returns and the comparison period's unadjusted common stock returns. Mikkelson concludes that if the negative impact on common stock prices due to convertible debt calls is caused by an increase in the number of shares outstanding, resulting in a dilution of earnings, similar results should be observed for convertible preferred stock calls. The lack of similarity between the two samples suggests that dilution is not a sufficient explanation for stock price behavior on the call announcement date.

Mikkelson states that the difference in common stock returns due to convertible debt calls versus convertible preferred stock calls suggests that leverage changes due to these calls may be different because they may change the priority of claims of the firm's remaining securities in different ways. Also, since dividend payments on convertible preferred stock are not deductible, differences in common stock price reactions due to calls of these two kinds of securities are consistent with an interest expense tax shield loss hypothesis.

In contrast to Mikkelson's findings, Ingersoll (1977b), who also compares calls of convertible debt with those of convertible preferred stock, does not document any significant differences due to the calls of these two kinds of convertible securities. His findings are not consistent with a leverage effect or with a tax shield effect.

2.4.3.3 Evidence Supporting the Tax Shield Loss Hypothesis

One of the assumptions under which Ingersoll and Brennan and Schwartz develop their optimal call policy is that there are no taxes. Perhaps in a world with taxes, the Ingersoll-Brennan and Schwartz optimum no longer holds. Mikkelson (1983) formulates an econometric model that he uses in an attempt to explain the negative common stock price reactions to convertible debt calls which he observed earlier.[8] In addition to a proxy for the tax shield provided by convertible debt, he includes proxies for each of the following: wealth redistributions from common stockholders to senior security holders, decrease in the conversion privilege value, increase in the number of shares outstanding, and change in earnings per share due to dilution.

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[8] Mikkelson (1981).

In testing his model Mikkelson makes the following assumptions: (1) the firm has callable convertible debt, non-convertible debt and common stock outstanding, (2) the value of the convertible debt exceeds the call price so that the optimal response of the convertible bondholders is conversion, and (3) the call is unanticipated by the market.

Mikkelson states that the priority of claims on the firm's assets which are higher than common stock but not as high as the convertible security will be affected by a convertible call. A decrease in the value of the stock upon a convertible call represents a wealth transfer from common stockholders to senior security holders.

If the market value of the convertible security exceeds its conversion value then the call of such a security will eliminate this premium. The loss of this premium by convertible security holders represents a wealth transfer to the remaining security holders.

An increase in the number of shares outstanding due to conversion may result in a drop in common stock prices if the demand for the firm's shares is not elastic. In addition, an increase in shares outstanding will have a dilution effect upon earnings per share.

Mikkelson runs a regression using variables representing each of these possible explanations for a change in common stock prices due to convertible security calls. His results indicate that only the variable which proxies for the change in interest expense tax shields is significant. This indicates that a convertible security call either reduces the firm's after-tax cash flows or that it conveys negative information about the firm.

Although, Mikkelson's findings support the tax shield loss hypothesis, Brennan and Schwartz (1982) do not believe this to be a plausible explanation for the negative returns to common stock observed on the call announcement date. They find it difficult to believe that management is taking action that is not in the best interest of current stockholders. They state that the negative returns are more likely due to an information effect. The call of convertible bonds may signal bad news to the market. Since convertible bonds are more often issued by relatively risky firms, their call may indicate that the firm anticipates tough times in the near future and wants to rid itself of fixed obligations that may represent a cash drain.

Chapter III

A CONVERTIBLE BOND VALUATION MODEL

3.1 INTRODUCTION

In the preceding chapter it was noted that Dann and Mikkelson's (1984) empirical evidence indicates that, on average, negative daily excess returns are earned on the common stock of firms raising capital through a convertible debt offering both on the announcement date as well as on the issuance date. As Dann and Mikkelson point out, this result is contrary to what is predicted by the leverage hypothesis, given the assumption that the issuance of convertible debt is leverage increasing. The leverage hypothesis predicts positive excess returns to the common stock of firms which engage in leverage increasing capital structure changes, ceteris paribus. Dann and Mikkelson were also unable to show complete consistency between their empirical findings on the announcement date and the Myers and Majluf and Miller and Rock models which predict that the market reacts negatively to the announcement of a new securities issue. They also rejected underpricing as a completely consistent explanation for their findings. Dann and Mikkelson's findings may be an empirical anomaly, however, they examined a relatively large data set.

An alternative route to explaining the negative announcement date returns leads to a critical examination of the assumption that the issuance of convertible bonds increases financial leverage. The convertible bond is a hybrid security simultaneously containing both debt and equity characteristics. Given its hybrid nature, there is no obvious a priori reason for assuming that the convertible bond is sufficiently debt-like so that its issuance causes leverage increasing valuation consequences. Currently, however, there are no economic models of the convertible bond which permit correctly identifying the bond's debt and equity components.

The purpose of this chapter is to develop a valuation model which permits decomposing the convertible bond's value into its equity portion and its debt portion, as they are perceived by the market. This model will then be used in Chapter IV to derive an econometric equation which permits the estimation of the market's perception of the equity and debt composition of the convertible bond.

3.2 THE NEED FOR A NEW MODEL

Prior to developing a new convertible bond valuation model which permits separating the market's perception of its value into its straight debt and equity components, the intractability of existing models for this purpose is shown.

3.2.1 Non-Callable Convertible Debt

To show that existing convertible bond valuation models cannot be used to identify perceived debt and equity components, we'll first examine the simple case of non-callable bonds.

Smith (1979) discusses a simple valuation model for non-callable pure discount risky convertible bonds. The model is a simplification of Ingersoll's (1977a) model previously discussed in Chapter II. Except for the fact that the convertible is not callable, all of Ingersoll's assumptions hold, including that the firm issues only convertible debt and common stock.

Since the convertible is non-callable, bondholders cannot be forced into converting before maturity. On the maturity date, they may either accept the conversion value of the bond, $\gamma V^{\bullet}$, or its face value, F. Therefore, the convertible's maturity value is described by

$$C^{\bullet} = \min[V^{\bullet}, \max(F, \gamma V^{\bullet})], \tag{3.1}$$

where $C^{\bullet}$ is the maturity value of the convertible bond, $V^{\bullet}$ is the value of the firm at maturity, and γ is the fraction of the firm for which the convertible may be exchanged.

Smith shows that the non-callable convertible bond is worth the present value of a straight bond, D, and the present value of a call option, O, on the fraction, γ, of the firm. Thus

$$C = D + O \tag{3.2}$$

where

$$D = e^{-rT}[\int_{0}^{F} V^{\bullet} L'(V^{\bullet}) dV + \int_{F}^{\infty} F L'(V^{\bullet}) dV^{\bullet}] \tag{3.3}$$

and

$$O = e^{-rT}[\int_{F/\gamma}^{\infty} (\gamma V^{\bullet} - F) L'(V^{\bullet}) dV^{\bullet}]. \tag{3.4}$$

C is the current convertible bond value, r is the risk-free rate of return, T is time to maturity, and $L'(V^{\bullet})$ is the log normal density function. Equation (3.3) states that the straight bond value, D, is worth the present value of the firm's maturity value, $V^{\bullet}$, if $V^{\bullet}<F$, otherwise it is worth the present value of the bond's face value, F. Equation (3.4) states that the option component, O, is worth the present value of the difference between the conversion value and the face value, $(\gamma V^{\bullet}-F)$, given that the conversion value exceeds the face value at maturity, $\gamma V^{\bullet}>F$. The value of a non-callable convertible bond is shown in Figure 5 which is very similar to Figure 2, however, because the bond is now non-callable, it may still be alive where firm value exceeds F/γ.

The central problem with existing theoretical models is that it does not appear possible to simply adjust some of their parameters to arrive at equations which value the perceived debt or equity components of the convertible bond. It was seen in Chapter II that this approach was followed by King (1984) who claims that by lowering the conversion ratio to zero in the Brennan and Schwartz model, the bond component of the convertible bond's value can be obtained. To see the fallacy with King's methodology, consider its application to Smith's convertible bond valuation equation. When the conversion ratio, γ, is driven to zero, the call option becomes worthless and the value of the convertible is equivalent to the value of straight debt. If, in fact, the

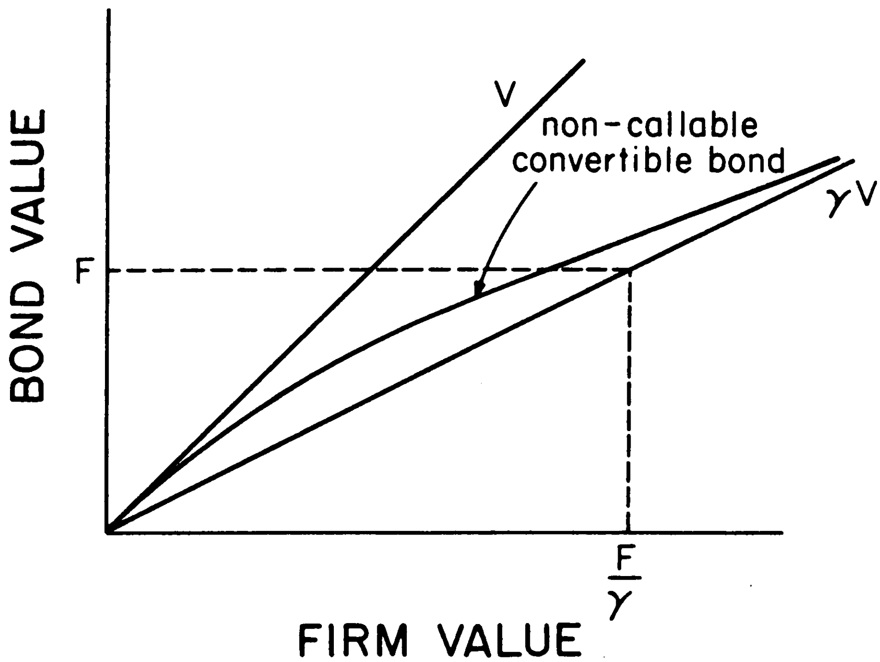

Figure 5: Smith's Non-Callable Convertible Bond Valuation Model

convertible bond had a zero level conversion ratio, we could logically conclude that the market correctly perceives the convertible as straight debt. However, the conversion ratio is never zero, and the bond's straight debt value will not, in general, equal the market's perceived debt value of the convertible bond. Suppose for example, that the convertible is issued way in the money so that the market believes the probability of conversion is equal to one. The market's perceived straight debt component will now be zero, but if we force $\gamma=0$, we would conclude that the convertible is all debt. In this case, the convertible bond's option component equals exactly the present value of the terminal conversion value of the bond, hence the convertible is perceived as all equity. But as long as the probability of conversion is less than one, the option component of the bond will be worth less than the bond's conversion value. Therefore, in general, the model does not permit us to write the convertible bond's value as the sum of its straight debt and equity values as perceived by the market.

A second valuation model for non-callable convertible bonds presented by Baumol, Malkiel, and Quandt (1966), and discussed in Chapter II, also cannot be used to identify the convertible bond's value as the sum of its market perceived straight debt and equity components. Recall that the BMQ model displays the value of a non-callable convertible bond as the maximum of its conversion value plus insurance against stock price declines or its straight debt value plus an option on the firm's common stock. The BMQ convertible bond valuation model was developed prior to the Black and Scholes option pricing model, therefore, it is not as sophisticated as Smith's model for valuating non-callable convertible bonds.

Let's assume once again that the convertible bond is sufficiently in the money for the market to believe that the probability of conversion is equal to one. Now, insurance on the convertible bond against stock price declines is worthless as is the value of the straight debt component of the convertible because the market believes with certainty that the bond will be converted. Therefore, according to the BMQ model, the convertible is worth its conversion value which is equal to the value of the implicit call option since the straight debt portion of the bond is worthless. This is also the market's perceived value of the equity portion of the convertible bond. But, like the model discussed by Smith, if the probability of conversion is less than one, the value of the option component is not, in general, equal to the market perceived value of the equity component and this model also cannot be used to display a convertible bond's value as the sum of its market perceived straight debt and equity components.

3.2.2 Callable Convertible Debt

It was demonstrated in Chapter II that Brigham's model valuates a callable convertible bond as a stream of interest payments plus a terminal value. In Brigham's model, there is complete agreement among market participants as to the exact date when the convertible bond will expire, through call, voluntary conversion, or maturity. The Brigham model contains a kind of separation of the convertible's cash flows into debt interest expense plus a terminal payoff of principal or common stock. Since there is no way of being sure whether the terminal payoff will be in the form of equity or principal, Brigham discounts the terminal payoff, as well as the debt interest expense, at the same internal rate of return. The uncertainty about the form of the terminal payoff and the use of a unique internal rate of return prohibits separating the convertible's value into market perceived debt and equity components. Moreover, as is shown below, the assumption of a consensus expiration date is unnecessarily restrictive, and it certainly cannot be identified from market data.

In the more recently developed models of Ingersoll and Brennan and Schwartz, callable convertible debt is valued using option pricing techniques. As noted, these models are more general than the non-callable convertible bond valuation model discussed by Smith, since they also incorporate the corporation's option to call. However, since these models contain the same limitations noted in the one Smith discusses, then for the same reasons they cannot be used to analytically decompose the convertible bond's value into its perceived debt and equity components.

3.3 A NEW MODEL OF THE VALUATION OF CONVERTIBLE BONDS

When a firm issues a convertible bond the market may perceive it as being either straight debt or pure equity, but more generally it will be perceived as some combination of both. We may thus write this convertible's value as the sum of its perceived debt, B, and equity, E, components:

$$C = B + E. \tag{3.5}$$

How the market perceives the value of the debt and equity components will determine how the convertible bond is valued. For example, suppose the convertible is way in the money and call appears imminently soon. Thus, it is perceived by the market to be primarily equity. Then the period to period change in the convertible's market price will behave like the period to period change in the company's common stock netted for any intermediate term dividends. Alternatively, perhaps the convertible is way out of the money and maturity is very near. In this case we would expect that the convertible will be perceived as primarily straight debt and its market price should behave very much like that of straight debt, regardless of the behavior of the firm's common stock price.

This discussion suggests that we may focus on the behavior of changes in a convertible's market price, and then assess how much of that behavior resembles market price changes in equity and market price changes in straight debt.

3.3.1 Assumptions

The following assumptions are made:

1. Capital markets are assumed to be efficient; current prices reflect all available information.
2. The firm may have convertible debt, straight debt, and common stock in its capital structure.
3. Personal and corporate taxes exist and bankruptcy can occur through default of principal on the convertible bond.
4. The convertible bond is issued at time $t=0$ and it matures in T discrete time periods.

5. Conversion may occur voluntarily or because of call but only at the end of each discrete time period.

6. Convertible bondholders receive I, the interest payment on the convertible, at the end of each discrete time period for which the convertible is still alive. If the bond is held to maturity, bondholders either receive F, the promised repayment on the bond, or V, the value of the convertible bondholders' claim on the firm, whichever is smaller.

7. The one period before tax required rate of return on the firm's straight debt is r and the one period before tax required rate of return return on its equity, net of dividends, is k.

8. The market formulates some subjective probabilities that conversion will occur at the end of each future time period.

From assumption (7), r can be written as

$$r = (E[D_1] + I - D_0)/D_0, \tag{3.6}$$

where D_0 equals the current market price of an "otherwise equivalent straight bond" (that is a bond having the same coupon payments, maturity, default risk, etc.), $E[D_1]$ is the end of time period one expected market price of the same straight bond, and I, the value of the coupon payment to be received at the end of time period one.

From assumption (7), k can be written as

$$k = (E[S_1] - S_0)/S_0, \tag{3.7}$$

where S_0 equals the current market price of a share of common stock and $E[S_1]$ the end of period one expected market price of a share of common stock.

At the end of any discrete time period the convertible bond will either be converted or it will remain alive as a convertible bond. Conversion may be due to call or it may occur voluntarily. While the issues of when to call and when to convert are under active investigation in the literature, for present purposes it is not necessary to know precisely why the convertible bond is converted when it is. Indeed, within a more general framework than those adopted by analysts pursuing optimal call and conversion policies, it is unlikely that we can identify, ex-ante, exactly when and why a convertible bond should be called or converted. There is, for example, no model for optimal call policy which incorporates differential and progressive personal taxes, corporate taxes, and liquidity costs, let alone a variety of possible information asymmetries. What we do assume, however, is that for each future period the market has formulated current subjective probabilities of conversion occurring. These probabilities are further assumed to be time invariant and they represent the market's assessment of conversion. These probabilities are each conditional upon there being no conversion prior to the time period in question. Notationally, let P_{ct} denote the beginning of current period probability that conversion takes place at the end of time period t given that conversion has not already taken place prior to time period t. If conversion did take place prior to time period t, then $P_{ct}=0$.

3.3.2 The Equity Component

Since convertible bondholders will not receive dividends which are paid to current stockholders, the current equity value of the convertible bond as perceived by the market is defined as being equal to the present value of the expected future common stock components of the convertible bond. Thus, the equity value is the discounted sum of the conversion probabilities times their corresponding expected common stock values:

$$E_0 = \sum_{t=1}^{T} P_{ct} E[CV_t]/(1+k)^t. \qquad (3.8)$$

Alternately, E_0 is the current value of the weighted average of the future expected conversion values, $E[CV_t]$, where the weights are the conditional conversion probabilities.

To consider the behavior of this equity value, suppose the market believes there is a one hundred percent probability of conversion at the end of time period one. This may occur, as it would in the Ingersoll-Brennan and Schwartz world, if the market fully expects the end of period conversion value to exceed the call price. In this case, equation (3.8) simplifies to

$$E_0 = E[CV_1]/(1+k), \tag{3.9}$$

since all future conversion probabilities are zero. Alternatively, if the market is convinced that future conversion values will be prohibitively low, there will be no probability of conversion, in which case $P_{ct}=0$ for all t, hence $E_0=0$. In this case, the entire value of the convertible bond is described by its straight debt component. More generally, the current equity value of the convertible bond will depend upon the current time pattern of conversion probability beliefs and currently expected future conversion values.

The time t=0 expected equity portion of time t=1 convertible bond value can be written as

$$E[E_1] = P_{c1}E[CV_1] + \sum_{t=1}^{T-1} P_{ct}E[CV_{t+1}]/(1+k)^t. \qquad (3.10)$$

Note that because equation (3.10) is valued at t=0, investors' expectations about conversion occurring at the end of each subsequent time period are the same as those used in (3.8).

Multiplying both sides of equation (3.8) by (1+k), subtracting this product from equation (3.10) and rearranging terms yields

$$(E[E_1] - E_0)/E_0 = k. \qquad (3.11)$$

Equation (3.11) states that the current one period expected rate of return on the equity portion of the convertible bond, as perceived by the market, is equal to the same one period required rate of return on the firm's common stock (netted for dividends).

3.3.3 The Straight Debt Component

Since it is assumed that conversion can only occur at the end of each discrete time period, the bondholder necessarily receives the interest payment on the convertible bond at the end of the first time period. The bondholder may then convert or hold the bond one more period. The current value of the straight debt portion of the convertible bond, as perceived by the market, B_0, is thus the present value of this certain interest income, plus the discounted sum of the expected future interest payments, and the expected termination bond value of the convertible. The terminal bond value is the smaller of F, the promised payment on the bond or V, the bondholders' claim on the firm's assets in default:

$$B_0 = I/(1+r) + \sum_{t=1}^{T-1} I(1-P_{ct})/(1+r)^{t+1}$$

$$+ (1-P_{cT})\min(F,V)/(1+r)^{T}. \tag{3.12}$$

If the market believes there is a one hundred percent probability that the convertible bond will be converted at the end of the first time period, $P_{c1}=1$, hence $P_{ct}=0$ for all

$t>1$, then equation (3.12) simplifies to $B_0=I/(1+r)$. Thus, in the extreme case when conversion is fully expected at the end of the current period, the value of the straight debt portion of the convertible bond simply equals the present value of the end of period coupon payment. At the other extreme, if the market believes that there is no likelihood of conversion, the value of the convertible is equivalent to that of straight debt.

As with the equity component, the time $t=0$ expected straight debt portion of time period $t=1$ convertible bond value can be written as

$$E[B_1] = \sum_{t=1}^{T-1} I(1-P_{ct})/(1+r)^t$$

$$+ (1-P_{cT})\min(F,V)/(1+r)^{T-1}. \quad (3.13)$$

Multiplying both sides of equation (3.12) by $(1+r)$, subtracting this product from equation (3.13) and rearranging terms yields

$$(E[B_1] + I - B_0)/B_0 = r. \qquad (3.14)$$

Equation (3.14) states that the expected one period rate of return on the straight debt portion of the convertible bond, as it is perceived by the market, equals the required rate of return on "otherwise identical" straight debt.

Comparing equations (3.11) and (3.14) highlights an important feature of convertible bonds. While convertible bondholders receive coupon payments as do the holders of straight debt, they do not receive dividend payments which are only paid to common stockholders.

In the development of this model, it is implicitly assumed that the probability of immediate conversion is equal to zero (i.e. $P_{co}=0$). This appears to be a reasonable assumption as none of the convertible bonds used in the analysis were converted in whole or in part during the months immediately following issuance.

3.4 A GENERAL VALUATION MODEL

Consider now the valuation of the convertible bond which can be written as the sum of the values of its debt and equity components. Using equations (3.8) and (3.12) the current value of the convertible bond is given by

$$C_0 = \sum_{t=1}^{T} P_{ct} E[CV_t]/(1+k)^t + I/(1+r)$$

$$+ \sum_{t=1}^{T-1} I(1-P_{ct})/(1+r)^{t+1}$$

$$+ (1-P_{cT})\min(F,V)/(1+r)^T \qquad (3.15)$$

or

$$C_0 = E_0 + B_0. \qquad (3.16)$$

Using equations (3.10) and (3.13), the end of next period expected convertible bond value can be written as

$$E[C_1] = P_{c1}E[CV_1] + \sum_{t=1}^{T-1} P_{ct}E[CV_{t+1}]/(1+k)^t$$

$$+ \sum_{t=1}^{T-1} I(1-P_{ct})/(1+r)^t$$

$$+ (1-P_{cT})\min(F,V)/(1+r)^{T-1} \qquad (3.17)$$

or

$$E[C_1] = E[E_1] + E[B_1]. \qquad (3.18)$$

Accounting for the end of period coupon payment, equation (3.18) can be equivalently written as

$$E[C_1] + I = E[E_1] + E[B_1] + I. \qquad (3.19)$$

To obtain a required rate of return on the convertible bond, subtract equation (3.16) from (3.19) and divide both sides of the sum by C_0:

$$(E[C_1] + I - C_0)/C_0 = (E[E_1] - E_0)/C_0$$

$$+ (E[B_1] + I - B_0)/C_0. \qquad (3.20)$$

Substituting from equations (3.11) and (3.14), equation (3.20) may be rewritten

$$c = (E_0/C_0)k + (B_0/C_0)r. \qquad (3.21)$$

Equation (3.21) states that the required rate of return on the convertible bond, c, is a weighted average of the required rates of return on the firm's common stock and otherwise identical straight debt (the weights being the proportions of the convertible bond perceived by the market to be equity and straight debt respectively).

Chapter IV

METHODOLOGY

4.1 INTRODUCTION

We learned in Chapter II that, on average, the announcement of issuance of convertible debt results in abnormally negative returns to issuing firms' stockholders. Dann and Mikkelson stated that this empirical observation is not consistent with several popular financing theories. In this chapter we extend the valuation model developed in Chapter III in an attempt to realign financing theory with announcement period returns.

Equation (3.16) defines the value of convertible debt as the sum of its intrinsic values of equity and straight debt. In this chapter, a methodology for estimating this valuation equation is presented, and it is shown that estimates of the proportions of the convertible perceived to be straight debt and equity can be obtained. An exact specification of the estimating equation will be presented and the method for grouping according to the expected value of the market perceived equity component is discussed. The chapter also discusses the expected relationships between the perceived equity component, the change in the issuing firm's financial leverage, and the computed excess returns.

4.2 AN EXTENSION OF THE MODEL

Equation (3.21) is an ex-ante equation; that is c, k, and r are required, or expected, rates of return. To determine the proportions of the convertible bond perceived to be equity and debt, ex-post convertible bond rates of return are regressed on ex-post common stock rates of return (netted for dividends) and ex-post rates of return on "otherwise identical" straight debt. Running such a regression implicitly assumes that the ex-post rate of return on the equity portion of the convertible bond equals the ex-post rate of return on the firm's common stock, netted for dividends. The same equivalent relationship is assumed to hold between the ex-post rate of return on the straight debt portion of the convertible bond and the ex-post rate of return on otherwise identical straight debt. These relationships can be written in equation form as

$$(E_1 - E_0)/E_0 = (S_1 - S_0)/S_0 \tag{4.1}$$

and

$$(B_1 + I - B_0)/B_0 = (D_1 + I - D_0)/D_0, \tag{4.2}$$

where S_1 and D_1 are end of period one observed market prices of common stock and straight debt respectively. Now equation (3.21) can be written as

$$c_x = (E_0/C_0)k_x + (B_0/C_0)r_x, \tag{4.3}$$

where the subscript x denotes ex-post.

4.3 ESTIMATING THE CONVERTIBLE'S PERCEIVED EQUITY COMPONENT

4.3.1 An Econometric Model

According to equation (4.3) the ex-post return on a convertible bond is a weighted average of the respective ex-post returns on its equity and straight debt components.

This model can be used to determine the leverage impact of convertible debt issuance by estimating the proportion of the convertible perceived by the market to be equity, E_0/C_0. To estimate E_0/C_0, equation (4.3) is first written in econometric form as follows:

$$c_{xi} = \alpha k_{xi} + \beta r_{xi} + e_i \tag{4.4}$$

$$\text{s.t.} \quad \alpha + \beta = 1$$

$$0 \leq \alpha \leq 1$$

$$0 \leq \beta \leq 1,$$

where α is an estimate of E_0/C_0, the proportion of the convertible perceived to be equity, β is an estimate of the proportion of the convertible perceived to be straight debt, and e_i is the error term which captures any errors due to misspecification of the model or to measurement of the variables c_x, k_x, and r_x. The first constraint recognizes that the equity and debt portions sum to one, as given by equation (3.5). The second and third constraints bound α and β to between zero and one and this follows because a convertible bond cannot be perceived to be more than all equity or all straight debt nor can it be perceived to have a negative equity or straight debt component.

Equation (4.4) is used to perform cross-sectional OLS regressions on homogenous groups of convertible bonds. Grouping of the data is discussed in Chapter V. A significant estimated value of α implies that the return on that group of convertible bonds is at least partly explained by their respective common stock returns and these bonds are, therefore, perceived to have a significant equity component.

4.3.2 Measuring Returns

Even though the convertible bondholder receives no dividends, coupon payments are received while the bond is alive. If the bond is sold or converted between coupon dates, the bondholder receives the accrued value of the forthcoming interest payment. Therefore, accrued interest income value must be accounted for when calculating the monthly returns on the convertible. The calculation of the convertible bond's return is described by the following equation:

$$c_{it} = (C_{it+1} + I_i - C_{it})/C_{it} \quad \text{for } t = 1 \text{ to } 3, \tag{4.5}$$

where C_{it} is the end-of-month t market price for convertible bond i as found in Standard and Poor's Bond Guide and I_i is the accrued monthly value of any interest payment due on bond i. I_i is estimated by multiplying the face value of the bond ($1000) by the stated coupon rate, then dividing this product by twelve. Month t=1 is the first month for which a market price is available from Standard and Poor's Bond Guide. Usually this is the first month following issuance of the bond, however, for unknown reasons, some convertibles do not have prices listed until several months after issuance.

Equation (4.1) indicates that the monthly return on the equity portion of the convertible bond can be estimated by the return on the firm's common stock net of any dividends. Therefore, monthly equity returns are estimated using end-of-month common stock prices. This calculation is described in the following equation:

$$k_{it} = (S_{it+1} - S_{it})/S_{it} \qquad \text{for } t = 1 \text{ to } 3, \tag{4.6}$$

where S_{it} is the market price of firm i's common stock as of the end of month t.

Estimating the return on otherwise identical straight debt is not as clear cut a matter. Some firms in the sample have no outstanding straight debt issues, hence there are no firm specific market prices from which proxies for the straight debt prices can be calculated. Other firms have more than one kind of debt outstanding and a problem of which security to use for returns calculations emerges. But even if a firm has only one outstanding straight debt issue, we cannot be sure that it is otherwise identical to the convertible issue. For example, seniority, maturity, and coupon payments are seldom the same.

The method chosen for calculating the monthly bond return is to estimate it indirectly by using published bond indices. In particular, the Standard and Poor's annualized monthly yields on long term new industrial and utility bonds are used to estimate an end-of-month theoretical market price for the bond component embedded in the convertible. This computation is shown below:

$$P_{it} = \sum_{m=1}^{T_i} I_i/(1+y_t/12)^m$$

$$+ F_i/(1+y_t/12)^{T_i} \quad \text{for } t = 1 \text{ to } 4, \qquad (4.7)$$

where P_{it} is the inferred market price of the straight debt portion of convertible bond i as of month t, y_t is the annualized Standard and Poor's yield for month t, I_i is the accrued monthly value of any interest payment due on convertible bond i, F_i is the face value of convertible bond i, and T_i is the time to maturity, in months, of convertible bond i. Since Standard and Poor's publishes bond yields for investment grade bonds only, the BBB bond yield is used in equation (4.7) for bonds rated BBB or below. The proper corresponding yield is used for investment grade bonds (AAA to BBB). Equation (4.7) is written in a form assuming monthly coupon payments.

The one month rate of return on the straight debt portion of the convertible bond, r_{it}, can now be computed using the estimated values of P_{it} and P_{it+1}:

$$r_{it} = (P_{it+1} + I_i - P_{it})/P_{it} \qquad \text{for } t = 1 \text{ to } 3. \qquad (4.8)$$

Use of the BBB rate for lower rated and unrated bonds may bias the estimated return on the straight debt portion of the convertible bond. Since the true value of y_t for lower rated bonds is expected to be greater than y_t for BBB bonds, P_{it} will probably be upward biased. But this bias will wash out to some extent when computing the estimated value of r_{it} from equation (4.8). Therefore, depending upon the degree of bias in P_{it} and P_{it+1}, r_{it} can be upward biased, downward biased, or not biased at all.

4.4 EXPLAINING ANNOUNCEMENT PERIOD ABNORMAL RETURNS

4.4.1 The Relationships Between Alpha, Financial Leverage, and Excess Returns

4.4.1.1 Alpha and the Change in Leverage

Earlier, it was noted that α represents the proportion of the convertible bond perceived by the market to be equity. Therefore, a direct relationship between the change in financial leverage due to the issuance of convertible debt and α is expected. Defining leverage as the debt to firm value ratio, the leverage of a firm before it issues convertible debt is given by

$$L_{pre} = D/V, \tag{4.9}$$

where D is the value of outstanding straight debt and V is the value of the firm.

When a firm makes a convertible bond offering, there may be a change in the market's perception of the firm's degree of leverage. If the portion of the convertible bond perceived as being equity is sufficiently large, then the issuance of the convertible will decrease financial leverage; otherwise, leverage will increase. In general, the post-issuance level of leverage is given by

$$L_{post} = [D + (1-\alpha)C_0]/(V + C_0), \qquad (4.10)$$

where C_0 represents the market value of the new convertible bond issue.

The perceived change in leverage is simply the difference between equations (4.10) and (4.9):

$$\Delta L = (C_0[V(1-\alpha) - D])/[V(V+C_0)]. \qquad (4.11)$$

If a convertible issue is perceived to decrease leverage, equation (4.11) will be negative. For example, suppose the market believes that a particular convertible bond issue is all equity, implying that $\alpha=1$. For the underlying firm, equation (4.11) reduces to $\Delta L=-DC_0/[V(V+C_0)]$ which is the maximum decrease in leverage due to the issuance of convertible debt. On the other hand, suppose a particular convertible bond is perceived to be all straight debt, implying that $\alpha=0$. In such a case, $\Delta L=C_0(V-D)/[V(V+C_0)]$, the maximum increase in leverage due to convertible debt issuance.

Of course, it is possible that the proportion of the convertible bond perceived to be equity is such that there is no effect upon the firm's financial leverage. The value of α which causes no change in leverage, denoted as $\alpha^{\bullet}$, can be derived by setting equation (4.11) equal to zero and solving for α:

$$\alpha^{\bullet} = 1 - D/V = S/V, \qquad (4.12)$$

where S is the market value of the firm's common stock. Any value of α greater than $\alpha^{\bullet}$ results in a leverage decreasing effect. Any value of α less than $\alpha^{\bullet}$ results in a leverage increasing effect. Thus, a convertible bond may be primarily straight debt ($\alpha<.5$), as King (1984) claims, yet its issuance will reduce financial leverage as long as $\alpha>\alpha^{\bullet}$. In order to determine if a particular convertible bond issue increases or decreases leverage, the values of α and $\alpha^{\bullet}$ must be estimated.

In general, the relationship between ΔL and α can be explained by examining the first derivative of ΔL with respect to α:

$$\delta\Delta L/\delta\alpha = - C/(V+C) < 0. \tag{4.13}$$

Equation (4.13) implies that the value of ΔL decreases as the value of α increases. Figure 6 shows a graphical representation of this relationship.

4.4.1.2 The Change in Leverage and Excess Returns

According to the leverage hypothesis, leverage increasing capital structure changes should result in positive common stock price reactions. Although the exact relationship between excess returns and the change in leverage isn't known, it can be described as follows:

$$ER = ER(\Delta L) \tag{4.14}$$

$$\delta ER/\delta\Delta L > 0,$$

where ER represents excess returns. Equation (4.14) indicates that positive leverage changes (increases in leverage) should result in positive excess returns to the common stock. This relationship is depicted in Figure 7. As

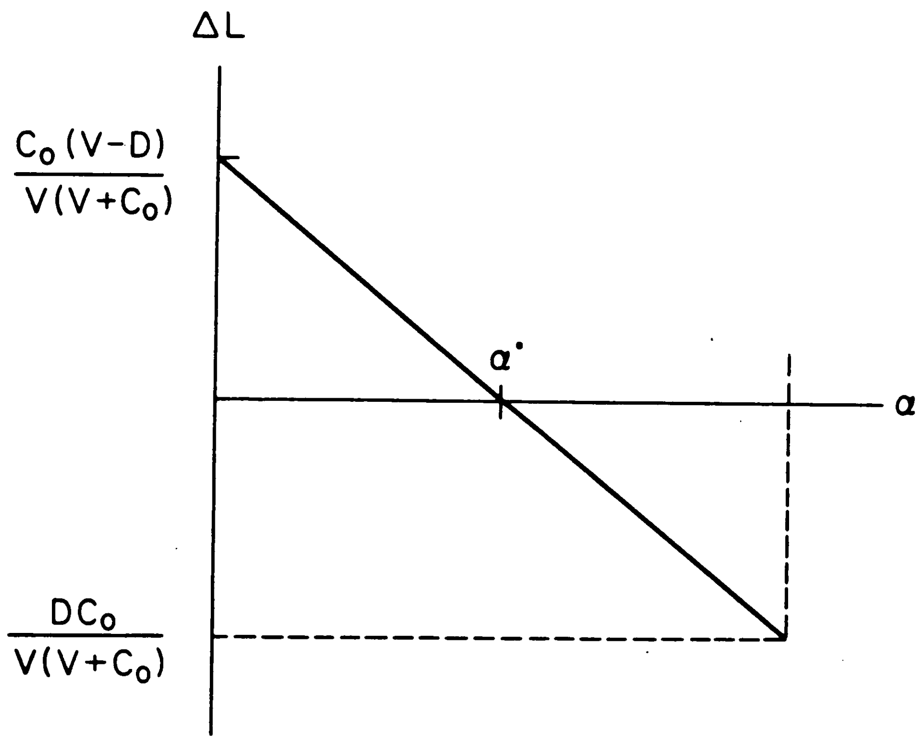

Figure 6: The Expected Relationship Between Alpha and the Change in Leverage

shown, no excess returns are expected if there is no change in leverage due to convertible debt issuance.

4.4.1.3 Alpha and Excess Returns

Since the change in leverage is related to the value of α and since excess returns are related to the change in leverage (according to the leverage hypothesis), then excess returns are related to α. If the convertible bond is perceived to decrease leverage, the leverage hypothesis predicts that common stock prices will react in a negative manner. As long as $\alpha > \alpha^{*}$, the perceived change in leverage is negative. Therefore, the relationship between excess returns and α can be written as

$$ER = ER(\alpha/\alpha^{*}) \tag{4.15}$$

$$\delta ER/\delta(\alpha/\alpha^{*}) < 0,$$

where α/α^{*} is a measure of the leverage change due to the announcement of convertible debt issuance. Note that there is no change in leverage when $(\alpha/\alpha^{*})=1$, hence, in this case, the leverage hypothesis predicts that excess returns will be zero. Figure 8 depicts the relationship between excess returns and the change in leverage given by (α/α^{*}).

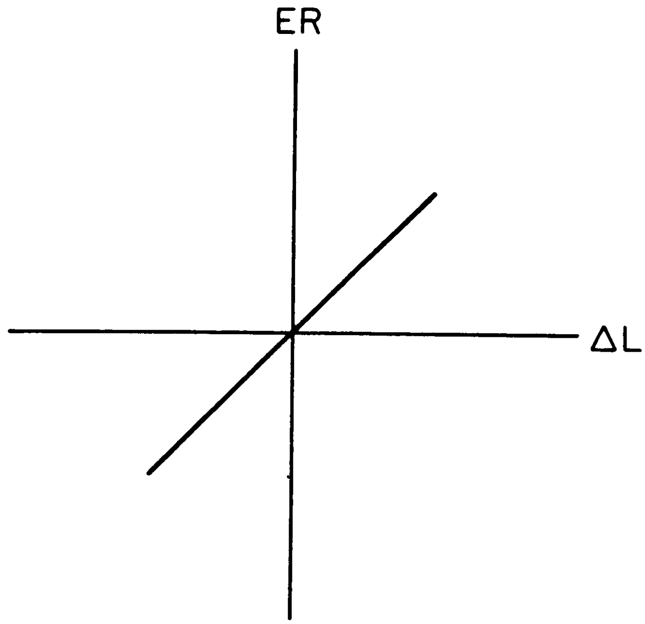

Figure 7: The Expected Relationship Between the Change in Leverage and Excess Returns

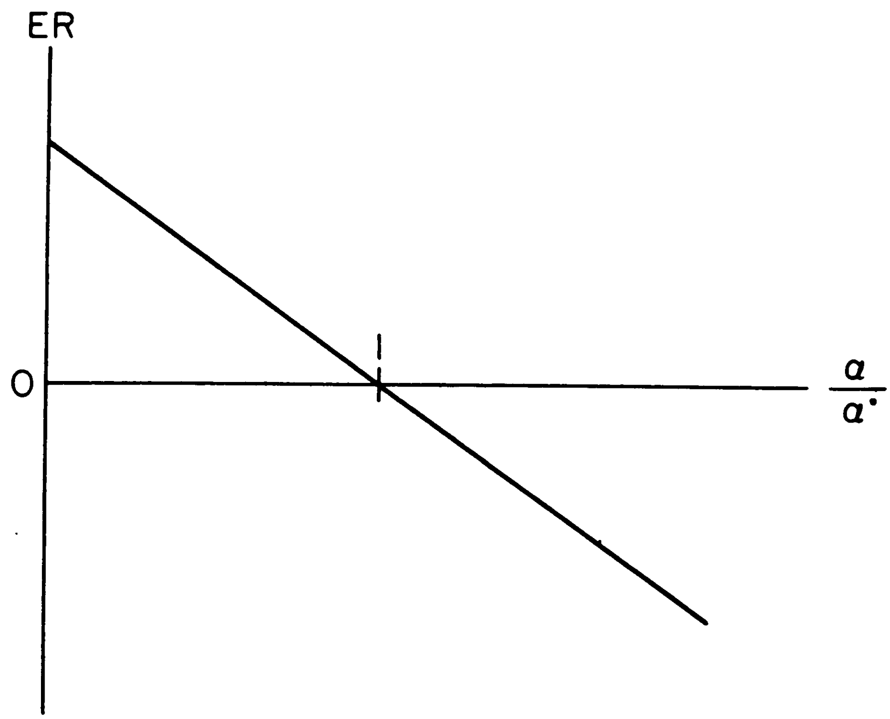

Figure 8: The Expected Relationship Between Excess Returns and Alpha

The relationship between the change in leverage and excess returns is tested by regressing announcement period excess returns, ER, on $(\alpha/\alpha^{\bullet})$. This regression is described by

$$ER_i = a + bLEV_i + e_i, \tag{4.16}$$

where ER_i is the announcement period excess return on convertible bond issuing firm i's common stock and LEV is $\alpha/\alpha^{\bullet}$.

The leverage theory predicts that the estimator, b, will be significantly negative. In other words, announcement of the issuance of convertible debt perceived to decrease leverage (LEV>1), will cause underlying common stock prices to react in a negative manner. The greater the perceived leverage decreasing effect of announcement of the issuance of the convertible (the greater the value of LEV), the more negative the expected announcement period excess return earned by the issuing firm's common stock.

4.4.2 Alternative Explanations

Although the emphasis in the dissertation is to show that the leverage hypothesis is consistent with observed announcement period abnormal returns to common stockholders of convertible debt issuing firms, other hypotheses may also prove to be consistent with this observed relationship. For example, information effects due to new financing is an alternative explanation not directly tested for in this study.

Recall that the Miller and Rock and Myers and Majluf articles predict negative returns to common stockholders of convertible debt issuing firms because the issuance of new securities in their models conveys bad news to the market. It was noted in Chapter II that Dann and Mikkelson directly test this hypothesis and conclude that it does not provide a fully consistent explanation for the negative announcement period abnormal returns.

According to the Myers and Majluf model, issuing equity signals bad news. Issuing debt also signals bad news but to a lesser extent. Therefore, the expected relationship between excess returns and the leverage change can be described as in Figure 9. As shown, any new convertible issue should result in negative excess returns, even if it is perceived to be all debt ($\alpha/\alpha^{\bullet}=0$). But, as with the leverage hypothesis, the Myers and Majluf model predicts a negative relationship between excess returns and the relative leverage change because the more the convertible bond is like equity, the worse is the news signalled to the market.

On the other hand, the Miller and Rock model states that the issuance of equity and debt signal equally bad news to the market. Therefore, according to this model, negative excess returns should be observed upon announcement of issuance of convertible debt and these excess returns should not be related to the perceived change in leverage. The relationship between excess returns and α/α^{*}, as predicted by the Miller and Rock model, is shown in Figure 10.

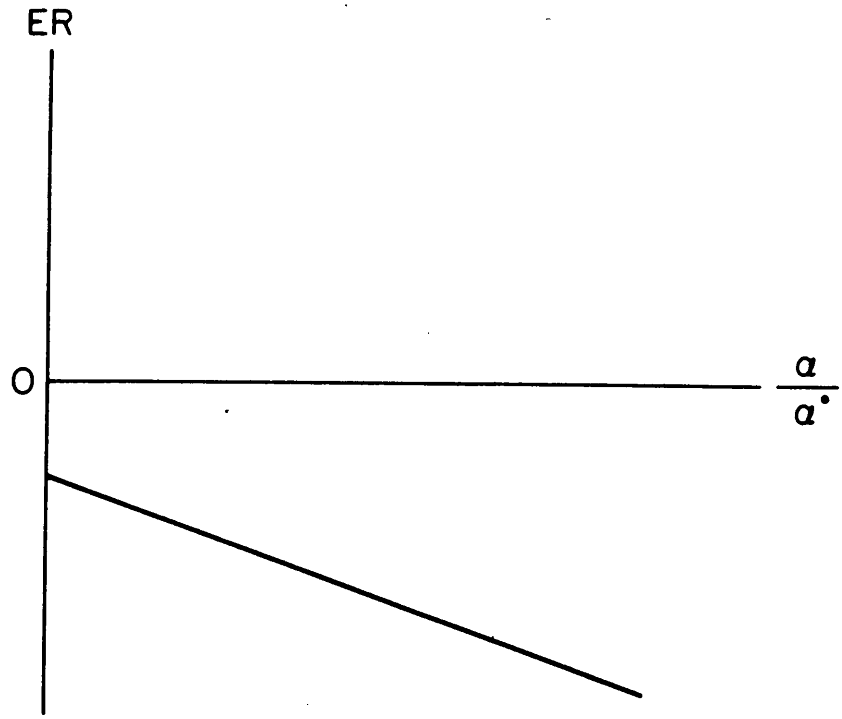

Figure 9: The Myers and Majluf Predicted Relationship Between Excess Returns and Leverage Change

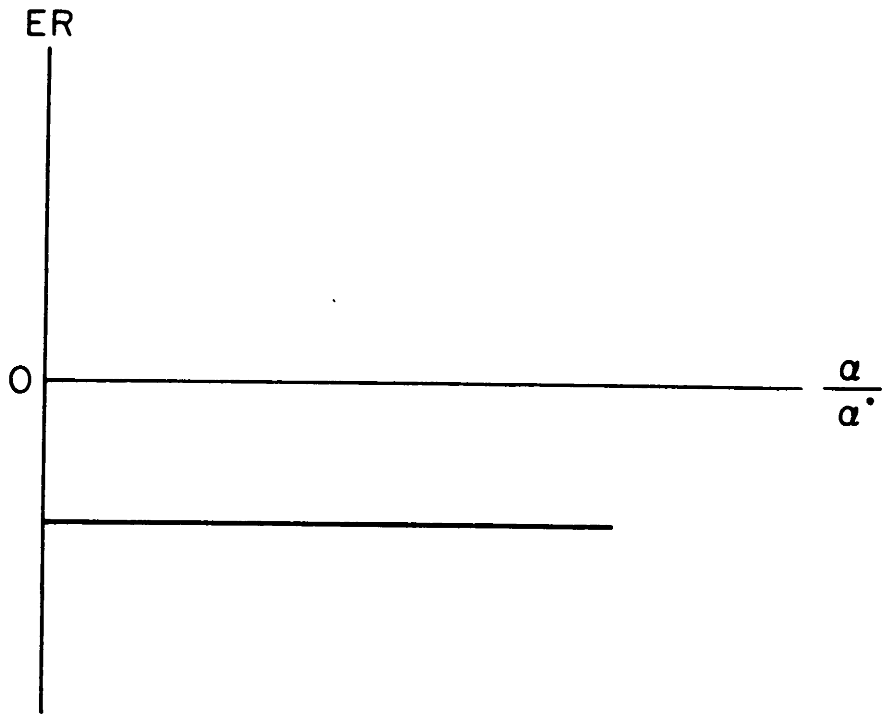

Figure 10: The Miller and Rock Predicted Relationship Between Excess Returns and Leverage Change

Chapter V

DATA AND ANALYSIS

5.1 THE DATA USED IN THE STUDY

To conduct the analysis, a list of 1393 convertible bonds issued between 1968 and 1983 inclusive is compiled. Bonds issued in 1968 and 1969 are identified in Investment Dealers' Digest. Those issued between 1970 and the first quarter of 1983 are identified in the Registered Offerings of Securities (ROS) computer tapes. Convertibles issued prior to 1968 are excluded from the study because monthly price data on these bonds is not readily available. The sample is further restricted to those bonds which meet the following requirements:

1. The convertible bond's underlying common stock is listed on the NYSE or the ASE and it is also listed on the Center for Research in Securities Prices (CRSP) Daily Stock Returns computer tapes beginning at least 75 days prior to the announcement of the convertible bond issue. 710 issues satisfy this requirement.

2. Four consecutive end-of-month market prices are available from Standard and Poor's Bond Guide following issuance of the convertible bond. 441 of the remaining issues meet this requirement.

3. Announcement of the issuance of the convertible bond is printed in the Wall Street Journal Index. 374 of the remaining convertible bonds meet this requirement.

4. The underlying common stock did not split during the four month period in which end-of-month convertible

bond prices are collected. 357 of the remaining issues meet this requirement.

Table 2 compares the sample used in this study with the sample used by Dann and Mikkelson by year of announcement and number of announcements per year. Announcements for convertibles issued in the first few months of any year usually appear during the latter months of the prior year. This explains the large discrepancy for 1969 between the samples since Dann and Mikkelson studied bonds issued between 1970 and 1979.

Four end-of-month convertible bond prices are collected for each of the convertible bonds in the final sample. These four prices are used to compute three consecutive monthly rates of return for each bond. In effect, this procedure triples the size of the data set. Therefore, 1,071 rates of return are computed, three for each of the 357 convertible bond issues.

5.2 ESTIMATING ALPHA

5.2.1 The Equation to be Estimated

To determine the portion of the convertible bond perceived by the market to be equity, convertible bond rates of return are regressed on common stock and straight debt rates of return as given by equation (4.4) which is written again here for convenience:

TABLE 2

Comparison of Data by Year of Announcement

Year of Announcement	Number of Announcements: Dann and Mikkelson	Number of Announcements: Janjigian
1967	-	6
1968	-	60
1969	7	51
1970	23	16
1971	41	37
1972	15	13
1973	2	3
1974	3	7
1975	15	13
1976	6	10
1977	4	4
1978	7	3
1979	9	11
1980	-	40
1981	-	35
1982	-	33
1983	-	15
Total Number of Observations	132	357

$$c_{xi} = \alpha k_{xi} + \beta r_{xi} + e_i \tag{4.4}$$

$$\text{s.t.} \quad \alpha + \beta = 1$$

$$0 \le \alpha \le 1$$

$$0 \le \beta \le 1,$$

5.2.2 Grouping the Data

In equation (4.4), α is an estimator of the portion of a convertible bond perceived to be equity. It is reasonable to expect α to differ across convertible bond issues. For this reason, the bonds in the sample are separated into groups according to their expected α value.

Convertible bonds are usually issued with a stated conversion price above the current market price of a share of the underlying common stock. Thus, they are generally issued out of the money. However, at issuance, some convertibles are closer to being in the money than are others, in the sense that their conversion price is closer to their market price. Ceteris paribus, bonds issued closer to the money have a greater chance of conversion and, hence, behave more like equity than those issued way out of the money.

Similarly, convertible bonds whose underlying stock exhibit greater temporal return variability have a greater probability of conversion to equity, ceteris paribus. If the price of the common stock is very volatile, there is a greater chance that it will rise above the stated conversion price on the convertible bond. Therefore, convertibles whose underlying common stock exhibit highly volatile price behavior may be perceived as more equity-like than those whose underlying common stock exhibit very stable price behavior.

There are probably other characteristics which may be used to distinguish further the α groupings, however, here the degree to which a convertible is in the money and the variability of its underlying stock will be used to determine the probability of its being in the money. These probabilities are then used to group the data.

If it is assumed that common stock rates of return are normally distributed, then the logarithm of price is normally distributed. That is, if $S_2/S_1 = e^r$ or $\ln(S_2/S_1) = r$, where S_i is the common stock price at the end of period i and r is rate of return, then $\ln(S_2/S_1)$ is normally distributed if r is normally distributed. If it is also assumed that the price of the common stock is equal to the mean of the distribution of stock prices, then the statistic $[\ln(CP)-\ln(S)]/\sigma$, where CP is the conversion price of the convertible bond and σ is the temporal standard deviation, follows a standard normal distribution and the probability of S exceeding CP is given by the area to the right of the statistic. The larger is this probability, the more equity-like is the convertible bond. Therefore, the three rates of return for each convertible bond in the sample are grouped according to these estimated probabilities of being in the money.

5.2.3 Estimating Probabilities Using Ex-Ante and Ex-Post Prices

Recall that for each of the three consecutive monthly rates of return computed for each convertible bond in the sample, a corresponding monthly rate of return is computed for the underlying common stock as given by equation (4.6). Since an end-of-month (ex-post) stock price and an end-of-previous-month (ex-ante) stock price is used to compute a rate of return, it is not clear which stock price should be used in computing the probability of the convertible bond being in the money.

To determine if the estimated value of α is sensitive to the method of computing probabilities, probabilities using both methods are computed and the 1,071 convertible bond returns are segmented into deciles according to each. Deciles 1 though 9 include 107 returns observations each; decile 10, the group containing bonds with the highest probability of conversion, includes 108. This grouping procedure may result in a separation of the three returns associated with each convertible bond.

5.2.4 Restricted versus Unrestricted Regressions

According to regression equation (4.4), constraints should be imposed upon the parameters of the model and the intercept term should be suppressed. To determine if the estimated value of α is sensitive to these restrictions, the regression equation is reestimated without constraints and with an intercept term. The form of the unrestricted regression is given by

$$c_{xi} = \alpha_0 + \alpha k_{xi} + \beta r_{xi} + e_i, \qquad (5.1)$$

where α_0 is the intercept term and all other variables are as defined in equation (4.4). Therefore, a total of forty regression are performed: ten each for an ex-ante restricted model, ten each for an ex-post restricted model, ten for an ex-ante unrestricted model, and ten for an ex-post unrestricted model.

5.2.5 Results

The estimated values of α and β using the restricted form of the regression for both the ex-ante and ex-post models appear in Tables 3 and 4. The probability of being in the money increases from Decile 1 to Decile 10. In each cell, the first figure is the parameter estimate, t-values for each estimate are shown in parenthesis, and p-values which indicate the level of significance, appear below the t-values. The F-value and R^2 for each regression is also shown. The number of observations in each decile is shown in parenthesis. The correlation between the independent variables (return on equity and return on straight debt) is equal to 0.0298. The unrestricted regression results for both the ex-ante and ex-post methods of grouping observations are displayed in Tables 5 and 6.

It is evident from the t-values and the R^2's in Tables 3 through 6 that the estimated values of α are highly significant and that the model explains a high degree of variation in convertible bond rates of return. The highly significant and large estimates of α indicate that the market believes convertible bonds have a large equity

TABLE 3

Ex-Ante Restricted Regression Results

Probability Deciles	Alpha	Beta	F	R^2
1 (107)	.3951 (8.113) .0001	.6049 (12.424) .0001	84.973	.44
2 (107)	.4317 (13.970) .0001	.5683 (18.389) .0001	190.437	.64
3 (107)	.5023 (14.856) .0001	.4977 (14.718) .0001	167.155	.61
4 (107)	.4129 (14.312) .0001	.5871 (20.351) .0001	167.778	.61
5 (107)	.4841 (14.502) .0001	.5159 (15.452) .0001	159.820	.60
6 (107)	.5712 (19.348) .0001	.4288 (14.524) .0001	374.732	.78
7 (107)	.4970 (14.940) .0001	.5030 (15.118) .0001	209.307	.66
8 (107)	.6482 (18.859) .0001	.3518 (10.237) .0001	342.106	.76
9 (107)	.6461 (17.860) .0001	.3539 (9.782) .0001	286.603	.73
10 (108)	.7139 (22.011) .0001	.2861 (8.821) .0001	409.554	.79

component; much higher than the 18.4% estimated by King. For example, in the ex-ante restricted case (Table 3), about 40% of the value of the convertible bonds represented in Decile 1 are perceived to be equity. About 71% of the value of the convertibles represented in Decile 10 are perceived to be equity.

The return on the straight debt portion of the convertible is most probably measured with some degree of error. Therefore, the estimated value of β is downward biased. However, the direction of the bias in the estimated value of α is not clear.[9]

As expected, there is a general rise in the estimated values of α from Decile 1 to Decile 10. The rise is not linear, however, perhaps because the market has difficulty in distinguishing the probability of being in the money for observations in the middle deciles. The estimated values of α for the extreme deciles (1, 9, and 10) are found to differ significantly from the estimated values of α for the middle deciles. Overall, the estimated values of α appear to be insensitive to the method of determining the probability of being in the money (ex-ante versus ex-post) and to the form

[9] see Madalla (1977).

TABLE 4

Ex-Post Restricted Regression Results

Probability Deciles	Alpha	Beta	F	R^2
1 (107)	.3698 (9.945) .0001	.6302 (16.945) .0001	102.009	.49
2 (107)	.4586 (14.245) .0001	.5414 (16.814) .0001	142.800	.57
3 (107)	.4430 (11.930) .0001	.5570 (14.999) .0001	116.495	.52
4 (107)	.4366 (10.405) .0001	.5634 (13.429) .0001	93.737	.47
5 (107)	.5651 (15.042) .0001	.4349 (11.576) .0001	161.344	.60
6 (107)	.5037 (11.542) .0001	.4963 (11.374) .0001	117.986	.53
7 (107)	.5018 (12.750) .0001	.4982 (12.656) .0001	126.791	.54
8 (107)	.4365 (14.335) .0001	.5635 (18.508) .0001	202.868	.66
9 (107)	.6416 (23.431) .0001	.3585 (13.091) .0001	480.844	.82
10 (108)	.7087 (24.827) .0001	.2913 (10.205) .0001	615.573	.85

of the regression equation (restricted versus unrestricted). However, restricting the regression does affect the estimated value of β, the coefficient for the return on the straight bond component. In fact, the unrestricted regression results indicate that, for the most part, there is no significant relationship between convertible bond rates of return and the returns on otherwise identical straight debt.

As discussed earlier, each of the three returns associated with each convertible bond may be included in different deciles. Therefore, the estimated value of α for the decile which includes the first monthly return is the estimate assigned to that bond for the excess returns regression discussed in the following section. Using the estimate associated with the first return minimizes the lag in time between announcement of the issue and the computation of convertible bond rates of return used to estimate α.

TABLE 5

Ex-Ante Unrestricted Regression Results

Probability Deciles	Intercept	Alpha	Beta	F	R^2
1 (107)	.0060 (1.089) .2786	.3921 (8.034) .0001	.4319 (2.286) .0243	40.728	.44
2 (107)	.0008 (0.214) .8306	.4245 (14.047) .0001	.1899 (1.343) .1821	104.023	.67
3 (107)	.0031 (0.919) .3602	.4679 (14.819) .0001	-.0039 (-0.036) .9717	110.199	.68
4 (107)	.0102 (3.020) .0032	.3807 (13.655) .0001	.1322 (0.971) .3337	93.261	.64
5 (107)	.0112 (3.015) .0032	.4404 (14.301) .0001	-.0518 (-0.446) .6566	102.283	.66
6 (107)	.0065 (1.863) .0653	.5682 (18.966) .0001	.3578 (2.641) .0095	183.920	.78
7 (107)	.0210 (6.224) .0001	.4842 (16.428) .0001	.2077 (1.325) .1879	135.011	.72
8 (107)	.0168 (4.793) .0001	.6182 (19.868) .0001	-.0707 (-0.527) .5995	198.426	.79
9 (107)	.0203 (5.193) .0001	.6586 (20.204) .0001	-.1446 (-0.953) .3429	204.108	.80
10 (108)	.0173 (4.181) .0001	.6924 (21.026) .0001	.0106 (0.067) .0001	231.200	.82

5.3 ESTIMATING ANNOUNCEMENT PERIOD EXCESS RETURNS

5.3.1 The Announcement Period and the Sample

Announcement period excess returns are computed for each of the convertible bonds in the sample in order to determine if they can be explained by the estimated values of α as given by the regression equation (4.16). Computing announcement period excess returns also allows comparison with Dann and Mikkelson's results. As in the Dann and Mikkelson study, the announcement period is defined as the day of and the day before the announcement of convertible debt issuance appears in the Wall Street Journal.

Before computing excess returns, 51 firms which made contemporaneous financing announcements are removed from the sample. Contemporaneous financing announcements include issuance of common stock, straight debt or warrants, secondary offerings of common stock, dividend increases, and exchange offers (convertible debt for convertible debt). Additionally, firm's whose common stock price is below $7.50 per share are removed from the sample because low priced firms can exhibit extremely large relative price changes even when absolute price changes are not that large. Twelve observations failed to meet this requirement. A distribution

TABLE 6

Ex-Post Unrestricted Regression Results

Probability Deciles	Intercept	Alpha	Beta	F	R^2
1 (107)	.0004 (0.056) .9554	.3684 (8.111) .0001	.3402 (1.480) .1419	38.152	.42
2 (107)	-.0015 (-0.365) .7158	.4158 (10.040) .0001	.1895 (1.315) .1914	51.389	.50
3 (107)	.0002 (0.045) .9646	.4189 (10.064) .0001	.2075 (1.522) .1311	56.902	.52
4 (107)	.0059 (1.788) .0767	.4159 (9.809) .0001	.2531 (2.238) .0273	54.164	.51
5 (107)	.0085 (2.490) .0143	.5260 (15.137) .0001	-.2165 (-1.656) .1008	115.910	.69
6 (107)	.0151 (4.819) .0001	.4650 (12.031) .0001	-.0059 (-0.053) .9579	74.155	.59
7 (107)	.0115 (3.758) .0003	.4241 (11.122) .0001	-.0247 (-0.208) .8354	61.857	.54
8 (107)	.0130 (3.758) .0003	.3939 (13.162) .0001	.1710 (1.288) .2005	87.955	.63
9 (107)	.0046 (0.983) .3278	.6073 (18.185) .0001	.0222 (0.149) .8816	170.252	.77
10 (108)	.0112 (1.653) .1013	.6631 (17.098) .0001	.1052 (0.621) .5361	146.401	.74

of the remaining 294 observations by industry group and year of announcement is displayed in Table 7.

5.3.2 Excess Returns Methodology

Announcement period excess returns are determined in two ways. The first is to use Scholes-Williams excess returns directly from the CRSP Excess Returns computer tapes. For each observation, a two-day excess return is computed over days t=0 and t=-1. An average two-day excess return is computed as follows:

$$ER = \sum_{i=1}^{n} ER_i/n, \tag{5.2}$$

where ER is the average two-day excess return and ER_i is the two-day excess return for firm i.

A mean standard error is computed across all firms during the 120 day comparison period. Specifically, the comparison period includes days -71 to -12 and +12 to +71. A t-statistic is computed to determine if the two-day average announcement period excess return is statistically different from zero:

TABLE 7

Distribution of Announcements by Industry Group and Year of Announcement

Year of Announcement	Industrials	Financials	Transportations	Utilities
1967	3	0	2	1
1968	39	0	3	1
1969	40	2	2	4
1970	9	2	1	3
1971	21	6	0	0
1972	6	2	0	1
1973	1	2	0	0
1974	2	0	0	0
1975	10	1	0	0
1976	5	0	0	0
1977	2	0	1	1
1978	2	1	0	0
1979	4	2	2	0
1980	24	6	2	1
1981	29	3	0	1
1982	20	3	5	2
1983	11	2	1	0
Total	228	32	19	15

$$t = ER/(SE)2^{.5}, \tag{5.3}$$

where SE is the standard error estimated from the comparison period.

The second way in which excess returns are computed is the Mean-Adjusted method. Using the CRSP Daily Returns tape, daily returns are read about the announcement date for each observation. The same comparison period used above is used to compute a mean comparison period return for each observation. The two-day mean-adjusted return is equal to the difference between the actual two-day return and twice the mean comparison period return. Two-day mean adjusted returns are averaged across firms as follows:

$$MAR = \sum_{i=1}^{n} MAR_i/n, \tag{5.4}$$

where MAR is the average two-day mean-adjusted return and MAR_i is the two-day mean-adjusted return for firm i.

A sample standard error is estimated from the 120 day comparison period (days -71 to -12 and +12 to +71). A t-statistic is computed as follows:

$$t = MAR/SE(2)^{.5}. \qquad (5.5)$$

5.3.3 Description of Announcement Period Excess Returns

Cumulative excess returns and daily excess returns for the period ten days prior to ten days after the announcement period (days -1 and 0) by the method of computing excess returns are shown in Tables 8 through 11 for the respective industry groups.

Two-day announcement period excess returns computed for the 294 observations, by industry category, using Scholes-Williams excess returns and Mean-Adjusted excess returns are shown in Table 12. T-values appear in parenthesis.

For the most part, the results shown in Table 12 indicate that stock prices react in a significantly negative manner to the announcement of convertible debt financing, supporting the findings of Dann and Mikkelson who document an average two-day announcement period return of -2.31% for all firms in their sample regardless of industry category. This is especially true for industrial firms as indicated by the large t-values. The common stock of financial firms seem

TABLE 8

Returns for Industrials-Twenty Days Surrounding Announcement Period

Day	Scholes-Williams Excess Return	Scholes-Williams Cumulative Excess Return	Mean-Adjusted Excess Return	Mean-Adjusted Cumulative Excess Return
-11	-0.001085	-0.001085	-0.001469	-0.001469
-10	+0.000073	-0.001012	-0.000568	-0.002037
-9	-0.000036	-0.001048	-0.000356	-0.002393
-8	+0.002398	+0.001350	+0.002254	-0.000139
-7	+0.003116	+0.004466	+0.003514	+0.003653
-6	+0.000594	+0.005060	+0.000998	+0.004651
-5	+0.001043	+0.006103	+0.000854	+0.005505
-4	-0.000792	+0.005311	-0.000820	+0.004685
-3	-0.001720	+0.003591	-0.002470	+0.002215
-2	-0.000123	+0.003468	-0.001138	+0.001077
-1	-0.011165	-0.007697	-0.012138	-0.011061
0	-0.006259	-0.013956	-0.007273	-0.018334
+1	-0.000976	-0.014932	-0.002226	-0.020560
+2	-0.004085	-0.019017	-0.004789	-0.025349
+3	-0.000447	-0.019464	+0.000276	-0.025073
+4	+0.000591	-0.018873	-0.000518	-0.025591
+5	+0.002109	-0.016764	+0.001938	-0.023653
+6	+0.000968	-0.015796	-0.000121	-0.023774
+7	-0.001856	-0.017652	-0.001646	-0.025420
+8	+0.000736	-0.016916	+0.001085	-0.024335
+9	-0.002669	-0.019585	-0.003852	-0.028187
+10	-0.000685	-0.020270	-0.001225	-0.029412

TABLE 9

Returns for Financials-Twenty Days Surrounding Announcement Period

	Scholes-Williams		Mean-Adjusted	
Day	Excess Return	Cumulative Excess Return	Excess Return	Cumulative Excess Return
-11	+0.004511	+0.004511	+0.002568	+0.002568
-10	+0.002114	+0.006625	+0.000242	+0.002810
-9	-0.001845	+0.004780	+0.000773	+0.003583
-8	+0.001827	+0.006607	+0.002960	+0.006543
-7	+0.001199	+0.007806	+0.000632	+0.007175
-6	-0.003557	+0.004249	+0.000178	+0.007353
-5	+0.005430	+0.009679	+0.006920	+0.014273
-4	+0.007885	+0.017564	+0.011495	+0.025768
-3	-0.000568	+0.016996	-0.000362	+0.025406
-2	-0.007441	+0.009555	-0.007884	+0.017522
-1	-0.013228	-0.003673	-0.011296	+0.006226
0	-0.010761	-0.014434	-0.010585	-0.004359
+1	+0.005628	-0.008806	+0.004889	+0.000530
+2	+0.002488	-0.006318	+0.002108	+0.002638
+3	+0.001274	-0.007592	-0.001322	+0.001316
+4	-0.004953	-0.012545	-0.007956	-0.006640
+5	+0.000814	-0.011731	-0.001856	-0.008496
+6	-0.001175	-0.012906	-0.000865	-0.009361
+7	-0.007713	-0.020619	-0.009716	-0.019077
+8	+0.002903	-0.017716	-0.000257	-0.019334
+9	+0.003814	-0.013902	+0.000136	-0.019198
+10	+0.004543	-0.009359	+0.004089	-0.015109

TABLE 10

Returns for Transportations-Twenty Days Surrounding Announcement Period

	Scholes-Williams		Mean-Adjusted	
Day	Excess Return	Cumulative Excess Return	Excess Return	Cumulative Excess Return
-11	-0.002407	-0.002407	-0.002385	-0.002385
-10	+0.001072	-0.001335	-0.000060	-0.002445
-9	+0.004998	+0.003663	+0.004620	+0.002175
-8	+0.001393	+0.005056	+0.003833	+0.006008
-7	+0.000527	+0.005583	+0.001960	+0.007968
-6	+0.003379	+0.008962	+0.003968	+0.011936
-5	-0.007696	+0.001266	-0.006309	+0.005627
-4	+0.008395	+0.009661	+0.011093	+0.016720
-3	+0.004684	+0.014345	+0.004661	+0.021381
-2	+0.002816	+0.017161	+0.004440	+0.025821
-1	-0.010186	+0.006975	-0.007733	+0.018088
0	-0.012112	-0.005137	-0.010515	+0.007573
+1	-0.008420	-0.013557	-0.004280	+0.003293
+2	-0.005732	-0.019289	-0.008644	-0.005351
+3	+0.001892	-0.017397	+0.000460	-0.004891
+4	-0.006311	-0.023708	-0.004055	-0.008946
+5	+0.002218	-0.021490	+0.001462	-0.007484
+6	+0.001586	-0.019904	+0.000894	-0.006590
+7	-0.004743	-0.024647	-0.004764	-0.011354
+8	+0.003730	-0.020917	+0.004331	-0.007023
+9	-0.006838	-0.027755	-0.008984	-0.016007
+10	-0.000362	-0.028117	-0.003723	-0.019730

TABLE 11

Returns for Utilities-Twenty Days Surrounding Announcement Period

Day	Scholes-Williams Excess Return	Scholes-Williams Cumulative Excess Return	Mean-Adjusted Excess Return	Mean-Adjusted Cumulative Excess Return
-11	+0.003121	+0.003121	+0.001751	+0.001751
-10	-0.006016	-0.002895	-0.005684	-0.003933
-9	-0.002224	-0.005119	+0.002505	-0.003179
-8	+0.001248	-0.003871	+0.005143	+0.001964
-7	+0.000879	-0.002992	+0.004298	+0.006262
-6	-0.000235	-0.003227	+0.000761	+0.007023
-5	-0.004865	-0.008092	-0.002963	+0.004060
-4	+0.004085	-0.004007	+0.006625	+0.010685
-3	-0.004629	-0.008636	-0.000754	+0.009931
-2	-0.005779	-0.014415	-0.004786	+0.005145
-1	-0.007633	-0.022048	-0.009069	-0.003924
0	+0.005684	-0.016364	+0.007145	+0.003221
+1	-0.012991	-0.029355	-0.012813	-0.009592
+2	-0.009971	-0.039326	-0.008998	-0.018581
+3	+0.000512	-0.038814	+0.000554	-0.018026
+4	-0.001619	-0.040433	-0.004722	-0.022748
+5	+0.011363	-0.029070	+0.010475	-0.012273
+6	-0.002769	-0.031839	+0.000148	-0.012125
+7	-0.004045	-0.035884	-0.004482	-0.016607
+8	+0.002628	-0.029211	+0.007905	-0.008702
+9	-0.002567	-0.031778	-0.000069	-0.008771
+10	+0.002145	-0.029633	+0.006901	-0.001870

TABLE 12

Two-Day Announcement Period Excess Returns by Industry Category

	Scholes-Williams	Mean-Adjusted
Industrials (228)	-1.7424% (-7.7516)	-1.9411 (-7.8083)
Financials (32)	-2.3989 (-4.6018)	-2.1881 (-3.6975)
Transportations (19)	-2.2298 (-2.9066)	-1.8248 (-2.1379)
Utilities (15)	-0.1949 (-0.2904)	-0.1924 (-0.2386)

to react in a similar manner, but given the small number of observations, the evidence is not as strong. Because of even fewer observations, meaningful conclusions cannot be reached about transportations or utilities. For this reason, the results of further analysis is reported only for industrial firms.

The distribution of the announcement period excess returns for industrial firms is displayed in Table 13. The significant negative excess returns earned by the stockholders of convertible issuing industrial firms during the announcement period is not due to a small number of firms with large negative returns. Almost 60% of the 228 firms have two-day announcement period excess returns of less than -1.0%, while less than 20% have positive excess returns exceeding 1%. It is evident from this distribution, however, that the announcement of convertible debt financing results in positive returns for a significant number of firms.

5.4 THE CHANGE IN LEVERAGE AND THE ANNOUNCEMENT PERIOD EXCESS RETURNS

5.4.1 Measuring the Change in Leverage

To determine if announcement period excess returns due to the announcement of convertible debt issuance can be explained by the market perceived change in the firm's

TABLE 13

Distribution of Two-Day Announcement Period Excess Returns for Industrial Firms

Two-Day Announcement Period Return	Scholes-Williams	Cumulative Percentage	Mean-Adjusted	Cumulative Percentage
< -11%	1	0.439	2	0.877
-11 to -9	4	2.193	5	3.070
-9 to -7	9	6.140	17	10.526
-7 to -5	25	17.105	20	19.298
-5 to -3	42	35.526	43	38.158
-3 to -1	54	59.211	49	59.646
-1 to 1	49	80.702	50	81.579
1 to 3	25	91.667	21	90.789
3 to 5	10	96.053	13	96.491
5 to 7	3	97.368	3	97.807
7 to 9	4	99.123	3	99.123
9 to 11	2	100.000	1	99.561
> 11	0		1	100.000
Total	228		228	

financial leverage, the two-day announcement period excess returns for each firm are regressed on the ratio α/α^{*} (LEV):

$$ER_i = a + bLEV_i + e_i. \tag{4.16}$$

This approach is similar to that of Asquith and Mullins (1984) and Masulis and Korwar (1985).

Recall that α^{*} is a measure of the proportion of firm value that is equity (S/V) and that α is a measure of the proportion of the convertible bond that is perceived as equity. To compute α^{*}, information is needed from each firm's balance sheet. To incorporate the market value of each firm's outstanding common stock, a market value adjustment is made. Therefore, α^{*} is computed as follows:

$$\alpha^{*} = NP/(A - B + NP), \tag{5.6}$$

where N is the number of shares of common stock outstanding and P is the market price per share as of the end of the fiscal year just prior to the convertible announcement. A denotes total assets, and B is book value of the common stockholders' equity. Number of shares outstanding and share price data are taken from the Standard and Poor's Daily Stock Price Record. Total Assets and book value of common are taken from the Compustat tapes and the respective Moody's Manuals (Industrial, Bank and Finance, Transportation, and Utility). This approach is similar to that used by Hansen, Pinkerton, and Wolfe (1984).

5.4.2 Results

Table 14 displays the mean and standard deviation of LEV for the 228 industrial firms by estimating method. The mean is very close to one, indicating that, on average, the market believes the issuance of convertible debt does not alter leverage.

Each of the four estimates of LEV is separately used in the regression described by equation (4.16) to determine if the regression is sensitive to the method of estimating α. The regressions are run using the Scholes-Williams excess returns as well as the Mean-Adjusted excess returns in order assess the sensitivity of the estimated value of b to the method of measuring excess returns. Therefore, a total of eight regressions are performed on the 228 industrial firms. The results are displayed in Tables 15 and 16. The estimated value of the intercept is followed by the estimated value of b, the statistic F (a measure of significance for the model

TABLE 14

Distribution of LEV for Industrial Firms

	Mean	Standard Deviation
Ex-Ante Restricted	0.9921	0.7132
Ex-Post Restricted	0.9825	0.7228
Ex-Ante Unrestricted	0.9518	0.6985
Ex-Post Unrestricted	0.9087	0.6682

as a whole), and the R^2 for the regression equation. T-values for the intercept term and the estimate of b are given in parenthesis followed by p-values.

The intercept term in all forms of the regression shown in Tables 15 and 16 is significantly negative; a finding consistent with the new financing models of Myers and Majluf and Miller and Rock. The F-values and the t-values for b indicate a strong linear relationship between announcement period excess returns and LEV at the .05 level of significance, confirming the presence of a strong leverage effect. This finding is also consistent with the model presented by Myers and Majluf. Only the ex-post restricted and ex-post unrestricted forms of the regression using Mean-Adjusted excess returns do not indicate a significant linear relationship between announcement period excess returns and LEV at the .05 level (the relationship is significant at the .10 level).

The explanatory variable, LEV, is equal to the ratio of the estimated variables α and $\alpha^{\bullet}$. Therefore, there is probably some degree of error in measuring LEV. However, this fact serves to emphasize the strength of the relationship between announcement period excess returns and LEV. Because LEV is measured with error, the estimated value of b is downward biased and the true value of b is really

TABLE 15

Scholes-Williams Excess Returns for Industrial Firms Regressed on LEV

	Intercept	b	F	R^2
Ex-Ante Restricted	-1.0043 (-2.416) .0165	-.7518 (-2.208) .0282	4.875	0.021
Ex-Post Restricted	-1.0472 (-2.556) .0113	-.7154 (-2.128) .0344	4.528	0.020
Ex-Ante Unrestricted	-1.0038 (-2.448) .0151	-.7843 (-2.257) .0250	5.093	0.022
Ex-Post Unrestricted	-1.0445 (-2.548) .0115	-.7767 (-2.136) .0338	4.560	0.020

TABLE 16

Mean-Adjusted Excess Returns for Industrial Firms Regressed on LEV

	Intercept	b	F	R^2
Ex-Ante Restricted	-1.1927 (-2.705) .0074	-.7545 (-2.089) .0378	4.364	0.019
Ex-Post Restricted	-1.2749 (-2.930) .0037	-.6781 (-1.900) .0588	3.608	0.016
Ex-Ante Unrestricted	-1.1827 (-2.720) .0070	-.7969 (-2.162) .0316	4.676	0.020
Ex-Post Unrestricted	-1.2730 (-2.925) .0038	-.7355 (-1.905) .0581	3.627	0.016

more negative than is indicated by the regression results in Tables 15 and 16.[10] The R^2's indicate that only about 2% of the variation in excess returns is explained by the regressions and that other factors not tested for may also be significant in explaining announcement period excess returns. However, low R^2's are not unusual in this kind of analysis.[11]

For some firms, the announcement of convertible debt issuance is found to produce a significant effect upon its perceived level of financial leverage. The greater is the market's perception of the leverage decreasing effect of convertible debt financing, the more negative are the announcement period excess returns. These results indicate that for industrial firms, a one percent increase in the value of LEV results in about a .7% decrease in announcement period excess returns. The results appear to be somewhat stronger for Scholes-Williams excess returns than for Mean-Adjusted excess returns. Additionally, the results do not appear to be sensitive to the various methods of estimating α.

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[10] see Madalla (1977).

[11] see Asquith and Mullins (1984) for example.

The regression analysis is also performed for the three groups of non-industrial firms, however, significant results are not found. Due to the small number of non-industrial firms, this finding is not surprising.

Chapter VI

SUMMARY AND CONCLUSIONS

Announcement period excess returns earned by the common stockholders of convertible debt issuing firms are shown to be significantly negative. This is especially true for industrial firms which compose the bulk of the data. This finding is not new, but supports the results reported by Dann and Mikkelson in their recent study.

Dann and Mikkelson assume that convertible debt financing increases the firm's financial leverage. Their study is one of only a few cited in Table 1 whose excess returns are not in the same direction as the assumed leverage change. As Dann and Mikkelson point out, their findings are not consistent with the leverage hypothesis. Therefore, they conclude that an apparent anomaly exists for convertible debt financing.

The assumption that convertible debt financing increases financial leverage is questioned in this study. It is shown that convertible bonds contain a significant equity component which is directly related to the probability that the convertible will eventually be in the money. For some firms, this equity component is sufficiently large to produce leverage decreasing capital structure changes.

To see if the observed behavior of common stock returns upon the announcement of convertible debt financing can be explained by the leverage hypothesis, announcement period excess returns are regressed on a measure of the change in leverage due to convertible debt financing. The results indicate that the returns earned by stockholders upon the announcement of convertible issuance can be explained by the perceived change in leverage caused by the convertible bond. Therefore, common stock price behavior during the announcement period is consistent with the leverage hypothesis and the anomaly is explained.

Because the findings indicate that the proportion of the convertible bond perceived to be equity is directly related to observed announcement period excess returns, the new financing model presented by Myers and Majluf appears to be supported, while the one presented by Miller and Rock does not. The Miller and Rock model predicts the significant negative intercept which results from the regressions, however, their model does not lead us to expect the significant relationship that is found between announcement period excess returns and LEV. But, since the convertible bonds in the sample may include those issued for new financing as well as those issued for refinancing, strong conclusions concerning the new financing hypothesis as presented by Myers and Majluf and Miller and Rock cannot be reached.

The results presented in this study do not explain the significant negative returns that Dann and Mikkelson document on the issue date. Although the regression model may be helpful in relating issue date returns to a change in leverage, it is not clear why common stocks should react in a significant manner on the issue date in the first place. As Dann and Mikkelson state in their paper, specific information about the convertible bond issue not already released, may become public on the issue date. One suggestion for further research is to investigate whether new information is released on the issue date and to determine whether it can be used to explain issue date excess returns.

It would also be interesting to determine if the model presented in this study can explain the negative excess returns documented on the call date. An unanticipated call of convertible bonds will cause the firm's perceived financial leverage to decrease. If the change in leverage on the call date can be estimated, call date excess returns might be explained via the leverage hypothesis through use of the model presented here.

Another suggestion for further research is to investigate whether the size of the convertible bond issue can be used to explain announcement period excess returns. Because convertible bonds are hybrid securities, the size of their equity component relative to outstanding equity is not easy to measure. The model presented in this study may be helpful in estimating the relative size of the convertible's equity component.

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