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Agency Problems, Information Asymmetries, and Convertible Debt Security Design*

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This paper proposes and implements a security design framework to assess why corporate managers issue convertible debt. We examine three theories that make predictions about the design of convertible debt. Our results suggest that some issuers design convertible debt to mitigate asset substitution problems, while others design it to reduce adverse selection problems. We also find that issuers vary convertible debt security design over the business cycle in response to time variation in asset substitution and adverse selection problems. Overall, the results indicate that corporate managers actively alter convertible debt security design to mitigate costly external finance problems. Journal of Economic Literature Classification Number: G32

1. INTRODUCTION

Why do corporate managers issue convertible debt? Financial economists traditionally have attempted to answer this question by estimating and

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analyzing investor reactions to new issue announcements. While these studies agree that, on average, investors react negatively to convertible debt issue announcements, there is little evidence provided that explains why firms issue these securities.[1] In this paper, we propose and implement an alternative framework for assessing managerial motives. Specifically, we examine the way managers design convertible bonds.

Convertible debt securities include a number of endogenous features. Since different convertible debt security designs have different pricing and valuation effects, corporate managers must make important decisions regarding security features such as issue size, maturity, coupon rate, call features, the conversion premium, and the conversion ratio. These decisions are likely to influence the way current stakeholders and new investors interpret the issue of convertible debt as a financing instrument. However, existing theory only ascribes an important theoretical role to some of these security characteristics. Therefore, we confine our empirical tests to an analysis of these design features, which include postconversion equity ownership by the bondholders, maturity structure, and call features.

We examine three different (although not necessarily mutually exclusive) theories that make predictions about the design of convertible debt. The theories differ primarily in their assumptions regarding management's motivation for issuing convertible debt. Unfortunately, no unified theory of convertible debt financing has been offered that fully explains the tradeoffs associated with alternative design packages. Therefore, while we provide evidence on the validity of each theory's empirical implications, our primary goal is to provide researchers with a more complete understanding of how certain key convertible debt features are designed.

An important limitation of many empirical studies in corporate finance is that the endogenous nature (and therefore the information content) of security design features such as debt maturity and call provisions are often ignored. Interrelationships are particularly important for convertible debt security design, because postconversion equity ownership, debt maturity, and call protection have strong interactive effects. While each individual feature may help resolve certain private information and moral hazard problems, a more interesting line of inquiry is to consider how all three features interact to determine the optimal contract design. For example, a convertible security may have a long maturity, but this maturity is effectively shortened by a call provision with a short period of call protection. Consequently, empirical tests that focus on one design feature in isolation are likely to be biased and uninformative. We explicitly consider security design endogeneity in our empirical tests by estimating postconversion equity

[1] See, e.g., Dann and Mikkelson (1984), Eckbo (1986), Mikkelson and Partch (1986), Essig (1991), Lewis, *et al.* (1994), and Asquith (1995).

ownership, debt maturity, and call protection as a system of simultaneous equations using Generalized Method of Moments (GMM) estimation.

Our empirical results suggest that agency conflicts and asymmetric information both play a key role in the design of convertible debt. Specifically, some of our results are consistent with Green's (1984) hypothesis that convertible debt is designed to mitigate bondholder/stockholder agency costs. Consistent with the predictions of this theory, we find that convertible bondholders receive high postconversion ownership stakes in small firms with high financial leverage. In addition, issues with low conversion premiums, shorter maturities, and shorter call protection periods have high levels of post-ownership conversion equity.[2] Note, however, that because the empirical hypotheses proposed in the literature are not mutually exclusive, this latter finding also is consistent with Stein's (1992) conjecture that "backdoor" equity issuers want to force conversion in a reasonably short time period. To the extent that high levels of post-conversion equity ownership proxy for "backdoor" equity financing, we find that these firms accelerate the expected time to conversion by shortening maturities and reducing call protection.

We also find that convertible debt has a relatively long maturity, regardless of issuer creditworthiness. To the extent that longer debt maturities expose bondholders to greater risks of a shift in corporate investment policies, the inclusion of a conversion privilege may alleviate investors' concerns by effectively shortening a bond's maturity. Brennan and Schwartz (1988) suggest that highly leveraged firms with profitable growth opportunities should use long-term convertible debt. We document to the contrary that issuing firms select long maturities when growth opportunities are small.[3] Issues with longer maturities also tend to have low post-conversion equity ownership and shorter periods of relative call protection. This suggests that issuers seeking long-term debt financing design convertible bonds to behave more like straight debt than equity.

We document that call protection is included in the majority of convertible debt issues. This result highlights an important difference between convertibles and straight debt, because the use of call provisions in straight debt has diminished recently.[4] Stein (1992) offers one explanation for this difference.

[2] Postconversion equity ownership is defined as the proportion of common equity owned by the convertible bondholders assuming full conversion.

[3] The finding that convertible debt maturity is longer in firms with *fewer* growth opportunities is consistent with the findings of Barclay and Smith (1995) but contrasts with those of Hoven-Stohs and Mauer (1996). Hoven-Stohs and Mauer argue that Barclay and Smith obtain their results because they fail to control for the issuing firm's capital structure. Rather than confirming Barclay and Smith, we interpret our finding as an illustration of an important difference between firms that issue convertible bonds and those that issue straight debt.

[4] Crabbe and Helwege (1994) find that an increasing proportion of straight corporate debt issued since 1982 has been noncallable. They find that straight corporate debt issues with call provisions are most likely to be speculative grade, or investment grade with 30 or more years to maturity.

In his "backdoor equity" theory of convertible debt financing, call provisions play a key role, especially for firms facing high financial distress costs. Stein suggests that firms prefer to issue equity and avoid costly financial distress but also want to avoid selling underpriced equity. By varying the security design features to make an issue more or less "equity-like," a manager can optimally design a convertible bond to minimize these costs. Assuming the issuing firm wants investors to convert the bond into equity as soon as it is fairly valued, managers will include call provisions to force early conversion. Consistent with this theory, we find that firms with better private information use less call protection. In addition, issues with longer maturities and those that convert to greater proportions of equity ownership provide less call protection. We also find that, over the sample period, the length of call protection increases when measured in relation to the convertible bond's maturity.

Finally, we show that it is important to control for time trends in convertible debt maturity. Using year of issue dummies as control variables, we find that average convertible debt maturity increases each year over the 1979 through 1988 period, and then decreases each year thereafter. Interestingly, this is similar to the pattern followed by the Leading Indicators Index, which may suggest that convertible debt maturity varies directly with investors' expectations of the future direction of the economy.

The remainder of the paper is organized as follows. Section 2 contains our discussion of various hypotheses that make predictions about convertible debt security design and stock market reactions to different design characteristics. We describe our data and discuss our selection of proxy variables in Section 3. Section 4 contains our empirical results, and Section 5 concludes the paper.

2. FIRM VALUE, ASSET RISK, AND CONVERTIBLE DEBT FINANCING

Here we discuss the theories related to various aspects of the convertible debt security design problem. Our empirical tests examine three attributes of convertible debt financing: post-conversion equity ownership, maturity, and call structure. We summarize the testable implications of the different theories in Table I.

2.1. Private Information and Asset Risk

Brennan and Schwartz (1988) and Brennan and Kraus (1987) develop a model that explains a firm's choice of financing instruments when investors and management differ as to the riskiness of a company. Brennan and Schwartz (1988) argue that the maturity of the convertible bond is a good proxy for this type of risk, since longer maturities involve greater risk of

TABLE I
Convertible Specific Predictions of Alternative Hypotheses

(H1) Private Information and Asset Risk (Brennan and Kraus, 1987, and Brennan and Schwartz, 1988)
(1) Postconversion equity ownership is lower in highly leveraged small firms with high growth opportunities.
(2) Highly leveraged, small firms with ample growth opportunities design convertible bonds with longer maturities.
(3) Highly leveraged, small firms with ample growth opportunities design convertible bonds with more call protection.
(H2) Agency Costs and Asset Risk (Green, 1984)
(1) Small firms with low credit ratings and high financial, as well as issues with low conversion premiums, design convertible bonds with high postconversion ownership.
(2) This theory offers no testable predictions for a bond's maturity and call protection.
(H3) Private Information and Financial Distress (Stein, 1992)
(1) Since firms with positive information want to see convertible debt converted to equity in a fairly short time period, issuing firms with good information use shorter call period protection.
(2) This theory offers no testable predictions for a bond's postconversion equity ownership and maturity.

a shift in corporate investment policies. This suggests that the manager's choice of convertible debt maturity may convey information to investors about the risk of future operations and profitability.

The advantage of a well-designed convertible bond is that its value is not affected much by changes in company risk. Note that the relevant risk is not only the risk of the company's existing operations, but also the risk of any future operations in which the company may become involved over the life of the bond. Clearly, all else equal, longer issue maturities involve greater risks of a shift in investment policies.

Brennan and Schwartz (1988) also argue that uncertainty about risk is related to firm size, growth rates, and financial leverage. For example, it is hardest to predict the future investment decisions of firms with high growth opportunities.

In our maturity regressions, we examine the extent to which issue maturity is related to firm size, growth opportunities, and financial leverage. Issues with longer maturities are expected to be particularly useful for small firms with high leverage and high growth opportunities.[5]

[5] Brennan and Schwartz (1988) argue that there appears to be no compelling risk-related rationale for large, mature companies with strong credit ratings to issue convertible debt. For this type of company, they argue that investors have a good understanding of the risks associated with existing operations as well as the risk of any future investment projects that management may undertake over the life of the bond. Consequently, this theory predicts that smaller, riskier, high-growth firms are the most likely issuers of convertible debt. We do not test this hypothesis because it requires a cross-sectional comparison of firms that issue securities other than convertible debt.

As Green (1984) notes, however, the theoretical focus on the link between project risk and conversion privileges abstracts from other bondholder–shareholder agency conflicts such as the underinvestment problem (see Myers, 1977). With risky debt outstanding, bondholders and shareholders may disagree over the optimal exercise of the firm's future growth opportunities. Longer term debt involves greater risk of a shift in corporate investment policies and exacerbates the underinvestment problem. One approach for controlling this investment incentive problem is to shorten the effective maturity of the debt.

Thus, while the inclusion of a conversion option in longer term debt may be necessary to ''compensate'' investors for the possibility of subsequent changes in the risk of the firm's investment decisions, we anticipate that the fastest growing firms that raise capital to exercise growth options may elect to issue shorter term convertibles to mitigate the underinvestment problem. Underinvestment is a more important consideration in firms that are expanding their capital investments and have the largest amount of leverage.

Thus, while the use of long-term convertible debt may reduce financing problems created by uncertainty about issuer risk, it may also exacerbate underinvestment problems. If the latter problem is a greater concern for convertible debt issuers, then issue maturity would be shorter for small firms with high leverage and high growth rates.

Brennan and Schwartz (1988) provide no specific predictions about post-conversion equity ownership or call provision structure. Implicitly, however, an optimal level (or range) of post-conversion equity ownership is at least suggested by their analysis, since only a ''well-designed'' convertible bond is relatively immune to changes in company risk. Because higher risk increases the value of the equity component and decreases the value of the straight debt component of convertible debt, postconversion equity ownership should be higher in riskier firms or in firms in which investors are uncertain about risk.

2.2. Agency Costs and Asset Risk

When a corporation has risky debt outstanding, shareholders may prefer the firm to adopt investment policies that do not necessarily maximize the value of the firm, such as overinvesting in risky projects. This investment policy benefits shareholders by transferring wealth away from bondholders. Green (1984) shows that, under certain conditions, the use of a conversion feature in the firm's debt securities can restore value-maximizing investment incentives. That is, appropriately designed conversion privileges mitigate the distortionary investment incentives created by risky debt and risky investment opportunities.[6]

[6] In Green's (1984) model, all of the firm's risky debt includes a conversion feature. Thus, relative to the use of straight debt, he shows that a conversion privilege reduces the asset substitution problem. Firms with risky straight debt outstanding should still benefit from the incremental use of convertible debt when risk-shifting problems exist.

By varying the security design parameters, corporate managers control the shape of the equityholders' residual claim and hence the incentive to overinvest in risky projects. Allocation of greater post-conversion equity ownership to the convertible bondholders reduces the original common stockholders' gain from overinvestment in riskier projects. Green (1984) also notes that additional debt worsens the underinvestment problem. As a consequence, to the extent that convertible debt is designed to minimize agency problems, we expect that security parameters are selected to mitigate the overinvestment and underinvestment incentives of the common stockholders.[7]

Green's (1984) analysis of the asset substitution problem provides explicit predictions about how managers should design convertible bonds to mitigate adverse investment incentives. All else equal, the greater the opportunity to expropriate bondholder value through risk-enhancing investment decisions, the larger the post-conversion equity ownership percentage that should be allocated to the convertible bondholders.

Even though technological opportunity and managerial propensity to shift risk ex post are difficult to measure ex ante, we predict that post-conversion equity ownership will be positively related to the firm's debt ratio, and inversely related to the issue's credit rating, conversion premium, and firm size.[8] Thus, we expect that high postconversion ownership by the bondholders is likely to occur in small firms with low credit ratings and high financial leverage, as well as issues with low conversion premiums. We also include a measure of the issuer's preannouncement stock price volatility as a control for cross-sectional differences in risk.

Green's (1984) analysis provides no predictions about issue maturity or call provision structure because his model is single-period. He acknowledges that the model framework limits the general implications of the analysis for security design. Its advantage is that it provides clear insights into how the payoff structure of equity-linked debt works to control managerial (and stockholder) incentives to adopt excessively risky projects.

2.3. Private Information and Financial Distress

Stein (1992) suggests that corporations may issue convertible securities as an indirect way to increase the equity in their capital structures, thereby diminishing the adverse selection costs associated with direct common eq-

[7] To restore NPV-maximizing investment decisions, the convertible bond must have a precise convex-concave shape in Green's model. This shape is needed to prevent over- and underinvestment in risky projects. In Green's model, an increase in the bondholders' postconversion equity ownership increases the value of the equity component of convertible debt, potentially increasing risk aversion. The decrease in the value of the bond component, and hence in the concavity of the equity component payoff function, comes about by an increase in the conversion premium.

[8] Smith and Watts (1992) note that if financial distress costs limit the use of financial leverage, larger firms should have higher leverage than small firms.

uity issues. The intuition for the role of convertible debt as ''backdoor'' equity financing rests on the trade-off between the sale of mispriced corporate securities and the costs of financial distress. Convertible bonds attenuate the high expected costs of financial distress associated with a debt issue and reduce the large negative announcement effects that typically occur with common equity issues.

The theory focuses on two factors that do not occupy a central role in other theories of convertible debt design and issuance. The first is issuer-specific; the other is issue-specific. First, the theory emphasizes the importance of financial distress costs to the information content of a convertible issue. Since high debt levels can lead to the onset of costly financial distress, a firm that is already substantially leveraged ought to issue convertible debt only if it is relatively optimistic about its future performance.

The second factor emphasized in this theory is the importance of call provisions. Assuming that the issuing firm would like investors to convert the debt into equity as early as possible, the length of call period protection might be an informative indicator of management's view of future share price performance. To the extent that cross-sectional variation in call period protection conveys information to outside investors, we expect to observe that issuers with better information use shorter call period protection. Stein's (1992) model emphasizes why issuers use convertible debt rather than straight debt or common equity. Our empirical analysis is not designed to explain this decision.[9]

3. SAMPLE SELECTION AND DATA DESCRIPTION

3.1. Sample Selection Procedure

Our sample of convertible debt issues is drawn from a listing of all domestic public offerings of convertible debt in the ''Investment Dealers' Digest Domestic and International New Issues'' data base during the years 1978 through 1992. Issuers that are financial institutions or regulated public utilities are eliminated. We also require the issuing company to have daily common stock returns that are included in the Center for Research in Security Prices (CRSP) Daily Returns File, and the firm must appear on the COMPUSTAT Annual Research Tapes in the years immediately prior to and subsequent to the issue announcement date. Our final sample consists of 712 convertible bond issues, 465 whose common equity is listed on the New York Stock Exchange (NYSE) or the American Stock Exchange

[9] An empirical analysis of whether convertible debt is a substitute for straight debt (as is implied by the asset substitution agency problem) or for common equity (as is implied by the backdoor equity theory) is in Lewis *et al.* (1997b).

TABLE II

Announcement Dates by Year for the Sample of 712 Convertible Debt Offerings by NYSE/AMEX and Nasdaq Firms over the Period 1978–1992 and Business Cycle Variables[a]

Year	Number of offerings	Cumulative percentage of sample (%)	Composite index of 11 leading indicators	Inflation rate based on CPI
1978	6[b]	0.80	1.000	0.076
1979	16	3.10	0.982	0.112
1980	70	12.90	0.969[b]	0.122[c]
1981	41	18.70	0.971	0.101
1982	42	24.60	0.964	0.058
1983	67	34.00	1.025	0.025
1984	41	39.70	1.033	0.042
1985	92	52.70	1.049	0.033
1986	127[c]	70.50	1.064	0.016[b]
1987	84	82.30	1.084[c]	0.042
1988	25	85.80	1.082	0.039
1989	39	91.30	1.073	0.046
1990	20	94.10	1.069	0.054
1991	30	98.30	1.073	0.037
1992	12	100.00	1.078	0.031
Total	712	100.00		

[a] The business cycle variables are the composite index of 11 leading indicators (1977 = 1.00), and the inflation rate is based on the Consumer Price Index (CPI) for all urban consumers, all items. The data source is the Business Cycle Indicators Economic Series data base.

[b] Indicates the minimum value over the sample period.

[c] Indicates the maximum value over the sample period.

(AMEX) at the time of the offer announcement, and 247 whose common equity trades on Nasdaq.

Table II presents the number of convertible debt issue announcements sorted by calendar year. For purposes of comparison, we also include two business cycle variables: a leading indicators index, and the inflation rate based on the Consumer Price Index (CPI).[10]

The number of convertible bond issues varies considerably over time. This variation may simply reflect the equity-linked nature of these securities, since we know that there is substantial time variation in the frequency of equity issues. Choe *et al.* (1993) document this time variation and show

[10] The business cycle variables are the composite index of 11 leading indicators (1977 = 1.00) and the inflation rate is based on the Consumer Price Index (CPI) for all urban consumers, all items. The inflation rate is computed as $\ln(\text{CPI}(t)/\text{CPI}(t-1))$. The data source is the Business Cycle Indicators Economic Series data base.

TABLE III
Issue- and Issuer-Specific Summary Statistics for the Sample of 712 Convertible Debt Offerings by NYSE/AMEX and Nasdaq Firms over the Period 1978–1992

Descriptive measure	Mean	Median
(1) Issue size (millions)	100.28	50.00
(2) (Issue size) ÷ (Market value of common stock)[a]	0.47	0.27
(3) (No. of shares issued upon conversion ÷ (No. of shares outstanding)[b]	0.17	0.14
(4) (Conversion price) ÷ (Stock price)[c]	1.21	1.21
(5) Call protection period (years)	2.10	2.00
(6) Bond maturity (years)	21.20	25.00
(7) Yield advantage (%)[d]	7.03	7.00
(8) (Total assets after the offering) ÷ (Total assets before the offering)[e]	1.47	1.34
(9) Debt–asset ratio before the offering[f]	0.18	0.15
(10) Debt–asset ratio after the offering[f]	0.25	0.23
(11) Two-day announcement period excess return (%)	−1.15	−1.14

[a] Market value of common equity is measured at the fiscal year end preceding the announcement date. It is measured as the closing stock price at the fiscal year end preceding the announcement date multiplied by the number of shares outstanding at the same date.

[b] Shares outstanding is the number reported at the fiscal year end preceding the announcement date plus the number of shares issued upon full conversion.

[c] The conversion premium is calculated as the conversion price divided by the market price per share on the day preceding the issue announcement.

[d] Yield advantage is the difference between the yield on the convertible bond issue and the dividend yield on the common stock at the issue date.

[e] Total assets are estimated by their book values reported at the fiscal year end.

[f] Debt ratio is calculated as the book value of long-term debt divided by the market value of the firm at the fiscal year end.

that it corresponds to changes in the business cycle. Our sample is most heavily concentrated in the years 1985–1987, which include 43% of the offerings throughout the 1978–1992 sample period.

Table II also shows that issue activity increases when expectations about the performance of the economy are high, since the leading indicators index reaches its peak in 1987. Although the relation is not as pronounced for the inflation rate, the issue announcements are highest in the same year that the inflation rate is lowest over our sample period. Thus, firms are likely to seek convertible debt financing when expectations about the economy are high and nominal interest rates are low.

3.2. Description of Issue and Issuer Characteristics

Table III provides summary statistics describing characteristics of convertible bond offerings and their impact on the financial structure of the firms in our sample. The mean (median) issue size is $100.28 million ($50.0

million). The median convertible debt issue represents approximately 27% of the market value of the issuer's common stock prior to announcement. Upon conversion, the median offering allocates 14% of the equity to convertible bondholders. The median conversion premium is 21%.

Rows (5) through (7) provide information about the call protection period, maturity, and yield advantage in the typical convertible bond issue. Overall, 673 of the 712 issues are callable. The median time to first call is 2.00 years. Of the 673 callable offerings, 84 are callable immediately after issue. For the remaining 589 callable issues, the median length of call period protection is 2.76 years. Convertible bond offerings typically have long maturities. In our sample, the average offering has a maturity of 21.2 years. Convertible bonds offer investors a yield advantage of 703 basis points over the issuer's common stock dividend yield at the time of issue.

Information about the issuing firm's use of proceeds and financial leverage is provided in rows (8) through (10). The change in total assets provides an estimate of the level of new investment around the time of the convertible debt offer. It is computed as total assets after the offering divided by total assets before the offering. The change in total assets indicates that the median convertible bond issuer increases assets by 34% during the year of the offering. Financial leverage also changes after the offering. The mean debt–asset ratio is 18% prior to issue and 25% at fiscal year-end immediately after the issue. Overall, convertible debt issues represent a significant capital acquisition activity that substantially impacts the issuer's investment behavior and financial structure.

Row (11) presents the mean and the median 2-day announcement period excess return, which respectively are -1.15 and -1.14%. Excess returns are computed using the conventional event study methodology. Two-day announcement period excess returns measure the share price response to announcement of the convertible financing event and are computed as the sum of the daily excess returns for days -1 and 0.[11]

Table IV provides descriptive information on the relation between credit quality and call provisions in the sample of convertible debt offerings. For the 652 observations that have both credit rating and call structure

[11] For each firm in the sample, a one-factor market model is estimated using the 280 trading days spanning the combined intervals $\{-200, -61\}$ plus $\{+61, +200\}$, where day 0 is the announcement date. The market return is the rate of return on an equal-weighted index of NYSE, AMEX, and Nasdaq companies obtained from the CRSP market index file. Daily excess returns are calculated by taking the difference between the actual daily return and the expected return based on the market model parameter estimates. The event day is determined as the earliest of the Dow Jones News Retrieval listing date, the *Wall Street Journal* publication date, or the trading day following the date the offering was registered with the SEC. If we are unable to confirm a filing date or a public announcement date for an offering, the issue is excluded from our sample. We limit the sample to firms that have no more than one missing observation during the market model estimation period.

TABLE IV
Credit Ratings and Call Option Frequency for the Sample of 712 Convertible Debt Offerings by NYSE/AMEX and Nasdaq Firms over the Period 1978–1992

S&P bond rating	Number of offerings	Percent of sample offerings that are callable (%)
All ratings	652	94.90
Investment grade	170	96.5
Speculative grade	482	94.4
AAA	5	80.0
AA	10	90.0
A	57	96.5
BBB	98	98.0
BB	94	98.9
B	208	95.2
CCC	27	85.2
CC	2	0.0
NR	151	93.4

information, we find that only 26% are investment-grade at the time of issue. A convertible bond is considered investment-grade if it has a Standard & Poor's (S&P) bond rating of ''BBB'' or better. Ninety-five percent of the observations are callable, with 96.5% of the investment grade issues callable and 94.4% of the speculative-grade issues callable. The largest credit rating classification of convertible debt issuers is the ''B'' rating, representing 32% of the sample. The summary information indicates that investment-grade issuers are as likely to issue callable convertible debt as speculative-grade issuers are.

Table V presents a frequency distribution that categorizes the time to maturity and time to first call for convertible bond issues sorted by investment-grade and speculative-grade. Although it is not reported, the average times to first call for investment- and speculative-grade issuers, respectively, are 2.26 and 2.47 years. A difference in means test indicates this difference is not statistically significant. The distributions in Table V indicate that a greater proportion of investment-grade offerings than speculative-grade offerings are immediately callable (16.47% vs 10.79%).[12] They also indicate that 87.06% of investment grade and 91.70% of speculative grade convertible bonds are first callable within 3 years of the issue date. Consistent with

[12] The Chi Square statistic that tests whether credit ratings are independent of immediate callability has a value of 3.77, which indicates the null hypothesis of independence can be rejected with a probability value of 0.052.

TABLE V
Frequency Distribution of First Call Date and Maturity by Investment or Speculative Grade

	Years to maturity						
Years to first call	1 to 5	5 to 10	10 to 15	15 to 20	20 to 25	25	Total
			A: Investment-grade bonds				
Immediate	0	0	1	0	20	7	28
1 year	0	1	0	1	1	0	3
2 years	0	2	12	13	43	4	74
3 years	0	7	2	2	26	6	43
4 years	0	1	0	1	2	2	6
5 years	0	1	3	1	3	1	9
5 to 10 years	0	0	0	0	0	1	1
Noncallable	0	1	0	3	2	0	6
Total	0	13	18	21	97	21	170
			B: Speculative-grade bonds				
Immediate	0	0	4	18	26	4	52
1 year	0	2	9	4	6	0	21
2 years	0	7	29	74	109	8	227
3 years	1	19	13	29	67	13	142
4 years	0	0	2	1	1	0	4
5 years	0	1	3	5	0	0	9
5 to 10 years	0	0	0	0	0	0	0
Noncallable	1	3	7	11	4	1	27
Total	2	32	67	142	213	26	482

our Table IV results, we do not find substantial differences in first call dates across bond rating classifications.

3.3. Measurement of Proxy Variables for Convertible Debt Financing Hypotheses

We group the proxy variables that we use to examine different convertible debt financing hypotheses. We group them according to the theoretical measure to which they can be attributed. The corresponding COMPUSTAT data item is indicated in parentheses. They are as follows.

3.3.1. *Convertible Bond Design Variables*

Postconversion Equity Ownership. This variable is the number of shares issued to bondholders assuming full conversion divided by the sum of (1) the total shares outstanding on the issue date and (2) the number of shares issued to bondholders assuming full conversion.

Conversion Premium. We measure the conversion premium as the ratio of the conversion price to the market price of the underlying common equity at the time of issue.

Maturity. We measure maturity as the time between the issue date and the date on which the last payment on the bond is due.

Length of Call Period Protection. We measure an issue's call protection as the time between the issue date and the date on which the issue is first callable. If the bond is not callable, the time to first call equals the bond's maturity.

Relative Period of Call Protection. This variable equals the length of call period protection divided by the bond's maturity.

Not Callable Dummy. The not callable dummy variable is an indicator variable that takes the value 0 if the bond is callable and the value 1 if it is not callable.

3.3.2. *Private Information Proxies*

Growth Opportunities. We measure growth opportunities as the ratio of the market value of the firm's assets to the book value of its assets (item 6) at the fiscal year end prior to the issue announcement. We estimate the market value of the firm's assets as the book value of total assets (item 6) less the book value of equity (item 60) plus the market value of equity (item 24 multiplied by item 25). This variable also is used as a proxy for uncertainty about company risk.

Change in Total Assets. We measure the change in total assets as the ratio of the book value of the firm's assets (item 6) at the fiscal year end subsequent to the issue announcement relative to the book value of the firm's assets at the fiscal year end prior to the issue announcement.

Abnormal Earnings. We measure a firm's abnormal earnings as the difference between earnings per share (item 58) in the fiscal year ending immediately after issue announcement and earnings per share in the fiscal year ending immediately prior to the issue announcement. This difference is scaled by the pre-issue fiscal year end stock price (item 24).

3.3.3. *Company Risk Proxies*

Firm Size. We measure firm size as the natural logarithm of the market value of the firm's assets at the fiscal year end prior to the issue announcement. Firm assets are the sum of the book value of long-term debt (item 9), the book value of preferred stock (item 130), and the market value of the outstanding common stock (item 24 multiplied by item 25).

Volatility. Volatility is calculated as the standard deviation of the issuer's raw return over the 140-day period beginning 200 days prior to and ending 60 days prior to the issue announcement date.

3.3.4. *Default Risk Proxies*

Credit Quality. We measure a firm's credit quality as a cardinalized bond rating that depends on the issue's S&P bond rating, where AAA = 1, AA = 2, . . . , and C = 9. Issues that are not rated are assigned a value of 10.[13]

Not Rated Dummy. An indicator variable that takes the value 1 if the bond is not rated and a value of 0 if the bond is rated.

Financial Leverage. We measure financial leverage as the firm's debt-asset ratio at the fiscal year end prior to the issue announcement. The debt–asset ratio is calculated as the book value of long-term debt (item 9) divided by long-term capital. Long-term capital is total assets (item 6) net of short-term liabilities (item 5). This variable also is used as a proxy for company risk.

3.3.5. *Other Control Variables*

Preissue Debt Maturity. We measure pre-issue debt maturity as the book value of long-term debt due after three years divided by the book value of long-term debt at the fiscal year end prior to the issue announcement. The book value of long-term debt due after 3 years equals the book value of long-term debt (item 9) less the sum of the book value of long-term debt due in one year (item 44), the book value of long-term debt due in 2 years (item 91), and the book value of long-term debt due in 3 years (item 92).

Term Structure. We estimate the slope of the term structure of interest rates as the difference between the yield on a 10-year U.S. Treasury bond and a 6-month U. S. Treasury bill in the month ending immediately prior to the issue announcement.[14]

Year Dummies. We include a set of dummy variables based on the year of issue. For example, the 1979 dummy is an indicator variable that takes the value 1 if the issue year is 1979 and 0 otherwise. The regression results do not include a year dummy for 1978 because the six issues in that year are eliminated from the final sample due to missing COMPUSTAT data.

[13] This measure is similar to that used by Hoven-Stohs and Mauer (1996).

[14] These variables are obtained from the FactSet Historical Prices data base.

4. EMPIRICAL RESULTS

We examine three endogenously determined attributes of the convertible debt financing decision: post-conversion equity ownership by bondholders, issue maturity, and call structure. Given the highly interactive nature of these design attributes, we estimate them as a system of simultaneous equations using GMM. We use GMM to control for heteroscedasticity in the independent variables.[15]

Each equation in our simultaneous equation model includes the other two design features as endogenous variables. For instance, the postconversion equity ownership equation includes bond maturity and the relative period of call protection as endogenous variables. The coefficient estimates for these endogenous variables provide new evidence regarding the trade-offs among different security attributes. Our results demonstrate that the endogenous variables have a significant impact on the dependent variables.

We estimate the following system of equations.

$$
\begin{aligned}
&\text{Post-conversion equity ownership} \\
&\quad = a_0 + a_1\,\text{Credit quality} + a_2\,\text{Not rated dummy} \\
&\quad + a_3\,\text{Conversion premium} + a_4\,\text{Firm size} + a_5\,\text{Financial leverage} \\
&\quad + a_6\,\text{Volatility} + \sum_{j=7}^{13} a_j\,\text{Year dummy}_{j-6} \\
&\quad + a_{14}\,\text{Relative time to first call} + a_{15}\,\text{Time to maturity}
\end{aligned}
$$

$$
\begin{aligned}
&\text{Time to maturity} \\
&\quad = b_0 + b_1\,\text{Market-to-book} + b_2\,\text{Firm size} \\
&\quad + b_3\,\text{Abnormal earnings} + b_4\,\text{Term structure} \\
&\quad + b_5\,\text{Preissue debt maturity} \\
&\quad + b_6\,\text{Financial leverage} + \sum_{j=7}^{13} b_j\,\text{Year dummy}_{j-6} \\
&\quad + b_{14}\,\text{Relative time to first call} + b_{15}\,\text{Postconversion equity ownership}
\end{aligned}
$$

$$
\begin{aligned}
&\text{Relative time to first call} \\
&\quad = c_0 + c_1\,\text{Not callable dummy} + c_2\,\text{Credit quality} \\
&\quad + c_3\,\text{Not rated dummy} + c_4\,\text{Market-to-book} + c_5\,\text{Change in total assets} \\
&\quad + c_6\,\text{Abnormal earnings} + c_7\,\text{Financial leverage} + \sum_{j=8}^{14} c_j\,\text{Year dummy}_{j-7} \\
&\quad + c_{15}\,\text{Time to maturity} + c_{16}\,\text{Postconversion equity ownership.}
\end{aligned}
$$

[15] The system we estimate is overidentified. Complete details regarding the instrument set are available from the authors upon request. We also estimate this system of simultaneous equations using two-stage least-squares estimation and obtain the same qualitative results.

4.1. Postconversion Equity Ownership by Bondholders

Table VI summarizes the results obtained from the GMM estimation of postconversion equity ownership on several explanatory variables hypothesized to measure the propensity to expropriate bondholder wealth. We use a logistic transformation of the bondholders' postconversion equity ownership because it significantly reduces the levels of skewness and kurtosis in the dependent variable.[16] Bond maturity and the relative time to first call are endogenous variables in our system of simultaneous equations. The exogenous variables are credit quality, the not rated dummy, firm size, the conversion premium, financial leverage, volatility, and year of issue dummies. Our empirical findings are consistent with Green's (1984) hypothesis that convertible debt issues are designed to allocate greater relative postconversion ownership to bondholders when the potential for risk-shifting investment decisions is most likely to exist.

The conversion premium, firm size, and financial leverage are statistically significant and have the sign predicted by Green (1984). Bondholders' postconversion equity ownership is higher in firms that have high leverage and small market capitalization, and that choose lower conversion premiums. Thus, firms with high debt levels must give larger fractions of equity ownership to debtholders to reduce management's incentive for asset substitution. This result is mitigated to some extent in large firms, possibly because the larger asset base serves as better collateral for the debt. All else equal, the larger asset base would attenuate shareholder gains from asset substitution.

Our results also document several additional significant relations that are not adequately explained by the theories of convertible debt financing. Issues with high levels of postconversion equity also have lower conversion premiums and shorter maturities. Managers may design securities this way if their stock is currently undervalued but they are optimistic about near-term stock price performance. If so, some convertible debt issues can be viewed as deferred equity because shorter maturity forces conversion to occur relatively soon and the low conversion premium increases the probability that the convertible bond is converted at maturity.

Table VI also indicates that issues with high levels of postconversion equity ownership have shorter relative call protection periods. That is, high postconversion equity ownership firms not only shorten the maturity of the debt issue but also shorten the proportion of the bond's life that is protected from being called.

[16] Tests for normality of the transformed and untransformed values of postconversion equity ownership indicate that the untransformed variable does not come from a normal distribution (p value of 0.001). By contrast, we cannot reject the hypothesis that the transformed variable comes from a normal distribution (p-value 0.8582). We repeat our analysis using the untransformed postconversion equity ownership variable, and the results are qualitatively the same. The adjusted R-square for the untransformed version is lower.

TABLE VI
Generalized Method of Moments Estimates of the Determinants of Postconversion Equity Ownership by Convertible Bondholders, 1979–1992

	Estimate	Standard error	*p*-Value
Endogenous variables:			
Relative time to first call	−5.303	1.111	0.0001
Time to maturity	−0.100	0.016	0.0001
Exogenous variables:			
Intercept	1.224	1.516	0.4197
Credit quality	−0.001	0.028	0.7247
Not rated dummy	−0.058	0.121	0.6305
Conversion premium	−0.011	0.003	0.0002
Firm size	−0.295	0.027	0.0001
Financial leverage	0.721	0.165	0.0001
Volatility	2.407	2.391	0.3145
Year dummies			
1980	0.977	1.537	0.5253
1981	1.039	1.564	0.5067
1982	1.200	1.550	0.4392
1983	1.467	1.589	0.3565
1984	1.740	1.559	0.2649
1985	1.604	1.554	0.3026
1986	1.773	1.547	0.2524
1987	1.646	1.561	0.2923
1988	1.834	1.556	0.2393
1989	1.972	1.561	0.2071
1990	2.289	1.575	0.1468
1991	2.032	1.569	0.1959
1992	1.407	1.572	0.3711
Adjusted R^2	0.2604		
Observations	458		

Note. The dependent variable is a logistic transformation of the postconversion equity ownership variable. Postconversion equity ownership is the proportion of the equity that will be owned by convertible bondholders if they convert. Relative time to first call is equal to the bond's time to first call divided by its time to maturity. If the bond is not callable, time to first call equals time to maturity. Time to maturity is the number of years until the bond matures. Credit quality is a cardinalized bond rating variable based on the firm's S&P bond rating, where AAA = 1, ... , C = 9, and unrated firms receive a code of 10. The rating dummy equals one if the bond is not rated and 0 otherwise. Conversion premium is equal to the bond's conversion price divided by the issuer's market price per share, measured on the day prior to issue. Firm value is equal to the sum of the market value of common equity, the book value of preferred stock, and the book value of long-term debt. Financial leverage is the debt–asset ratio in the fiscal year ending prior to the issue. The debt-asset ratio is calculated as the book value of the long-term debt divided by total assets net of short-term liabilities. Volatility is the standard deviation of the issuer's raw returns over the period [−200, −60] relative to the issue announcement date. The year dummy variables are a set of dummy variables based on the issue year. The dummy for 1980 takes the value 1 if the issue year is 1980 and 0 otherwise.

Table VI also includes stock price volatility as an independent variable. The risk-shifting hypothesis states that the ex post incentive to shift investment allocations toward riskier projects influences convertible debt security design. Since risk measures for each project in the firm's investment opportunity set are unobservable, we use stock price volatility as a proxy for the volatility of the firm's operations.

The results indicate that cross-sectional variation in issuer volatility is an insignificant determinant of bondholders' postconversion equity ownership. Finally, year dummies are not important cross-sectional determinants of postconversion equity ownership.

4.2. Issue Maturity

Table VII presents results obtained from the GMM estimation of convertible debt issue maturity on variables that have been proposed as determinants of the corporate debt maturity decision. The relative time to first call and postconversion equity ownership are endogenous variables in our system of simultaneous equations. The exogenous variables are the market-to-book ratio, firm size, abnormal earnings, term structure, preissue debt maturity, financial leverage, and year of issue dummies. The market-to-book ratio, log of firm value, and financial leverage relate to the asymmetric information theories of convertible debt maturity. The remaining exogenous variables control for explanations of debt maturity that are based on straight debt issuers. Overall, our empirical findings do not support the private information and asset risk hypothesis (Brennan and Kraus, 1987, and Brennan and Schwartz, 1988) that small firms with profitable growth opportunities and high leverage will prefer longer maturities.

Table VII shows that large firms with high leverage and valuable growth opportunities issue convertible debt with shorter maturities. While the coefficient estimate for the market-to-book ratio is statistically significant, its sign is opposite from that predicted by Brennan and Schwartz (1988). The negative coefficient estimate for firm size is statistically significant and has the predicted sign. However, leverage is not an important determinant of the original maturity of the convertible debt issues in our sample. Taken together, private information about company risk does not explain the cross-sectional variation in issue maturity for convertible debt issuers.[17]

Note, however, that the market-to-book ratio result is consistent with the hypothesis that underinvestment problems influence cross-sectional variation in convertible debt maturity. Firms with valuable growth opportu-

[17] Note that our results do not imply that private information about company risk has no influence on the convertible debt issue decision. It is possible that firms choosing to issue convertible debt face private information problems. In this case, the maturity of each issue may reflect differences in the potential for issuers to experience underinvestment problems.

TABLE VII
Generalized Method of Moments Estimates of the Determinants of Convertible Debt Maturity, 1979–1992

	Estimate	Standard error	*p*-Value
Endogenous variables:			
Relative time to first call	−42.168	6.181	0.0001
Postconversion equity ownership	−3.322	0.442	0.0001
Exogenous variables:			
Intercept	9.851	2.327	0.0001
Market-to-book ratio	−0.333	0.152	0.0291
Firm size	−0.460	0.193	0.0174
Abnormal earnings	0.442	2.907	0.8792
Term structure	0.029	0.152	0.8510
Preissue debt maturity	0.118	1.810	0.9480
Financial leverage	0.702	1.055	0.5061
Year dummies			
1980	10.185	1.955	0.0001
1981	11.074	2.153	0.0001
1982	12.490	2.223	0.0001
1983	13.169	2.244	0.0001
1984	14.585	2.248	0.0001
1985	14.241	2.283	0.0001
1986	14.619	2.188	0.0001
1987	14.918	2.177	0.0001
1988	15.447	2.370	0.0001
1989	15.583	2.362	0.0001
1990	16.534	2.563	0.0001
1991	11.056	2.648	0.0001
1992	10.280	3.118	0.0011
Adjusted R^2	0.2469		
Observations	458		

Note. The dependent variable is the time to maturity, which is the number of years until the bond matures. Relative time to first call is equal to the bond's time to first call divided by its time to maturity. If the bond is not callable, time to first call equals time to maturity. Postconversion equity ownership is a logistic transformation of the proportion of the equity that will be owned by convertible bondholders if they convert. The market-to-book ratio is equal to the market value of common equity plus the book value of preferred stock plus the book value of long-term debt divided by the book value of total assets. Firm size is equal to the natural log of the sum of the market value of common equity, the book value of preferred stock, and the book value of long-term debt. Abnormal earnings is equal to the difference between earnings per share at fiscal year end immediately after and prior to the issue announcement, scaled by preissue fiscal year and stock price. Term structure is equal to the difference between the yield on a 10-year government bond and a six-month government bill in the month ending immediately prior to the issue announcement. Pre-issue debt maturity is equal to the proportion of long-term debt due after three years in the fiscal year ending prior to the issue. Financial leverage is the debt-asset ratio in the fiscal year ending prior to the issue. The debt-asset ratio is calculated as the book value of the long-term debt divided by total assets net of short-term liabilities. The year dummies are a set of dummy variables based on the issue year. The dummy for 1980 takes the value 1 if the issue year is 1980 and 0 otherwise.

nities are especially vulnerable to the underinvestment problem described by Myers (1977) because their managers have strong incentives to change the firm's investment policy. This theory predicts that small firms with ample growth opportunities and high leverage will prefer shorter maturities.

The exogenous variables based on straight debt theories include abnormal earnings, a term structure variable, and pre-issue debt maturity structure. The abnormal earnings measure proxies for the impact of asymmetric information on the debt maturity decision (see, e.g., Flannery, 1986, and Diamond, 1993).[18] Term structure considerations may impact the debt maturity decision through the term structure's influence on the present value of interest tax shields (see, e.g., Brick and Ravid, 1985, and Lewis, 1990).[19] The pre-issue debt maturity structure is included to control for the differences in the issuers' outstanding debt maturity structures at the time of the offer announcement. Table VII shows that abnormal earnings, tax effects, and preissue debt maturity provide little explanatory power for the convertible debt maturity decision, since they all have statistically insignificant coefficient estimates.[20]

The year dummies show that average debt maturity increases each year over the period 1979–1988, and decreases each year thereafter. A comparison with Table II indicates that the general trend in debt maturity corresponds to the number of convertible debt issues. This finding suggests that firms issue more convertible bonds with longer maturities when credit is relatively easy to obtain and investors' expectations about the economy are high.

Table VII also indicates that issues with shorter maturities are designed to have shorter relative time to first call and greater proportions of postconversion equity ownership. The coefficients for the relative time to first call and postconversion equity ownership are negative and significant

[18] According to Flannery (1986), higher-quality firms issue debt with shorter maturity. Thus, issue maturity is predicted to be inversely related to abnormal earnings.

[19] Brick and Ravid (1985) argue that firms will employ longer-term debt when the term structure is upward sloping because interest expense from issuing long-term debt is greater than the expected interest expense from rolling over short-term debt in early years, and less in later years. This reduces the firm's expected tax liability and increases firm value. A similar argument suggests that firms will prefer shorter term debt when the term structure of interest rates is downward sloping. Lewis (1990) predicts that the same level of interest tax shields can be generated with either short- or long-term debt by varying the debt levels. He predicts that maturity structure is unrelated to the term structure.

[20] We also estimate issue maturity regressions that include change in total assets and credit quality as additional explanatory variables, as suggested by Brennan and Schwartz (1988). Although we do not report these regression results in Table VII, none of the additional variables is found to be a statistically significant determinant of convertible debt issue maturity. Moreover, the overall explanatory power of the model does not improve with the inclusion of these variables. This suggests that issuers are establishing convertible debt maturity for reasons beyond uncertainty about issuer risk, as hypothesized by Brennan and Schwartz (1988).

There are several potential explanations for our results. First, there is no theory that fully identifies the factors that determine the maturity structure of convertible debt. Although convertible debt has a straight debt component, it also includes an equity conversion option. The hybrid nature of this type of security may indicate that other more significant (but as yet unidentified) factors determine the maturity structure of convertible debt.

Second, maturity structure is not a *unique* way to control some of the problems under consideration here. For example, the underinvestment problem also can be mitigated through the use of restrictive covenants in the indenture agreement, by including less debt in the capital structure, or by including a call provision.[21] Our findings may indicate that these other factors are more significant than maturity structure in the case of convertible debt issues.

Finally, our empirical testing approach allows us to focus specifically on the variation in convertible debt maturity at issuance. Barclay and Smith (1995) and Hoven-Stohs and Mauer (1996) examine variation in debt maturity across all of the firm's outstanding debt. Our tests focus only on the cross-sectional variation in maturity for a particular financing instrument on the issue date rather than the time series and cross-sectional variation in the firm's aggregate debt maturity structure.

Further insights regarding the maturity of new convertible debt issues can be gained by comparing convertible debt issues with maturity structures of other types of corporate debt. Guedes and Opler (1996) find that the maturity of corporate debt issues is related to the firm's creditworthiness. They document that large firms with investment-grade credit ratings typically borrow at either the short end or the long end of the maturity spectrum, while firms with speculative-grade credit ratings typically borrow in the middle of the maturity spectrum. As we document in Table V, regardless of credit rating, firms almost never issue short-term convertible debt (i.e., maturities less than 5 years). Moreover, over 75% of both investment-grade and speculative-grade convertible debt offerings have maturities of 20 years or more. Hence, both lower and higher quality convertible debt issuers avoid the short end of the maturity spectrum.

Guedes and Opler (1996) argue that lower-quality firms cannot issue long-term debt because of investor concerns about risk-shifting problems. Our results suggest that a conversion option allows firms to issue long-term debt regardless of credit quality. This is consistent with the prediction that convertible debt reduces asset substitution problems, as suggested by Green

[21] Cornell and Shapiro (1988) suggest that, if conversion features are set properly, convertible securities can overcome some of the problems that cause investors to demand strict covenants on straight debt. They argue that rapidly growing companies are most likely to benefit from convertible financing.

(1984). The results also suggest that firms can proactively extend maturities on their debt obligations by attaching conversion options. Firms desiring access to long-term debt capital (perhaps because of long asset maturities) that are also vulnerable to asset substitution problems may find convertible debt to be an especially attractive source of funding. The fact that issuers in our sample have high betas is further evidence consistent with the argument that these firms may be vulnerable to asset substitution problems (see Lewis *et al.* 1997a).

4.3. Call Structure

Stein's (1992) "backdoor equity" theory of convertible debt financing highlights the prominent role of call provisions in convertible debt. Since financially risky companies issue convertible bonds only if management has favorable private information, issuers signal better information by shortening the period of call protection. Thus, we expect a negative relation between proxies for the quality of private information and relative call protection.

One of the difficulties associated with a direct test of this hypothesis is that call options are common in a variety of corporate debt instruments. There are theoretical explanations for the prevalence of callable corporate debt that do not rely on conversion privileges. Other explanations of the role of call features in corporate debt securities focus on market imperfections similar to those under consideration here: (1) asymmetric information, (2) asset substitution, and (3) underinvestment.[22] While these theories offer explanations for the inclusion of call provisions, they do not make specific predictions about the length of the call protection period in relation to other design features such as time to maturity. Since default risk and time to maturity play a key role in each of the alternative theories of callable corporate debt, we include control variables for these effects in our regression specifications.

Table VIII provides the results obtained from the GMM estimation of relative call protection on several variables that proxy for potential sources of issuer private information. Time to maturity and postconversion equity ownership are endogenous variables in our system of simultaneous equations. The exogenous variables that proxy for private information are the market-to-book ratio, the change in total assets, and abnormal earnings. The exogenous variables that control for default risk are credit quality, the not rated dummy, financial leverage. Since we assume that bonds without explicit call provisions have a time to first call equal to the bond's maturity date, we include a "not callable" dummy that takes the value 1 if the

[22] See, Myers (1977), Bodie and Taggart (1978), and Barnea *et al.* (1980).

TABLE VIII
Generalized Method of Moments Estimates of the Determinants of the Relative Call Period Protection, 1979–1992

	Estimate	Standard error	*p*-Value
Endogenous variables			
Time to maturity	−0.012	0.002	0.0001
Postconversion equity ownership	−0.037	0.006	0.0001
Exogenous variables			
Intercept	0.064	0.055	0.2436
Not callable dummy	1.930	0.305	0.0001
Credit quality	0.005	0.002	0.0259
Not rated dummy	−0.026	0.012	0.0284
Market-to-book ratio	−0.009	0.003	0.0010
Change in total assets	0.080	0.081	0.3233
Abnormal earnings	0.024	0.041	0.5483
Financial leverage	−0.005	0.018	0.7939
Year dummies			
1980	0.141	0.029	0.0001
1981	0.160	0.029	0.0001
1982	0.208	0.028	0.0001
1983	0.218	0.028	0.0001
1984	0.242	0.028	0.0001
1985	0.231	0.028	0.0001
1986	0.240	0.028	0.0001
1987	0.238	0.029	0.0001
1988	0.257	0.029	0.0001
1989	0.268	0.029	0.0001
1990	0.268	0.032	0.0001
1991	0.245	0.033	0.0001
1992	0.243	0.035	0.0001
Adjusted R^2	0.3464		
Observations	458		

Note. The dependent variable is the relative time to first call, which is equal to the bond's time to first call divided by its time to maturity. If the bond is not callable, time to first call equals time to maturity. Time to maturity is the number of years until the bond matures. Post-conversion equity ownership is a logistic transformation of the proportion of the equity that will be owned by convertible bondholders if they convert. The not callable dummy takes the value 1 if the bond is not callable and 0 otherwise. Credit quality is a cardinalized bond rating variable based on the firm's S&P bond rating, where AAA = 1, . . . , C = 9, and unrated firms receive a code of 10. The not rated dummy equals 1 if the bond is not rated and 0 otherwise. The market-to-book ratio is equal to the market value of common equity plus the book value of preferred stock plus the book value of long-term debt divided by the book value of total assets. Change in total assets is equal to the book value of the firm's assets subsequent to the issue announcement relative to the book value of the firm's assets prior to the issue announcement. Abnormal earnings is equal to the difference between earnings per share at fiscal year end immediately after and prior to the issue announcement, scaled by preissue fiscal year and stock price. Financial leverage is the debt-asset ratio in the fiscal year ending prior to the issue. The debt–asset ratio is calculated as the book value of the long-term debt divided by total assets net of short-term liabilities. The year dummies are a set of dummy variables based on the issue year. The dummy for 1980 takes the value 1 if the issue year is 1980 and 0 otherwise.

bond is not callable and 0 otherwise. This variable is predicted to have a positive sign.

Our empirical findings are consistent with the Stein (1992) hypothesis that convertible debt issues are designed to have shorter periods of call protection if managers have favorable private information. Table VIII indicates that issues with relatively short periods of call protection also have longer maturities and give away greater fractions of equity ownership upon conversion. This indicates that the maturities of long-term bonds are effectively shortened by short periods of call protection. Moreover, the greater fraction of postconversion equity ownership reinforces the notion that call protection effectively shortens the life of the bond. This latter observation follows because good news about future performance increases equity value and forces an earlier exercise of the conversion option.

Table VIII also shows that the not callable dummy, the credit quality dummy, the not rated dummy, and market-to-book ratio are highly significant and have the predicted sign. That is, firms with better private information have relatively shorter periods of call protection. If managers use call protection to convey private information about their firms, our results suggest that growth opportunities are the source of the private information that managers are trying to communicate to investors.

Finally, note that the year dummy estimates display a strong tendency to increase over the sample period, indicating that relative call protection lengthens over the sample period. This result is different from the time to maturity results where we find that time to maturity increases through 1987 and then decreases relative to this peak for the rest of the sample period.

Stein (1992) argues that firms with positive information want to see convertible debt issues converted into equity in a short time period. The average time to first call for convertible bonds is 2.10 years (see Table III). The average time to first call for nonconvertible bonds is shown in Crabbe and Helwege (1994) to be 4.47 years.[23] This confirms Stein's hypothesis that times to first call are shorter for convertible debt than for straight debt.

Overall, we find support for the asymmetric information hypothesis. Table VIII shows that among those firms issuing convertible debt, the firms that design bonds with less call protection have better private information, even after controlling for maturity and postconversion equity ownership. In addition, convertible issues have less call protection than straight debt issues.

5. SUMMARY AND CONCLUSION

This paper provides empirical evidence regarding the design of convertible bonds. We examine three attributes of the convertible debt financing

[23] The average time to first call is computed using information from Table VII in Crabbe and Helewege (1994).

decision: postconversion equity ownership by the bondholders, issue maturity, and call structure. The testable hypotheses that we examine are drawn primarily from three different theories. The main distinction among these theories is in their assumptions regarding the motivations underlying management's decision to issue convertible debt. Risk plays a central role in the agency-based theory of Green (1984) and the asymmetric information theories of Brennan and Schwartz (1988) and Brennan and Kraus (1987). Firm value is the most important factor in the asymmetric information model of Stein (1992).

Because of the endogenous nature of postconversion equity ownership, issue maturity, and call structure, we analyze these design features as a system of simultaneous equations using GMM estimation. We find that high postconversion equity ownership by convertible bondholders occurs in small firms with high financial leverage, as well as issues with lower conversion premiums. Convertible debt maturity is negatively related to the issuing firm's growth opportunities. Issues with longer maturities also tend to have low postconversion equity ownership and shorter periods of relative call protection. Call provisions are included in the majority of convertible debt issues regardless of the issuer's creditworthiness. We find that there is less relative call protection in firms with high growth opportunities, as well as issues with longer maturities and high postconversion equity ownership.

We provide a number of new insights into the design of convertible debt. We find that corporate managers structure convertible bonds so that postconversion equity ownership reduces the incentive to over-invest in high-risk projects. Managers of firms with ample growth opportunities also set relatively short periods of call protection to overcome the adverse selection costs associated with common stock issues.

Our results suggest that asset substitution and asymmetric information problems play a prominent role in the way that corporate managers design convertible debt. Moreover, design characteristics change through time across the business cycle in response to time-variation in asset substitution and asymmetric information. These findings suggest several avenues for future research. First, future empirical tests should explicitly control for the possibility that issuers offer convertible debt for different reasons. A promising approach is to examine why firms offer convertible debt instead of straight debt or common equity. Green (1984) suggests that some issuers offer convertible debt instead of straight debt, while Stein (1992) suggests that other issuers offer convertible debt instead of common equity. Controlling for these differences in the issuer universe may provide a better understanding of investor reactions to these security offers. A second important area of future research is a postissue analysis of operating performance. By examining the change in actual operating performance and risk charac-

teristics after a convertible debt offer, we may gain further insights in the motives for issuance. Finally, given the important role that we document for security design, further examination of newer forms of convertible financing is warranted. In particular, the recent increase in the use of mandatory convertible securities is likely to be a fruitful area of future research.

REFERENCES

Asquith, P. (1995). Convertible bonds are not called late, *J. Finance* **50,** 1275–1289.

Barclay, M., and Smith C. (1995). The maturity structure of corporate debt, *J. Finance* **50,** 609–631.

Barnea, A., Haugen, R. A., and Senbet L. (1980). A rationale for debt maturity structure and call provisions in the agency theoretic framework, *J. Finance* **35,** 1223–1234.

Bodie, Z., and Taggart, R. (1978). Future investment opportunities and the value of the call provision on a bond, *J. Finance* **33,** 1187–1200.

Brennan, M., and Kraus, A. (1987). Efficient financing under asymmetric information, *J. Finance* **42,** 1225–1243.

Brennan, M., and Schwartz, E. (1977). Convertible bonds: Valuation and optimal strategies for call and conversion, *J. Finance* **32,** 1699–1715.

Brennan, M., and Schwartz, E. (1988). The Case for Convertibles, *J. Appl. Corp. Finance* **1,** 55–64.

Brick, I., and Ravid, S. A. (1985). On the relevance of debt maturity structure, *J. Finance* **40,** 1423–1437.

Choe, H., Masulis, R., and Nanda, V. (1993). Common stock offerings across the business cycle: Theory and evidence, *J. Emp. Finance* **1,** 3–31.

Cornell, B., and Shapiro, A. (1988) Financing corporate growth, *J. Appl. Corp. Finance* **1,** 6–22.

Crabbe, L., and Helwege, J. (1994). Alternative tests of agency theories of callable corporate bonds, *Finan. Manage.* **23,** 3–20.

Dann, L., and Mikkelson, W. (1984). Convertible debt issuance, capital structure change, and financing-related information, *J. Finan. Econ.* **13,** 157–186.

Diamond, D. (1993). Seniority and maturity of debt contracts, *J. Finan. Econ.* **33,** 341–368.

Eckbo, B. (1986). Valuation effects of corporate debt offerings, *J. Finan. Econ.* **15,** 119–151.

Essig, S. (1988). "Convertible Securities and Capital Structure Determinants," Ph. D. dissertation, Graduate School of Business, Univ. of Chicago.

Flannery, M. (1986). Asymmetric information and risky debt maturity choice, *J. Finance* **41,** 19–37.

Green, R. (1984). Investment incentives debt and warrants, *J. Finan. Econ.* **13,** 115–136.

Guedes, J., and Opler, T. (1996). The determinants of the maturity of corporate debt Issues, *J. Finance* **51,** 1809–1833.

Hoven-Stohs, M., and Mauer, D. (1996). The determinants of corporate debt maturity structure, *J. Bus.* **69,** 279–312.

Lewis, C. (1990). A multiperiod theory of corporate financial policy under taxation, *J. Finan. Quant. Anal.* **25,** 25–43.

Lewis, C., Rogalski, R., and Seward, J. (1994). ''An Empirical Analysis of Convertible Debt Financing by NYSE/AMEX and Nasdaq Firms.'' Working paper, Vanderbilt Univ. and Dartmouth College.

Lewis, C., Rogalski, R., and Seward, J. (1997a). ''Industry Conditions, Growth Opportunities and Market Reactions to Convertible Debt Financing Decisions,'' working paper, Vanderbilt Univ. and Dartmouth College.

Lewis, C., Rogalski, R., and Seward, J. (1997b). ''Is Convertible Debt a Substitute for Straight Debt or Common Equity?,'' working paper, Vanderbilt Univ. and Dartmouth College.

Mikkelson, W., and Partch, M. (1986). Valuation effects of security offerings and the issuance process, *J. Finan. Econ.* **15,** 31–60.

Myers, S. (1977). Determinants of corporate borrowing, *J. Finan. Econ.* **5,** 147–175.

Smith, C., and Watts, R. (1992). The investment opportunity set and corporate financing, dividend and compensation policies, *J. Finan. Econ.* **32,** 263–292.

Stein, J. (1992). Convertible bonds as backdoor equity financing, *J. Finan. Econ.* **32,** 3–21.