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Convertible Bond Design and Capital Investment: The Role of Call Provisions

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ABSTRACT

If firms issue convertible securities to facilitate sequential investment, the securities should be engineered to give sufficient flexibility to accommodate timing of follow-on investment. We examine call provisions in convertible bonds and argue that firms with investment options expected to expire sooner (later) will offer weaker (stronger) call protection. We find that issues with weak or no call protection are offered by firms that invest greater amounts soon after issuance than those issuing convertibles with strong protection. Moreover, capital expenditure levels during the 5-year period following issuance are inversely related to the length of call-protection periods.

MOST CONVERTIBLE BONDS AND NOTES have call provisions, and most provisions have important qualifications or protection. Broadly speaking, convertibles may have absolute protection (not callable), hard call protection (noncallable for a specified period), provisional or soft call protection (callable if certain conditions on stock price are met), or no protection (callable anytime). In this study, we investigate the relations between the strength and length of call protection and firms' subsequent investment behavior.

Our hypothesis is a natural implication of the sequential financing motive for convertible debt financing. For example, in Mayers (1998), firms finance their planned multistage investment programs with convertibles. Besides Mayers' sequential financing motive, other explanations for convertible financing include theories based on post-issuance risk shifting (Jensen and Meckling (1976), Green (1984)), heterogeneous risk assessment (Brennan and Schwartz (1988)), and asymmetric information (Stein (1992)). In a recent study, Lewis, Rogalski, and Seward (2001) offer an explanation based on equity market rationing.

Stein's (1992) model has at least an implicit role for callability, but we believe Mayers' explanation has direct implications for the nature of call provisions that we examine here. He argues that convertible financing is well suited to

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circumstances where a firm requires immediate financing to undertake a project that is expected to be followed by a second project at some (uncertain) time in the future.

We argue that firms facing investment options that are expected to mature shortly after issuance will offer convertibles with little or no call protection, and those issues with protection features will have short protection periods. Of course, this comes with a cost, as the call feature has higher value to the issuer, hence the bonds are priced lower. Firms with investment options expected to mature later should offer convertibles with hard or even absolute protection, and protection periods should be longer. This enables them to issue the securities at higher prices because the embedded call options have reduced value.

To evaluate investment patterns, we examine issuers' capital expenditures for each of the 5 years following issuance. Our primary measure of capital investment behavior reflects the number of years following issuance it takes for firms' cumulative capital expenditures to meet or exceed the proceeds raised at issuance. Firms with lower values of this measure should rely on weaker protection than those with higher values, and this is found to be the case in our sample of 705 issues during 1980 to 1996. Moreover, our investment timing measure should be positively related to the length of the call protection period. Firms that issue convertibles with shorter call protection periods should spend the most, shortly after issuance. This is the case in our data as well.

In Section I, we describe our sample of convertible bond issues and offer some preliminary evidence that firms' capital expenditures are linked as predicted to call protection. We set forth our primary measure of capital investment timing and present tests in Section II. Our first test involves estimation of an ordered probit model of the strength of call protection—that is, no protection, soft, hard, and absolute. Then we examine the length of the contractual call protection period by estimating a Poisson regression model of the number of years of protection. We include extensive robustness and specification tests in view of the empirical challenges in convincingly identifying the hypothesized relations. We summarize our findings and conclude in Section III.

I. Sample of Convertible Bond Issues

Most of the issue-specific data used in this study come from Securities Data Corporation's (SDC) New Issues database. The SDC reports 3,970 convertible bond issues between 1980 and 1996. We truncate the sample in 1996 so that we may observe 5 years of capital expenditure data following issuance. We remove from the sample "mandatory" convertibles, that is, those that are automatically converted at maturity. We also omit variable coupon rate issues since many of these have coupon reset provisions. Such provisions may be invoked to force conversion without resorting to calling the issue.

Exchangeable bonds, that is, those that are convertible into the shares of a firm other than the issuer, are omitted to allow us to link capital expenditures of issuers with their respective call provisions. Convertibles that are putable conditional on a change of control event are retained, but those with put features not tied to such events are omitted. Also, we reject issues for which call protection terms are unavailable from either SDC, the Lexis-Nexis Academic Universe, the Securities and Exchange Commission's EDGAR database, or *Moody's* industrial manuals. For the remaining sample, primary SIC codes were obtained from Standard & Poor's COMPUSTAT database. After elimination of issuers with primary SIC codes between 6000 and 7000 (financial institutions), the sample consists of 935 convertible bond issues.

In order to determine whether call provisions are designed in anticipation of sequential financing needs, we identify each issuer's annual capital expenditures for 5 years following the year of issuance. This is item 128 in Standard & Poors' COMPUSTAT database and is the same measure reported by Mayers (1998) for a sample of firms following their calls of convertible bonds. Missing data item 128 reduces the full sample by 230 issues, resulting in 705 firms reporting capital expenditures for the full 5 years following issuance.

We categorize each of the 705 issues as (1) no protection, (2) soft protection, (3) hard protection, or (4) absolute protection. The first category (no protection) represents issues that are callable anytime, whereas the second group (soft call protection) has call provisions contingent on stock price behavior. For example, an issue that may be called if the stock price exceeds a specified level by 150 percent for 20 consecutive trading days is categorized as soft protection. The third category (hard protection) features unconditional call deferment periods, and this category includes issues with soft call protection that takes effect following a period of hard protection.[1] The fourth group includes convertibles that are not callable.

In Table I, the sample is summarized according to these four groupings by year of issuance. Some interesting patterns are apparent. Notice that the total number of convertible issues fell sharply in 1988 following the 1987 market crash, and then recovered gradually. This pattern reflects that identified by Mann, Moore, and Ramanlal (1999) linking aggregate convertible bond issuance and overall stock market performance.

Soft call protection became prominent in the early 1980s according to Noddings, Christoph, and Noddings (1998), and this development is reflected in our data given in Table I. Our data also show that around 1988, soft call protection subsided and hard protection began returning to prominence. Korkeamaki (2002) reports that a similar pattern is reflected in the international convertible bond markets. We are unable to identify a specific event or change in the regulatory environment or tax laws that might explain the short-lived popularity of soft call protection.

Preliminary evidence consistent with our hypothesis is provided by examining capital expenditure patterns of the sample firms during the 5-year period following issuance. To facilitate the analysis, we calculate yearly capital expenditure ratios for each firm by dividing the respective annual expenditures by

[1] Of the 360 issues classified as hard protection, 17 have hard protection followed by soft protection. Some issues have nonrefunding protection; that is, call is allowed except for re-funding. We categorize these issues as unprotected.

Table I

Distribution of Convertible Bond Issues During the Period 1980 to 1996 by Call Protection Type, by Year

Bonds with soft protection have a call protection period during which the bonds are callable only if the issuer's stock price exceeds a certain predetermined level relative to the conversion price. Hard protection does not allow the issuer to call the issue under any circumstances. Bonds with initial periods of hard protection followed by soft protection are classified as having hard call protection.

Year	No Protection	Soft Protection	Hard Protection	Noncallable	Total
1980	43	1	6	0	50
1981	23	2	18	0	43
1982	1	11	24	0	36
1983	0	24	15	1	40
1984	5	12	3	1	21
1985	4	36	16	1	57
1986	7	68	10	0	85
1987	2	58	26	1	87
1988	0	6	8	0	14
1989	0	10	23	0	33
1990	0	2	7	1	10
1991	1	2	19	2	24
1992	0	2	26	1	29
1993	0	2	39	0	41
1994	0	2	31	1	34
1995	1	2	37	0	40
1996	0	5	52	4	61
Total	87	245	360	13	705

total assets (in book value) at the end of the year. Mean capital expenditure ratios for the 705 convertible issuers are reported in Table II, Panel A. For comparison, we calculate mean ratios for firms in the corresponding two-digit SIC groupings that report expenditure data in Standard & Poor's COMPUSTAT database. For convertible issuers, the means lie in the range from 12.58 to 14.89 percent, compared to the industries' range of 8.75 to 9.09 percent. Average differences between firm and industry ratios are positive and significant at the 0.01 level for each of the 5 years following issuance.[2] Of course, we would expect firms to exhibit increased capital expenditure levels relative to their respective industries in the aftermath of *any* significant financing event, thus the pattern depicted in Panel A is not a surprising one. The next two panels of Table II, however, reveal noticeable differences *among* convertible issuers when analyzed according to two key aspects of their call provisions.

To explore how capital expenditure patterns compare for different levels of call protection, in Panel B, we report mean expenditure ratios for firms for each of the 5 years according to the strength of call protection. The pattern is

[2] We repeat the calculations using assets at the beginning of the year and the findings are nearly identical.

Table II

Mean Ratios of Annual Capital Expenditures for Convertible Bond Issuers and Respective Industries

In Panel A, we report mean ratios for 705 convertible issuers during the period 1980 to 1996, and mean ratios for respective two-digit SIC industries. In Panel B, the mean ratios are arranged by strength of call protection, and in Panel C, the ratios are reported by length of protection period. The annual capital expenditure ratio is formed for each firm by dividing annual capital expenditures by book value of assets.

Year	1	2	3	4	5
Panel A: Mean Ratios (%) for Full Sample and Corresponding Industries (by Two-Digit SIC Codes)					
Issuing firms	12.70	13.18	12.58	13.54	14.89
Corresponding industries	8.75	9.09	8.82	8.92	8.95
Difference	3.95	4.09	3.76	4.62	5.94
Panel B: Mean Ratios (%) by Strength of Call Protection					
No protection (n = 87)	17.88	17.51	16.75	20.54	18.83
Soft (n = 245)	11.97	13.52	13.09	13.99	16.42
Hard (n = 360)	10.96	13.29	12.42	12.34	15.05
Absolute (n = 13)	9.08	11.66	6.73	7.28	3.73
Panel C: Mean Ratios (%) by Length of Call Protection Period (in Years)					
0 (n = 87)	17.88	17.51	16.75	20.54	18.83
1 (n = 29)	13.62	15.23	15.62	17.03	18.76
2 (n = 215)	12.59	13.80	10.76	11.95	15.60
3 (n = 299)	12.06	12.28	11.05	10.72	12.96
4 (n = 31)	10.15	7.97	8.65	8.43	14.23
5 (n = 31)	10.58	7.35	7.60	8.38	8.24
6 (n = 3)	4.81	5.47	4.78	4.83	4.72
7 (n = 10)	4.27	4.73	4.28	3.98	3.30

clear—mean (and median, not reported) expenditure ratios decline throughout the range from no protection to absolute protection.

A similar pattern emerges when we examine mean capital expenditure ratios for firms by length of the call protection period in Panel C. A length of zero represents no call protection, and our sample has call protection periods ranging from 1 to 7 years. Note that the lengths of the protection periods described in Panel C are for hard and soft protection. For instance, a bond that is not callable under any conditions for 3 years is recorded as a 3-year protection length, and a bond with soft protection for 3 years also is recorded as 3-year protection. We will discuss the ramifications of this recording scheme below. In those 13 cases with absolute protection, the length of the protection period is the nominal maturity of each bond. With only minor variation, average capital investment ratios decline as the length of call protection increases. Median ratios (not reported) exhibit the same pattern; that is, median investment ratios generally decline as the length of the call protection period increases. Thus, this evidence is consistent with our story stemming from Mayers (1998). Firms issuing convertibles with weaker call protection and shorter call protection periods tend to invest more in the early periods following issuance.

II. Empirical Models of Call Protection

A. Relation between Call Protection Strength and Capital Expenditures

Our primary thesis is that firms with investment options expected to mature shortly after bond issuance will offer convertibles with weaker (or no) call protection. In this section, we test this prediction by estimating an ordered probit model of protection strength that is denoted as PROT. Because there are only 13 instances of absolute protection, we combine the absolute and hard protection groups. We set PROT = 0 if the issue has no protection, PROT = 1 if it has soft protection, and PROT = 2 if it has hard or absolute protection. (Recall that issues with hard protection followed by soft are categorized as hard protection, thus they are included in PROT = 2.)

A.1. Measure of Investment Timing

To test the predicted relation between call protection strength and capital investment activity, we include in the probit model a measure of capital investment activity during the 5-year period following convertible issuance, assuming that this period will capture most of the inter-firm variation in maturity of investment options. Our measure, denoted as TIMING, is the number of years following issuance in which cumulative annual expenditures first meet or exceed proceeds from convertible issuance. The measure resembles the familiar "payback period" and is determined beginning with the first year following bond issuance. Thus TIMING ranges from 1 to 5. Of our 705 firms, 231 had expenditures in the first year following issuance that exceeded their respective amounts raised (hence TIMING = 1). By the second year following issuance, cumulative expenditures of 136 firms exceeded amounts raised (TIMING = 2), 64 by the third year (TIMING = 3), 50 by the fourth year (TIMING = 4), and 152 by the end of the fifth year (TIMING = 5). Seventy-two firms had cumulative expenditures by the end of the fifth year that fell short of the proceeds from convertibles, thus we also record their TIMING measure as five.[3] Firms with relatively low (high) values of TIMING are predicted to issue convertibles with weaker (stronger) call protection.

A.2. Other Variables

Variation in the strength of call protection may be due to factors apart from capital investment activity, and in this section, we briefly describe other variables included in the full probit model of PROT. In the case of straight bonds,

[3] In our robustness checks presented later in this section, we examine the effect of this coding scheme on the results.

Barnea, Haugen, and Senbet (1980) suggest that callability shortens effective maturity and allows bond issuers with severe agency costs of debt to lessen the unfavorable effects of these costs on their bond prices.[4] To the extent that greater leverage implies potentially severe agency costs, this argument predicts a negative relationship between leverage and strength of protection (PROT). However, calling a convertible bond typically results in forced conversion, and unlike calls of straight debt, convertible calls have special implications for incentive alignment problems. Jensen and Meckling (1976) and Green (1984) argue that outstanding conversion rights reduce agency problems between shareholders and bondholders. Stronger call protection terms allow conversion rights to be outstanding for a longer time, thus providing longer-lived incentive alignment. This implies a positive relationship between leverage and PROT. We control for issuer leverage with a measure of the debt/assets ratio (LEV) as of the year-end before issuance. LEV is measured as the book value of debt and preferred stock divided by the book value of assets.[5]

Ingersoll and Ross (1992) point out that since an expected increase in short-term rates represents an expected increase in projected interest expenses of future investment, a steeper slope in the yield curve should lead to shorter optimal waiting to undertake second-stage investment, hence weaker call protection. We calculate a rough measure of the slope of the yield curve at issuance (CURVE) by dividing the 30-year Treasury bond yield in the issue month by the corresponding 1-year Treasury bill rate. The Ingersoll and Ross (1992) argument predicts a negative sign for CURVE in the probit model.

Kim and Stulz (1988, 1992) report self-selection among U.S. convertible issuers; that is, large and low-risk firms are more likely to issue offshore. The indicator variable EURO should capture potential effects of such differences on call protection terms. This variable is equal to one if the issuer is a U.S. firm issuing abroad, and zero otherwise.

A firm may substitute short maturity for callability; that is, a short-maturity issue implies a limited role for the call provision. Thus we include the variable MATURE, the original time to maturity in years. We predict a negative relation between MATURE and strength of call protection (PROT) to the extent that firms offering short-maturity issues find strong call protection acceptable.

Issue size is added as a control variable denoted as PROCEEDS, and measured as the gross dollar amount raised divided by total asset value of the firm (book value) as of the end of the year of issuance. A large proportion of convertible bonds in the sample (almost 15 percent) were first issued as private placements. An indicator variable PRIVATE for those issues controls for the possibility that their call protection terms are set in a different manner.[6] Such

[4] Bodie and Taggart (1978) and Thatcher (1985) report evidence that increasing agency costs of debt are associated with the use of weaker call protection.

[5] The version of LEV used in the analysis reported uses book value of assets. The results are substantially the same when this measure is replaced by market value of equity plus book values of preferred stock and debt.

[6] The variables MATURE, EURO, and PRIVATE pose potential endogeneity problems that we confront in Section II.C.

Table III

Summary Statistics for Attributes of Convertible Bonds Issued During the Period 1980 to 1996

The measure CURVE = estimated slope of the yield curve; that is, yield on 30-year Treasury bond divided by yield on 1-year Treasury bill at time of issuance; LEV = year-end leverage of issuing firm measured as book value of debt and preferred stock divided by total assets; PROCEEDS = dollar amount raised divided by total assets; MATURE = nominal maturity of the issue; EURO = 1 if issue is a eurobond and zero otherwise; and PRIVATE = 1 if issue is a private placement and zero otherwise.

	Mean	Minimum	Maximum
CURVE	1.324	0.000	2.561
LEV	0.270	0.000	0.907
PROCEEDS	0.215	0.009	0.971
MATURE	16.982	4.000	30.000
			Frequency
EURO			98
PRIVATE			104

a difference could be motivated, for example, by lower levels of information asymmetry leading to a reduction in agency problems.

Finally, to account for the apparent structural shift in the design of call provisions that occurred in the late 1980s, we use the indicator variable BF88 that takes on a value of one for all issues that were issued in years 1980 to 1987, and zero otherwise.

The variables are summarized in Table III. On average, the convertible issues represent 21.5 percent (PROCEEDS) of total assets. The firms' mean leverage (LEV) is 27.0 percent. Nominal maturities average 16.98 years, and range from 4 to 30 years.

A.3. Estimation of the Model of Protection Strength

A.3.1. Role of Timing. In Table IV, we report ordered probit results for various specifications. Recall that lower values of TIMING are hypothesized to be associated with weaker call protection. This is supported by our data in all five specifications. In column (1), the full model, TIMING enters with a positive coefficient estimate (0.025), significant at the 0.01 level ($t = 2.78$).

In column (2) of Table IV, we suppress all issue-specific variables except for PROCEEDS as a size control; that is, we drop EURO, MATURE, and PRIVATE. The investment measure TIMING continues to exhibit a positive association with call protection strength. In column (3), we omit market variables BF88 and CURVE, and the results for TIMING, LEV, and PROCEEDS continue to hold. We drop all except TIMING and the size control (PROCEEDS) in column (4), and in column (5), we restrict the model to the investment timing variable (TIMING) only. In all cases, the investment timing variable is positive and significant, thus we conclude that firms issuing convertible bonds with weak (strong) call protection experience higher (lower) levels of capital investment shortly after issuance.

Table IV

Ordered Probit Estimation Results for Call Protection Strength (PROT)

The measure PROT = 0 if no protection, one if soft protection, and two if hard or absolute protection; TIMING = measure of capital expenditure timing; LEV = debt/assets ratio; CURVE = slope of Treasury yield curve; EURO = indicator variable for offshore U.S. issues; MATURE = original maturity of the issue; PROCEEDS = issue size relative to total assets; PRIVATE = indicator variable for private placement; and BF88 = indicator variable for issuance dates prior to 1988. Sample size = 705. Expected signs of coefficients are in parentheses adjacent to variable names.

	(1)	(2)	(3)	(4)	(5)
TIMING (+)	0.025	0.054	0.130	0.131	0.105
	(2.78)***	(2.81)***	(5.03)***	(5.108)***	(4.78)***
LEV (+/−)	−0.072	−0.015	−0.316		
	(−0.23)	(0.05)	(−1.22)		
CURVE (−)	1.965	2.021			
	(6.13)***	(6.308)***			
EURO (+/−)	−0.315				
	(−1.71)*				
MATURE (−)	−0.028				
	(−2.42)**				
PROCEEDS (+/−)	−0.568	−0.388	−0.757	−0.715	
	(−1.36)	(−0.96)	(−2.10)**	(−2.01)**	
PRIVATE (+/−)	0.579				
	(2.69)**				
BF88 (−)	−1.250	−1.582			
	(−8.80)***	(−13.10)***			
R^2	0.455	0.430	0.060	0.058	0.052

Notes: R^2 is a nonlinear transformation of the likelihood ratio test for zero slopes (Estrella (1998)). Test statistics (in parentheses) are based on Huber–White Sandwich estimation of variance (Huber (1967), White (1980)). ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

The R^2 values reported in Table IV are determined as in Estrella (1998). For the full model, R^2 is over 45 percent, and TIMING alone accounts for over 5 percent of the variation in PROT (column (5)).

A.3.2. Role of Other Variables. The variable MATURE enters with a negative and significant coefficient estimate in the full model (column (1)); that is, longer-maturity issues feature weaker call protection. The variables LEV and PROCEEDS are insignificant in the full model, and issues executed before 1988 have significantly weaker call protection as expected (BF88 has a negative coefficient estimate). The variable EURO enters with a negative sign and is significant at the 0.10 level. Thus, eurobond issues appear to exhibit weaker call protection than U.S. issues.[7]

[7] In another version of the full model (not reported), we include an interaction term (EURO × TIMING) to determine whether the relation between PROT and TIMING is different for eurobonds. The estimated coefficient for the interaction term is negative and significant ($t = -2.20$), thus the relation between protection strength (PROT) and capital expenditures (TIMING) is weaker for eurobonds.

The yield curve variable (CURVE) is positive and significant in the full model and in the abbreviated model (column (2)); that is, stronger call protection appears to be acceptable when issuers expect short-term interest rates to rise. Ingersoll and Ross (1992) predict a shorter optimal waiting period when the yield curve is steep, hence our finding of stronger call protection is at odds with their prediction. Privately placed issues exhibit stronger call protection (PRIVATE enters with a positive coefficient estimate; $t = 2.69$).[8]

B. Relation between Length of Call Protection and Capital Expenditures

Previous work often ignores the distinction between soft and hard protection and focuses on protection length (e.g., Lewis, Rogalski, and Seward (1998)). In this section, we define LENGTH as the number of years of call protection specified in each contract, regardless of whether the protection is hard or soft. Those issues with no protection have LENGTH = 0 and those with absolute protection have LENGTH set equal to the bond's maturity.

We estimate a model of LENGTH using the same variables as in Table IV. Because LENGTH is a count variable, we estimate the model using Poisson regression. This model may be incorrectly specified if the conditional variance of the dependent variable is greater than the conditional mean (overdispersion). This appears to be the case in our data set.[9] However, even with this problem, coefficient estimates continue to be consistent and asymptotically normal under fairly general regularity conditions (Woolridge (2002)). Estimation of the Poisson model in the case of overdispersion amounts to quasi-maximum likelihood estimation (QMLE) and these are the results reported in Table V.

B.1. Role of Timing

In Table V, TIMING enters all specifications with a positive coefficient, significant at the 0.01 level. In column (2) of Table V, we suppress issue-specific variables except for PROCEEDS and the coefficient estimate for TIMING is positive and significant at the 0.01 level. As we continue to delete variables successively in columns (3), (4), and (5), the positive coefficient for TIMING continues to hold. Consistent with our prediction, firms with capital expenditures distributed over longer periods following convertible issuance feature longer periods of call protection.

For the full model (column (1)), R^2 is 0.215. The measure TIMING alone (column (5)) accounts for a little over four percent of the variation in LENGTH.

[8] Moreover, we find that strength of call protection for private issues is *more* sensitive to capital expenditures (TIMING) than for public issues. In a version of the model (not reported), we include an interaction term (PRIVATE $\times$ TIMING) and find that it is positive and significant ($t = 2.975$).

[9] We test for overdispersion using a χ^2 statistic (see Hardin and Hilbe (2001)) and reject the null hypothesis that the conditional variance and mean of LENGTH are equal in four of the five versions of the model in Table V. This indicates the use of robust standard errors in determining t-statistics (Woolridge (2002)), as reported in parentheses in Table V.

Table V

Poisson Regression Estimation Results for Call Protection Length (LENGTH)

The measure LENGTH = call protection period in years; TIMING = measure of capital expenditure timing; LEV = debt/assets ratio; CURVE = slope of Treasury yield curve; EURO = indicator variable for offshore U.S. issues; MATURE = original maturity of the issue; PROCEEDS = issue size relative to total assets; PRIVATE = indicator variable for private placement; and BF88 = indicator variable for issuance dates prior to 1988. Sample size = 705. Expected signs of coefficients are in parentheses adjacent to variable names.

	(1)	(2)	(3)	(4)	(5)
TIMING (+)	0.037	0.048	0.063	0.063	0.047
	(3.90)***	(5.16)***	(6.47)***	(6.56)***	(5.53)***
LEV (+/−)	0.119	0.036	−0.030		
	(1.42)	(0.43)	(−0.31)		
CURVE (−)	0.308	0.307			
	(4.81)***	(5.51)***			
EURO (+/−)	0.249				
	(4.70)***				
MATURE (−)	−0.005				
	(−1.31)				
PROCEEDS (+/−)	−0.296	−0.388	−0.459	−0.458	
	(−2.13)**	(−2.56)***	(−2.80)***	(−2.87)***	
PRIVATE (+/−)	0.077				
	(1.52)				
BF88 (−)	−0.191	−0.281			
	(−3.78)***	(−8.09)***			
R^2	0.215	0.177	0.055	0.055	0.041

Notes: ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. R^2 is the squared correlation between LENGTH and predicted LENGTH.

B.2. Role of Other Variables

We also find that EURO is positive and significant, thus eurobonds tend to have longer call protection periods than others. Recall that eurobonds tend to have weaker call protection based on the probit results (Table IV).[10]

The shift variable BF88 is negative and significant, indicating that call protection periods were shorter before 1988. This is expected in view of the shift away from soft protection beginning about that time (evidence in Table I). Larger issues are associated with shorter protection periods (the coefficient estimate for PROCEEDS is negative and significant at the 0.05 level). Evidence on the relation between LENGTH and whether the issue is a private placement is weak ($t = 1.52$ for PRIVATE).[11]

[10] With an interaction term (EURO × TIMING) included in the full model of LENGTH, we find that the relation between LENGTH and TIMING is weaker for eurobonds (the t-statistic for the interaction term is −2.41).

[11] We include an interaction term (PRIVATE × TIMING) to determine whether the sensitivity of LENGTH to TIMING differs for private issues and this term is not significant at conventional levels ($t = 1.50$).

C. Robustness and Specification Tests

C.1. Ordered Probit Specification

If endogeneity of some of the right-hand variables induces significant correlation among the right-hand variables and the error term, the coefficient estimates reported in Table IV are biased and inconsistent. Rivers and Vuong (1988) set forth and examine endogeneity tests for probit models and we conduct such tests.[12]

A firm may set the nominal maturity (MATURE) jointly with the strength of call protection (PROT). The choices of issuing offshore (EURO) and whether to issue publicly or privately (PRIVATE) also may be decided jointly with PROT, hence we treat these three variables as potentially endogenous. The indicator variable BF88 and the variable CURVE are assumed to be exogenous. We regard the firm's leverage (LEV) before issuance to be predetermined, and we treat the size of the issue (PROCEEDS) as predetermined.

The test proceeds in two steps. First, we estimate a regression model using ordinary least squares of MATURE, using all exogenous variables as explanatory variables. We employ an additional exogenous variable, FOREIGN, an indicator for issuers not based in the United States (FOREIGN = 1 if foreign and zero otherwise). The residuals from the regression are then included as an explanatory variable in an ordered probit model of PROT. The right-hand side variables in that model include all exogenous variables plus MATURE, plus the residuals. The t-statistic for the coefficient for the residuals represents a test of the null hypothesis of exogeneity. The result for MATURE is $t = -0.75$, not significant at normal levels, hence we accept the null.[13] We repeat the procedure for the two remaining endogenous variables, EURO and PRIVATE.[14] The test statistics are 0.65 and -1.09, respectively. We conclude that endogeneity is not a significant problem, thus the coefficient estimates in Table IV should be consistent.

A further potential problem with the ordered probit tests is that in some instances, soft protection may be specified in bond contracts so that it is effectively "hard protection," hence our ordering (PROT) may not be strict. For example, soft protection could be based on a specified level of minimum stock price performance that is highly unlikely. We re-estimate the probit models using a modified measure of PROT defined as no protection (=0), and soft, absolute, or hard protection (=1). The results are qualitatively identical to those using PROT in Table IV.

For probit estimation to be appropriate, the error term (ε) must be normal. We apply the Shapiro and Wilk (1965) test of normality to residuals of each of the five versions of the ordered probit model and do not reject normality. A popular alternative is to assume that ε follows the logistic distribution and estimate an

[12] See Woolridge (2002, Section 15.7.2).

[13] Woolridge (2002) notes that a robust test statistic is essential for this test. We use the Huber–White sandwich estimator.

[14] EURO and PRIVATE are binary variables; however, the same test procedure involving OLS is valid. See Woolridge (2002, p. 474).

ordered logit model. We do that for all five specifications and the resulting signs of coefficients and significance levels are nearly identical to those reported in Table IV.

C.2. Poisson Specification

The same potential endogeneity problem exists for the model of length of call protection period (LENGTH) as was tested for the model of call protection strength (PROT). We perform the same tests again identifying MATURE, EURO, and PRIVATE as possibly endogenous. The t-statistic for residuals from the regression for EURO in the Poisson regression is -0.61. That for PRIVATE is -0.44. Neither is significant at conventional levels. The t-statistic for MATURE is 1.67, significant at the 0.10 level. Though it is only marginally significant, we caution that the coefficient estimates could be inconsistent.

We perform a variety of alternative tests to assess robustness of the Poisson specification. Ordinary least squares (OLS) estimates are consistent and even unbiased with count data, and we find the OLS t-statistics for TIMING to be greater than those in Table V for every specification. As noted previously, the Poisson specification is predicated on the equality of the conditional mean and variance of LENGTH. In our data, the variance exceeds the mean (overdispersion). In cases of overdispersion, it is often recommended that a negative binomial specification be used (see Cameron and Trivedi (1986) and Woolridge (2002, pp. 657–659)). We repeat the estimation results in Table V with three negative binomial specifications. The sign of TIMING is positive in all cases and all estimates are significant at the 0.05 level.[15] Hence, we conclude that there is a reliable positive relation between capital expenditures and the length of call protection.

We also examine the robustness of our measure LENGTH. Recall that LENGTH is measured the same for hard and soft protection, thus in the latter case it is only an upper bound on the realized protection length because the soft constraint may be satisfied before the end of the protection period. A crude treatment is to omit the 245 soft call bonds, then repeat the tests. Despite the considerable deterioration in sample size, the estimated coefficients for TIMING remain positive and significant at the 0.05 level in most specifications.

C.3. Alternative Measures of Investment

Our TIMING measure may fall short of identifying the maturation of second-stage investment options for a number of reasons. Our observation period extends only 5 years following issuance, and 72 of our firms' cumulative expenditures had not exceeded convertible proceeds by that time. We set TIMING equal to five for those cases in the analysis presented in Tables V and VI. We re-estimate the models of PROT and LENGTH with those 72 observations

[15] Overdispersion is treated in the three specifications as (1) variance equal to a constant, (2) variance equal to a constant proportion of the mean, and (3) variance equal to a quadratic function of the mean.

deleted, and TIMING continues to be positive and significant in each. Then we set TIMING equal to 6 for those 72 observations, repeat the full analysis, and the results remain the same.

We specify an alternative measure of capital expenditure activity (CAPRATE) based on the concept of bond duration:

$$\text{CAPRATE} = \left(\frac{C_1}{A_1}\right) + \left(\frac{C_2}{A_2}\right)\Big/2 + \left(\frac{C_3}{A_3}\right)\Big/3 + \left(\frac{C_4}{A_4}\right)\Big/4 + \left(\frac{C_5}{A_5}\right)\Big/5, \quad (1)$$

where C_i = capital expenditures in year i, and A_i = book value of assets at the end of year i, $i = 1, \ldots, 5$. Firms that invest the most in the shortest period will have higher values of CAPRATE, thus this measure should have a *negative* influence on call protection strength (PROT) and the length of the protection period (LENGTH). In all versions of the ordered probit model of PROT, and all versions of the Poisson model of LENGTH, we find negative coefficients for CAPRATE that are significant at the 0.05 level or better.[16]

III. Conclusions

Our analysis focuses on a narrow but important feature of security design involving convertible bonds. We show that firms design call provisions largely consistent with the need for short-term financing flexibility. In particular, firms' subsequent capital expenditures occur sooner after issuance when convertibles are issued with weaker call protection. Moreover, we find that the length of the call protection period is shorter for firms that experience higher levels of capital investment shortly after issuance.

This finding fits a more general analysis of the interplay between restrictive covenants and investment opportunities reported by Nash, Netter, and Poulsen (2003). They analyze bonds in the framework of a "nexus of contracts" and find that high-growth firms tend to write contracts that preserve flexibility with respect to dividend payments and debt financing.

While alternative theories of convertible financing have a role for callability, Mayers' (1998) model features an uncertain investment timing dimension that provides a logical link to the strength of call protection. Our findings complement the evidence cited by Mayers in support of the sequential financing motive, and they reveal that firms that value flexibility are willing to pay for it.

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[16] In versions of the models not reported, we use measures of CAPRATE that are adjusted for industry-wide expenditure levels. This is done by subtracting median industry measures C_i/A_i from each corresponding value in equation (1), and the findings are essentially the same.

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