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Are they still called late? The effect of notice period on calls of convertible bonds ☆

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Abstract

When calling its convertible bonds, a company must typically give bondholders a notice period of about 30 days to decide whether to convert the bonds. This notice period affects the optimal call policy for convertible bonds. After accounting for the notice period, convertible bonds in our sample would have been optimally called when the stock was at about an 11% premium (median) relative to the conversion price. We show that after properly accounting for the call notice period and other factors, the median excess call premium is less than 4%—substantially less than the 26–44% call premium previous researchers have documented.

JEL classification: G30; G32
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1. Introduction

When should firms call their convertible bonds? When do they actually call their convertible bonds? And why are the answers to these questions not usually the same? This paper provides some resolution to these questions that have occupied researchers for years. Brennan and Schwartz (1977a,b) and Ingersoll (1977a) suggest that the optimal call policy

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is to call convertible bonds when the embedded conversion option in the bonds is first in the money—in other words, as soon as the stock price reaches the effective conversion price.[2] But observed call policies do not fit this elegant result. Most calls seem to be delayed too long, where the median company waits until the conversion value of the bonds is far in excess of the redemption price (Ingersoll, 1977b; Mikkelson, 1981; Asquith, 1995).

Practitioners advocate a safety cushion for calling convertible bonds, citing the fact that firms generally must give convertible bondholders a 15- to 60-day notice period, during which time the bondholders can put the securities back to the firm for the call price of the bond plus any accrued interest. This important institutional detail is not incorporated in the optimal call policies proposed by Brennan and Schwartz (1977a,b) and Ingersoll (1977a), but Butler (2002) shows that under plausible conditions, a firm might optimally call its bonds at a premium of 50% or more due to the notice period.[3] While this safety cushion is intuitively appealing and consistent with anecdotal evidence of why firms call their convertibles when the conversion option is deep in-the-money, to our knowledge, the model in Butler (2002) has not been empirically tested.

In this paper, we provide empirical evidence for each of the three questions that began this section. We calibrate the optimal call policy model proposed in Butler (2002) with our data and test whether convertible bonds are called late relative to this new optimal call policy. Using a sample of convertible bonds called for redemption between 1986 and 2000, we find that our median firm calls its convertible bonds at about the point that they "should" after taking into account the effects of the notice period. We find that, after properly accounting for convertible bonds' notice periods and call protection and yield advantage (see Asquith, 1995; Asquith and Mullins, 1991), the median excess call premium in our sample is 3.74%—far lower than the call premiums found by previous researchers.[4]

Although, on average, firms are calling their convertibles close to the point that they should, there is variation in firms' call policy and the excess call premium. We thus turn our attention to explaining the cross-section of firms' actual call policy and the difference between firms' actual call policy and the point at which the bonds should have been called. After controlling for the optimal call policy that takes the call notice period into account, leverage, and the (risk-neutral) probability that the attempt to force conversion will be unsuccessful, we find that yield disadvantage, binding call protection, and balance sheet liquidity have little power to explain either the observed call policy or the deviation from the optimal call policy. Thus, we find little evidence to support Jaffee and Shleifer's (1990)

[2] The effective conversion price is the strike price at which the conversion option can be exercised plus the accrued interest per share.

[3] The model shows that optimal call policy is very sensitive to both the length of the notice period and the volatility of the underlying stock. For instance, consider a firm with a convertible issue that will create 1% dilution when fully converted and has 25 years until maturity. Further, assume that there is no accrued interest, the underlying stock has an annualized volatility of 48%, and risk-free rates are 5%. The model suggests that a notice period of 53 days will induce the firm to optimally call the convertibles when the stock price exceeds the conversion price by 50%. In contrast, with a notice period of 0 days, the firm would call when the stock price is equal to the conversion price.

[4] "Excess call premium" is the actual call policy (S/X) minus the optimal call policy (S^*/X). Ingersoll (1977b) finds a median excess call premium of about 44%. Asquith finds an excess call premium of about 20–25% for bonds that do not have binding call protection.

suggestion that firms delay calling due to liquidity reasons, and show that, in our sample, call delays due to notice period may be as important as call delays induced by yield advantage and binding call protections.

Firms may delay calling to avoid the risk that the stock price might fall, precipitating redemptions from the convertible bondholders; we estimate the risk-neutral probability of the stock price dropping below the conversion price by the end of the notice period and find that it can be an important determinant of when firms call. If the stock price were to drop below the conversion price by the end of the notice period, convertible bondholders would all rationally tender their bonds for cash. By delaying the call until the stock price is higher, firms can reduce this "busted call" risk.[5] Some firms use underwriters (see Jaffee and Shleifer, 1990; Singh et al., 1991) as a way to reduce busted call risk, and we show that firms engaging in underwritten calls of their convertibles call closer to the optimal point.

Our paper fits closely with a large literature on convertible bond call policy. Many researchers have addressed the question of why firms apparently delay calling their convertibles, but to our knowledge, our paper is the first to provide an explanation that explains virtually all of this apparent delay.

Asquith and Mullins (1991) and Campbell et al. (1991) provide a tax incentive explanation for the delayed call policy phenomenon. They suggest that if the after-tax cash flow to bondholders is less than the after-tax cash flow to equity holders, there is no benefit to the firms from calling the bonds. However, if the reverse relationship is true, that the after-tax cash flow to bondholders is greater than the after-tax cash flow to equity holders, stockholders will benefit from calling the bonds. Therefore, cash flow advantage to equity holders and the lack of a safety margin explain why bonds remain uncalled after the theoretically optimal point. After we control for the effects of the notice period, we do not find strong evidence supporting the importance of after-tax cash flow or yield advantages in explaining call policy.

Jaffe and Shleifer (1990) appeal to the potential for financial distress costs to explain why firms call their convertibles "late." An attempt to force conversion fails if the stock price falls enough to make the conversion option out-of-the-money at the end of the notice period. If this happens, convertible bondholders will tender the bonds for cash, which highly levered, cash-constrained, or regulated firms may find costly. These costs may lead firms to wait until there is a large safety cushion to call convertible bonds. Our evidence on this is mixed—while the probability of a "busted" call is an important determinant of call policy, our results do not show that balance sheet liquidity is a key factor in explaining the difference between observed and optimal call policies.

Asquith (1995) points out that a large proportion of convertible bonds (79% of his sample) is call-protected for several years, during which time the firm is unable to call the bond even if it were optimal to do so because the conversion option is deep in-the-money. He finds that the average premium at which convertibles are called is 20–25%, which is substantially less than what previous researchers find. We find that call protection is a binding constraint for many firms, but that after controlling for the effects of the notice

[5] A busted call is a failed attempt to "force" conversion of the bonds (i.e., the stock price falls below the conversion price, to which bondholders respond by redeeming the bonds for cash).

period and other factors, binding call protection is not a statistically significant determinant of observed call policy or the excess call premium.

The remainder of the paper is structured as follows. In Section 2, we briefly review the theory we test. Section 3 describes our data and the methods we employ. Section 4 presents our empirical findings and Section 5 concludes.

2. The theory

When a firm calls its convertible bonds, it in effect takes away the bonds and the embedded warrants and gives the bondholders the underlying stock and a put option on that stock with an exercise price equal to the conversion price. Butler (2002) exploits this intuition to incorporate the effect of a non-zero notice period on optimal call policy. Firms trying to maximize the value of the existing equity will minimize the value of the bond plus the warrant, net of the stock plus the put options given up at the call.

Assuming a frictionless market and non-zero call notice periods, Butler (2002) solves the optimization problem described above.[6] The solution to that optimization problem provides the optimal call policy for a convertible as the stock price-to-conversion price ratio S/X, which satisfies the equation:

$$N[d_1(t, r_t)] - \left(\frac{n}{n+m}\right)^2 N[d_1(T, r_T)] = 1 - \frac{n}{n+m} \tag{1}$$

where

$$d_1 = \frac{\ln(S/X) + (r_\tau + \sigma^2/2)\tau}{\sigma\sqrt{\tau}}, \tag{2}$$

S is the underlying stock price, X is the effective conversion price, r_τ is the rate of return for a risk-free security maturing in τ years, T is the time to maturity, t is the length of the conversion period, n is the existing number of shares, m is the number of shares into which the warrants can be converted, σ is the annualized standard deviation of the underlying stock returns, τ denotes either t or T, and $N[.]$ denotes the cumulative standard normal distribution.[7] We denote the S/X that satisfies the above equation as S^*/X.

3. Data and methods

The sample consists of all bonds that were called for redemption between 1986 and 2000. The initial sample of 1143 bonds was obtained from the call announcements listed in Standard and Poor's Bond Guides. We exclude exchangeable bonds and those that are convertible into another firm's equity. We find announcement dates of calls for redemption

[6] Thus, our empirical tests constitute a joint hypothesis that firms follow the optimal call policy and that market frictions, such as an inability to create a riskless hedge, do not alter the optimal call policy predicted by the model.

[7] Effective conversion price is the conversion price per share plus any accrued interest on a per-share basis.

and the details of the convertible issue and the call schedule from the *Wall Street Journal Index* and Bloomberg. After requiring call announcement dates, our sample is reduced to 292 convertible bond calls. We exclude another 41 bonds that lack necessary Center for Research in Security Prices (CRSP) or Compustat data, leaving us with 251 calls of convertible bonds. Restricting our sample to only those bonds called in the money leaves us with our final sample of 229 observations. We obtain data for convertible bond calls that are underwritten from Securities Data Company (SDC). These data are not reliably available for calls that happened after 1996, so in our regressions where we control for whether a call is underwritten, we restrict our sample to those bonds called prior to 1997 (reducing the usable sample for those tests to 116 observations).

Our sample is further reduced when we apply requirements of availability of accrued interest data and/or information about whether the convertible bond call was underwritten. To compute accrued interest at the end of the notice period for the bonds in our sample, we gather coupon payment dates from Bloomberg and Datastream and compute the accrued interest as the coupon payment multiplied by the fraction of a year between the last coupon date and the end of the notice period. We are able to get sufficient data to calculate accrued interest for 144 of the bonds in our sample. The mean (median) accrued interest per share in our sample is US$1.18 (US$0.91); this represents about 5.0% (4.5%) of the conversion price per share for the bonds for which we are able to calculate accrued interest.

We obtain information on each bond's conversion ratio, call protection information, minimum notice period to be provided before call, call schedule, face value, call announcement date, and coupon rate from Bloomberg.[8] The notice period is calculated as the number of days between the expiration of the conversion option and the announcement of the call period. The time to maturity is the number of years left to maturity at the announcement of the call. The short-term risk-free rates are 30-day Treasury bill rates and the long-term risk-free rates are on long-term government bonds with the maturity closest to the convertibles. Risk-free rates come from the CRSP bond files based on the date closest to the announcement date. We obtain data on dividends, stock prices, and the number of shares outstanding before the call from CRSP daily files. The volatilities during, before, and after the call period are calculated as the annualized standard deviations of the stock returns over the same number of days as the notice period.[9]

The accounting information for the firms issuing the bonds is obtained from Compustat for the fiscal year prior to that in which the call announcement is made. Dilution is the ratio of the number of shares into which the warrants will be converted to the total number of shares (new and existing) after the conversion is made.

Following Asquith (1995), we treat the call protection on a bond as binding if the bond is called within the first month after the call protection period expires. In our sample, 61 bonds have binding call protection clauses, while 139 bonds have call protection clauses

[8] The final sample includes two bonds with floating coupon rates. The coupon rates for those two observations are denoted as missing.

[9] The volatilities used in our calculations are the annualized standard deviations of the underlying stock returns before the call announcement based on the same number of days as the notice period. The volatilities *during* the notice period and *after* the final conversion are also provided. Our results are invariant to our choice of the period used for volatility calculations.

Table 1
Descriptive statistics of the sample of bonds

Variable	N	Mean	Median	S.D.	Min	25%	75%	Max
Panel A: entire sample								
Notice period (days)	229	30.21	30	22.30	0	22	33	249
Accrued interest per share	127	18.43	16.05	12.94	0.15	8.31	29.07	51.88
Years to maturity	229	13.02	14	7.39	1	6	20	28
Volatility	227	0.38	0.34	0.19	0.05	0.26	0.46	1.11
Moneyness (S/X)	229	1.57	1.35	0.84	1	1.22	1.54	8.6
Optimal call policy (S^*/X)	229	1.12	1.11	0.07	1.01	1.07	1.16	1.40
Excess call premium ($S/X - S^*/X$)	229	0.45	0.23	0.84	− 0.28	0.08	0.42	7.54
Moneyness with accrued interest	106	1.43	1.25	0.63	0.67	1.11	1.45	5.27
Optimal call policy with accrued interest	113	1.16	1.14	0.09	1.01	1.09	1.20	1.57
Excess call premium with accrued interest	104	0.27	0.10	0.63	− 0.71	− 0.02	0.31	3.91
Moneyness at end of notice period	229	1.57	1.35	0.88	0.61	1.20	1.58	9.23
Issue size (US$000)	222	94,455	54,200	133,196	7	27,800	114,000	1,104,000
Total assets	228	2717	736.43	6364	22.24	311.60	2154	48,991
TL/assets	228	0.64	0.63	0.19	0.12	0.51	0.75	1.46
Cash/assets	228	0.11	0.06	0.14	0	0.02	0.16	0.83
Dilution	229	0.14	0.10	0.15	0	0.06	0.16	0.92
Panel B: Bonds with call protection clauses that are not binding								
Notice period (days)	121	27.31	29	10.38	0	21	32	64
Accrued interest per share	75	20.46	19.71	12.12	0.5	11.22	30.22	48.75
Years to maturity	121	13.40	15	7.20	1	6	19	28
Volatility	119	0.37	0.33	0.20	0.05	0.24	0.45	1.11
Moneyness (S/X)	121	1.46	1.28	0.86	1	1.19	1.42	8.6
Optimal call policy (S^*/X)	121	1.12	1.11	0.07	1.01	1.07	1.16	1.33
Excess call premium ($S/X - S^*/X$)	121	0.34	0.15	0.87	− 0.18	0.04	0.31	7.54
Moneyness with accrued interest	63	1.28	1.19	0.32	0.99	1.09	1.37	2.95
Optimal call policy with accrued interest	79	1.15	1.13	0.10	1.01	1.09	1.97	1.57
Excess call premium with accrued interest	73	0.14	0.07	0.07	− 0.41	− 0.04	0.21	1.86
Moneyness at end of notice period	121	1.46	1.29	0.89	0.61	1.16	1.50	9.23
Issue size (US$000)	121	91,701	52,000	130,298	7	28,000	105,263	1,020,000
Total assets	121	2883.57	696.67	6791.58	22.24	339.10	2156.60	47,388.1
TL/assets	121	0.67	0.66	0.21	0.12	0.51	0.81	1.46
Cash/assets	121	0.09	0.05	0.12	0.001	0.018	0.11	0.62
Dilution	121	0.14	0.11	0.14	0	0.06	0.16	0.92

Issue size (face value) is obtained from Bloomberg. The notice period is calculated as the days between the announcement date and the date when conversion rights expire. Volatility is the annualized standard deviation of returns of the underlying stock calculated prior to the announcement date based on the same number of days as the notice period. Dilution is new shares issued as a result of full conversion over the total number of shares outstanding after conversion. Moneyness is the price at the call announcement divided by the conversion price of the bond. The optimal call policy (S^*/X) is the underlying stock price-to-conversion price ratio that satisfies the Butler (2002) model. Moneyness at the end of the notice period is the price of the underlying stock at the end of the notice period divided by the conversion price. Accounting data are from Research Insight. All the numbers are in millions of US dollars except for the ratios. Panel A presents the descriptive statistics for the entire sample of 229 bonds while Panel B presents the descriptive statistics for the subsample of bonds with call protection clauses that are not binding.

that are not binding at the time the issues are called for redemption. No information on call protection clauses is available for 51 bonds in our sample.

4. Empirical results

4.1. Descriptive statistics

Table 1 presents the descriptive statistics for the sample of 229 bonds, our calibration of the Butler (2002) model, and firm characteristics. On average, bonds in our sample are called when they have 13 years left to maturity and the average dilution of existing equity upon full conversion is 14%. Using historical volatilities prior to the call, we calculate the optimal point at which firms should call their convertibles; the length of our window for calculating these volatilities is the length of the notice period.[10] The average (median) leverage of the issuer firms is 64% (63%) as measured by the ratio of total liabilities to total assets, whereas their cash is, on average (median), 11% (6%) of their total assets.

The distribution of the bonds in our sample is presented by year in Table 2. During our sample period, a total of 56 convertible bonds matured. In contrast, our initial sample contains 1143 convertible bond calls. The relative frequency of called issues to maturing issues underscores the importance of having an appropriate call policy for convertible bonds.

4.2. Univariate tests

In this section we present our main result—convertible bonds are called at about the point that they should be. Table 3 presents distributional statistics on the excess call premium for bonds that fulfill the following criteria: they do not have binding call protection, we could find accrued interest data, there is no yield advantage to delaying calling, and the convertible is not an out-of-the-money call (46 observations).[11]

We find that for these bonds, the median excess call premium is 3.7% and the mean excess call premium is 9.6%—substantially lower than what other researchers have found.

[10] Following Cowan et al. (1990) and Campbell et al. (1991), we have also computed the optimal call policy and other model variables with volatilities after conversion. This produces qualitatively similar results, as does using volatilities calculated during the notice period.

[11] Most previous researchers have excluded out-of-the-money calls from their analysis because out-of-the-money calls are thought to be inherently different than in-the-money calls. Thus, excluding out-of-the-money calls conveys the advantage of studying a relatively homogeneous group of convertible calls and provides a direct comparison to other researchers' findings. On the other hand, one could argue that excluding out-of-the-money calls removes potentially relevant data. We are testing whether the mean/median of the observed call policy is equal to a benchmark optimal point at which call should be made, and if we truncate the distribution of the observed call policy by omitting all observations for which the conversion option is out of the money, the mean/median excess call premium will be biased upwards. Indeed, when we include out-of-the-money calls, the mean (median) excess call premium is −2.9% (−1.6%). That is, when looking at all convertibles—those called in-the-money and out-of-the-money—firms are calling their convertibles *earlier* than they should.

Table 2
Distribution of the sample over years

Year	Full sample: bonds called	Non-binding call protection: bonds called	Number of bonds that matured	Full sample: call policy (*S*/*X*)	Non-binding call protection: call policy (*S*/*X*)	Non-binding call protection: optimal call policy (*S**/*X*)
1986	14	4	0	1.51	1.33	1.12
1987	20	5	0	1.37	1.21	1.12
1988	7	0	5	1.42	–	–
1989	9	4	3	1.36	1.22	1.08
1990	15	10	6	1.35	1.35	1.15
1991	19	11	7	1.46	1.38	1.17
1992	22	13	5	1.54	1.56	1.12
1993	25	18	0	1.67	1.71	1.13
1994	5	4	7	1.23	1.21	1.10
1995	11	5	0	1.77	1.36	1.14
1996	20	10	3	1.88	1.30	1.14
1997	26	19	4	1.59	1.46	1.07
1998	16	5	1	1.53	1.38	1.07
1999	11	6	6	1.85	1.34	1.08
2000	9	7	9	1.84	1.95	1.17
Entire sample	229	121	56	1.57	1.46	1.12

The number of bonds called represents the number of convertible bond calls included in our sample for that year, while the number of bonds matured shows the number of convertible bonds that matured during the same year. This number is obtained from Standard and Poor's Bond Guides. Moneyness (*S*/*X*) is the price at the call announcement divided by the conversion price of the bond. The optimal call policy is the underlying stock price-to-conversion price ratio that satisfies the Butler (2002) model. The last row presents the averages over the entire sample.

Table 3
Comparison of actual vs. optimal call policy

	Excess call premium
Mean	0.096
Median	0.037
S.D.	0.334
Minimum	− 0.408
25th percentile	− 0.036
75th percentile	0.171
Maximum	1.860
Proportion <0	0.357
p value for t test: mean = 0	0.0569
p value for signed-rank test: median = 0	0.0474
p value for sign test: median = 0	0.1839
N	46

This table contains descriptive statistics for the excess call premium for bonds that do not have binding call protection and for which there is no yield advantage to delaying calling. Excess call premium is defined as the difference between (stock price at call/conversion price plus accrued interest per share) and the optimal call policy that satisfies the Butler (2002) model.

In fact, over one-third (18 of 46) of these bonds are called *early*. We are unable to reject that the mean excess call premium is different from zero at the 95% confidence level ($p = 0.0569$), nor are we able to reject that the median is different from zero using a sign test ($p = 0.1839$), but we are able to reject that the median is zero using a Wilcoxon signed-rank test ($p = 0.0474$). Collectively, these results suggest that, after properly accounting for the notice period and other factors, convertible bonds are called only marginally later than they should be.

4.3. Notice period

The average (median) notice period between the announcement and the expiration of the call is 30.21 (30) days, with half the sample falling between 22 and 33 days, and all but four bonds having notice periods of less than 2 months. Bonds with binding call protection have notice periods that are, on average, 5 days longer than bonds with non-binding call protection. The difference of means is marginally statistically different from zero ($p = 0.0683$).

Firms with bonds with binding call protection also give bondholders more notice than they are required to give. For those bonds for which we are able to find the contractual minimum notice period (51 bonds), we compare the minimum required notice to the actual notice firms give bondholders. The mode call notice is the same as the minimum required notice. However, for firms with binding call protection, the actual notice period is, on average, almost double the minimum required length. The mean ratio of actual notice period divided by the minimum required length is 1.78, compared to 1.01 for bonds with non-binding call protection. The difference is statistically significant ($p = 0.0643$), but is driven by outliers in the binding call protection group—the *median* ratios are 1.01 and 1.00 for bonds with and without binding call protection, respectively. Note, though, that these are driven not by firms with very low minimum notice periods, but by firms that give bondholders a very long notice. Generally, as firms approach the end of their call protection period, they announce the call of the convertible in advance, before the actual end of the call protection, in order to be able to call them as soon as the protection period is over.[12] This is the case for about one-third of the firms in our sample with binding call protections.

4.4. Regression results

In this section, we turn our attention to explaining the cross-section of firms' observed call policies and the excess call premium when firms call their convertibles. So that our regression results will be comparable to those of previous researchers, all our regressions

[12] While it is surprising that firms would give bondholders a longer notice than required, the conversion option for these observations is generally very deep in-the-money. This in turn means that the put option that the firm gives the bondholders is deep out-of-the-money. For instance, one bond has a minimum contractual notice period of 30 days, but the firm gives bondholders 205 days' notice. This bond is called when the stock price is at a 184% premium relative to the conversion price on the bonds. The value of a put option so deep out-of-the-money is relatively insensitive to the option's maturity.

Table 4
Determinants of call policy

	Full sample	Full sample	Called prior to 1997	Called prior to 1997
Intercept	− 0.4175	− 0.3996	− 0.4087	− 0.7308
	(− 0.42)	(− 0.39)	(− 0.35)	(− 0.56)
Optimal call policy (S^*/X)	1.8227**	1.8022*	1.8442*	2.1067*
	(2.01)	(1.93)	(1.72)	(1.73)
Issue size/total assets	− 1.3531**		− 1.6533	
	(− 2.08)		(− 1.61)	
Leverage (total liabilities/ total assets)	− 0.4738	− 0.5324*	− 0.6390	− 0.6203
	(− 1.63)	(− 1.79)	(− 1.45)	(− 1.50)
Liquidity (cash ratio)	0.4964	− 0.06010	0.2704	− 0.2423
	(1.00)	(− 0.16)	(0.57)	(− 0.67)
Yield disadvantage to shareholders	− 0.2252	− 0.2372	− 0.2363	− 0.3491
	(− 1.01)	(− 1.06)	(− 1.09)	(− 1.43)
Ex ante probability of bust at optimal	2.6810*	2.3989	4.3941	3.8196
	(1.83)	(1.68)	(1.42)	(1.29)
Underwritten			− 0.1705*	− 0.1769*
			(− 1.79)	(− 1.81)
Binding	0.2367	0.2255	0.1882	0.1072
	(1.25)	(1.18)	(0.68)	(0.38)
F statistic for overall significance	2.23**	2.42**	1.17	1.33
N	175	175	116	116
R^2	0.11	0.08	0.13	0.11

The dependent variable in the regressions is S/X, the ratio of the underlying stock price to conversion price at the announcement of the call. Optimal call policy is calculated using the Butler (2002) model. Issue size relative to total assets is the total dollar value of the issue divided by total assets. Yield disadvantage to shareholders is a dummy variable that takes the value of one if the after-tax coupon payments, the cash flows to the bondholders, are greater than the dividend per share, the cash flow to the shareholders, and zero otherwise. Binding is a dummy variable that takes the value of one if the call protection clauses of the bonds are binding. Underwritten is a dummy variable that takes a value of one if the call is underwritten, and zero otherwise. Regressions including the Underwritten variable include only those calls that occurred prior to 1997.

t statistics calculated with heteroskedasticity robust standard errors are presented in parentheses.

* Denotes significance at the 10% level.

** Denotes significance at the 5% level.

*** Denotes significance at the 1% level.

exclude out-of-the-money calls (e.g., see Cowan et al. 1993); including them does not materially change our results. Table 4 presents the results of regressing observed call policy S/X on a number of potentially explanatory independent variables.[13] We include in all our regressions the calculated optimal call policy, the firm's leverage (total liabilities to total assets) and liquidity (cash ratio), a dummy variable for whether the bonds create a yield disadvantage to the shareholders, the risk-neutral probability of a bust (calculated as the $N[-d_2]$ term from the Black–Scholes option pricing model), and a dummy variable

[13] In all our regressions, we use call policies and excess call premiums calculated *without* accrued interest per share factored in to the effective conversion price. Restricting the sample to only those observations for which we have accrued interest data does not change the sign of any of the regression coefficients, but the reduced sample size substantially reduces the power of our tests.

that captures if the bond had binding call protection or not.[14] We include convertible issue size divided by total assets in some regressions. The yield disadvantage dummy takes a value of one if the after-tax coupon payments (cash flows to the bondholders) exceed the dividends that would be paid to the shareholders upon conversion, and zero otherwise. That is, when the variable takes a value of zero, the firm would rationally wait to call the convertibles.

In our regressions using our full sample of 175 in-the-money calls with information about whether call protection was binding, the only consistently significant determinant of call policy is the optimal call policy. The longer firms *should* wait to call based on the optimal call policy that incorporates the notice period, the longer they *do* wait. When using the full sample, the coefficient on relative issue size (issue size/total assets) is negative and significant when it is included (indicating that larger issues are called sooner, on average), and the coefficient on ex ante risk-neutral probability of a busted call is positive and significant where we use our full sample and include relative issue size. The coefficient on leverage is negative and significant when we use the full sample and exclude relative issue size. However, after controlling for optimal call policy, none of liquidity, yield disadvantage, or binding call protection is a significant determinant of observed call policy.

One other consideration potentially affecting call policy is whether the convertible bond call was underwritten. The put option created by calling the convertible bonds creates a risk to the issuing firm; this risk may lead issuing firms to seek insurance against a large shock to their cash balances. This is precisely the role played by investment banks that may be retained to underwrite the call of the convertible bonds. The underwriting contract typically obliges the underwriter to purchase any bonds that are not converted at the end of the notice period, convert the bonds to stock, and then sell the stock on the open market at their discretion. Thus, the underwriter takes on the put option risk, and for this service, the underwriter is paid a fee. Because the firm has shed ‘‘busted call’’ risk, this may induce the firm to call earlier than they otherwise would. We obtain data for convertible bond calls that are underwritten from SDC. SDC stopped collecting these data in early 1997, and so these data are not reliably available for calls that happened after 1996. In our regressions where we control for whether a call is underwritten, this reduces our usable sample to those bonds called prior to 1997, leaving us with 116 observations. Consistent with our expectations, the coefficient on our underwritten dummy is consistently negative, which indicates that firms carry out underwritten calls of convertibles earlier than naked calls.[15] Optimal call policy is the only other significant variable in these regressions.

In Table 5, we examine the determinants of the excess call premium—the difference between a firm's observed call policy and the optimal point at which the firm should have called. We regress the difference of the actual call policy and the optimal call policy

[14] We have run all regressions with alternate definitions of leverage (long-term debt to assets, total debt to assets, long-term debt to equity, total debt to equity, and short-term debt to long-term debt) and liquidity (current assets to total assets), all of which produced qualitatively similar results.

[15] We have also performed univariate tests (differences of means and differences of medians) for underwritten vs. non-underwritten calls—underwritten calls are called at lower S/X and at a lower excess call premium, but the differences are not statistically different from zero.

Table 5
Determinants of the excess call premium

	Full sample	Full sample	Called prior to 1997	Called prior to 1997
Intercept	0.5022**	0.4971**	0.5441*	0.5172*
	(2.10)	(2.08)	(1.70)	(1.71)
Issue size/total assets	− 1.3493**		− 1.7081	
	(− 2.08)		(− 1.61)	
Leverage (total liabilities/ total assets)	− 0.4564	− 0.5152*	− 0.6244	− 0.6002
	(− 1.61)	(− 1.80)	(− 1.46)	(− 1.52)
Liquidity (cash ratio)	0.6123	0.0545	0.3571	− 0.1500
	(1.15)	(0.14)	(0.71)	(− 0.44)
Yield disadvantage to shareholders	− 0.2025	− 0.2151	− 0.1894	− 0.2919
	(− 0.95)	(− 1.00)	(− 0.97)	(− 1.36)
Ex ante probability of bust at optimal	2.4391*	2.1638	4.1278	3.4420
	(1.80)	(1.64)	(1.40)	(1.23)
Underwritten			− 0.1663*	− 0.1717*
			(− 1.82)	(− 1.85)
Binding	0.2432	0.2318	0.2036	0.1240
	(1.29)	(1.22)	(0.73)	(0.44)
F statistic for overall significance	2.82**	3.17***	1.53	1.71
N	175	175	116	116
R^2	0.10	0.08	0.13	0.11

The dependent variable in the regressions is the excess call premium, defined as the difference between the actual call policy S/X and the optimal call policy S^*/X. Issue size relative to total assets is the total dollar value of the issue divided by total assets. Binding is a dummy variable that takes the value of one if the call protection clauses of the bonds are binding. Yield disadvantage to shareholders is a dummy variable that takes the value of one if the after-tax coupon payments, the cash flows to the bondholders, are greater than the dividend per share, the cash flow to the shareholders. Underwritten is a dummy variable that takes a value of one if the call is underwritten, and zero otherwise. Regressions including the Underwritten variable include only those calls that occurred prior to 1997.

The White-corrected *t* statistics for the coefficients are presented in parentheses.

* Denotes significance at the 10% level.

** Denotes significance at the 5% level.

*** Denotes significance at the 1% level.

(i.e.,$S/X - S^*/X$) on leverage, liquidity, yield disadvantage, probability of a bust, and a dummy variable for whether the call protection was binding, and, in some regressions, we include issue size divided by total assets and/or a dummy variable for underwritten calls.

The results here are broadly consistent with our findings on the determinants of call policy. The "usual suspects"—yield disadvantage and binding call protection—have little power to explain the excess call premium, which reflects the difference between when firms do call and when they should call after taking notice period into account. We do find that leverage, relative issue size, and ex ante risk-neutral probability of a busted call are each significant in one of our four model specifications. More highly levered firms call with a smaller excess call premium, higher bust probabilities correspond with higher excess call premiums, and larger issues tend to be called at smaller excess call premiums, on average. Consistent with our previous table, firms that engage in underwritten calls do so at a statistically significantly lower excess call premium than firms that call their convertible bonds naked.

5. Conclusion

About 20 times more convertible bonds are called than reach their maturity. Thus, it is important to carefully understand when firms *should* call and when firms *do* call their convertible bonds. Theory suggests that firms should call their convertible bonds when the stock price is at a 10–15% premium to the strike price of the conversion option due to the notice period that firms must give convertible bondholders upon calling the bonds. When the optimal call policy incorporates the optimal notice period "cushion," convertible bonds are not called late. In our sample of convertible bond calls during 1986–2000, we find a median excess call premium of about 3.7%—much lower than that found by previous researchers.

What determines how "late" a convertible is called? If the convertibles are call-protected, it is not surprising that the firm may ignore the call policy that would be optimal in the absence of contractual constraints. Consistent with Asquith (1995), a large number of our convertible bonds have binding call protection clauses. However, after controlling for optimal call policy and other factors, binding call protection does not statistically significantly affect observed call policy or the excess call premium. Moreover, while calling early may limit the conversion option value bondholders enjoy, it also increases the probability of a busted call and a subsequent redemption for cash. We find that, on average, firms wait until the bonds are deep in-the-money to call, thereby reducing the probability of a bust. Liquidity and the yield advantage to bondholders over stockholders, ceteris paribus, have little power to explain the cross-section of excess call premiums. Collectively, these results underscore the importance of the call notice period—in univariate tests, controlling for the notice period and other factors brings the excess call premium to almost zero; in multivariate tests, controlling for the effects of the call notice period and other factors reduces the empirical importance of yield advantage and call protection in explaining convertible bond call policy.

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