Journal of Banking and Finance 16 (1992) 687–703. North-Holland

Determinants of the call option on corporate bonds*

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Received September 1990, final version received April 1991

A number of hypotheses have been proposed as explanations of the call feature in corporate bonds. Using a large sample of callable and noncallable corporate bonds issued during the period 1977–1986, this paper simultaneously examines the empirical validity of five hypotheses that have been offered to explain the call option. The evidence provides no support for the hypotheses that the call option provides managerial flexibility or tax advantages. There is mixed support for agency cost explanations of the corporate call feature. The call feature is found to be highly correlated with the level of interest rates and the maturity of debt issues. That is, the call feature is found to be more likely during periods of higher interest rates and for longer maturity bonds.

1. Introduction

The appropriate use of various debt convenants has attracted substantial attention. One convenant that continues to be widely discussed is the call provision. Most research has tried to explain why the call feature is included in corporate debt. Several reasons for the inclusion of the call feature have been presented, namely added flexibility for management, the uncertainty of interest rates, the resolution of agency problems, and tax advantages.[1]

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*The authors would like to thank D. Brown and the anonymous referees for helpful comments. Any remaining errors are our own responsibilities.

[1]Callable debt is claimed to provide a firm's managers with the opportunity to refund a bond issue at lower interest rates. [See Bowlin (1966), Pye (1966), Jen and Wert (1967), Van Horne (1984), and Kidwell (1976).] Other arguments include: agency problems associated with information asymmetry between borrowers and lenders [Barnea et al. (1980, 1981)], different risk tolerances of equityholders and debtholders [Barnea et al. (1985)], the need for managers to signal private information [Flannery (1986), Robbins and Schatzberg (1988), and Thatcher (1985)], differential tax rates between borrowers and lenders of funds [Boyce and Kalotay (1979) and Marshall and Yawitz (1980)], maturity preferences [Kidwell (1976)], and the opportunity to remove an undesirable protective covenant in the bond indenture [Smith and Warner (1979)].

During the period 1977 through 1986 about 17% of public offerings of corporate bonds were noncallable issues.[2] Using a unique data set of both callable and noncallable bonds issued during this period, our paper simultaneously tests the hypothesized explanations of the call feature on corporate bonds.

First, the results fail to support the position that the call feature adds managerial flexibility as suggested by Bowlin (1966), Jen and Wert (1967), Pye (1966), and Van Horne (1984). The evidence finds inclusion of the call feature to be unaffected by the variability of interest rates in the recent past. Second, the call feature is found to be more likely during periods with high interest rates. This is counter to the results of Kidwell (1976) for the municipal bond market.

Third, mixed support is offered for agency cost arguments for inclusion of the call feature on corporate debt. The evidence is consistent with the signaling arguments outlined by Flannery (1986), implying that the type of debt issued may be a signal of the firm's financial strength. The evidence supports Thatcher's (1985) view that a call option is more likely when default risk is high. There is also support for the argument of Bodie and Taggart (1978, 1980) that growth firms attach a call feature to debt issues as a means of limiting wealth shifts between equityholders and debtholders.

Fourth, the results show that debt maturity significantly affects the decision to attach a call option to a debt issue, supporting the positions of Flannery (1986) and Kidwell (1976). Call features are more likely with longer maturity debt. Finally, the arguments developed by Boyce and Kalotay (1979) and Marshall and Yawitz (1980), that firms in higher tax brackets are more likely to issue callable debt, are contradicted by the empirical evidence. The evidence is consistent with Miller's (1977) view that the corporate tax rate equals the marginal bondholder's tax rate.

This paper is organized as follows. Section 2 reviews the relevant literature about theoretical explanations for the use of the call feature on corporate debt. The data set, variables, and their tendencies are outlined in section 3. This is followed by an explanation of the methodology in section 4. A presentation of the empirical tests of the theories using both the means tests and logistic regression results are reported in section 5. The significance of the findings are summarized in section 6.

2. Existing literature: Theories for including a call feature

The existing literature suggests that the use of the call option is motivated by (at least) five separate, but not mutually exclusive, theories: managerial

[2]For more information on the quantities of callable and noncallable publicly issued corporate debt issues during the period 1977 through 1986 see Kish (1988).

flexibility, the level of interest rates, agency costs, maturity substitution, and taxes.

2.1. *Managerial flexibility hypothesis*

The managerial flexibility hypothesis states that the call provision provides the firm's management with increased flexibility in the face of market uncertainties, primarily interest rate uncertainty. The call option allows the issuer to replace a higher cost obligation with a lower cost bond if interest rates decline. Refunding is profitable provided the interest savings outweigh the call premium, flotation cost, and legal expenses.[3]

2.2. *Interest rate level hypothesis*

With any option, the call feature's value depends on the potential for upside movements in the underlying asset. According to the interest rate level hypothesis, as the level of rates increases above historical norms, the potential for a future decline in interest rates may be perceived to increase and the value of the call option may increase. Thus, a relatively high level of interest rates may increase the likelihood of attaching a call option to a bond.[4]

2.3. *Agency cost hypothesis*

Because of agency problems, the call option may change some of the incentives of equityholders in the levered firm. Noncallable debt may reduce equityholders' incentives to engage in value-enhancing projects. Noncallable debt creates an externality to the equityholders. The bondholders, who have claim to a partial share in the residual value of the firm's assets in case of default, are able to broaden their collateral base anytime a firm improves its position. Therefore, when the firm makes a profitable investment, part of the benefit goes to debtholders. Since equityholders are unable to reap the full benefits of additional investments, the incentive for investment may be less than optimal.

If the bonds are callable, however, the equityholders hold the option to retire the debt at a fixed price. Thus, the equityholders' incentive to invest is

[3]See for example Bowlin (1966), Jen and Wert (1967), Pye (1966), and Van Horne (1984). For other flexibility arguments see Ross (1977) for capital structure arguments, Smith and Warner (1979) and Kidwell (1976) for identure restrictions, and Van Horne (1984) for cash flows.

[4]For example, see Van Horne (1984). Kidwell (1976), studying the use of the call option by state and local governments, found that the inclusion of the call provision was affected by statutory requirements, the historical tradition of issuers, and precedents established in the market place. The expected economic savings resulting from lower interest rate levels was not a significant factor.

no longer weakened. The potential gain to bondholders is fixed and equity captures the full marginal benefit of any new project. An implication of the agency problem is that growth firms may have an incentive to issue callable bonds to capture the gains for stockholders.[5]

2.4. Maturity hypothesis

The value of the call option should increase as the time to maturity increases. Since the call feature's value is dependent upon the potential for upside movements in the associated asset, the longer the time period in which this price movement can occur, the greater the call's value. Thus, long maturity debt issues are more likely to have a call option attached.[6]

2.5. Tax advantage hypothesis

The tax advantage hypothesis as developed by Boyce and Kalotay (1979) states that both the issuer and the buyer benefit from callable debt at the expense of the government. In their model, the difference in the average tax rates between a profitable corporate borrower (high marginal tax rate) and the typical lender (low marginal tax rate) generates a preference for callable bonds. The exercise of the call results in a reduction of the tax liability of the issuer which is not offset by the additional taxes paid by the lender. Countering this view, Miller (1977) has argued that the marginal bondholder's tax rate should equal the corporate tax rate in equilibrium, which implies that the Boyce and Kalotay argument does not hold.

Marshall and Yawitz (1980) suggest a tax advantage for callable bonds because call premiums are deductible from ordinary income as an expense to the borrower, but treated by the lender as a capital gain. Under the current tax laws, this tax motivation argument has been weakened since capital gains are taxed at the regular tax rate.

3. Data, variables, and tendencies

3.1. Data

Information on all public corporate debt offerings was obtained from *Moody's Bond Survey* for 1977 to 1986. This information includes date of issue, size of offering, years to maturity, coupon, yield to maturity, firm

[5]See Bodie and Taggart (1980), Aivazian and Callen (1980) and Barnea et al. (1980, 1981) for a detailed discussion of the agency analysis. In a related agency cost argument, Robbins and Schatzberg (1986) suggested that managerial wage incentives make callable debt more desirable than noncallable debt. The robustness of their model has recently been questioned by Wall (1988).

[6]Short-term noncallable debt may substitute for long-term callable debt.

classification, conversion provisions, and debt ratings. Firm-specific data were obtained from the *Industrial Compustat Tapes* and include tax rates, total debt outstanding, total assets, and net income before taxes. Three year historical growth rates were calculated for the firm's assets. Additional data on Treasury security yields are compiled from the *Annual Statistical Digest*.

From the entire data set, we selected a sample meeting the following criteria: (1) the issuing firm's financial data are available on the Compustat Tapes, and (2) no convertibles, floating rates, or zero coupon bonds.[7] The resulting data set contained 2,061 debt issues of which 1,654 were callable and 407 noncallable.

Table 1 offers frequency distributions of the debt sample by call feature, firm classification, rating, and maturity. Noncallable debt is most frequent for financial firms and least frequent for utilities, although 7% of the utility bonds were noncallable. Noncallable debt tends to be more common for shorter maturities and for higher ratings.

3.2. *Variables and tendencies*

Based on the existing literature, the model is expressed in functional form as:

$$
\begin{aligned}
CALL = f\ (&\text{Flexibility factor: } UNCER \\
&\text{Interest rate factor: } LEVEL \\
&\text{Agency factors: Rating } (HIGH, MODERATE, \\
&\quad LOW),\ DA,\ MARKET,\ GROWTH \\
&\text{Maturity factor: } MAT \\
&\text{Tax factors: } MTAX \\
&\text{Firm classification } (FINANCE,\ UTILITY, \\
&\quad INDUSTRIAL)).
\end{aligned} \tag{1}
$$

The independent variable, *CALL*, is a 1/0 dummy (i.e. 1 if the bond is callable, 0 otherwise). The proxies used for testing the various hypotheses outlined in section 2 are defined below and summarized in table 2.

Firm classifications into Finance, Utility, and Industrial are included as explanatory variables to allow for the possibility that the advantage of a call option may depend upon the type of firm. In addition, separate regression results are reported later for industrial and financial firms.[8]

[7]Convertibles were excluded because a convertible bond is effectively a portfolio of a bond and stock. Floating rate notes are essentially very short-term debt; the issuing firm must call the debt and refinance periodically. Zeroes may have very unusual call features. See Narayanan and Lim (1989).

[8]Because there are very few noncallable utility bonds, a separate logit regression was not done for utilities.

Table 1a

Number (percent) of industrial, financial and utility bonds.

Rating	Mat < 10		Mat = 10		Mat > 10		Total	
	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable
Low	51 (2.5%)	17 (0.8%)	96 (4.7%)	5 (0.2%)	215 (10.4%)	1 (0.0%)	362 (17.5%)	23 (1.1%)
Moderate	122 (5.9%)	160 (7.8%)	234 (11.4%)	60 (2.9%)	448 (21.7%)	34 (1.6%)	804 (39%)	254 (12.3%)
High	101 (4.9%)	106 (5.1%)	106 (5.1%)	17 (0.8%)	281 (13.6%)	7 (0.3%)	488 (23.7%)	130 (6.3%)
Totals	274 (13.3%)	283 (13.7%)	436 (21.2%)	82 (4.0%)	944 (45.8%)	42 (2.0%)	1654 (80.3%)	407 (19.7%)

Grand total: 2061.

Table 1b

Number (percent) of industrial bonds.

Rating	Mat < 10		Mat = 10		Mat > 10		Total	
	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable
Low	41 (4.4%)	6 (0.6%)	80 (8.5%)	3 (0.3%)	178 (19.0%)	1 (0.1%)	299 (31.8%)	10 (1.1%)
Moderate	54 (5.8%)	52 (5.5%)	99 (10.5%)	29 (3.1%)	194 (20.7%)	18 (1.9%)	347 (37.0%)	99 (10.5%)
High	33 (3.5%)	22 (2.3%)	29 (3.1%)	7 (0.7%)	90 (9.6%)	3 (0.3%)	152 (16.2%)	32 (3.4%)
Totals	128 (13.6%)	80 (8.5%)	208 (22.2%)	39 (4.2%)	462 (49.2%)	22 (2.3%)	798 (85.0%)	141 (15.0%)

Grand total: 939.

Table 1c

Number (percent) of financial bonds.

Rating	Mat < 10		Mat = 10		Mat > 10		Total	
	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable
Low	8 (1.4%)	5 (0.9%)	11 (1.9%)	1 (0.2%)	21 (3.6%)	0 (0.0%)	40 (6.8%)	6 (1.0%)
Moderate	50 (8.5%)	92 (15.7%)	57 (9.7%)	28 (4.8%)	46 (7.8%)	13 (2.2%)	153 (26.1%)	133 (22.7%)
High	61 (10.4%)	79 (13.5%)	50 (8.5%)	9 (1.5%)	53 (9.0%)	3 (0.5%)	164 (27.9%)	91 (15.5%)
Total	119 (20.3%)	176 (30.0%)	118 (20.1%)	38 (6.5%)	120 (20.4%)	16 (2.7%)	357 (60.8%)	230 (39.2%)

Grand total: 587.

Table 1d

Number (percent) of utility bonds.

Rating	Mat < 10		Mat = 10		Mat > 10		Total	
	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable	Callable	Non-callable
Low	2 (0.4%)	6 (1.1%)	5 (0.9%)	1 (0.2%)	16 (3.0%)	0 (0.0%)	23 (4.3%)	7 (1.3%)
Moderate	18 (3.4%)	16 (3.0%)	78 (14.6%)	3 (0.6%)	208 (38.9%)	3 (0.6%)	304 (56.8%)	22 (4.1%)
High	7 (1.3%)	5 (0.9%)	27 (5.0%)	7 (0.2%)	138 (25.8%)	1 (0.2%)	172 (32.1%)	7 (1.3%)
Total	27 (5.0%)	27 (5.0%)	110 (20.69%)	5 (0.9%)	362 (67.7%)	4 (0.7%)	499 (93.3%)	36 (6.7%)

Grand total: 535

The managerial flexibility hypothesis implies that the main reason for issuing callable debt is the variability of interest rates. We define interest rate variability, *UNCER*, as the mean absolute deviation in rates on 3 year US Treasury securities during the 10 weeks prior to the debt issue. *UNCER* is a proxy for the riskiness of interest rates over the recent past. As the variability of rates increases, the proportion of callable debt issued is hypothesized to increase. Thus, the variable *UNCER* is predicted to have a positive effect on the occurrence of callable debt.[9]

The interest rate level hypothesis implies that the level of interest rates influences the call option decision. The proxy for the default-free level of interest rates, *LEVEL*, is defined as the yield to maturity on a three-year fixed-maturity Treasury security measured in the secondary markets on the same date the sample debt instrument was issued.[10]

The agency cost hypothesis suggests variables associated with signaling, default, and wealth shifts. The set of rating variables, *HIGH*, *MODERATE*, and *LOW* are utilized as a proxy for the firm's need to signal its 'goodness'. *HIGH* is a binary variable for Moody's highest ratings, Aaa or Aa. Similarly, *MODERATE* and *LOW* are binary variables for Moody's moderate debt ratings (A or Baa) and low debt ratings (Ba or lower including nonrated debt), respectively. The rating is expected to show a negative effect on the issuance of callable debt, i.e. the lower the debt rating, the greater the probability that the debt issue will be callable.

Thatcher's (1985) agency analysis implies that firms facing default are more likely to issue callable debt. The probability of default is analyzed through

[9]This approach assumes that market expectations change on the basis of the last 10 weeks. It is plausible that expectations are revised in some other manner. Other time frames for calculating the period of uncertainty were tried with similar results.

[10]Thirty-year Treasuries were also utilized as proxies for the level of interest rates with similar results.

Table 2

Symbols and definitions of variables.

Dependent variable:	
CALL	= A binary variable for the presence (1) or absence (0) of a call feature being placed on the debt issue
Independent variables:	
Flexibility factor	
UNCER	= Average change in interest rates over the 10 weeks prior to the debt issue
Interest rate factor	
LEVEL	= The yield on a 3 year treasury security issue
Agency factors	
DA	= Debt to asset ratio
MARKET	= The ratio of the new debt issue to the amount of debt outstanding
GROWTH	= Growth during the year the debt was issued, measured ex-post
Ratings:	
HIGH	= A binary variable for debt ratings Aaa or Aa
MODERATE	= A binary variable for debt ratings A or Baa
LOW	= A binary variable for debt rating Ba or lower
HIGH was the base case	
Tax factors	
MTAX	= The marginal corporate tax rate of the issuing firm
Maturity factor	
MAT	= Maturity of the debt issue in years
Sector classifications	
FINANCE	= A binary variable for financial firms
UTILITY	= A binary variable for utilities
INDUSTRIAL	= A binary variable for industrial firms
INDUSTRIAL was the base case	

two debt ratios to determine if significant differences between the noncallable and callable debt samples exist. The debt to asset ratio, *DA*, is a measure of the firm's ability to take on additional debt. *MARKET* is the ratio of the new debt issue relative to the total amount of consolidated funded debt the firm has outstanding, including the relevant issue.[11] Thus, *DA* and

[11]Both debt ratios, *DA* and *MARKET*, were calculated with book values for existing debt outstanding. Other default measures attempted included debt/equity, profit margin, change in profits before and after the debt was issued, and the interest coverage ratio. All were less significant than *DA* and *MARKET* in explaining the decision to issue debt with or without the call option attached.

MARKET are expected to have a positive impact on the issuance of callable debt. The more debt the firm takes on, the greater the probability that the firm will desire to recall some portion of the debt to either modify the capital structure or eliminate restrictive covenants.

Wealth shifts, another aspect of the agency hypothesis, involve the transfer of wealth from one group of security holders within the firm to another. The higher the expected growth rate of the firm, the greater the potential for wealth shifts. Therefore, high growth firms are expected to have a greater propensity for issuing callable debt when compared to firms issuing noncallable debt. *GROWTH* is defined as the average three-year historical growth in the firm's assets during the period prior to issuing debt.[12] The growth variable is expected to exert a positive effect on the dependent variable, *CALL*. Growth is a proxy for the need to avoid wealth shifts. The larger the growth, the stronger the need for callable debt as a means of limiting the gain of the debtholders from investment opportunities.

The maturity of the debt issue, *MAT*, should affect the decision to attach a call option to a debt issue. Longer maturity is expected to make a call option more likely. The shorter the maturity, the less the value of the call option. Shortening of the maturity is a potential substitute for the call feature.

The tax advantage argument is analyzed using the marginal tax rates of the issuing firms. *MTAX* is the firm's marginal tax rate and is based upon the firm's pretax profits and the tax schedule in effect at the time of the debt issue. Some authors suggest that taxes will increase the probability that the firm will issue callable debt, although Miller's (1977) position suggests no impact.[13]

4. Methodology

Two types of testing were undertaken to analyze the differences in firms that issue callable and noncallable debt. The means tests were used for descriptive purposes, for testing the effects of the predictor variables individually, and for supporting the results obtained from the logit regression.[14] The logit regression, estimated using the conditional maximum likelihood estimation algorithm as outlined by Palepu (1986), was used to gauge the predictive

[12]Several other growth rates were calculated including the growth rate for the 3- and 5-year periods prior to the debt issue for revenues, long-term debt, and property, plant, and equipment. Each of the alternative pregrowth variables generated insignificanct results. Growth during the current year measured ex-post was also tested.

[13]Average tax rates were also utilized with the same results. Average tax rates were obtained from the Compustat Data Tapes and were defined as the firm's total tax expense, including all income taxes paid to federal, state, and foreign governments, divided by the firm's pretax income.

[14]Since many of the attributes tested under the standard t-test may violate the assumption of normality, the Wilcoxon rank sum test was also used. The results confirmed those found with the simple t-test for the means.

powers of the various proxies and to test the merits of the call option hypotheses. The logit regression allows the simultaneous testing of all the theories since it allows for the predictors to be tested as a group. The model is formally classified as a univariate dichotomous model, since it is concerned only with the occurrence or nonoccurrence of the inclusion of the call option when debt is issued.

The logit model uses the logistic distribution as a probability function. One of the basic benefits of this distribution is that it constrains the dependent variable to lie between 0 and 1. The model coefficients are estimated using the maximum likelihood function. Logistic regression is utilized rather than discriminant analysis since it does not require the assumption of multivariate normality.[15] The only assumption necessary for logit regression is that the probability that p of a callable debt issue equals:

$$p = 1/[1 + \exp(-BX)], \tag{2}$$

where B denotes the vector of regression parameters and X is the vector of explanatory variables.

In our data set, the number of callable debt issues is much greater than the number of noncallable debt issues. Palepu (1986) has outlined a logit methodology for this case. In our estimation sample (from the debt issues during the years 1977 through 1985), all the noncallable debt issues in the population were selected. However, out of the callable debt issues, only 10% (selected at random) were included in the sample. Hence, a noncallable bond had a probability of one of being in the sample. For a callable debt issue the probability was 10%. Under this sampling scheme, Palepu has shown that the probability of an event in the sample being callable debt issue is:

$$p' = 1/[1 + 0.10\exp(-BX)]. \tag{3}$$

Note that the functional form of p' is also logistic. The likelihood function to be maximized in the estimation uses the above expression for p'.

In the estimation phase, the data set was restricted to (1) firms that had issued either callable or noncallable debt during any one-year time period; (2) debt issued during the years 1977 through 1985; and (3) debt from financial, industrial, or utility firms. The year 1986 was omitted from the estimation phase to allow the predictive powers of the model to be tested on a holdout sample of 1986 debt issues.

[15]See Judge et al. (1985) for the theoretical justification behind the logistic regression. A comparison of logistic regression and discriminant analysis by Press and Wilson (1978) offers support that logistic regression is preferable to discriminant analysis when the variables do not have multivariate normal distributions within classes.

Table 3
Mean value summary statistics for logit regression variables.

Variable	Debt type		t-value	Prob.
	Callable	Noncallable		
UNCER	0.60%	0.81%	−1.4276	0.1536
**LEVEL*	10.27%	9.49%	6.5188	0.0001
**DA*	0.29	0.24	5.7182	0.0001
**MARKET*	0.13	0.05	6.8948	0.0001
**GROWTH*	14.89%	10.96%	3.3984	0.0007
MTAX	31.43%	34.42%	−0.6110	0.5413
**MAT*	18.14 yrs	7.22 yrs	29.8925	0.0001

*There exists a statistically significant difference between the callable and the noncallable samples for this variable. (Level of significance is 1% or better.)

5. Results

5.1. Means test and logit regression

This section presents two types of results, differences in means (shown in tables 1 and 3) and logistic regression (shown in table 4).

For the uncertainty of interest rates prior to issuing debt, *UNCER*, there was no statistical difference between the means from the callable and noncallable bonds. See table 3. In the logit regression in table 4, this variable is also insignificant.[16]

In table 3 the level of rates, *LEVEL*, has a higher mean for the callable bonds. Similar results are obtained for the logit analysis in table 4. The logit model shows a positive and significant relationship. When interest rates are high, callable debt is more likely than when interest rates are low.

For the ratings variables (*HIGH*, *MODERATE*, and *LOW*), table 1 reports the proportions of the debt issues in each of the rating groups. The *t*-tests on the proportions reveal statistically significant differences between the low and moderate debt classifications. A larger proportion of callable debt is found in the low ratings group and a smaller proportion in the moderate and high rating groups when compared with the noncallable proportions. In the logit regression only *MODERATE* is significant, providing some support for the hypothesis that noncallable debt issues tend to have higher ratings when compared with callable issues.

The default proxies show that call features are more likely with higher

[16]The coefficients reflect the effect of a change in an independent variable upon the natural logarithm of $\text{Probability}_i/(1-\text{Probability}_i)$. The amount of the increase in the probability depends upon the original probability and thus upon the initial values of all the independent variables and their coefficients. The sign of the coefficient does indicate the direction of the change.

Table 4

Logistic regression estimation equation.

Variable[a]	Predicted sign[b]	β	Std. error	χ^2	Prob.[c]	R^d
Intercept		−7.9903	2.1696	13.56	0.0002	
*DA	+	+5.5881	1.7870	9.77	0.0018	+0.528
GROWTH	+	+3.9645	3.4139	1.35	0.2455	+1.737
*LEVEL	+	+0.2746	0.1560	3.09	0.0784	+0.248
*MARKET	+	+2.6789	1.1323	5.59	0.0180	+0.387
*MAT	+	+0.4789	0.0951	25.38	0.0001	+2.578
MTAX	+	+0.0088	0.0171	0.26	0.6073	+0.073
Ratings:[e]						
*MODERATE	−	−1.4569	0.6292	5.36	0.0206	−0.399
LOW	+	+1.3381	0.8680	2.37	0.1232	+0.277
UNCER	+	+11.7123	14.5606	0.65	0.4212	+0.146
Classifications:[f]						
*FINANCE	−	−1.6897	0.5925	8.13	0.0043	−0.441
UTILITY	+	+0.5658	0.7056	0.64	0.4227	+0.131

Model χ^2	127.29
Probability	0.0001
Correct Classification (estimation sample):	
Total	79.2%
Callable	77.6%
Noncallable	81.3%

[a]Models estimated using only firms that issued either noncallable or callable debt during any one year time period.

[b]Note that a plus sign (+) means that callable debt is more likely and a negative sign (−) means that noncallable debt is more likely.

[c]The significance level is defined as the probability of obtaining a larger absolute value of the coefficient when the coefficient is actually equal to zero.

[d]Individual R statistics are defined as

$$R = [(\text{MLE } \chi^2 - 2)/-2L(0)]^{\frac{1}{2}},$$

and provide a measure of the contribution of the independent variable's contribution to explaining the dependent variable.

[e]The base case is a *HIGH* rating.

[f]The base case is *INDUSTRIAL*.

*Variable is statistically significant in the logit model. (Level of significance is 10% or better).

default risk. The two debt ratios, *DA* and *MARKET*, are statistically significant when tested by the means test. The logit analysis supports the results from the means tests. Both the debt to asset ratio (*DA*) and the ratio of new debt to existing debt (*MARKET*) are statistically significant and positively related to the incidence of callable bonds. As debt becomes larger, the firm has a greater need for recalling outstanding debt to eliminate undesirable covenants or to change capital structure in the future.

The maturity of the debt issue, *MAT*, is positively related to the dependent variable *CALL*. As the maturity increases, the probability of issuing callable

debt increases. This is supported by both the means test and the logistic regression.

Although the difference in means of the marginal tax rates shown in table 3 is significant at 1%, marginal tax rates in the logit regression are not significantly related to the incidence of callable bonds. These results contradict the Boyce and Kalotay (1979) claim, but support the Miller position that the marginal bondholder tax rate equals the corporate tax rate.[17]

As shown in table 1, financial firms have a greater tendency to issue noncallable bonds when compared to industrials. Utilities have a greater tendency to issue callable bonds. The proportion of debt issues that are callable and noncallable segmented by classification differs at the 5% significance level. Thus, financial firms have a greater probability of using noncallable debt than the other firm types, industrials and utilities.

Therefore, the logit model was estimated for industrials separately and for financial firms separately,[18] see table 5. All regressions yielded similar results. The predictive power of the financial data set was 76.6% versus 86.0% and 77.1% for the industrial and the industrial/utility data sets, respectively.

5.2. *Predictive power of the logit model*

The estimated logistic regression was utilized to test the predictability of the model for the holdout sample of debt issues from 1986. As shown in table 4, the logit model produced an 79.2% prediction ratio for the debt issues correctly identified during the estimation phase of the analysis. The predictions were correct 77.6% for callable debt and 81.3% noncallable debt.[19] Table 5 reports the predictive results when the data was segmented by firm type. The best results are obtained for the regression for the industrial sector separately.

When the estimated parameters were applied to the holdout data set of 509 debt issues for the year 1986, the predictive power of the model declined. See table 6. On the complete holdout data set, the accuracy of the model for predictive purposes was 69.4% (82.6% and 63.2% for the noncallable and callable debt issues respectively).

The predictive powers of the model was also examined for a holdout

[17]The question of multicollinearity was also addressed. Not only were zero-order correlations analyzed, but partial correlations were also tested. The results show that *DA* and *MARKET* are highly correlated, but since both are used to test the default aspect of the agency hypothesis, their combined impact on the results will be unaffected. The binary variable *UTILITY* is also highly correlated to both *DA* and *MARKET*. This may account for the insignificance of *UTILITY* in the model.

[18]Because of the small number of noncallable utilities, the utility case was omitted.

[19]The prediction results are statistically significant when tested against the naive model of assuming all debt is callable, using the probabilities for callable and noncallable debt found within the population of debt issues during the period 1977 through 1989, and excluding firms that issue both callable and noncallable debt within the same year.

Table 5

Logistic regression estimation equations by sector classification.

Variable[a]	Predicted sign[b]	All	Industrial	Finance
Intercept		−7.9903	−16.2138	−5.7359
Class				
FINANCE	−	−1.6897*		
UTILITY	+	+0.5658		
DA	+	+5.5881*	+10.2431*	+2.4804*
GROWTH	+	+3.9645	+14.7276*	+1.2929
LEVEL	+	+0.2746*	+0.6477*	+0.0483*
MARKET	+	+2.6789*	+3.9215*	+0.7038*
MAT	+	+0.4789*	+0.4975*	+0.4771*
MTAX	+	+0.0088	+0.0547	+0.0360
Ratings				
MODERATE	−	−1.4569*	−2.3239	−1.0441*
LOW	+	+1.3381	+2.2272	+2.7061*
UNCER	+	+11.7123	+31.3047	+10.0821
χ^2	127.29	80.79	67.75	
Probability	0.0001	0.0001	0.0001	
Correct Classification (estimation sample):				
Total	79.2%	86.0%	76.6%	
Callable	77.6%	86.1%	70.0%	
Noncallable	81.3%	86.0%	73.7%	

[a]Models estimated using only firms that issued either noncallable or callable debt during any one year time period.

[b]Note that a plus sign (+) means that callable debt is more likely and a negative sign (−) means that noncallable debt is more likely.

*Variable is statistically significant in the logit model. (Level of significance is 10% or better).

Table 6

Prediction results; logistic regression applied to 1986 data.

a. Total holdout data set.

Debt type	Correct prediction	Wrong prediction
Callable debt	220 (63.2%)	128 (36.8%)
Noncallable debt	133 (82.6%)	28 (17.4%)
Total	353 (69.4%)	156 (30.6%)

b. Holdout data set excluding firms issuing both callable and noncallable debt in a 1-year period.

Debt type	Correct prediction	Wrong prediction
Callable debt	187 (68.8%)	85 (31.2%)
Noncallable debt	66 (76.7%)	20 (23.3%)
Total	253 (70.7%)	105 (29.3%)

Predictions based on final model shown in table 4.

sample for 1986 excluding firms issuing both callable and noncallable debt. The prediction results, reported at the bottom of table 6, show that the overall percentage of correct predictions increases to 70.7% (76.7% and 68.6% for the noncallable and callable debt issues, respectively).

Finally, the model was estimated without the two variables with the highest chi-square values to determine the predictive powers of the remaining variables. The model without *MAT* and *LEVEL* had a correct prediction ratio of 70.0%. This reinforces the importance of the level of rates and the maturity of the debt issue in the determination of whether or not to attach a call option to the debt issue.

6. Summary and conclusions

The determinants of the call option on debt have been examined. Interest rate uncertainty did not increase the frequency of callable debt. The use of the call option was more likely with higher interest rates. A call option was found to be more likely with high default risk. Growth firms were more likely to attach a call feature to debt issues as a means of limiting wealth shifts between equityholders and debt holders. A call feature was more likely with longer maturity debt. Finally, a firm's tax brackets did not affect the likelihood of callable debt. Thus, the empirical analysis supports the view that the level of interest rates, agency costs, and bond maturity significantly affected the attachment of a call option to debt during the period 1977 through 1986.

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