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Security Design That Addresses Agency Conflicts And Information Asymmetry

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SECURITY DESIGN THAT ADDRESSES AGENCY CONFLICTS AND INFORMATION ASYMMETRY

by

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ABSTRACT

This study focuses on the role of structured derivative securities to meet diverse corporate financing objectives in the light of agency theory and asymmetric information. The focus is on the nonconvertible callable-puttable fixed-coupon bonds. The primary objective is to discern the marginal role of the put and put-deferred features in addressing the agency issues and asymmetric information.

A sample of (159) securities issued over the period (1977-2005) are examined using Merton's (1974) structural contingent claims valuation model. The put option as well as the deferred put option incorporated in these securities is found to mitigate the asset substitution issue. It is also found that these contract features provide considerable insurance against the asymmetric information about the firm's downside risk.

Specifically, the effects of asset substitution are mitigated because the put option reduces sensitivity of the security's value to the changes in the firm's volatility. Prior to this study, this effect was believed to be driven primarily by the conversion feature in the convertible bonds and the preferred stocks. In addition, the long-term performance of the underlying common stock indicates systematic negative performance for the protracted periods both prior and subsequent to the issuance, yet it is found that this decline in the equity value has only a limited negative impact on the security.

To my late wife, Soraida, and my children Brittany and Ashley.

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LIST OF ABBREVIATIONS

NPV – Net Present Value

NYSE – New York Stock Exchange

AMEX – American Stock Exchange

LUXBG – Luxembourg Stock Exchange

OTC – Over the Counter

REIT – Real Estate Investment Trust

NR – Not Rated

SDC – Securities Data Company

CRSP – Center for Research in Security Prices

WRDS – Wharton Research Data Services

IPO – Initial Public Offering

SIC – Standard Industrial Classification Code

CHAPTER ONE: INTRODUCTION

This study focuses on the role of structured derivative securities to meet diverse corporate financing objectives in light of agency theory and asymmetric information. The dramatic proliferation of these types of securities is evident from the types of securities issued in the recent past to meet a host of corporate financing objectives [see Emery and Finnerty (1992, 2002), for an excellent review and summary].

The origins of this field of study can be traced to two separate strands of literature that have since merged: (a) the mathematical theory of pricing derivatives facing default risk and interest-rate risk starting with Merton (1974), Ingersoll (1977a,b) and Brennan and Schwartz (1977), and (b) the optimal design of these derivatives to meet financing objectives under the agency conflicts and asymmetric information framework beginning with the seminal works of Jenson and Mecking (1976), Myers (1977), Leland and Pyle (1977), and Myers and Majluf (1984).

While the range of the securities issued to meet diverse financing objectives is varied, a vast majority of these securities can be summarized into a single class with a prudent choice of parameters, specifically, callable, convertible, and puttable fixed income securities (either bonds or preferred stocks) with a prudent choice of call, conversion and put parameters.

Collapsing this complex field into a simple framework is convenient because it permits separation of the mathematics of pricing derivatives from the design of these securities to meet specific corporate financing objectives. In particular, the default and/or interest-rate risk of these securities can be priced using a common differential equation while all the variants designed to meet specific corporate financing objectives can be accommodated via the choice of boundary conditions imposed on this differential equation.

Despite the reduction to a simple framework of the dual task of pricing these securities, virtually no quantitative analysis has emerged in the literature regarding optimal security design. A vast majority of the voluminous literature is focused on the qualitative arguments using illustrative examples as to how a specific security design may meet certain financing objectives. For example, the conversion feature may alter the convexity of the security's payoff function, which has the potential to mitigate asset substitution. Even this earliest suggestion by Brennan and Schwartz (1988) has yet to be implemented and tested within the previously outlined analytical framework.

The problem associated with this framework of analysis is three-fold: first, specifying analytically the corporate objective in relation to a financing decision in the light of competing stakeholders' interests is difficult; second, even if such an objective can be specified, its incorporation into the mathematical framework of the conventional derivative pricing is challenging; and third, determining the optimal security design that meets the specified corporate objective within the said security-pricing framework can be difficult given a diverse range of available security choices. Leland (1994) exemplifies the difficulty of this task even for the choice of straight debt within the framework of optimizing capital structure.

A rudimentary analysis of how varied security designs may serve competing corporate interests is insightful. Consider a callable straight bond. A significant number of outstanding corporate bonds give the issuer the right to call the debt at a point in time. The time until the issue becomes callable for the first time is referred to as the call-deferred period or the call-protection period. Several theories that have been put forward to explain the motivation behind issuing callable bonds such as managing the interest rate risk and addressing the agency problems [Barnea et al. (1980), Kish and Livingston (1992), and Guntay et al. (2004)]. It is easy to see that the falling interest rates increase the bond values, resulting in firms benefiting from refinancing at lower rates. The call feature facilitates refinancing.

Securities with conversion features offer a different set of opportunities. They allow the security holders an option to convert the bonds into the shares of the common stock of the issuing company at a predetermined exchange rate. Convertibles possess both the equity and the debt characteristics. Debt characteristic offers downside protection, and the equity characteristic offers upside participation. Taken together, they mitigate asset substitution [Green (1984) and Brennan and Schwartz (1988)]. Of course, the situation can be complicated, as is often the case when the convertible security has a call option attached to it. In general, convertible securities that are immediately callable exhibit different risk characteristics than the ones that are call-deferred. The call-deferred convertibles exhibit a greater convexity in the valuation function with respect to the firm's value. This convexity is believed to address the agency and asymmetric-information issues [Brennan and Krause (1987) and Stein (1992)].

Unlike the call and conversion features which have drawn significant attention in the literature, the put option has remained largely unexplored. Put options provide the holders of these securities the opportunity to put the security back on the firm at a predetermined price. Just like the call option, the put option may be deferred for a time. The obvious potential use of the put option is that it has the potential to protect the security holder from the rising interest rates or the falling equity values. However, unlike the call-deferred feature that has the potential to increase the convexity of the valuation function, the put-deferred feature's role has largely remained unclear.

In general a manager's choice of security parameters spans five dimensions: the conversion feature, call feature, put feature, deferred-call feature, and the deferred-put feature. Some examples of these types of bonds are: callable bonds, callable-convertible bonds, puttable bonds, callable - puttable bonds, and callable – puttable - convertible bonds. The coupons associated with these bonds such as fixed, variable, and zero coupons make for very complex but interesting study. Table 1– clearly depicts the number of callable (71,676), callable - puttable (840), and puttable (563) non-zero fixed coupon bonds issued in the US between 1975 and 2006.

This paper studies callable-puttable fixed coupon bonds. The primary objective is to discern the marginal role of the put and put-deferred features in addressing the agency issues and the asymmetric information. As previously noted, this specific contract feature has received the least amount of attention in the literature. Indeed, it will be shown that these features play a key role in meeting certain corporate objectives that cannot be gleaned from a cursory examination of the contract parameters. For example, while it is well known that the conversion feature has the potential to make the derivative security's valuation function convex, thereby addressing the asset-substitution issue, it is largely unknown that an added call-deferred feature can accentuate that convexity. It will be shown in this study that the put-deferred feature creates convexity even in the absence of the conversion feature. Of course, once the marginal impact of the put feature is isolated, this study can be extended to analyze the role of callable-puttable-convertible securities in addressing agency and information-symmetry issues.

Table 1. Number of and Market Capitalization of Bonds Issued Between 1975 and 2006.

Year	*No. Of Straight Bonds*	*No. of Straight Bonds with Fixed Coupon Rate*	*Market Cap. of Straight Bonds (US$Mill)*	*Number of Callable and/ or puttable Bonds withFixed Coupon*	*Market Cap. of Callable and/ or Puttable Bonds with Fixed Coupon*	*Callable - Puttable Fixed Coupon Bonds*		*Puttable only Fixed Coupon Bonds*	
						Non-Zero Coupon	*Market Cap. (US$Mill)*	*Non-Zero Coupon*	*Market Cap (US$Mill)*
1975	426	384	28146.7	95	7385	1	65	1	40
1976	132	125	5548.9	317	26220.1	0	0	2	200
1977	81	75	3007.3	312	23050.7	4	33	0	0
1978	49	46	1874.5	263	19423.7	4	41	2	275
1979	31	29	1378.4	236	21658.7	7	524	0	0
1980	70	65	4281.4	333	31933.5	2	31	0	0
1981	59	56	5451	305	34883.6	4	290	2	24
1982	148	139	13008.2	323	30990.7	9	151.5	1	15
1983	148	107	8648.9	254	23377.6	4	62.5	1	50
1984	181	130	39410	221	26668.4	9	825	17	1545
1985	220	173	23375.1	398	43912.4	5	423	2	275
1986	400	367	52136.3	637	87872	8	296	4	600
1987	429	391	53912.8	408	57670.8	6	86.5	10	1800
1988	385	252	49738.8	350	53956.9	8	722	14	2450
1989	395	312	58570.2	319	53676.9	29	4669.2	51	8060
1990	526	426	75421.1	158	21962.1	3	375	19	3725
1991	1369	1151	142777.1	222	35428.8	4	2805	14	4085
1992	1527	1124	189737.1	532	81191.6	110	16126.4	24	5031.7
1993	2280	1409	235877.6	769	117575.4	185	27753.3	52	11165
1994	2338	1267	158834.2	638	79198.8	106	16850.4	39	7066.4
1995	3077	2140	250591.4	2097	165796.1	61	10778	58	13634.1
1996	4004	2827	303403.9	2869	192379.1	63	12012.7	84	17336.4
1997	6627	5054	458347.7	3284	216729.4	28	5270	79	14142.9
1998	7050	5152	684666.1	5358	375594.4	97	22034.9	26	5509.2
1999	6893	5204	788286.7	5002	279499.8	16	4706.3	21	5407
2000	7856	5907	724865.7	3216	213850.3	9	2092	9	2648
2001	6795	5405	840737.6	9614	610164.3	14	2905	10	3725
2002	5306	4048	713384.2	9019	642307.2	8	2112.6	5	2537.5
2003	4241	2640	658266.7	9630	789710	28	8477	8	2185
2004	3881	2276	548671.3	7123	479320.9	7	1650	5	800
2005	3304	2114	600094.7	4102	286340.2	1	300	0	0
2006	2020	1300	555349.1	3272	274587.3	0	0	3	4450
Total	72248	52095	8277800.7	71676	5404316.7	840	144468.3	563	118782.2

Number and market capitalization of straight, callable, and puttable bonds from SDC Platinum Database.

The only publication that has studied puttable bonds, Crabbe and Nikoulis (1997), concludes that mitigation of the interest-rate risk is the only reason for the inclusion of put feature. The evidence in the current study contradicts this finding.

We perform two studies in this paper. In the first study we examine the impact of call and put options, using the contingent claims valuation model tested by Ramanlal, Mann, and Moore (1998) on the factors such as: the relative pricing at issuance (defined as the offer price relative to the model price calculated by the contingent claims valuation model in this paper), change in the value of the bond with respect to the change in the value of the firm, change in convexity-which determines the downside protection provided to the investors, change in the value of the security with respect to the change in the volatility of the firm's common stock, and the duration of the security.

We find that the deferred put option in the security increases the gap between the offer price and the model price. The deferred put option greatly reduces the security's exposure to the change in the market value of the firm. The deferred put option not only makes the security less susceptible to the change in the market value of the firm but also provides information on the magnitude of downside protection that the investors have. Finally, the call option is primarily incorporated in these securities by the firms to control their exposure to the interest rate risk.

In the second study we examine the long-term performance of stocks of the firms issuing callable - puttable bonds. We examine the stock performance for the periods:

1. From issue date to two years before the issue date;
2. From issue date to two years after the issue date;
3. The period between the issue date and the put date;
4. Two years before the put date;
5. Two years after the put date.

We find that the stocks of the firms significantly underperform in the period two years after the issue date as compared to the performance in the period two years before the issue date. In addition to this result, we find that the firms significantly perform better in the period between the issue date and the put date as compared to the performance two years after the put date. This result suggests that the firms improve their performance in the period closer to the put date. Finally, we find that the stocks significantly underperform two years after the put date in comparison to the performance two years before the put date. This result clearly indicates that the put date is an important date as far as management's decisions with respect to the firm's performance are concerned. Also, these securities are designed to signal managerial intent to the market. These securities signal firm underperformance to the market, which serves to address the information asymmetry problem.

The rest of the paper is divided into four chapters. Chapter Two contains a discussion and analysis of the characteristics of the issuers of callable-puttable bonds. Chapter Three contains the literature review of the determinants of the capital structure, the reasons for issuing callable bonds, and the reasons for issuing convertible bonds. Chapter Four contains a discussion of valuation models. Chapter Five contains the research design and methodology used in this study to numerically analyze different aspects of callable - puttable bonds. Chapter Six details the event study conducted to measure the actual long-term performance of firms around the issue and put dates. Chapter Seven contains the concluding remarks.

CHAPTER TWO: ISSUER CHARACTERISTICS

In this section, we summarize the characteristics of firms that issue callable-puttable bonds to provide perspective for the reasons for issuing this type of security within the context of widely postulated theories in finance, namely, *the Static trade-off theory* (Mackie-Mason, 1990), *the Pecking order hypothesis* (Myers and Majluf, 1984), and *Agency theories* (Jensen and Meckling, 1976).

Analysis of Full Sample

In order to show which of the above mentioned theories best explains the reason for the issuance of callable-puttable bonds, we provide a profile of issuing firms for our sample of 159 issues between the years 1977 to 2005. Of the 159 issues, 154 were senior issues and 5 were subordinate issues. Based on S&P ratings, 122 issues were rated investment grade and the remaining 37 issues were rated high yield. The year 1998 saw an abnormally large number of callable-puttable issues, namely 69. Table 2 indicates that firms across a broad industry cross-section issued these types of securities.

To see if the issuers of the callable-puttable bonds observe the pecking-order theory, we collect data on all the remaining securities issued by these firms for the period two years prior to the date of issuance of the callable-puttable bonds. Data is obtained from the *Securities Data Corporation* platinum database, *Moody's Industrial Manual*, prospectuses from *Edgar*, and *Compustat*.

Table 2. Distribution of Callable - Puttable Bonds Issuing Firms by their Respective Industry for the Full Sample Between 1977 and 2005 and Issues only in 1998.

Industry(2 Digit SIC Code)	*Number of issues (Full Sample)*	*Number of issues (In 1998)*
Agriculture	1	0
Communication	3	3
Finance	27	10
Insurance	6	2
Manufacturing	21	15
Mineral	6	2
Real Estate	7	7
Retail	11	10
Services	11	2
Transportation	3	2
Utilities	63	16
Total	159	69

Number of issuing firms distributed by their two digit SIC code obtained from SDC Platinum Database.

Table 3. Distribution of Full Sample of Callable - Puttable Bond's (1977-2005) Issuing Firms by their Prior Issues, and Reasons Given for the Use of Proceeds from the Issue.

Number of Issues	*Range of Prior Issues by the Issuing Firm*	*Reasons Given for Issue*		
		Refinance Debt	*Make Payment on Borrowings*	*Other*
68	0	44	16	8
55	1 to 3	36	9	10
23	4 to 9	11	7	5
13	10 - above	8	3	2
Total=159		99	35	25

Other reasons include: General Corporate Purposes, Future Acquisitions, and Stock Repurchase.

Table 3 depicts a breakdown of these prior offerings, which include common stock, non-convertible and convertible bonds (including straight, callable only, puttable only, and fixed, variable, and zero coupon rates; there was no prior issue of preferred stocks). There were 68 firms without any prior offerings in the preceding two-year period; 55 firms had 1 to 3 prior offerings, 23 firms had 4 to 9 prior offerings, and 13 firms had 10 or more prior offerings. This indicates there were 91 firms that issued at least one other security in the preceding 2 years. In 64 of these instances, the callable-puttable bond issue had a principal amount larger or equal to the largest amount among all prior issues (data not included in the table). In 34 of these instances, prior issues included only debt; in 19 instances, prior issues included only common stock; and in 36 instances, prior issues included both debt and common stock. The evidence does not support the *pecking-order* theory.

Table 3 also displays reasons for the current issuance: 99 issuances were to *"refinance existing debt,"* 35 issuances were to *"make payments on borrowings,"* and 25 issuances were for other reasons. These reasons indicate that the firms were having difficulty paying down debt using proceeds from operations, and they needed to borrow more to pay off old debt.

We provide further analysis on the debt-to-equity ratio and issue size in table 4 to understand this reasoning more clearly.

Table 4, which is organized by the issuing firms' previous security issues, depicts the average of long-term debt-to-equity ratio, **the average of the issue size (%) [a parameter used by Huckins (1999)], the ratings assigned to these issues by Standard and Poor's, and the ratings upgrade or downgrade between investment grade (IG) and high-yield (HY) ratings.

We find that the firms with no prior issues average high long-term debt-to-equity ratio of 1.13. This ratio consistently increases to 1.63 for firms with 10 or more prior issues. The

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***Issue size (%) = Net proceeds from the callable - puttable bonds/ (market value of equity + book value of total debt + book value of preferred stock).*

result indicates that the firms issuing callable-puttable bonds tend to operate with a high long-term debt-to-equity ratio, and the ones with a high number of recent prior issues tend to take on more debt. Similarly, the firms with no prior issues have an average issue size of 10.37%, which decreases to 3.31% for the firms with 10 or more previous offerings. These numbers provide a measure of default risk associated with these securities. The higher the issue size, the higher the risk.

Here we observe that the firms which raised capital infrequently maintained a high debt level in their capital structure and issued callable-puttable bonds with a higher principal amount as compared to the firm value. On the other hand, firms which raised capital more frequently maintained an even higher debt level in their capital structure and issued callable-puttable bonds with lower principal amount as compared to the firm value. In both instances investors would be looking for the downside protection. This observation shows that the *static trade-off theory* cannot explain the issuance of callable-puttable bonds by these firms.

The ratings observation shows that out of 68 issues (issued by the firms with no prior issues), 45 were assigned an investment grade rating (IG) and 23 were assigned a high yield (HY – below investment grade) rating. Similarly, out of 55 issues (1 to 3 prior issues), 44 were assigned the IG rating and 11 were assigned the HY rating. Out of 23 issues (4 to 9 prior issues), 20 were assigned the IG rating and 3 were assigned the HY rating. Finally, all 13 (10 and more issues) were assigned the IG rating. Overall, 122 issues were assigned the IG rating, and 37 were assigned the HY rating. We infer that the issues with a large issue size tend to a get lesser proportion of IG rating as compared to the ones with a smaller issue size. Also, the issues by the firms with more frequent offerings tend to get a higher proportion of IG rating. Table 4 displays long-term debt rating upgrade or downgrade of the issuing firms one year prior to the issue date. There was only one instance (Noram Energy – issue date 11/15/1998) when the rating was downgraded from IG to HY.

Table 4. Distribution of Full Sample of Callable - Puttable Bond's (1977-12005) Issuing Firms by their Prior Issues, Average Long Term Debt to Equity Ratio, Average Issue Size (%), Ratings, and Ratings upgrade/downgrade.

Number of Issues	*Range of Prior Issues by the Issuing Firm*	*Average Debt/Equity*	*Average Issue Size (%)*	*Number of Issues with IG Rating*	*Number of Issues with HY Rating*	*Number of Rating upgrade Compared to Last Issue/Last Year*	*Number of Rating Downgrade Compared to Last Issue/Last Year*
68	0	1.13 (0.54)	10.37 (4.89)	45	23	0	0
55	1 to 3	1.18 (0.49)	7.007 (3.99)	44	11	0	0
23	4 to 9	1.28 (0.67)	3.96 (1.94)	20	3	0	1*
13	10 - above	1.63 (0.78)	3.31 (2.18)	13	0	0	0
Total=159				122	37	0	1

* - Noram Energy (issue date 11/15/1998).
IG corresponds to investment grade rating by S&P (BBB- or better).
HY correspond to high yield rating S&P (BB+ or lower).
Issue size (%) = Net proceeds from the callable - puttable bonds/ (market value of equity + book value of total debt + book value of preferred stock).
Number in ( ) denotes Standard Deviation.

Table 5. Distribution of Sample of Callable - Puttable Bond's (Issued in 1998) Issuing Firms by their Prior Issues, Reasons Given for the Use of proceeds from the Issue.

Number of Issues	*Range of Prior Issues by the Issuing Firm*	*Reasons Given for Issue*		
		Refinance Debt	*Make Payment on Borrowings*	*Other*
23	0	17	2	4
19	1 to 3	12	4	3
17	4 to 9	9	5	3
10	10 - above	5	3	2
Total=69		43	14	12

Other reasons include: General Corporate Purposes, Future Acquisitions, and Stock Repurchase.

Analysis of issues in 1998

We further analyze the sample of issues in 1998 in an attempt to explain an unusually high number (69) of the callable - puttable bonds issued in 1998. Table 5 displays 23 firms with no prior offerings, 19 firms with 1 to 3 prior offerings, 17 firms with 4 to 9 prior offerings, and 10 firms with 10 or more prior offerings in the two-year period. Also, 43 issuances were to *"refinance existing debt,"* 14 issuances were to *"make payments on borrowings,"* and 12 issuances were for other reasons.

Table 6 shows results that are different from the results of the full sample. 23 issuing firms with no prior issues have an average debt to equity ratio of 1.11, 19 firms with 1 to 3 prior issues have an average ratio of 0.99, 17 firms with 4 to 9 prior issues have an average ratio of 0.95, and 10 firms with 10 or more prior issues have an average ratio of 1.21. These ratios are much closer to each other in contrast to the ones in full sample. The average issue size ranges from 2.51% for the firms with no prior issues to 3.89% for the firms with 10 or more prior issues.

Table 6 also displays that all 23 issues (issued by firms with no prior issues) were assigned an investment grade (IG) rating, 18 out of 19 issues (1 to 3 prior issues) were assigned the IG, 16 out of 17 issues (4 to 9 prior issues) the IG rating, and finally, all 10 (10 or more issues) were assigned the IG rating. Also, table 1(a) clearly shows that the issuing firms were evenly distributed across all industries.

The question is what caused the firms to issue such a large number of callable-puttable bonds in the year 1998. We look at the economic conditions in 1998 and medium to long term economic forecasts made in 1998, to determine whether there were factors other than company-specific that led to such a large number offerings of callable-puttable bonds in 1998.

Table 6. Distribution of Sample of Callable - Puttable Bond's (issued in 1998) Issuing Firms by their Prior Issues, Average Long Term Debt to Equity Ratio, and Average Issue Size (%) Ratings and Ratings upgrade/downgrade.

Number of Issues	*Range of Prior Issues by the Issuing Firm*	*Avg Debt/Equity*	*Avg Issue Size (%)*	*Number of Issues with IG Rating*	*Number of Issues with HY Rating*	*Number of Rating upgrade Compared to Last Issue/Last Year*	*Number of Rating Downgrade Compared to Last Issue/Last Year*
23	0	1.11 (0.38)	2.51 (.89)	23	0	0	0
19	1 to 3	0.99 (0.59)	4.28 (1.29)	18	1	0	0
17	4 to 9	0.95 (0.45)	3.55 (1.36)	16	1	0	1*
10	10 - above	1.22 (0.53)	3.89 (1.62)	10	0	0	0
Total=69				67	2	0	1

*- Noram Energy issue date 11/15/1998.
IG corresponds to investment grade rating by S&P (BBB or better).
HY correspond to high yield rating S&P (BB+ or lower).
Issue size (%) = Net proceeds from the callable - puttable bonds/ (market value of equity + book. value of total debt + book value of preferred stock).
Number in ( ) denotes Standard Deviation.

Economic Conditions in 1998 and Outlook

The following information was obtained from the Federal Reserve Bank of San Francisco (FRBSF), Economic Letter (March 5, 1999) and Economic and Budget Projections from the California Legislative Analyst's Office (LAO), (1998).

Economic Conditions in 1998

World Economy

The currency devaluations of a few small countries in Asia escalated into a severe financial crisis that slowed the growth around the world. Foreign real GDP growth during 1998 was about 3 percentage points weaker than had been assumed for the FRBSF forecast. Also, a weakening of worldwide demand for energy in the wake of the Asian crisis (along with the mild winter weather in the U.S.) led to an unexpected drop in the oil prices. During 1998, the price of imported oil averaged about $4 a barrel lower than had been anticipated in September 1997. Finally, the Asian crisis had more modest ramifications for the dollar, which appreciated as a safe haven during the first half of 1998 but gave up those gains in the second half.

The U.S. Economy

The real GDP growth roared in 1998 at 4.2%. The unfolding of Asia's economic and financial problems and turmoil in the U.S. stock market had prompted mid-year concerns that the U.S. economy was headed toward a serious slowdown or perhaps even a recession late in 1998. Recent evidence suggests, however, that the national economy remained on an upward track through the summer months. In fact, the S&P 500 soared over 20% by the end of 1998.

Economic Outlook and Forecast

The U.S. Economic Outlook

Despite the economy's continued expansion and growth in aggregate output, there are a number of key indicators pointing toward some economic softening in the months ahead. One of these indicators is a continued deterioration in the U.S. foreign trade balance, caused primarily by falling exports to Asia. Another is a slowdown in business investment, partly reflecting weakening sales and profits in key manufacturing sectors of the economy. In addition, recent surveys have indicated a marked decline in the consumer confidence levels. These and related factors suggest that, while the U.S. economy continues to expand, the near-term outlook is for a more subdued growth than in the recent past.

Near-Term Forecast (1998 Through 2000)

The U.S. economy will slow down but remain on a positive growth path through 2000. The real GDP is projected to grow by 1.9 percent next year and 2.4 percent in 2000, compared to 4.2 percent in 1998. Slower growth in spending by consumers and businesses is the main factor responsible for the overall slowdown. Inflation is expected to rise modestly, as lower import and commodity prices only partly offset increases in labor costs. The U.S. CPI is projected to increase by 2.3 percent in 1999 and 2.9 percent in 2000, compared to 1.6 percent in the current year.

Longer-Term Forecast (2001 Through 2004)

The U.S. economy is expected to experience moderate growth and slowly rising inflation over the longer-term forecast period. This projection reflects the fact that the U.S. economy is currently operating at near full capacity, characterized by low levels of unemployment and high factory operating levels. Given this, the longer-term outlook is tied to increases in the U.S. labor force (estimated to grow by slightly less than 1 percent per year) and the growth in productivity of the workforce (estimated to be about 1.4 percent per year). The forecast implies moderate real output gains averaging about 2.4 percent per year. It also assumes that inflation will slowly accelerate, with the CPI increasing at annual rates of slightly over 3 percent by the end of the forecast period.

Implications

The U.S. economic outlook and forecast in 1998 clearly suggest the expectation of an economic slowdown or even a recession. Global economic slowdown was expected to impact the U.S. growth rate, which had seen a boom in 1997 and 1998. An unusually large proportion of callable-puttable bonds issued in 1998 can *possibly* be explained by the fact that the investors expecting a slowdown in the U.S. economy are looking for a premium in the financial instruments. This fact *might be* instrumental in the management incorporating the put option to mitigate the agency issues arising out of the future expectation of the firm's performance.

In the backdrop of this analysis, we provide in chapter three a literature review of the determinants of capital structure from the agency perspective. Also, we discuss the reasons proposed in the literature for including convertible and callable features in order to better understand the relative importance of including these features in the debt instruments.

CHAPTER THREE: LITERATURE REVIEW

<u>The Determinants of Capital Structure</u>

Before we look at the reasons suggested by the research studies in finance for the issuance of debt instruments, it is important that we look at various determinants of capital structure as suggested by the literature.

Agency Cost

<u>Asset Substitution</u>

Jensen and Meckling (1976) show that in certain situations, the management might act in the best interest of stockholders at the expense of bondholders. The management can decrease the value of existing bonds by:

a) Increasing debt or adding senior debt; this is commonly known as the claims dilution problem.

b) Investing in riskier projects after the debt is issued; this is commonly known as risk-shifting or an asset substitution problem.

Over/Under investment

According to Mayers (1977) all the firms are valued based on the expectation of a continued future investment by the firm. The amount invested depends on the net present value of the opportunities as they arise in the future. In case of an unfavorable future environment the firm would refrain from investing. This might result in “under-investment.” The reason for this under-investment is that if the firms are required to infuse equity to fund a project whose benefit will accrue largely to the debt holders, they would rather forego the project. Thus, large debt holdings result in under-investment.

Asymmetric Information

Investment and Financing

According to Meyers and Majluf (1984) the firms should use debt first to raise external capital if possible. Firms which have used up all the internal funds and their ability to raise the capital through the low cost debt may give up a good investment opportunity rather than issue new common stock hence; it is important for the firm to put aside internal funds in order not to forego potential attractive investment opportunities.

According to Modigliani and Miller (1958) the market value of any firm is independent of its capital structure. This theory is based on strict set of assumptions about the environment, such as absence of taxes, no information asymmetry and no bankruptcy costs. In the presence of corporate taxes, the value of the firm should increase with the substitution of debt for equity financing. However, the amount of debt financing would be limited in the presence of bankruptcy costs.

Signaling

Ross (1977) states that, if the managers possess inside information, then the choice of a managerial incentive schedule and of a financial structure signals information to the market. An empirical implication of this theory is that the values of firms will rise with the leverage since it increases the market's perception of value.

Reasons for Issuing Callable Bonds

There have been several reasons proposed for issuing callable bonds from the agency and information asymmetry perspective. Following is a summary of reasons proposed in the field of research.

Interest Rate Level Hypothesis

This theory states that, if the interest rate levels are higher during the period, the likelihood of rates going down in the near future is higher and this increases the probability of attaching the call option to the bonds. Kish and Livingston (1992) find results that support this theory. Guntay et al. (2004) also find a positive relationship between the level of interest rates and the call feature usage on the bonds.

Agency Cost Hypothesis

Barnea et al. (1980) contend that the maturity structure of the debt and the call option on the debt are alternative solutions to specific agency problems. They break down agency problems into three categories: information asymmetry, risk incentives, and the future investment opportunities.

Information Asymmetry

Chen et al. (2007) contend that inclusion of the call option feature in the bonds solves the risk-shifting problem studied by Jensen and Meckling (1976). Barnea et al. (1980) state that the transfer of wealth from the stockholders to the bondholders due to mis-pricing can be avoided by adding the call feature, if the call protection period expires immediately after the revelation of the true nature of the firm (nature of investment in a particular project). Consequently, the bond holders may interpret the inclusion of call option as a signal of strong prospects for the firm and require a lower yield.

Robbins and Schatzberg (1986) show that the quality of a project can be signaled by attaching call option to the bonds. Making the bonds callable increases bondholders' required rate of return, and making the bonds mature before the information becomes symmetric forces the firm to incur re-contracting costs sooner. These two additional costs are only borne by the firms that are financing high quality projects. Ederington and Stock (2002), also find that the market can interpret inclusion of the call feature as a reliable indicator of future firm investment and strong performance, thus reducing the required yields.

Risk Incentives

According to Parrino and Weisbach (1999) inclusion of a call option on the debt at an appropriate price eliminates the agency cost associated with the risk incentives because, if the managers were to shift to risky projects, they would decrease the value of the shareholders' long position in the call option. Inclusion of a call option is perceived by the bondholders as a protection against risky investing.

Future Investment Opportunities

According to Bodie and Taggart(1978; BT), the call feature allows stockholders to call the bonds and exclude bondholders from sharing in the future potential gains from the investment opportunities. Thus, the presence of the call feature may be interpreted by bondholders as a reduction in the likelihood that an underinvestment will occur. Acharya and Carpenter (2000) also reinforce this finding that the call feature addresses the underinvestment issue.

Avizian and Callen (1980), on the other hand, contradict BT by stating that in the absence of transaction costs (as is assumed by BT in their model), stockholders will buy up all the debt or the bondholders will buy up all the stock in order to eliminate the above mentioned externality. In the presence of transaction costs such as time-consuming negotiation costs to buy back the debt, it will be too costly for stockholders to buy back all the debt. Hence, the call feature is introduced to prevent or reduce such transaction costs.

According to Crabbe and Helwege (1994) these theories explain the existence of the call provision by relying on the default risk and maturity. Since increase in default risk increases the agency problems, shorter maturity can be substituted for the call option to mitigate these problems. Overall, their findings suggest that call features are not indicative of future investment and performance.

Agency Cost of Default

Sarkar (2004) in his theoretical comparison between non-callable and callable bonds finds that the yield on the callable bonds can exceed the ones on non-callable bonds when the firm is close to default. He shows that the default-related costs are higher for non-callable debt. This makes the callable debt more attractive.

Maturity Hypothesis

The value of the call option on the bond increases as the maturity term of the bond increases. A longer maturity period provides for greater chance of increase in the value of the asset. Therefore, longer term bonds are more likely to have a call option. This theory is supported by Kish and Livingston (1992), Flannery (1986) and Guntay et al. (2004), who find that the callable bond usage is more likely for the larger size and for the longer maturity debt issues.

Managerial Flexibility Hypothesis

Pye (1966) and Van Horne (1984) state that the call provision on the bonds provides management with the flexibility to counter market and interest rate uncertainties. The call option provides management with an opportunity to replace the higher cost bonds with lower cost in case of a decline in interest rates if interest savings outweigh the refunding cost. On the other hand, Guntay et al. (2004) in their empirical analysis provide strong evidence that the call option used on the bonds is related to multiple proxies for the interest-rate risk faced by issuers. They show that the call feature is more likely to be used when a firm's operating income is positively related to the interest rates.

Tax Advantage

According to Boyce and Kalotay (1979), both the issuer and the buyer of the callable bonds benefit at the expense of the government as far as the taxes are concerned. Since a profitable firm is likely to be in a high tax bracket and a typical lender in a low tax bracket, the exercise of call reduces the tax liability of the firm which is not offset by an increase in the tax liability of the lender. Marshall and Yawitz (1980) suggest that the call premiums are deductible from ordinary income tax as an expense to the borrower, but treated by the lender as capital gain. This will be an advantage if the capital gains are taxed at a lower rate than ordinary income.

Having looked at the reasons for callable bonds, it is imperative that we look at the reasons proposed in the literature for issuing convertible bonds from the point of view of agency, information asymmetry, and other reasons.

Reasons for Issuing Convertible Bonds

Information Asymmetry

Myers and Majluf (1984) explain that the announcement of an issue of convertible bond is not good news for the stockholders. They contend that, due to the presence of information asymmetry, the managers of the firm would issue common stock only when they believe it is overvalued. Issuance of a convertible also has the same information asymmetry impact since part of the convertible's value is an option on the company's common stock. Recognizing this information asymmetry, investors would be willing to reduce the issue's value in order to compensate for the information asymmetry. This cost is generally referred to as the "information cost."

Brennan and Kraus (1987) develop a single parameter model of information asymmetry. The goal of the firm is to maximize the difference between the value of the funds, raised from investors, and the true value of financing given the full information about the firm.

In equilibrium each financing strategy is chosen by the worst possible type of firm for that particular financing strategy. Convertible bonds can lead to such equilibrium since they can effectively resolve the issue of adverse selection, as each type of firm reveals the information with the choice of financing strategy.

Stein (1992) states that a growth-oriented firm may be more inclined to issue convertible bonds. Firms with a small amount of capital and a high growth opportunity may not be inclined to raise capital by issuing straight debt due to higher potential financial distress costs, which in turn would adversely impact their rating. On the other hand, issuing equity to finance projects may not be in their best interest since it might excessively dilute current ownership. Under these circumstances it might be beneficial for these firms to issue convertible debt with shorter call protection period. This will allow them to raise capital at a lower cost and force conversion to equity at a higher value. Convertibles may even be perceived as a positive by the potential bondholders, who might see it as a signal of confidence by the management about the future of the firm.

In another study, Kim (1990) concludes that convertible bonds and in particular the conversion ratio signals the type of a firm. The conversion ratio sends a signal about the firm's future earnings. A higher conversion ratio might be perceived as a negative signal, given the manager's future expectations of the firm.

Agency Cost

Asset Substitution

Brennan and Schwartz (1988) contend that the agency problem due to the management's participation in higher risk projects can be neutralized by the hybrid (debt and equity) nature of convertibles. Investment in riskier projects decreases the value of debt but consequently increases the value of the option.

Green (1984) developed a model which shows that the equity-like characteristics of convertibles may mitigate the asset substitution problem. The equity option reduces the potential for excessive risk taking by the current shareholders since any potential gains would have to be shared with the future equity holders.

Overinvestment/Underinvestment

Mayers (1998) contends that the convertible bonds economize on the issue costs. The convertibility portion leaves the funds in the firm and reduces the leverage when an investment opportunity arises. Also, the convertibles control the overinvestment problem when the investment opportunity is not present.

Isagawa (2000) contends that the managerial investment decisions are affected through default risk. In the firms where management has a tendency to increase the size of the firm for its own personal benefits, a properly designed convertible debt can reduce the probability of such a managerial action.

Tax Advantage Theory

According to Jalan and Barone-Adesi (1995), issuing convertibles increases the residual equity value of the firm, since the debt portion provides a tax shield. Compared to a straight debt, a convertible bond provides less trade off between the interest tax benefits and the cost of bankruptcy.

Management Entrenchment Theory

Isagawa (2002) in his paper states that an entrenched manager has no motivation to issue debt in the absence of corporate control since it increases the probability of bankruptcy. In the presence of corporate control, a manager will issue debt in order to avoid becoming a takeover target. In the absence of other financing choices, a manager will issue straight debt, which increases the probability of bankruptcy while undertaking value increasing projects. By issuing convertible debt, managers can reduce the probability of bankruptcy. Thus, convertibles are a favorable instrument of financing for an entrenched manager but may not be in the best interest of the firm from the value standpoint.

CHAPTER FOUR: THE VALUATION MODEL

Interest rate derivatives and the securities with embedded options such as callable convertible bonds, convertible preferred stocks, and callable-puttable bonds are typically priced by models of the term structure of interest rates. As Guzhva (2004) summarizes, there are two main approaches to the modeling of the term structure of interest rates in continuous time. These two approaches are the equilibrium approach and the no-arbitrage approach. The major distinction between these two approaches is that the yield curve generated from the equilibrium models closely follows but does not exactly match the actual yield curve. Consequently, the current bonds are not priced precisely and therefore even a small error in pricing of the underlying securities results in large errors in the pricing of derivative securities. On the other hand, no-arbitrage models match the current yield curve exactly, resulting in accurate pricing of underlying securities and minimal error in the pricing of derivative securities.

The Equilibrium Approach

This approach starts from a description of the underlying economy and from the assumptions about the stochastic evolution of one or more exogenous factors or state variables. The interest rate and the price of all contingent claims are exogenously derived under general equilibrium. Here, the initial term structure of interest rates is an output of the model, which can be calibrated so that the generated yield curve is as close to the actual yield curve as possible.

The equilibrium models can be further subcategorized into either single factor or two-factor models.

Single factor models:

Vasicek (1977) is a single factor model with three parameters with mean reversion. Cox, Ingersol and Ross (1985) developed a single factor three-parameter model, which keeps mean reversion and introduces a square root process to eliminate the possibility of negative interest rates. Rendleman and Barter (1980) develop a single factor, two-parameter model where the interest rates follow geometric Brownian motion.

Two factor models:

Brennan and Schwartz (1982) developed a two-factor, four-parameter model where the short rates and long rates are stochastic, and the short rates exhibit mean reverting to short rates. Longstaff and Schwartz (1992) build on the Brennan and Schwartz (1982) model by introducing stochastic volatility to the model.

No-Arbitrage Approach

This approach starts from the assumptions about the stochastic evolution of one or more interest rates and derives the prices of all contingent claims by involving the condition that there are no arbitrage opportunities in the economy. The no-arbitrage models can be further subcategorized into models of forward rates and models of short rate.

Forward rate model:

Heath, Jarrow and Morton (1992) developed the model where the short is obtained through the modeling of forward rates to replicate the yield curve. One drawback of this model is that it does not follow the Markov process, which eliminates the opportunity of employing the tree methodology to price derivatives.

Short rate models:

Ho and Lee (1986) developed the Brownian motion model in which the drift term is time dependent to ensure the exact matching of the current yield curve. There is no mean reversion; both short and forward rates have the same volatility, and the interest rates can be negative in this model. Hull and White (1990) introduce mean reversion to the Ho and Lee (1986) model. Black, Derman and Toy (1990) include another time dependent function in the model. In addition to the current yield curve, it allows matching the volatilities of all spot and forward rates at time zero.

They further use Brownian motion process, which removes the problem of negative interest rates. Black and Karasinski (1991) introduce a third time-dependent function which can be fitted to the local volatility curves.

Ramanlal, Mann, and Moore (1998) test various contingent claim valuation models adapted to callable convertible preferred stocks. The models they tested include: Ingersol (1977a, b), Brennan and Schwartz (1977, 1980), Emanuel (1983) and their own extension of the Brennan and Schwartz (1977) model. Brennan and Schwartz specify a general algorithm for valuing callable and convertible bonds which is robust to a very general set of contract provisions. Ramanlal et al. modify this algorithm so that the improved model is applicable to callable and convertible preferred stocks. The new model can accommodate a variety of realistic contract provisions including call, put, and conversion profiles that vary over a security's life.

CHAPTER FIVE: RESEARCH DESIGN AND METHODOLOGY

The Model

The Ramanlal, Mann and Moore (1998) model is an extension of the Merton (1974) model, which states that any contingent claim on the firm's value can be written as a function of the firm's value and the time *f(V, t),* where *f* is a contingent claim, *V* is the firm value, and *t* is the time. Merton assumes that the dynamics of the firm's value satisfies the stochastic differential equation:

$$dV = (\alpha V - C)dt + \sigma V d\tilde{z} \qquad (1)$$

Here:

α is an instantaneous growth rate of *V,*

C is the continuous cash flow for all claims,

σ is the standard deviation of the instantaneous return *dV/V,*

$d\tilde{z}$ is a Weiner-Bachelier variate,

The dynamics of the contingent claim f can also be described by a stochastic process similar to Equation 1:

$$df = (\alpha_f f - c)dt + \sigma_f f d\tilde{z} \qquad (2)$$

Here:

αf *and* σf are instantaneous growth rate and the standard deviation of the contingent claim, c is the continuous cash flow rate for the contingent claim.

Merton (1974) uses Ito's lemma to express df in terms of the first and second derivatives of f with respect to V, and the first derivative of f with respect to t. If a hedging portfolio with instantaneous return dX is formed, the riskless portfolio can be constructed, and the no-arbitrage equilibrium then requires that $dX = rdt$, where r is the instantaneous risk-free rate:

$$½\, \sigma^2 V^2 fvv + (rV - C)\, fv - rf + c + ft \;\; = 0 \tag{3}$$

Here:

fvv and fv are the first and second derivatives of the contingent claim with respect to the firm's value, and ft is the first derivative of f with respect to time.

This equation is a general partial differential equation that all claims on the firm's value should satisfy. Most of the realistic contractual provisions, such as call, put, and conversion features, can be modeled by specifying boundary conditions for Equation 3.

Ramanlal, Mann, and Moore (1998) adopt the solution techniques of Brennan and Schwartz (1977) in solving Equation 3 for convertible preferred stock.

Extended Model

The same approach is adopted to solve Equation 3 for callable-puttable fixed coupon bonds with a different set of boundary conditions.

When the bond is callable-puttable, the solution technique of Brennan and Schwartz (1977) in solving Equation (3) is adopted subject to boundary conditions that capture call protection periods and time-varying contractual call prices κ. Also, the κ is with accrued interest rates. The perfect market call policy as determined in Ingersol (1977a) and Brennan and Schwartz (1977) is adopted. The common stock dividends are held constant. Since the call price $\kappa(\tau)$ varies over time, $f_t \neq 0$ in Equation (3). Thus the upper boundary condition from the optimal exercise of call $f_V(\infty, t) = 0$. The lower boundary condition is $f(0,t) = 0$.

When the bond is neither callable nor puttable (both call and put options are removed), it acts as a straight bond. For constant cash flows c and C, $f_t=0$, in which case the contingent claim f is a function of the firm value V, $f(V)$. The lower boundary condition is $f(0) = 0$ and the upper boundary condition where the security is riskless perpetuity is $f(\infty) = c/r$ (asymptotic value goes to c/r).

Relative Pricing

First we check the relative pricing in case of these bonds at issuance. *ERRORi,t* term in Equation 4 defines the relative pricing parameter. It can be defined as the relative difference between the offer price of the bond and the price obtained from the contingent claims pricing model. We define this term "relative pricing" since we do not have access to the market value of these bonds after the issuance. It is common to apply the terminology "underpricing" while studying the relative issue price of securities where the market value after the issuance is observable. In the field of fixed income securities, the research on underpricing of securities has been very limited. However, the focus of study has primarily been on the underpricing of common stock IPOs. Loderer, Sheehan and Kadlec (1991) have examined underpricing in the case of convertible preferred stocks. Kang and Lee (1996) have done similar work in the case of convertible bonds. In this study we look at the impact of call and put options separately on the relative pricing of these bonds at issuance.

Relative pricing can be computed by:

$$ERRORi,t = \frac{(Offer\ Pricei,t - Model\ Pricei,t)}{Model\ Pricei,t} \qquad (4)$$

If the *ERRORi,t* term is negative, then the offer price is less than the model price at issuance.

Risk Characteristic Parameters

We calculate the parameters as defined below.

First Parameter: *Delta*

$$Delta = df/dV \tag{5}$$

It denotes a change in the value of security with respect to a change in the value of the firm.

We modified it to:

$$Delta = (df/f)/(dV/V) \tag{6}$$

This enables meaningful comparison across all firms irrespective of their values. Also, it denotes how sensitive the bondholder is to the downside risk.

Second Parameter: *Gamma*

$$Gamma = d^2f/dV^2 \tag{7}$$

This is the second derivative and denotes the shape of the valuation function at any point. If this factor is constant, then we know how much the downside risk is and it is linear. If there is convexity then the downside risk is non-linear. The reason derivative securities are so risky is that there is a of non-linear relationship between the security and the underlying asset. Nonlinearity implies that there can be an unpredictable change in the value of the security with respect to a change in the value of the underlying asset.

Third Parameter: *Vega*

$$Vega = df/d\sigma \qquad (8)$$

It denotes the change in the value of the security with respect to the change in the volatility of the firm.

We modified it to:

$$Vega = (df/f)/\ (d\sigma/\sigma) \qquad (9)$$

This enables a meaningful comparison between all issues.

Fourth Parameter: *Rho*

$$Rho = df/dr \tag{10}$$

Rho, denotes duration in years.

For annually compounded interest rate, duration is defined as:

$$D = -\frac{(1+r)(df/dr)}{f} \tag{11}$$

For continuous compounded interest rate, *D* can be defined as:

$$D = -\frac{(1)(df/dr)}{f} \tag{12}$$

Sample Design

The sample is obtained from the SDC platinum database. Following is the step-wise process by which the sample was refined in that order.

The initial sample is obtained by giving the search criteria for all the U.S. public issues of debt that have call or put or both options.

The resulting sample was further screened for only fixed coupon bonds. This resulted in 71,676 observations of callable and/or puttable bonds. The resulting sample was further screened for the observations with both call and put options. This resulted in 840 observations of callable-puttable bonds with specific put dates and also the change of control put option. “Change of control” put is a contract feature which enables the bond to become puttable under specific circumstances and not on a specific date specified in the contract. Typically, in a contract "Change of Control" means (i) the direct or indirect, sale, lease or other transfer of all or substantially all of the assets of the Company to any Person or entity or group of Persons or entities acting in concert as a partnership or other group (a "Group of Persons") other than Chairman of the Board of Directors and Chief Executive Officer of the Company; (ii) during any period of two consecutive calendar years, individuals who at the beginning of such period constituted the Company's Board of Directors (together with any new directors whose election by the Company's Board of Directors or whose nomination for election by the Company's shareholders was approved by a vote of at least two-thirds of the directors then still in office who either were directors at the beginning of such period or whose election or nomination for election was previously so approved) cease for any reason to constitute a majority of the directors then in office;(iii) a Person or Group of Persons (other than Chairman of the Board of Directors and Chief Executive Officer of the Company) shall, as a result of a merger or consolidation, a tender or exchange offer, open market purchases, privately negotiated purchases or otherwise, have become the beneficial owner (within the meaning of Rule 13d-3 under the Exchange Act) of securities of the Company or the entity surviving the merger or consolidation representing 50% or more of the combined voting power of the then outstanding securities of the Company ordinarily (and apart from rights accruing under special circumstances) having the right to vote in the election of directors.

The resulting sample of 840 observations was further screened for puttable bonds with only specific put dates, i.e. eliminating the ones with the change of control put feature. This resulted in 176 observations of callable-puttable bonds with fixed coupon rates and with specific call and put dates.

Finally, another 17 issues were eliminated since the firms issuing them did not meet the following criteria:

1. The firm must be listed and be searchable on the CRSP database on WRDS, and

2. The firm must have available daily stock price data at least 60 days prior to the issue date in order to estimate the return variance.

The final sample of 159 issues of callable-puttable bonds issued between 1977 and 2005 (Table 7) contains 134 callable - puttable bonds with a single specific put date and 23 with annual put dates becoming puttable annually on the specific date after the initial put date. The other 2 issues have multiple non annual put dates.

Table 7. Issues, Issue Date, Years to Maturity, Coupon Rate, Principal Amount, Market Capitalization, Volatility, Moody's Rating, and S & P's Ratings of the Callable - Puttable Bonds Issued Between 1977 and 2005.

Issuer	*Issue Date*	*Years to Maturity*	*Coupon Rate(%)*	*Principal (Mill)*	*Market Capitalization (Mill)*	*Volatility (%)*	*Moody's Rating*	*S&P Rating*
Fremont General Corp	9/8/1977	15	9.5	15	29.46	21.75	NR	BBB
Leisure Dynamics Inc	11/22/1977	14	10.25	3	10.71	20.99	NR	NR
Bank of North Carolina,NC	5/22/1978	15	9.5	5	34.04	12.81	NR	NR
Norin	8/16/1978	20	11	26	26.69	38.96	B2	B
Wetterau Finance	9/8/1978	15	9	6	118.74	19.13	NR	BB+
Cato Corp	12/8/1978	14	12	4	4.34	12.40	NR	NR
Tennessee Natural Gas Lines	4/4/1979	10	10.25	15	12.42	21.37	NR	B
CP National Corp	6/15/1979	12	10.375	15	25.03	19.24	NR	BB-
Brookwood Health Services Inc	10/5/1979	15	11	13	42.57	31.73	NR	B
Gulf Energy & Development Corp	11/8/1979	15	12	25	63.90	55.15	NR	NR
Beneficial Corp	12/19/1979	25	11.5	250	601.00	33.61	Aa2	AA
Louisiana General Services Inc	12/20/1979	11	12	6	34.83	24.67	NR	NR
Southwest Gas Corp	9/18/1980	15	12.5	15	71.36	25.91	NR	BB
Louisiana General Services Inc	12/10/1980	9	14	6	44.63	40.39	NR	NR
Providence Gas	8/5/1981	12	15.5	10	17.73	19.60	NR	NR
CP National Corp	9/11/1981	15	16.5	15	41.20	31.65	Ba1	NR
Humana Inc	11/9/1981	15	16.25	15	1341.18	41.11	NR	NR
Ford Motor Credit Co	11/17/1981	5	16.25	250	1811.80	26.85	A2	A
Gulf Energy & Development Corp	1/7/1982	14	16	20	50.38	37.94	NR	NR
Mark Twain Bancshares,MO	1/14/1982	12	16	15	57.53	3.85	NR	NR
Humana Inc	2/12/1982	15	16.5	25	1350.46	34.85	NR	NR
CP National Corp	6/25/1982	15	15.25	10	61.45	20.81	Ba1	BBB-
Southeastern Michigan Gas Ent	10/6/1982	12	14	8	15.30	10.24	NR	NR
Peoples Banking Corp,MI	11/12/1982	12	13.5	15	31.65	13.69	NR	NR
Central Wisconsin Bankshares	11/29/1982	12	13.5	3.5	9.60	22.90	NR	NR
Humana Inc	12/16/1982	10	12.5	50	2308.24	31.97	Baa3	BBB-
Florida Coast Banks Inc	3/8/1983	12	12.5	7.5	14.65	14.03	NR	NR
United Bankers Inc,Waco,Texas	3/17/1983	10	12.25	10	27.52	9.96	NR	NR

Issuer	*Issue Date*	*Years to Maturity*	*Coupon Rate(%)*	*Principal (Mill)*	*Market Capitalization (Mill)*	*Volatility (%)*	*Moody's Rating*	*S&P Rating*
Washington Gas Light Company	11/3/1983	25	12.375	30	204.80	15.69	A2	A-
Norstar Bancorp,Albany,NY	4/27/1984	10	13.375	60	388.71	23.14	Aa3	AA
DCS Capital	10/11/1984	12	12.375	100	5314.16	29.11	A2	A
Pacific Gas and Electric Co	10/17/1984	33	12.75	250	4704.20	28.85	A1	A+
Houston Natural Gas Corp	10/18/1984	7	11.875	100	1530.82	19.56	A2	A+
National Medical Enterprises	11/9/1984	15	12.75	20	1615.06	34.18	A3	A-
American Healthcare Management	12/12/1984	20	15	80	57.85	34.03	B1	B
National Medical Enterprises	12/19/1984	15	12.125	15	1632.43	30.01	A3	A-
Southeastern Michigan Gas Ent	6/20/1985	15	11.5	15	34.48	37.96	NR	NR
Valley Gas Co	9/4/1985	15	11.125	3	17.85	10.87	NR	NR
Valley Resources Inc	9/4/1985	15	11.375	5	17.85	10.87	NR	NR
Associates Corp of N America	4/9/1986	12	7.625	100	8.30	90.81	A3	A+
Providence Gas	5/16/1986	20	8.5	10	62.66	14.73	A2	BBB+
Essex County Gas	7/8/1986	20	8.625	3	15.83	5.15	NR	NR
Southwest Gas Corp	10/8/1986	25	9	35	261.68	25.42	Baa3	BBB
Berkshire Gas	11/5/1986	20	9.125	8	20.84	96.73	NR	NR
Southwest Gas Corp	11/18/1986	25	9	40	266.74	23.63	Baa3	BBB
Southwest Gas Corp	12/16/1986	25	8.75	25	259.99	15.46	Baa3	BBB
Mark Twain Bancshares,MO	2/23/1987	12	8.5	15	133.89	27.03	NR	NR
Delta Natural Gas	3/18/1987	20	8.625	14	15.36	23.45	NR	NR
Alabama Gas Corp(Energen Corp)	4/10/1987	25	8.75	10	96.46	23.18	A2	A-
Southeastern Michigan Gas Ent	11/18/1987	20	10	22	79.81	38.09	NR	NR
Southeastern Michigan Gas Ent	12/22/1987	20	10	13	78.71	43.65	NR	NR
Washington Gas Light Company	4/12/1988	30	9.25	50	406.94	16.27	Aa3	AA-
Laclede Gas Co	5/17/1988	25	9.625	25	231.28	17.02	Aa2	AA
Baxter International Inc	6/14/1988	30	8.875	100	5227.66	32.70	A3	BBB+
Southwest Gas Corp	8/23/1988	25	10	25	375.77	21.79	Baa3	BBB
Southeastern Michigan Gas Ent	1/17/1989	25	9.8	30	104.26	39.09	NR	NR
Deere & Co	6/8/1989	30	8.95	200	4430.27	22.54	A3	A-
Washington Gas Light Company	6/28/1989	30	8.75	50	528.83	15.65	Aa3	AA-
UGI Corp	7/20/1989	30	9	25	349.22	16.62	A2	A-

Issuer	*Issue Date*	*Years to Maturity*	*Coupon Rate(%)*	*Principal (Mill)*	*Market Capitalization (Mill)*	*Volatility (%)*	*Moody's Rating*	*S&P Rating*
John Deere Capital(Deere & Co)	7/31/1989	30	8.625	150	4420.94	21.70	Baa1	BBB+
Alabama Gas Corp(Energen Corp)	10/18/1989	25	9	30	186.09	24.94	A2	NR
National HealthCare LP	10/26/1989	15	10	15	93.11	25.07	NR	NR
Delta Natural Gas	4/24/1991	20	9	10	20.15	22.42	NR	NR
ONEOK Inc	10/17/1991	30	8.7	35	372.69	21.24	Baa1	A-
Energen Corp	1/24/1992	15	8	20	173.78	16.17	A3	A
Southeastern Michigan Gas Ent	4/1/1992	25	8.625	25	137.94	42.54	NR	NR
KN Energy Inc	9/11/1992	30	7.85	30	269.83	25.68	A3	A
Genesis Health Ventures Inc	10/8/1992	15	9.25	25	107.91	70.39	NR	NR
Litchfield Financial Corp	11/2/1992	10	10	13.1	21.77	53.83	NR	NR
Essex County Gas	12/7/1992	25	8.15	5	33.10	31.63	NR	NR
Beverly Enterprises Inc	4/22/1993	15	8.75	20	822.68	58.61	Ba3	B+
Litchfield Financial Corp	5/3/1993	10	8.875	17.5	37.82	54.79	NR	NR
Beverly Enterprises Inc	7/15/1993	15	8.625	30	977.03	33.13	Ba3	B+
Delta Natural Gas	10/7/1993	30	6.625	15	35.93	41.70	NR	NR
South Carolina Elec & Gas Co	4/5/1995	30	7.625	100	2035.28	9.58	A1	A
Commercial Federal,Omaha,NE	11/25/1996	10	7.95	50	666.34	24.77	B1	BB-
Solutia Inc	10/16/1997	40	6.72	150	2736.08	44.67	Baa2	BBB
Nabisco Inc	1/15/1998	37	6.375	300	2467.93	27.58	Baa2	BBB
Nabisco Inc	1/15/1998	35	6.125	300	2467.93	27.58	Baa2	BBB
Nabisco Inc	1/15/1998	13	6	400	2467.93	27.58	Baa2	BBB
Crestar Finl Corp,Richmond,VA	1/22/1998	20	6.5	150	5727.30	30.39	Baa1	BBB+
Wal-Mart Stores Inc	1/22/1998	12	5.65	500	89836.24	32.16	Aa2	AA
Highwoods/Forsyth LP	1/28/1998	15	6.835	125	1704.48	25.11	Baa2	BBB
Tyson Foods Inc	1/28/1998	12	6.08	100	2028.57	29.26	A3	A-
AmSouth Bank NA Inc	1/30/1998	20	6.45	300	4346.24	27.21	A1	A-
AlliedSignal Inc	2/5/1998	13	5.43	200	23128.51	35.89	A2	A
Beneficial Corp	2/10/1998	15	6.25	300	4371.72	24.52	A2	A
Williams Cos Inc	2/11/1998	14	6.125	240	9588.54	24.11	Baa2	BBB-
Washington RE Investment Trust	2/20/1998	20	6.898	60	587.04	18.78	Baa1	A-
Morgan Stanley Dean Witter	2/26/1998	13	6.09	350	41235.56	34.44	A1	A+

Issuer	*Issue Date*	*Years to Maturity*	*Coupon Rate(%)*	*Principal (Mill)*	*Market Capitalization (Mill)*	*Volatility (%)*	*Moody's Rating*	*S&P Rating*
DuPont	3/3/1998	15	6	200	71031.58	31.34	Aa3	AA-
TransCanada Pipelines Ltd	3/3/1998	31	6.43	200	4962.19	16.80	A2	A-
KN Energy Inc	3/4/1998	23	6.3	400	1636.02	23.59	Baa2	BBB-
Post Apartment Homes LP	3/11/1998	17	6.85	100	1201.14	14.76	Baa1	BBB+
Union Planters Corp,Memphis,TN	3/11/1998	20	6.5	300	5195.14	25.31	Baa1	BBB
Burlington Northern Santa Fe	3/13/1998	33	6.05	100	15649.40	21.62	Baa2	BBB
JDN Realty Corp	3/25/1998	20	6.918	75	625.33	14.98	Baa3	BBB-
First Industrial Realty Trust	3/26/1998	13	6.5	100	1307.00	18.83	Baa2	BBB
MCN Corp	3/26/1998	13	6.3	100	2925.89	15.94	Baa2	BBB+
MCN Corp	3/26/1998	14	6.35	100	2925.89	15.94	Baa2	BBB+
MCN Energy Group Inc	4/1/1998	10	6.375	100	2976.52	14.57	Baa2	BBB+
Occidental Petroleum Corp	4/1/1998	15	6.4	450	10099.19	25.69	Baa2	BBB
Equity Residential	4/6/1998	17	6.63	300	4801.92	13.38	A3	BBB+
Union Texas Petroleum(Allied)	4/9/1998	40	7	150	1767.28	31.47	Baa3	BBB-
First Union Corp,Charlotte,NC	4/16/1998	30	6.3	200	39280.53	23.62	A2	A-
MCI Communications Corp	4/17/1998	14	6.125	700	30412.05	19.15	Baa2	A
Stewart Enterprises Inc	4/21/1998	15	6.4	200	2553.67	25.70	Baa3	BBB
Key Bank USA NA,Cleveland,Ohio	4/23/1998	29	6.5	300	17849.24	24.74	A1	A-
PP&L Inc	4/28/1998	8	6.125	200	3722.95	16.62	A3	A-
Cytec Industries Inc	5/6/1998	27	6.846	120	2480.70	24.26	Baa2	BBB
Public Service Electric & Gas	5/7/1998	25	6.375	250	7727.10	19.21	A3	A-
Dayton Hudson Corp	5/28/1998	12	5.95	200	20107.24	24.30	Baa1	BBB+
Cincinnati Gas & Electric Co	6/4/1998	40	6.35	100	5294.95	16.82	Baa1	BBB+
Conseco Inc	6/4/1998	13	6.4	550	290.32	17.58	Baa3	BBB
Tyco International Group SA	6/4/1998	15	6.25	750	31487.24	31.85	Baa1	A-
BellSouth Corp	6/17/1998	14	6	500	66831.41	32.88	Aaa	AAA
McDonald's Corp	6/18/1998	14	6	300	46659.31	28.15	Aa2	AA
Michigan Consolidated Gas Co	6/18/1998	40	6.2	75	2502.47	28.50	A2	A
Michigan Consolidated Gas Co	6/18/1998	40	6.45	75	2502.47	28.50	A2	A
Kroger Co	6/23/1998	12	6	200	11602.45	27.99	Baa3	BBB-
AMB Property Corp	6/25/1998	17	6.9	100	2066.37	25.31	Baa1	BBB

Issuer	*Issue Date*	*Years to Maturity*	*Coupon Rate(%)*	*Principal (Mill)*	*Market Capitalization (Mill)*	*Volatility (%)*	*Moody's Rating*	*S&P Rating*
BB&T Corp.	6/25/1998	27	6.375	350	9362.46	21.05	A3	BBB+
Canadian National Railway Co	7/1/1998	38	6.45	250	17.54	32.17	Baa2	BBB
Household Finance Corp	7/9/1998	14	6.125	600	16622.89	27.19	A2	A
Newell Co	7/9/1998	30	6.35	250	7966.40	27.27	A3	A
Newell Co	7/13/1998	30	6.11	75	7976.36	26.49	A3	A
USA Waste Services Inc	7/14/1998	13	6.13	600	12108.58	31.03	Baa3	BBB+
American Greetings Corp	7/22/1998	30	6.1	300	3467.95	22.51	A2	A
Comdisco Inc	7/22/1998	8	6.13	275	2826.73	40.82	Baa1	BBB+
Cox Communications Inc	7/22/1998	35	6.15	250	12794.58	32.91	Baa2	A-
Bausch & Lomb Inc	7/24/1998	27	6.5	100	2805.63	25.46	Baa2	BBB
Bausch & Lomb Inc	7/24/1998	13	6.15	100	2805.63	25.46	Baa2	BBB
Bausch & Lomb Inc	7/24/1998	15	6.375	100	2805.63	25.46	Baa2	BBB
PSI Energy Inc	7/29/1998	28	6.5	50	8227.79	16.46	Baa1	BBB+
Tampa Electric Co	7/29/1998	40	5.94	50	3382.35	14.90	Aa3	AA
Dillard's Inc	7/30/1998	15	6.39	150	3779.39	28.26	Baa1	BBB
Dillard's Inc	7/30/1998	14	6.31	150	3779.39	28.26	Baa1	BBB
Dillard's Inc	7/30/1998	13	6.17	100	3779.39	28.26	Baa1	BBB
Dillard's Inc	7/30/1998	12	6.08	100	3779.39	28.26	Baa1	BBB
Western Resources Inc	8/4/1998	20	6.25	400	2515.06	14.40	Baa1	BBB
Federated Department Stores	8/19/1998	13	6.125	350	10609.15	26.53	Baa2	BBB-
TECO Energy Inc	9/11/1998	40	5.54	150	3563.40	16.98	A1	AA-
Texas Utilities Co	10/14/1998	13	5.94	375	12888.52	24.82	Baa3	BBB
NorAm Energy Corp	11/5/1998	15	6.375	500	9475.14	28.16	Ba2	BB+
Aetna Services Inc	11/13/1998	11	5.66	300	10972.04	41.46	A3	A
Litchfield Financial Corp	11/24/1998	5	9.25	20	132.54	102.47	NR	NR
Browning-Ferris Industries Inc	1/12/1999	3	6.08	250	4607.87	35.13	Baa1	A-
NRG Energy Inc	11/2/1999	14	8	240	2048.93	56.01	Baa3	BBB-
SEMCO Energy Inc	6/26/2000	8	8.95	105	223.04	62.38	Baa1	BBB
Tampa Electric Co	8/16/2000	12	7.375	150	3163.24	27.26	Aa3	AA
TECO Energy Inc	9/20/2000	15	7	200	3209.12	26.14	A1	AA-
CenturyTel Inc	10/12/2000	12	7.75	400	4190.12	39.01	Baa2	BBB+

Issuer	*Issue Date*	*Years to Maturity*	*Coupon Rate(%)*	*Principal (Mill)*	*Market Capitalization (Mill)*	*Volatility (%)*	*Moody's Rating*	*S&P Rating*
Energy East Corp	11/8/2000	33	7.75	300	2521.83	31.50	Baa1	BBB+
Motorola Inc	1/26/2001	10	6.45	825	49284.76	80.11	A1	A
American Electric Power Co Inc	5/4/2001	12	5.5	250	15616.43	22.67	Baa1	BBB+
AES Corp	5/31/2001	12	7.375	200	21844.47	51.92	Ba1	BB
Dominion Resources Inc	7/21/2003	30	5.25	510	19302.78	20.14	Baa1	BBB+
Household Finance Corp	11/6/2003	10	6.7	110	8227.79	18.48	A1	A
PPL Energy Supply	10/20/2005	30	5.7	300	11079.62	21.89	Baa2	BBB
Mean		19	9	149	6063	28		
Standard Deviation		8.7444	2.864	166.09	12991.448	15.0223		
Median		15	8	100	1812	25		

The sample includes all callable - puttable bonds as obtained from SDC Platinum Database, issued between 1977-2005 with fixed coupon rates and with specific call and put dates. Volatility is estimated as the annualized sample variance of ln(Vt/Vt-1) over 60 days prior to the issue date. Vt is defined as the value of common stock at time period t.

Sample Characteristics

The final sample of 159 issues has an average maturity of 19 years with the standard deviation of 8.7 years. Frequency distribution of the coupon rate of the entire sample is shown in (Table 8). The range of coupon values in our sample is 5.25% to 16.5% with a mean value of 8.53%, a standard deviation of 2.9% and a median value of 7.63%.

Table 8. Distribution of Coupon Rate on Callable-Puttable Bonds Issued Between 1977 and 2005.

Coupon Range	*Number of Observations*
5%-6%	7
6.1%-7%	66
7.1%-8%	11
8.1%-9%	18
9.1%-10%	16
10.1%-11%	8
11.1%-12%	7
12.1%-13%	12
13.1%-14%	3
14.1%-15%	2
15.1%-16%	3
16.1%-17%	6
Total	159

Source: SDC Platinum Database

The call profile of these issues falls into two categories. First is the stepwise configuration where the call price on the day of expiration of the call protection is above the par value (i.e. 105*** in the case of Leisure Dynamics Inc., which is the second observation in the sample organized by the issue date), and it goes down linearly in a step-wise fashion annually until it reaches the par value (i.e. in case of Leisure Dynamics Inc. which becomes callable approximately 5 years after the issue date and it goes down from 105 to 100 over 5 years going down by 1 every year). The second category is for the bonds that are callable at par once the call protection expires (i.e. Solutia Inc., which becomes callable at 100, 10 years after the issue date). Once the call protection expires, these bonds remain callable anytime at the price listed until maturity unlike the put protection, which allows the investors to exercise the put only on a specific date.

These securities are designed in such a way that on average the first put date occurs before the first call date. The average first put date of the sample is 4.2 years with a standard deviation of 3.0 years while the average first call date of the sample is 5.4 years with a standard deviation of 2.9 years.

Over the entire sample there are only seven instances where the security is issued on an exchange (NYSE, AMEX, LUXBG), in the rest of the cases (152) it is an over-the-counter transaction (OTC).

*** 105 denotes 105% of the par value. If the par value is $1000, then the call price at 105% should be 1050.

The frequency distribution of issuing firms' market capitalization is shown in table 9. The firms issuing callable-puttable bonds are evenly distributed as small cap, mid cap, and large cap firms.

Table 9. Distribution of Market Capitalization of Firms Issuing Bonds in the Sample.

Market Capitalization (Mil)	*Number of Observations*
Up to 100	41
101-500	21
501-1000	7
1001-5000	52
5001-above	38
Total	159

Source: SDC Platinum Database

Empirical Analysis

The following parameter values are used in the algorithm to estimate the callable-puttable bonds' model value $G(V, \tau)$. These are in accordance with the valuation model in Ramanlal et al. (1998).

$V(\tau) =$ the aggregate market value of the issuing firm immediately before the issuance date. The market value is calculated by adding the market value of outstanding common stock, the book value of outstanding non convertible bonds, the book value of outstanding convertible bonds, and the book value of outstanding preferred stock. The common stock price and the number of shares outstanding are obtained from the CRSP database on WRDS. The book value of non convertible bonds and the book value of preferred stock is obtained from the SDC platinum database at the University of Central Florida. The book value of convertible bonds is obtained from the Moody's Industrial Manual.

$D =$ the dividend per share information is obtained from CRSP on WRDS.

$I =$ the coupon payment on the bonds to be valued. All the bonds pay semi-annual payments.

$C =$ the annualized value of $D + I$.

$c =$ the annualized value of I.

$\kappa(\tau) =$ the call profile defined as the actual call price plus accrued interest payments.

$p(\tau)=$ the put profile defined as actual put price plus the accrued interest rate.

$\sigma^2 =$ the variance of the instantaneous return dV/V and is estimated as the annualized sample variance of $ln(V_t/V_{t-1})$ over 60 days prior to the issue date.

$r =$ the estimated riskless rate of 30 year zero-coupon Treasury bonds. The yield curve is obtained from the U.S. Treasury website.

Empirical Results

The value of $ERROR_{i,t}$ (relative pricing parameter), and four risk parameters, *Delta, Gamma, Vega, and Rho,* is calculated on the issue date for each of the following four conditions:

When the bond is both callable and puttable: denoted by (C,P)

When the bond is only callable (put feature is removed): denoted by (C,0)

When the bond is only puttable (call feature is removed): denoted by (0,P)

When the bond is neither callable nor puttable (both put and call features are removed): denoted by (0,0)

The results for the four parameters described above under the four conditions are presented in table 10.

Table 10. Mean and Standard Deviation of Parameters for Callable - Puttable Bonds.

Condition	Estimate	$ERROR_{i,t}$	Delta	Gamma	Vega	Rho
(C,P)	Mean:	-0.04976	0.010445	-6E-05	-0.0247	4.645235
	Stdev.	0.037665	0.024548	0.000258	0.075819	1.96799
(C,0)	Mean:	-0.00839	0.06258	-0.00023	-0.13152	5.676433
	Stdev.	0.131453	0.083894	0.001463	0.215729	2.593607
(0,P)	Mean:	-0.06934	0.021306	-8.1E-05	-0.04737	8.053633
	Stdev.	0.044889	0.034085	0.000349	0.085739	2.927883
(0,0)	Mean:	-0.03117	0.070851	-0.00025	-0.15038	8.781216
	Stdev.	0.136395	0.09161	0.001532	0.225547	2.600696

$$ERROR_{i,t} = \frac{(\text{Market Price}_{i,t} - \text{Model Price}_{i,t})}{\text{Model Price}_{i,t}}$$

Delta = df/dV, *Gamma* = d^2f/dV^2, *Vega* = $df/d\sigma$, *Rho* = df/dr

Stdev. Denotes standard deviation

1. When the bond is both callable - puttable: denoted by (C,P).
2. When the bond is only callable (put feature is removed): denoted by (C,0).
3. When the bond is puttable (call feature is removed): denoted by (0,P).
4. When the bond is neither callable - puttable (both put and call features are removed) denoted by (0,0).

Relative Pricing

The *ERRORi,t* term under (C, P) has the value of -0.04976 under (C,P) while, it has the value of -0.00839 under (C,0). This shows that the offer price is closer to the model price when the security is only callable versus when it is callable-puttable. Similarly, if we compare *ERRORi,t* under (C,0) with that under (0,P), we see that the gap between the offer price and the model price increases from -0.00839 to -0.06934. Here, we make a very important observation that the deferred put option in the security increases the gap between the offer price and the model price, when compared to the call option in the security.

Parameter Value: *Delta*

This parameter provides an estimate of the percentage change in the value of the security for a percentage change in the value of the firm and, consequently, shows how stable the security is to the change in the value of the firm. In the case under (C,P), case *delta* is 0.01% for 1% change in the firm value. If we look at (0,0) with *delta* value of 0.070851 and compare that to (C,0) with *delta* of 0.06258 and (0,P) with a *delta* of 0.021306, we see that, when the security is only callable, then the risk of the security with respect to the change in the value of firm (measured by delta) goes down by 11.6%. However, if the security is only puttable, then the delta goes down by 69.9%. This result gives us a clear indication that the deferred put option greatly reduces the security's exposure to the change in the market value of the firm.

Parameter Value: *Gamma*

Gamma is a measure of convexity and it cannot be interpreted in absolute terms because it gives us the rate of change in the slope of the slope around a particular point. It has to be interpreted in relative terms. So we will compare the convexity among all the four cases (C,P), (C,0), (0,P), and

(0,0). We find that convexity (measured by Gamma) of the security goes up considerably from -0.00023 when the security is only callable to -0.00006 when it is both callable-puttable and goes up to -0.000081 when the security is only puttable. This gives us an important result that the deferred put option makes the security less susceptible to the change in the market value of the firm. But there is even more important function of *Gamma*. It enables us to calculate the magnitude of downside protection.

Parameter Value: V*ega*

V*ega* is the change in the value of the security with respect to the change in the volatility of the firm. We observe that, if the volatility of the firm goes up by 1%, then the value of the security will go down by 0.0247% (C,P). We find that *Veg*a, which measures % change in the value of security with respect to 1% change in the volatility of the firm, provides a very interesting result. When the put option is removed, the *Vega* goes up from -0.0247 (C,P) to -0.13152 (C,0). Similarly, when the call option is removed, the *Vega* goes down from -0.0247 (C,P) to -0.04737 (0,P). This result clearly shows that the deferred put option in the security makes its value less susceptible to change in the risk of the firm measured by the volatility.

Parameter Value: *Rho*

Rho measures the duration of the security. Since *Duration* is directly proportional to *df/dr*: a longer duration security is more susceptible to the interest rate risk and vice-versa. In this case we find that when we remove the put option, the *Rho* goes up from 4.645235 (C,P) to 5.676433 (C,0). When we remove the call option, the *Rho* goes up dramatically from 4.645235 (C,P) to 8.053633 (0,P). This result clearly shows that the call option is incorporated in the security primarily to control interest rate risk. Also, it is interesting to see that the average maturity across all securities is 19.02 years, which is greatly reduced to the duration of 4.645 years **(**table 5**,** *Rho* (C,P)) due to the presence of call and put options.

Table 11. Sample Statistics for Final Maturity, Years to first Call, and Years to first Put for the Entire Sample.

Estimate	*Maturity*	*Years to first call (rounded to 1 decimal)*	*Years to first put (rounded to 1 decimal)*
mean	19	5.4	4.2
Stdev.	9	2.9	3.0

Mean is the average value across all 159 issues of callable - puttable bonds.
Stdev. denotes standard deviation across all 159 issues of callable - puttable bonds.

We check the accuracy of these results by calculating the duration of a hypothetical straight bond with 19 years to maturity (*average maturity of issues in our sample is 19 years, the range of coupon values in our sample is 5.25% to 16.5% with a mean of 8.53%, standard deviation of 2.9% and a median of 7.63%*). For the bonds with a 5.25% coupon rate, we get a duration value of 12.5 years, and for the bonds with a 16.5% coupon rate we get a duration value of 6.7 years. This is consistent with our result of calculation of mean duration (*Rho*) of 8.8 years with a standard deviation of 2.6 years for the case without the call or the put option (table 10, *Rho* (0,0)).

Summary of Results

The above observations clearly indicate that the deferred put option is incorporated in these securities to account for and mitigate the asset substitution issue so widely researched in the agency theory context.

Also, the put deferred feature mitigates the information asymmetry problem. The management of these firms knows the magnitude of the downside of these firms but the investors do not. The deferred put option provides the investors with the information about the magnitude of downside protection (see *Gamma* above).

The result with respect to the presence of the call option (as indicated by *Rho*) clearly indicates that the call option is incorporated in these securities to counter the interest rate risk faced by the firm. It provides management with an opportunity to refinance the higher cost bonds if interest savings outweigh refunding cost.

CHAPTER SIX: EVENT STUDY

Introduction

There have been several studies that have documented the long-run abnormal returns in response to different events and the actions taken by the firms. Affleck-Graves and Miller (2003) examine the long-run performance of the common stock of firms following calls of both the straight and convertible debt and find the evidence of overperformance over the period of 5 years following the call. Ritter (1991) and Loughran (1993) measure the long-run performance of the firms going public through an IPO in comparison to non-IPO firms and find that the IPO firms significantly underperform for a period up to five years. Loughran and Ritter (1995) find that the firms offering seasoned equity also underperform. Spiess and Affleck-Graves (1999) find substantial post issue underperformance by the firms making straight and convertible debt offerings. Ikenberry et al. (1995) find significant positive abnormal returns in the four-year period following stock repurchase.

Subsequent to our risk analysis using the security valuation model, which confirms that the put option is incorporated in these securities to provide downside protection to the investors, we are interested in the long-term performance of the firms issuing callable-puttable bonds over the periods listed below.

We examine stock performance for the periods:

1 From issue date to two years before the issue date.
2 From issue date to two years after the issue date.
3 The period between the issue date and the put date: This period was chosen because the average time period for the sample between issue date and the put date is 4.2 years and there are a few observations with fewer than 4 years.
4 Two years before the put date.
5 Two years after the put date.

We find that the stocks of the firms significantly underperform in the period two years after the issue date as compared to the performance in the period two years before the issue date. This result is similar to the results obtained by Spiess and Affleck-Graves (1999) in their study, where they find substantial post–issue underperformance by the firms making straight and convertible debt offerings from 1975 to 1989. In addition to this result, we find that the firms significantly perform better in the period between the issue date and put date as compared to the performance two years after the put date. This result suggests that firms improve their performance in the period closer to the put date. Finally, the stocks of the issuing firms perform better in the two-year period before the put date as compared to the performance in the period two year after the put date.

Sample Construction

The sample in this study consists of 159 callable-puttable bonds issued between 1977 and 2005. The details of the bond sample are discussed in the previous section. The sample for the event study was separated into two categories. The first category consists of 134 firms with a single put date. The second category consists of the firms with more than one or an annual put date. We present here the results from the first category (firms with a single put date).

The monthly stock price data for these two categories was obtained from the CRSP database on WRDS. The criteria used for the firms selected in the sample are as follows: (1) the company is listed on the CRSP database on WRDS at the time of the issue; (2) only the issues with single put dates are included.

For the firms with multiple issue of the callable-puttable bond, if the issue date or the put date of more than one issue falls during the event period, the return on this firm would be included more than once in some of the monthly average returns. This violates the independence assumption implicit in most of our statistical tests. Hence, for those instances only one issue from that firm is considered in the regression analysis.

The distribution of full sample and the independent sample by the issue date and the put date are shown in tables 12 and tables 13 respectively.

Table 12. The Sample Distribution of the Callable-Puttable Bonds (Single Put Date) by Issue Date.

Issue Year	*Full Sample*	*Independent Offerings*
1977	2	2
1978	4	4
1979	6	6
1980	2	1
1981	4	4
1982	8	6
1983	3	3
1984	6	5
1986	4	4
1987	2	2
1988	3	3
1989	4	3
1992	2	2
1995	1	1
1996	1	1
1997	1	1
1998	69	59
1999	2	2
2000	5	5
2001	3	3
2002	0	0
2003	1	1
2004	0	0
2005	1	1
Total	134	119

The sample includes all callable-puttable offerings obtained from SDC platinum database over the period 1977 - 2005: (1) the firm is listed on the CRSP database on WRDS at the time of the issue; (2) only the issues with single put date are included. Independent offerings are those for which the firm has not made any other callable - puttable debt issue(s) during the two years prior and following the issue date.

Table 13. Sample Distribution of the Callable-Puttable Bonds (Single Put Date) by the Put Date.

Issue Year	*Full Sample*	*Independent Offerings*
1978	1	1
1979	1	1
1980	3	3
1981	5	5
1982	2	1
1983	5	4
1984	7	4
1985	5	4
1986	1	1
1987	0	0
1988	3	3
1989	2	2
1990	1	1
1991	1	1
1992	1	1
1993	3	3
1994	3	3
1995	1	1
1996	0	0
1997	1	1
1998	2	2
1999	3	2
2000	6	6
2001	19	18
2002	10	6
2003	21	21
2004	3	3
2005	9	9
Total	119	107

The sample includes all callable-puttable offerings obtained from SDC platinum database over the period 1977 - 2005: (1) the firm is listed on the CRSP database on WRDS at the time of the issue; (2) only the issues with single put date are included. Independent offerings are those for which the firm has not made any other callable - puttable debt issue(s) during the two years prior and after following the put date. All the issues with put dates past 2005 were obviously excluded

Research Method

We use the Fama and French (1993) three-factor regression method to examine the long-run performance. Fama and French (1993) suggest three-factor model for the stock returns. This model is designed similar to the model used by Affleck-Graves and Miller (2003) in their study to measure the long-run performance after the straight and convertible bonds are called. Affleck-Graves and Miller (2003) add the fourth factor known as momentum factor (Brav, Geczy, and Gompers 2000) in their model because convertible calls are typically made after a period of large positive returns in the underlying stock prices, and usually the call is made to force conversion to common stock. We also add the momentum factor in our analysis.

We use the following four-factor model:

$$(R_{pt}-R_{ft})=\alpha+\beta(R_{mt}-R_{ft})+s\ SMB_t+h\ HML_t+u.UMD_{t}+\varepsilon_t, \tag{13}$$

Where,

R_{pt} is the return on the portfolio of sample firms in month t;

R_{mt} is the return on the value-weighted index of NYSE, Amex, and NASDAQ stocks in month t;

R_{ft} is the 1-month T-bill yield in month t;

SMB_t is the return on small firms minus the return on large firms in month t;

HML_t is the return on high book-to-market stocks minus the return on low book-to-market stocks in month t;

UMD_t is the momentum factor;

SMB, HML, UMD, R_{mt}–R_{ft}, and R_f are obtained from the web site of Ken French (MBA.Tuck.Dartmouth.edu/pages/faculty/ken.French/Data_Library.html). This site provides additional details on the construction of these factors.

The intercept term α in regression provides a measure of the abnormal return per month and is the parameter of primary interest in event-type studies.

R_{pt} is computed using the calendar time average method described in Mitchell and Stafford (2000). If the stock is delisted before the end of the event period, the returns are used for whatever period they are available on the CRSP. For each month in the study, R_{pt} is the average of the monthly return on all stocks over the event period. Thus, R_{pt} represents the return on a portfolio strategy of buying stock in every company that falls in the event period. Investment is made at the end of the month in the particular event period and continues for the entire event period.

According to Loughran and Ritter (2000), two important decisions must be made in using the Fama and French model for the study of long-term performance. The first decision relates to the choice of equally or monthly weighting the calendar periods. Equally weighting the periods implies the same investment each period and should provide an indication of returns available to a portfolio approach applied over time. Monthly weighting implies performing weighted least squares (WLS) where each month's average returns are weighted according to the number of firms represented in that month. We report the results for both equally weighted and monthly weighted calender periods.

The second decision relates to the choice of equal or value weighting the portfolio of stocks under study. Fama (1998) argues that anomalies that disappear with value weighting of the returns are evidence of a mis-specified model of expected returns. Loughran and Ritter (2000) provide the counter argument that the tests based on value-weighted returns simply have low power to detect economically significant abnormal performance when that performance is expected to be more severe among the smaller firms. The choice of equal versus value-weighting the portfolio returns in event studies is ultimately an issue of "perspective rather than one of methodological correctness." If the relevant perspective is to measure the aggregate wealth effects experienced by investors, as argued by Fama, then value-weighting is appropriate. If, on the other hand, the relevant perspective is to measure the abnormal returns of a typical firm undergoing a particular event, as argued by Loughran and Ritter, then equally weighting is appropriate.

Equal weighting implies calculating average return across the firms in a specific month in an event period. Value weighting implies calculating the weighted average of the returns across the months in an event period weighted by the firm value. Firm value is measured as the sample firms' market capitalization immediately prior to the debt offering. We report results for both equal and value-weighted portfolio of stocks.

Regressions (1) in each panel use equally weighted (EW) returns, regressions (2) use value-weighted (VW) returns, regressions (3) in each panel use monthly weighed (EW) returns and are estimated using weighted least squares (WLS), and regressions (4) use monthly weighed (VW) returns and are estimated using weighted least squares (WLS).

Parameter estimates are presented with *t*-statistics in parentheses. All *t*-statistics are calculated using White's method (White, 1980). The results are depicted in the table 14.

Table 14. Results from Fama-French 4-Factor Model.

Event Period	*α*	*β*	*s*	*h*	*u*	*AdjR²*
Panel A: 2 - Years Before the Issue Date						
(1) EW portfolio/OLS	-0.60	0.68	0.13	0.22	0.003	0.34
	(-2.61)	(11.51)	(1.58)	(2.88)	(0.08)	
(2) VW portfolio/OLS	-0.33	0.56	0.18	0.01	0.20	0.33
	(-0.68)	(8.62)	(1.72)	(0.02)	(0.44)	
(3) EW Monthly Weighed portfolio/WLS	-0.68	0.79	0.14	0.46	0.23	0.46
	(-2.81)	(12.17)	(2.28)	(3.98)	(0.84)	
(4) VW Monthly Weighed portfolio/WLS	-0.46	0.87	0.09	0.11	-0.52	0.34
	(-0.92)	(9.89)	(2.31)	(0.03)	(-0.62)	
Panel B: 2 - Years After the Issue Date						
(1) EW portfolio/OLS	-1.38	0.97	0.20	0.72	-0.09	0.36
	(-4.57)	(12.01)	(2.01)	(6.22)	(-0.13)	
(2) VW portfolio/OLS	-1.21	0.98	-0.02	0.59	0.61	0.40
	(-3.32)	(10.68)	(-0.17)	(2.99)	(0.88)	
(3) EW Monthly Weighed portfolio/WLS	-1.42	1.34	0.11	1.01	0.43	0.38
	(-5.22)	(8.08)	(0.72)	(5.75)	(2.56)	
(4) VW Monthly Weighed portfolio/WLS	-1.18	0.91	-0.38	0.22	0.02	0.37
	(-3.77)	(9.62)	(-3.71)	(2.39)	(0.68)	
Panel C: 2 - Years Before the Put Date						
(1) EW portfolio/OLS	-0.81	0.81	-0.22	0.33	-0.13	0.37
	(-3.57)	(14.01)	(-1.87)	(3.75)	(-1.12)	
(2) VW portfolio/OLS	-0.53	0.98	-0.38	-0.04	0.00	0.40
	(-1.88)	(11.89)	(-3.97)	(-0.31)	(0.18)	
(3) EW Monthly Weighed portfolio/WLS	-1.11	0.81	-0.08	0.56	-0.21	0.50
	(-4.62)	(15.88)	(-1.33)	(6.59)	(-1.01)	
(4) VW Monthly Weighed portfolio/WLS	-0.53	1.02	-0.43	0.04	0.07	0.46
	(-1.89)	(14.81)	(-6.08)	(0.37)	(0.55)	
Panel D: 2 - Years After the Put Date						
(1) EW portfolio/OLS	-1.09	0.66	0.03	0.45	-0.61	0.25
	(-3.22)	(9.65)	(0.81)	(3.44)	(-2.11)	
(2) VW portfolio/OLS	-1.16	1.02	-0.22	0.38	0.47	0.25
	(-3.11)	(10.32)	(-0.98)	(2.59)	(2.35)	
(3) EW Monthly Weighed portfolio/WLS	-1.28	1.06	0.18	0.66	-0.21	0.46
	(-4.10)	(11.88)	(1.39)	(5.56)	(-2.28)	
(4) VW Monthly Weighed portfolio/WLS	-1.14	1.16	-0.14	0.62	0.36	0.44
	(-3.25)	(13.88)	(-1.30)	(3.87)	(1.99)	

Event Period	*α*	*β*	*s*	*h*	*u*	*AdjR²*
Panel E: After issue date but before put date						
(1) EW portfolio/OLS	-1.11	0.91	0.22	0.58	-0.06	0.39
	(-4.92)	(14.21)	(2.12)	(6.78)	(-0.68)	
(2) VW portfolio/OLS	-0.86	1.11	-0.13	0.57	0.48	0.42
	(-3.44)	(14.88)	(-1.39)	(5.33)	(2.26)	
(3) EW Monthly Weighed portfolio/WLS	-1.26	0.87	0.12	0.80	-0.21	0.51
	(-5.24)	(14.11)	(2.11)	(10.36)	(-1.22)	
(4) VW Monthly Weighed portfolio/WLS	-1.11	0.87	-0.11	0.66	0.51	0.53
	(-3.65	(14.42)	(-1.86)	(6.61)	(1.83)	

Results for the event dates mentioned in the respective panels (A, B, C, D, and E) following Fama French 4-factor model:
$(R_{pt}-R_{ft})=\alpha+\beta(R_{mt}-R_{ft})+s\ SMB_t+h\ HML_t+u.UMDt+\varepsilon_t$,
Regression (1) in each panel use equally weighted (EW) returns, regression (2) use value-weighted (VW) returns, regressions (3) in each panel use monthly weighed (EW) returns and are estimated using weighted least squares (WLS), and regressions (4) use monthly weighed (VW) returns and are estimated using weighted least squares (WLS).
Parameter estimates are presented with *t*-statistics in parentheses. All *t*-statistics are calculated using White's method (White, 1980).

Results of Empirical Analysis

Table 14 summarizes the results from the Fama and French four-factor regression model with the momentum factor for the sample of callable-puttable bonds. Results are provided for both value-weighted and equally weighted portfolios over the event periods listed in panels above. According to Fama (1998), the value weighting method captures aggregate wealth effects. According to Loughran and Ritter (2000), if the relevant perspective is to measure the abnormal returns of a typical firm undergoing a particular event, then equal weighting is appropriate. We concentrate most of the following discussion on the equally weighted results (EW/OLS) and make note of any difference we encounter between equally weighed and value-weighed results.

The intercept estimate in Panel A (2 years before the issue date) shows an abnormal return of -0.60% per month, which is significantly lower than zero at the 1% level (*t*-value = -2.61). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance but are not statistically significant. The intercept estimate for the Panel B (2 years after the issue date) shows abnormal returns of -1.38% per month, which is also statistically significant (t-value = -4.57). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance and are statistically significant at 1% level.

The intercept estimate in Panel C (2 years before the put date) shows an abnormal return of -0.81% per month, which is significantly lower than zero at the 1% level (*t*-value = -3.57). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance but are statistically significant at 5% level. The intercept estimate for the Panel D (2 years after the put date) shows abnormal returns of -1.09% per month, which is also statistically significant (t-value = -3.22). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance and are statistically significant at 1% level.

The intercept estimate in Panel E (after the issue date but before the put date) shows an abnormal return of -1.11% per month, which is significantly lower than zero at the 1% level (*t*-value = -4.92). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance and are statistically significant at 1% level. The intercept estimate for the Panel C (2 years before the put date) shows abnormal returns of -0.81% per month, which is also statistically significant (t-value = -3.57). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance but are statistically significant at 5% level.

The intercept estimate in Panel B (2 years after the issue date) shows an abnormal return of -1.38% per month, which is significantly lower than zero at the 1% level (*t*-value = -4.57). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance and are statistically significant at 1% level. The intercept estimate in Panel E (after the issue date but before the put date) shows an abnormal return of -1.11% per month, which is significantly lower than zero at the 1% level (*t*-value = -4.92). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance and are statistically significant at 1% level.
The weighted least squares (WLS) regression provides similar but a little stronger result and has higher R^2s.

Empirical Analysis with Dummy Variable

In order to test the significance of results when comparing the intercept coefficient (α), between the periods, we perform another regression analysis of the Fama-French 4-factor model by including a dummy variable. The dummy variable was included in the model to test the significance of α when comparing the results between periods:

1 Two years before the issue date and two years after the issue date.

2 Two years before the put date and two years after the put date.

3 The period between the issue date and the put date and two years after the put date.

Fama-French 4-factor model with a dummy variable is depicted by Equation (14).

$$(R_{pt}-R_{ft})=\alpha+\beta(R_{mt}-R_{ft})+s\ SMB_t+h\ HML_t+u\ UMD_t+d\ DUMMY+\varepsilon_t, \quad (14)$$

Where,

R_{pt} is the return on the portfolio of sample firms in month t;

R_{mt} is the return on the value-weighted index of NYSE, Amex, and NASDAQ stocks in month t;

R_{ft} is the 1-month T-bill yield in month t;

SMB_t is the return on small firms minus the return on large firms in month t;

HML_t is the return on high book-to-market stocks minus the return on low book-to-market stocks in month t;

UMD_t is the momentum factor;

$DUMMY$ = 1, for the data samples for the period two years after the issue date and two years after the put date;

$DUMMY$ = 0, for the data samples for the period two years before the issue date, two years before the put date, and the period between the issue date and the put date;

SMB, HML, UMD, $R_{mt}-R_{ft}$, and R_f are obtained from the Web site of Ken French (MBA.Tuck.Dartmouth.edu/pages/faculty/ken.French/Data_Library.html). This site provides additional details on the construction of these factors. The results from this analysis are depicted in table 15.

Panel F shows the results for the regression where the dummy variable is equal to 1 for the period two years after the issue date, and 0 for the period two years before the issue date. The objective is to compare the firm performance between the periods two years after the issue date and two years before the issue date.

Panel G shows the results for the regression where the dummy variable is equal to 1 for the period two years after the put date and 0 for the period two years before the put date. The objective is to compare the firm performance between the periods two years after the put date and two years before the put date.

Panel H shows the results for the regression where the dummy variable is equal to 1 for the period two years after the put date and 0 for the period between the issue date and the put date. The objective is to compare the firm performance between the periods two years after the put date and the period between the issue date and the put date.

The objective here is to observe the intercept term α, which provides the magnitude and significance of the difference between the monthly abnormal returns between the periods.

Table 15. Results from Fama-French 4-Factor Model with the Dummy Variable.

Event Period	α	β	s	h	u	d	AdjR²
Panel F: Two Years After the Issue Date Versus Two Years Before the Issue Date							
(1) EW portfolio/OLS	-0.73	0.83	0.14	0.48	-0.16	-0.36	0.31
	(-3.04)	(11.42)	(2.34)	(6.56)	(-0.28)	(-1.01)	
(2) VW portfolio/OLS	-0.42	0.96	0.07	0.28	0.42	-0.57	0.28
	(-1.21)	(10.11)	(0.82)	(2.86)	(1.04)	(-1.19)	
(3) EW Monthly Weighed portfolio/WLS	-0.71	1.01	0.12	0.86	0.28	-0.46	0.34
	(-3.69)	(11.33	(1.86)	(2.32)	(0.91)	(-1.81)	
(4) VW Monthly Weighed portfolio/WLS	-0.52	0.89	0.02	0.16	-0.39	-0.56	0.30
	(-1.33)	(9.68)	(2.68)	(1.75)	(-0.38)	(-0.96)	
Panel G: Two Years After the Put Date Versus Two Years Before the Put Date							
(1) EW portfolio/OLS	-0.63	0.83	0.04	0.41	-0.48	-0.37	0.26
	(-3.01)	(12.88)	(0.59)	(3.51)	(-1.96)	(-0.87)	
(2) VW portfolio/OLS	-0.73	1.08	-0.19	0.22	0.38	-0.59	0.29
	(-2.10)	(10.88)	(-2.32)	(2.19)	(2.17)	(-1.13)	
(3) EW Monthly Weighed portfolio/WLS	-0.73	0.84	0.09	0.59	-0.16	-0.68	0.35
	(-4.23)	(12.01)	(0.96)	(5.58)	(-1.88)	(-1.38)	
(4) VW Monthly Weighed portfolio/WLS	-0.68	1.11	-0.35	0.31	0.15	-0.38	0.30
	(-2.66)	(14.04)	(-3.65)	(1.93)	(1.81)	(-0.97)	
Panel H: Two Years After the Put Date Versus the Period Between the Issue Date and the Put Date							
(1) EW portfolio/OLS	-0.36	0.69	-0.01	0.39	-0.08	-0.47	0.32
	(-2.79)	(12.02)	(-1.66)	(3.49)	(-1.27)	(-0.66)	
(2) VW portfolio/OLS	-0.62	0.76	0.16	0.12	0.26	-0.67	0.31
	(-2.47)	(10.33)	(1.03)	(0.41)	(0.86)	(-1.26)	
(3) EW Monthly Weighed portfolio/WLS	-0.44	0.66	0.02	0.41	-0.09	-0.38	0.38
	(-4.21)	(13.58)	(0.69)	(5.91)	(-1.36)	(-1.11)	
(4) VW Monthly Weighed portfolio/WLS	-0.68	0.89	-0.29	0.46	0.09	-0.57	0.33
	(-2.11)	(14.21)	(-2.49)	(2.11)	(0.86)	(-1.21)	

Results for the event dates mentioned in the respective panels (F, G, and H) following Fama French 4-factor model: $(R_{pt}-R_{ft})=\alpha+\beta(R_{mt}-R_{ft})+s\ SMB_t+h\ HML_t+u.UMDt$ +d DUMMY+ε_t,
Regression (1) in each panel use equally weighted (EW) returns, regression (2) use value-weighted (VW) returns, regressions (3) in each panel use monthly weighed (EW) returns and are estimated using weighted least squares (WLS), and regressions (4) use monthly weighed (VW) returns and are estimated using weighted least squares (WLS).
Parameter estimates are presented with *t*-statistics in parentheses. All *t*-statistics are calculated using White's method (White, 1980).

Results of Analysis with Dummy Variable

Once again, we concentrate most of the following discussion on the equally weighted results (EW/OLS) and make a note of any difference we encounter between the equally weighed and the value-weighed results.

The intercept estimate in Panel F shows an abnormal return of -0.73% per month, in the period two years after the issue date relative to the period two years before the issue date. This result is significantly lower than zero (*t*-value = -3.04). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance but are not statistically significant.The firms issuing callable-puttable bonds tend to underperform more in the period 2 years after the issue date.

The intercept estimate for the Panel G shows abnormal returns of -0.63% per month, which is also statistically significant (t-value = -3.01). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance and are statistically significant. This clearly shows that the firms that issue callable-puttable bonds tend to underperform more in the period 2 years after the put date as compared to the period 2 years before the put date.

The intercept estimate for Panel H shows abnormal returns of -0.36% per month, which is also statistically significant (t-value = -2.79). This is consistent with EW/WLS results. VW/OLS and VW/WLS also show underperformance and are statistically significant. This also confirms our previous finding that the firms that issue callable-puttable bonds tend to underperform more in the period 2 years after the put date as compared to the period between the issue date and the put date.

CHAPTER SEVEN: CONCLUSION

A high proportion of the reasons given by the firms for issuing these securities signifies either their difficulty in paying down debt from their internal operations and a need to raise external capital to payoff old debt or a situation where they need to refinance the existing debt to lower the cost of old debt. This, coupled with a high average long-term debt-to-equity ratio and a relatively higher issue size, would warrant investors to look for the downside protection as well as the protection from any unfavorable future course of action from the management. We find that the inclusion of the deferred put option in these securities provides downside protection to the investors, which addresses the asset substitution issue.

The empirical results obtained in the event study confirm our results from the previous analysis. These securities signal potential future firm underperformance to the market. Also, once the put protection expires, it eliminates the fear of the impending put, and the firms tend to underperform in the period two years after the put date in comparison to performance in the period prior to the put date.

We observed that a very high proportion of these securities were issued in 1998. After an exhaustive research of possible reasons, we focus on the economic outlook and forecast in 1998. The economic forecast projected a bleak projection for 1998 where a global slowdown was projected to impact the U.S. economy in a negative fashion, even leading to a recession. This forecast coupled with the high risk associated with a majority of the issuing firms, might be a possible explanation for such a large proportion of these bonds being issued in 1998.

Also, we find that the firms incorporate the call option in these securities to limit their exposure to the interest rate risk. This result is in agreement with the result reported by Pye (1966) and Van Horne (1984), who find that the call provision on the bonds provides management with the flexibility to counter market interest rate uncertainties. The call option provides management with an opportunity to replace higher-cost bonds with lower-cost ones in case of a decline in the interest rates if the interest savings outweigh the refunding cost. Similarly, Guntay et al. (2004), also find a positive relationship between the level of interest rates and the call feature usage on the bonds, suggesting that the callable bonds are more likely to be issued when the interest rates are high. Narayanan (1987) theoretically demonstrates in his paper that it is not always possible to design a call option embedded in the bonds to resolve the problem of risk shifting and informational asymmetry.

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