DISTRESS & LOW-GRADE SECURITIES:

ISSUES IN DISTRESS & ILLIQUIDITY

by

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submitted

for the Ph.D.

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Dedicated to my parents

John Patrick Kihn (in memory of) and Roberta Mitchell Kihn (in memory of)

ACKNOWLEDGEMENTS

The act of writing can be a very personal affair, as well as an act of faith in one's own ideas. It is inherently arrogant to believe what one has to write is worthy of reading. In regards to being accepted as a person capable of dispassionate academic work, this section of the dissertation is least important. Personally, the following acknowledgements are the most personal and important part of the dissertation. Furthermore, I believe the acknowledgements, and even the dissertation, are worthy of reading.

Some of the original results of this thesis rely on a novel set of data and references I would not have been able to gather without the help of the following people (in alphabetical order): Mike Ciuchta, Edward Flynn, Mike Fong, Dan Harmetz, Merritt Hooper, Bill Jacobs, Gordon Johnson, Tana LaCotera, Bruce Neidermeir, Sally Overstreet, John Pecora, Joel Sternberg, David Ward, Alan Williams, and Chuck Yamarone. I cannot thank Merritt Hooper, Gordon Johnson, Tana LaCotera, Alan Williams, and Chuck Yamarone enough for putting up with what must have seemed endless data calls. My data was exclusively U.S., and being thousands of miles away from my data source was difficult, but the people who helped gather it made the dissertation possible.

Because a dissertation takes more than a few weeks to complete, significant things can happen to an unsuspecting doctoral student. In my case, I met a very nice visiting doctoral student and got married. This has not diminished the importance of the Ph.D., but it has put some added perspective on its importance in the general scheme of life. Paraphrasing David Webb: "there you see, some good things come out of doctoral programs at the LSE." Also, paraphrasing Michael Bromwich: "not everybody gets a wife as part of the deal." In short, I'm a lucky guy and I would like to thank my wife Lili for that.

Special thanks to those brave souls which have read and made constructive comments on the text which follows, especially Gordon Johnson. Without their comments and support I may not have been able to finish this document. I would like to think that my eight years of work experience in finance were not a hindrance to my studies. Personally, I believe it is that work experience which makes this thesis worth reading. Finally, I would like to thank Jon Sonstelie and Ted Keeler for encouraging me to further my studies, and Dan Harmetz for encouraging and helping me to research financial distress.

ABSTRACT

Given the economic importance of distressed firms, this thesis was motivated by an apparent lack of financial economic research examining distressed firms and their securities. The thesis principally focuses on the following two areas: (1) the costs of Chapter 11, and (2) the financial performance of low-grade bonds (i.e., "risky debt"). In addition, the laws and regulations affecting distressed firms are reviewed. Therefore, the main contributions of this thesis are empirical in nature.

Regarding the costs of Chapter 11, the evidence presented suggests that they are large. Specifically, the costs of "successful" Chapter 11 are found to be an increasing function of firm size up to a point (i.e., they are a declining function for the very largest firms). Therefore, these findings contrast with previous studies which have found economies of scale for the administrative costs of bankruptcy. This has important implications for capital structure theories which trade-off the costs of bankruptcy with the tax shield advantage of debt over equity. In addition, generally larger costs are found than were found in previous research.

Regarding the financial performance of low-grade bonds, the evidence presented suggests that risky debt valuation models which incorporate interest rate risk, in addition to default risk, best describe the return generation process for the three risky bond asset classes examined. The evidence for low-grade corporate bonds, low-grade municipal bonds, and convertible corporate bonds strongly supports this hypothesis. In addition, the evidence examined would suggest that the interaction between the various embedded options in risky debt should be an important element in any risky debt valuation model.

Therefore, at a very broad level the thesis has the following two arguments: (1) bankruptcy is very costly; and (2) risky debt displays a return generation process which is very complex. The evidence presented strongly supports both theses.

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CHAPTER 1

INTRODUCTION

This thesis is not a traditional monograph. Four of eight of the chapters which follow the introductory chapter are modified articles concerned with issues on bankruptcy and the risky bond return generation process (i.e., Chapters 4 and 6 through 8). The introduction is organized as follows: (1) background, (2) objectives of the thesis, and (3) outline of the thesis.

Excluding the introductory and concluding chapters, Chapters 2 through 4 and 5 through 8 can be viewed as two related groupings of chapters. Chapter 2 addresses legal issues and reviews relevant finance work in the area of low-grade debt and bankruptcy. Chapter 3 provides the more specific background to Chapter 4. Chapter 4 is an examination of the losses realized by firms which have emerged from bankruptcy. Chapter 5 provides the background to Chapters 6 through 8. Chapters 6 through 8 are studies analyzing the impact of embedded options on the financial performance of three risky bond asset classes.

> The smallest firms have about even odds of disappearing, for favorable or unfavorable reasons, within a decade. The largest firms have a mortality rate of about 20 per cent.
> Queen and Roll [1987, p.9]

Since the introduction of the corporate form in North America, about 50 businesses founded between 1767 and 1833 remain in business in the United States (U.S.).[1] Effectively, once a business has been born it is either acquired or liquidated. Most businesses end their lives being liquidated. Regarding firm mortality, it is more a

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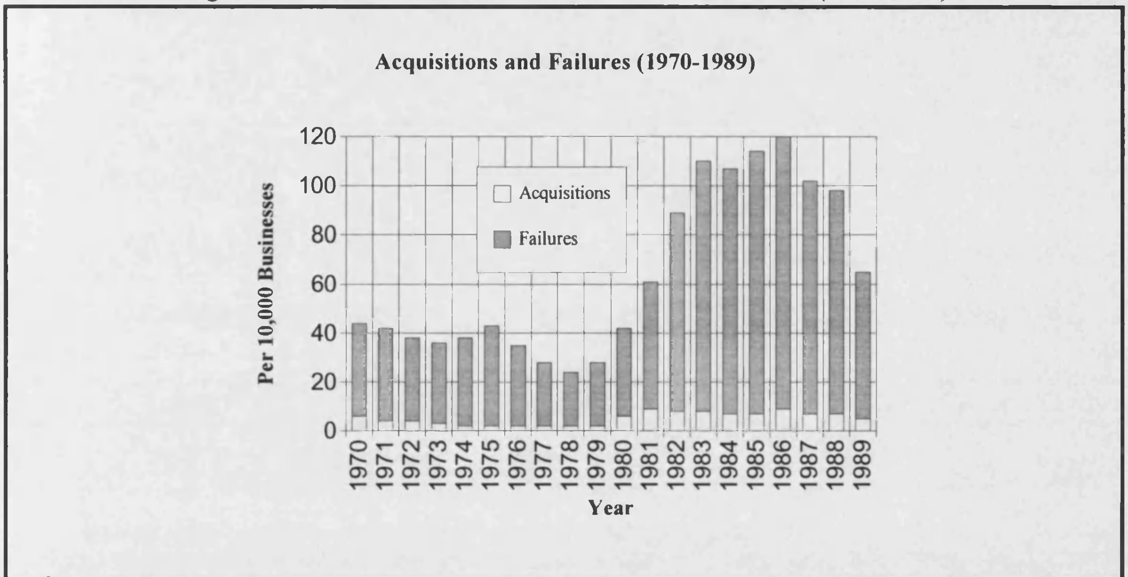
[1] See Zweig [1992] regarding the oldest U.S. firms. Currently there are over 8 million corporations in the U.S. Many of the oldest U.S. firms are not independent entities. For example, the oldest U.S. firm (i.e., the Dexter Corporation, founded in 1767) is now foreign owned.

question of when, not whether, a firm will die. In the U.S., the number of large business deaths during the period 1970 through 1989 can be seen in the following figure, which shows the number of acquisitions and failures over the period.[2]

Figure 1

Acquisitions and Failures (1970 through 1989)

These values were gathered from the Statistical Abstract of the United States (1970-1991).



Sources: Statistical Abstract of the United States (1970-1991)

Acquisitions are used here as a basis of comparison against failures. Also, acquisitions and failures represent the two methods by which firms die. Until recently, financial economists have focused their attention on large business acquisitions over business failures. There has been substantially more finance literature on business acquisitions than business failures. This is unfortunate, given that there is often more to be learned in business, and economics, from business failure than business success.

In the field of finance there has developed a large body of literature concerning business acquisitions (i.e., often referred to as "mergers and acquisitions" or "M&A"). The emphasis has been on large, public acquisitions. This thesis will focus on the less glamorous side of business mortality. More specifically, this thesis will address issues regarding the costs associated with firms in bankruptcy, and the return generation process of bonds with significant default probabilities. Specifically, low-grade bonds will be the focus of much of the empirical research performed. The following table

2 Interestingly, the average liabilities of bankrupt firms has increased for the very largest firms, but decreased for large firms relative to small firms (see Hudson [1992] for a model measuring this recent trend in the size of firms filing for bankruptcy).

has been provided to give some indication of the absolute level of businesses, new incorporations, acquisitions, and failures in the U.S. from 1970 through 1993.

Table 1
New Incorporations, Acquisitions, and Commercial Failures (1970 through 1993)[3]

		New Incorporations		Acquisitions		Failures	
Year	Concerns in Business	Number	# per 10,000 Concerns	Number	# per 10,000 Concerns	Number	# per 10,000 Concerns
1970	2,442,000	264,000	1,081	1,351	6	10,748	44
1971	2,466,000	288,000	1,168	1,011	4	10,326	42
1972	2,490,000	317,000	1,273	911	4	9,566	38
1973	2,567,000	329,000	1,282	874	3	9,345	36
1974	2,591,000	319,000	1,231	602	2	9,915	38
1975	2,679,000	326,000	1,217	439	2	11,432	43
1976	2,782,000	376,000	1,352	559	2	9,628	35
1977	2,793,000	436,000	1,561	590	2	7,919	28
1978	2,786,000	478,000	1,716	607	2	6,619	24
1979	2,708,000	525,000	1,939	519	2	7,564	28
1980	2,780,000	532,000	1,914	1,558	6	11,742	42
1981	2,745,000	581,000	2,117	2,395	9	16,794	61
1982	2,806,000	566,000	2,017	2,298	8	24,908	89
1983	2,851,000	602,000	2,112	2,395	8	31,334	110
1984	4,885,000	635,000	1,300	2,243	5	52,078	107
1985	4,990,000	663,000	1,329	1,719	3	57,078	114
1986	5,119,000	702,000	1,371	2,497	5	61,616	120
1987	6,004,000	685,000	1,141	2,479	4	61,111	102
1988	5,804,000	685,000	1,180	2,970	5	57,098	98
1989	7,694,000	677,000	880	3,752	5	50,389	65
1990	8,038,000	647,000	805	4,239	5	60,747	74
1991	8,218,000	629,000	765	3,446	4	88,140	107
1992	8,805,000	667,000	758	3,502	4	97,069	109
1993*	8,966,000	NA	NA	NA	NA	85,982	90

Source: exclusive of acquisitions, Dun & Bradstreet Corporation, New York, N.Y., The Failure Record and Monthly Failure Report.
Acquisitions source: Statistical Abstract of the United States (includes only change of control transactions of at least $1 million). * preliminary estimates.

[3] The following applies to new business incorporations and business failures: (1) before 1970 excludes Hawaii, (2) before 1975 excludes Alaska, (3) total concerns and failure data prior to 1984 exclude agriculture, forestry and fishing, finance, real estate, and services; therefore are not directly comparable with data for 1984 and later, (4) data through 1983 represent the number of names listed in the July issue of the Dun & Bradstreet Reference Book, (5) data for 1984-1993 represent the number of establishments listed in Dun & Bradstreet's Census of American Business. Also, note that the base has changed due to the expanded business failure coverage. The post 1983 base includes concerns discontinued following assignment, voluntary or involuntary petition in bankruptcy, attachment, execution, foreclosure, etc.; voluntary withdrawals from business with reorganization or arrangement which may or may not lead to discontinuance; and businesses making voluntary compromise with creditors out of court.
Also, the number of concerns in business does not match up with the number of new incorporations, failures, and acquisitions. This discrepancy is in part due to the emphasis on collecting data for large business failures. Again, these numbers are only gross indications not exact representations.

Even during merger waves (e.g., the 1980s), bankruptcies occur more frequently than acquisitions. In addition, as measured by total liabilities, there has been a general increase in the size and absolute level of bankruptcies. Specifically, after 1980 the absolute level of business failure has increased dramatically. In 1979 the total amount of current liabilities held by failing businesses was approximately $2.7 billion. By 1989 that figure had increased to approximately $44.3 billion.[4] The following table provides background on the failure rate and the mean size of failing firms.

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4 White [1989, p. 146-147] estimated that in the U.S. during the period 1980 through 1985 losses from bankruptcy averaged $18 billion per year. White based this estimate on the spread between interest rates on "high risk" and "low risk" corporate bonds and multiplied this value by the average level of liabilities of U.S. financial corporations. This value also suggests that bankruptcy has some economic importance.

Table 2
Industrial and Commercial Failures - Number and Liabilities (1955 - 1993)[5]

		Failures				Cases	
Year	Total Concerns in Business[6]	Number	Number per 10,000 Concerns	Current Liabilities (millions $)	Average Liabilities	Filed	Pending
1955	2,633	10,969	41.66	449	40,968	59	56
1956	2,629	12,686	48.25	563	44,356	62	59
1957	2,652	13,739	51.81	615	44,784	74	68
1958	2,675	14,964	55.94	728	48,667	92	80
1959	2,708	14,053	51.89	693	49,300	101	84
1960	2,708	15,445	57.03	939	60,772	110	95
1961	2,641	17,075	64.65	1,090	63,843	147	124
1962	2,589	15,782	60.96	1,214	76,898	148	134
1963	2,544	14,374	56.50	1,353	94,100	155	148
1964	2,524	13,501	53.49	1,329	98,454	172	157
1965	2,527	13,514	53.48	1,322	97,800	180	162
1966	2,520	13,061	51.83	1,386	106,091	192	169
1967	2,519	12,364	49.08	1,265	102,332	208	185
1968	2,481	9,636	38.84	941	97,654	198	184
1969	2,444	9,154	37.45	1,142	124,767	185	179
1970	2,442	10,748	44.01	1,888	176,000	194	191
1971	2,466	10,326	41.87	1,917	186,000	201	201
1972	2,490	9,566	38.42	2,000	209,000	183	197
1973	2,567	9,345	36.40	2,299	246,000	173	189
1974	2,591	9,915	38.27	3,053	308,000	190	201
1975	2,679	11,432	42.67	4,380	383,000	254	202
1976	2,782	9,628	34.61	3,011	313,000	247	271
1977	2,793	7,919	28.35	3,095	391,000	214	254
1978	2,786	6,619	23.76	2,656	401,000	203	240
1979	2,708	7,564	27.93	2,667	353,000	226	258
1980	2,780	11,742	42.24	4,635		361	421
1981	2,745	16,794	61.18	6,955		360	362
1982	2,806	24,908	88.77	15,611		368	461
1983	2,851	31,334	109.91	16,073		375	537
1984	4,885	52,078	106.61	29,269		344	578
1985	4,990	57,078	114.38	36,937		365	609
1986	5,119	61,616	120.37	44,724		478	729
1987	6,004	61,111	101.78	34,724		561	809
1988	5,804	57,098	98.38	39,126		595	814
1989	7,694	50,361	65.45	44,261		643	869
1990	8,038	60,747	75.57	56,130		725	962
1991	8,218	88,140	107.25	96,825		880	1,123
1992	8,805	97,069	110.24	94,317		972	1,237
1993*	8,966	85,982	95.90	48,423		919	1,191

Source: Dun & Bradstreet Corporation, New York, N.Y., The Failure Record and Monthly Failure Report.
* Preliminary estimate.

[5] The same caveats apply as those of the previous table. Also, liabilities exclude long-term publicly held obligations; and offsetting assets are not taken into account. Source: Dunn & Bradstreet Corporation, New York, N.Y., The Failure Record Through 1993 and Monthly Failure Report. Aggregate values were taken from the Statistical Abstract of the United States.

[6] Values in thousands of firms.

In the U.S., since 1955, there has been a significant increase in the relative number of failures, particularly since 1980[7], shortly after the new bankruptcy code (the "Code") took effect. The failure rate seemed to peak in 1986 at 120.37 per 10,000 business concerns, even though 1986 was not a recessionary period. Recently, the failure rate has become higher in both absolute and relative terms. Failure rates appear to now be less dependent on the business cycle (e.g., see Hudson [1989 & 1992]). Although, some of the observed decrease in the dependence of failures on the business cycle is due to the availability of Chapter 12 of the Code beginning in 1986.[8]

Over the period 1989 through 1992 the total current liabilities of business failures was estimated to be $291.5 billion[9], while the total value for M&As was estimated to be $789.2 billion over the same period (a ratio of failures to M&As of approximately 37%). Although, the M&A activity included divestitures[10] valued at $304.3 billion. If divestitures were added to failures in order to approximate the value of most large distressed situations over the period, the ratio of distressed situation value to net M&A activity was approximately 75%.

1 Background

This section consists of the following sub-sections: (1) low-grade corporate bonds, (2) bankruptcy and distress, (3) the approximate size of the asset classes under study, and (4) the role of theory. Research in the field of financial distress has primarily focused on the following areas: (1) bankruptcy prediction, (2) bankruptcy costs, (3) agency theory applied to financial distress, and (4) security performance around the bankruptcy announcement date. From the finance literature on distress, it is clear that the financial academics in the field of financial distress have been heavily reliant on the legal definition of bankruptcy. A great deal of research in the field has been concerned with bankruptcy prediction. The consensus has been that financial

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7 A comparison of the 1980-1989 mean of 42,415 versus the 1955-1979 mean of 11,735 resulted in a t value of 8.36, which is significant at well below the 1% level of significance.

8 This will be reviewed in Chapter 2.

9 The original source of these values was New Business Incorporations, monthly; The Failure Record Through 1991; and Monthly Failure Report, Dun & Bradstreet Corporation, New York, N.Y. Current liabilities excluded long-term publicly held obligations and offsetting assets were not taken into account.

10 In a sense, divestitures are tantamount to double counting in the case of M&A activity during the 1980s. Many acquisitions in the 1980s resulted in the sale of unprofitable businesses. Therefore, counting the purchase of a complete company and the following sale of specific unit(s) essentially results in the double counting of acquisition activity as it relates to divestitures.

statement information is useful in predicting bankruptcy. Regarding the absolute costs associated with bankruptcy and the significance of bankruptcy costs, there is no consensus. There has been limited application of agency theory to financial distress. In addition, there has been limited and contradictory evidence concerning the performance of securities around the bankruptcy announcement date.

This thesis is concerned with providing empirical evidence in order to resolve some issues in the field of financial distress. Given that the pricing of low-grade bonds are directly affected by defaults and the probability of defaults, the effect of defaults on several low-grade bond asset classes will be examined. This thesis is particularly interested in the impact of default periods on the time series of low-grade bond asset class returns. Finally, it is important to note that all the evidence provided is based on U.S. sources.

1.1 Why Study Low-Grade Bonds?

Low-grade bonds, by definition, are affected by economic distress. Low-grade corporate bonds, more commonly referred to as high yield bonds, junk bonds, or speculative grade debt, are corporate debt rated BAA and below by Moody's rating service or BBB or lower by Standard & Poor's ("S&P") rating service.[11] Ratings are based on the following considerations[12]:

> (1) Likelihood of default - capacity and willingness of the obligor as to the timely payment of interest and repayment of principal in accordance with the terms of the obligation;
> (2) Nature of and provisions of the obligation;
> (3) Protection afforded by, and relative position of, the obligation in the event of bankruptcy, reorganization, or other arrangement under the laws of bankruptcy and other laws affecting creditors' rights.
> [S&P High Yield Quarterly, p. 48]

Given the above definition, low-grade debt instruments are a useful security type to study the effects of distress. It is useful that discrete distress events such as default, reorganization, and bankruptcy are part of the definition of the low-grade bonds. Even

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[11] The National Association of Insurance Companies ("NAIC") has six categories of security ratings that directly correlate with those of the ratings agencies (see Dizard [1991, p. 43-44]).
[12] For an overview of the credit rating industry see Cantor and Packer [1995].

if the ratings reflect real information with a time lag[13], the ratings given to securities classified as low-grade imply a high expected probability of default relative to more highly rated securities.[14]

The following figure highlights the inflows and outflows in the low-grade debt universe.

Figure 2
Inflows and Outflows in the Low-Grade Universe

Inflows and Outflows in the Low-Grade Universe

Additions to the Low-Grade Universe

- Net New Issuance of Low-Grade Debt (New Issuance net of Refinancings)
- Downgradings of High-Grade Debt ("Fallen Angels")

Deletions from the Low-Grade Universe

- Upgradings of Low-Grade Debt ("Rising Stars")
- Calls
- Maturities
- Exchanges
- Partial Repurchases
- Defaults

Source: Modified from Cherry, M., and M. Fridson, "The Future of High Yield," The Journal of High Yield Bond Research: Merrill Lynch Extra Credit, September/October 1991

As can be seen from Figure 2, additions to the low-grade universe are composed of net new issues and downgrades of high-grade debt. From 1980 through 1990 Moody's reported that approximately $103 billion of corporate debt had been downgraded to noninvestment grade status. In 1970 there was approximately $7 billion of low-grade debt outstanding, by 1991 there was over $200 billion (Altman [1991a, p. 3]). Much attention has been focused on the new issue market for low-grade bonds (e.g., Blume

13 It should be noted that ratings differences generally reflect "differences in firm history rather than differences in the firm's prospects" (see Pogue and Soldofsky [1969, p. 224]). Therefore, although ratings tend to reflect a firm's fundamental financial information (e.g., see Pinches and Mingo [1973]), that historic information may not have much predictive power.

14 It has been pointed out that updates of bond ratings by the two ratings agencies are done very infrequently (see Lowenstein [1990]). Therefore, even if ratings were a relatively accurate representation of the probability of default, they would not necessarily be useful for much of the year for very distressed issues.

and Keim [1987]), but what has always distinguished the low-grade market is its abundance of "fallen angels".[15]

1.2 Bankruptcy and Financial Distress

> Although Beaver [1966, 1968] defined failure broadly, most subsequent empirical work has restricted it to mean bankruptcy. Most of the theoretical literature uses the term bankruptcy. But this is somewhat misleading, for the theory really deals with the failure of a firm to meet its financial obligations, and such failure does not always lead to bankruptcy.
> Scott [1981, p. 342]

Until recently, there has been relatively little empirical work in finance on business and security distress. One of the reasons may be that financial economists have been uncomfortable with the inherently legal issues involved with distress. Those financial economists which have ventured into the field have become dependent on the legal definition of distress, which has changed since the late 1970s.

Implicitly, often bankruptcy was assumed to represent the legal definition, which was assumed to be a subset of financial insolvency. This can be problematic, given that, for example, the largest "bankruptcy" in U.S. history (i.e., Texaco, 1987) was not what most financial economists would argue to be an economic failure.

> We refer to distressed securities as a market and as an asset class. These labels, however, are premature due to the field's developing condition and the fact that there has been a lack of rigorous research.
> Altman [1991b, p.1]

There is no universal definition of financial distress. Unfortunately, there are no definitions of distress in financial textbooks or financial journals. The word has often been used in the finance literature, but has never been defined. Good proxies for failure include the definitions of bankruptcy and insolvency; but distress, especially as it relates to securities, is harder to define with the use of proxies. As Zmijewski [1984, p. 637] wrote, "before data can be collected, the population of firms must be identified, and an operational definition of financial distress assumed." A sample set is usually drawn based on the assumption that legal bankruptcy is a good proxy for financial distress.

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15 Fallen angels represented approximately 30% of the low-grade corporate bond market in early 1987 (Altman [1987, p. 13]). In addition, see Fridson [1993] on the "Fallen Angel Hypothesis".

1.3 The Size of the Low-Grade Bond Asset Classes Studied

The following asset classes are of particular importance to this thesis: (1) low-grade corporate bonds (Chapter 6), (2) low-grade municipal bonds (Chapter 7), and (3) convertible corporate bonds (Chapter 8). In addition, high-grade corporate bonds and high-grade municipal bonds are used as reference asset classes. As of year-end 1993, the Federal Reserve Bulletin reported that corporate bonds were approximately $1.230 trillion and tax-exempt obligations were approximately $1.217 trillion. Regarding low-grade corporate bonds, the market was estimated to be approximately $175 billion as of year-end 1992, down from a high of about $200 billion in 1990 (see Altman [1993]). Regarding low-grade municipal bonds, there are no academic estimates available. Regarding convertible corporate bonds, the following table provides estimates of the overall size of the convertible security market (i.e., convertible bonds and preferred stocks).

Table 3
Total Par Value of Convertible Securities (1984 through 1993)

Year	Total Par Value (Billions $)
1984	$23.033
1985	28.434
1986	32.793
1987	33.601
1988	40.596
1989	43.897
1990	52.141
1991	61.732
1992	58.253
1993*	52.877

Source: Value Line Convertibles, Value Line Publishing, Inc., 711 3rd Avenue, New York, N.Y.
* as of June 28, 1993.

Given that the values are par values, the above values overestimate the market value of convertible securities, but they provide some notion of the size of the market since 1984.

Open-end mutual fund returns are used to proxy for the asset class returns analyzed. Therefore, some notion of the size of open-end mutual funds for the asset classes being analyzed in Chapters 6 through 8 is required as background. The following table provides estimates for the total year-end market value of various mutual fund types which correspond to the asset classes of special interest to the thesis.

Table 4

Open-End Mutual Fund year-end Market Values for Low-Grade Corporate Bonds, High-Grade Corporate Bonds, Low-Grade Municipal Bonds, High-Grade Municipal Bonds, and Convertible Corporate Bonds (1984 through 1994)

All values and definitions are derived from Lipper Analytical Services data. Low-grade corporate bond funds are defined as funds which tend to invest in lower grade debt issues. High-grade corporate bond funds are defined as funds which invests 65% or more of assets in corporate debt issues rated "A" or better or government issues. Convertible bond funds are defined as funds which invest primarily in convertible bonds and/or preferred stocks. Low-grade municipal bond funds are defined as funds which invest at least 50% of assets in lower rated municipal debt issues. High-grade municipal bond funds are defined as funds which invest at least 65% of assets in municipal debt issues in the top four credit ratings.

Year	Low-Grade Corporate Bond Funds	High-Grade Corporate Bond Funds	Convertible Bond Funds	Low-Grade Municipal Bond Funds	High-Grade Municipal Bond Funds
1984	$6.922 billion	$3.497 billion	$0.296 billion	$3.188 billion	$10.646 billion
1985	12.686.	4.820	0.875	5.610	17.493
1986	24.648	7.229	3.250	9.202	30.120
1987	24.836	7.555	3.353	8.436	28.945
1988	30.298	8.195	2.820	10.103	33.338
1989	25.555	10.016	2.518	13.112	38.387
1990	16.683	11.329	1.714	14.008	41.582
1991	23.499	15.375	1.834	16.358	50.515
1992	30.921	20.109	2.404	19.060	60.200
1993	44.413	24.500	3.599	23.427	74.182
1994	41.889	22.292	3.560	21.122	64.337

Source: Lipper Directors' Analytic Data, Lipper Analytical Services, Inc., 1994.

All five types of bond funds seem to have had dramatic increases over the past ten years. Of importance for this thesis is that the size of total open-end mutual fund assets under management for a particular asset class analyzed is large enough relative to the asset class to suggest that it is a representative sample of that asset class.

1.4 The Role of Theory in the Thesis

The four article chapters are motivated by the following two sets of theory: (1) capital structure theory, and (2) risky debt pricing theory. Capital structure theory as it relates to the bankruptcy costs is the basic motivation for the empirical research on the costs of bankruptcy. Therefore, it is indirectly used as a motivation for Chapter 4 and will be addressed in Chapter 3.

Chapter 5 reviews the theory on the pricing of risky debt. Given that Chapter 6 through 8 are empirical chapters analyzing the impact of embedded options on the financial performance of risky bond asset classes, a review of the theory of risky debt pricing will be provided. In particular, the expected direction and sensitivity of risky bond prices during periods when the various embedded options would be expected to be exercised and/or the probability of exercise increases will be analyzed. Embedded options (e.g., the put or default option) and their effects over time occupy much of the analytic work of this thesis.

2 Objectives

All the objectives of this thesis are directly or indirectly concerned with the field of financial distress. The next chapter will provide background on laws and regulations affecting financially distressed firms, but the focus of this thesis will be primarily on the finance literature in the field. Although the finance literature in the field has greatly increased in recent years, it remains limited.

The following are the objectives of the thesis:
1) review important laws and regulations affecting distressed firms (Chapter 2),
2) review the empirical literature on the costs of bankruptcy and provide the background to the empirical chapter on the losses incurred during successful bankruptcy (Chapter 3),
3) further address the question of the size and magnitude of the costs of distress as well as examine several factors which might affect the total costs of successful bankruptcies (Chapter 4),
4) review the relevant literature on risky debt pricing and empirical studies on risky debt returns (Chapter 5),
5) establish the theoretical expectations regarding the three related empirical chapters (Chapter 5),
6) generally extend the empirical literature on low-grade corporate bond financial performance (Chapter 6),
7) begin empirical literature on low-grade municipal bond financial performance (Chapter 7),

8) generally extend the empirical literature on convertible bond financial performance (Chapter 8), and
9) provide evidence to support more complex contingent claims analysis ("CCA") models of risky bond pricing (Chapters 6 through 8).

The contributions of this thesis will be dependent upon the thesis' ability to resolve these nine objectives.

3 Outline of the Thesis

This introductory chapter is followed by eight chapters. Chapter 2 provides background on U.S. laws and regulations affecting the creditors of distressed and bankrupt businesses. Also, background information on the rate and magnitude of bankruptcy in the U.S. is provided. Chapter 3 provides background for the chapter analyzing the costs of bankruptcy. Chapter 4 examines the losses realized in successful bankruptcies.

Chapter 5 provides the empirical and theoretical background on risky bonds. Chapter 6 examines the financial performance of low-grade corporate bonds. Chapter 7 examines the financial performance of low-grade municipal bonds. Chapter 8 examines the financial performance of convertible corporate bonds.

CHAPTER 2

BACKGROUND ON LEGAL CONSIDERATIONS

1 Introduction

The objective of this chapter is to present an overview of legal factors which impact distressed firms and the securities they issue. Regarding laws and regulations, the emphasis will be on those laws and regulations which have an economic impact on distressed security valuation. Also, some background numbers regarding the frequency of "Chapter 7" and "11" bankruptcies will be presented. This chapter will provide background on some of the legal aspects of low-grade bonds and firm distress in general.

2 Laws and Regulations

The complexity of laws and regulations affecting distressed securities generally increases the costs associated with investing in those securities. Specific laws and court rulings have significant impacts on the valuation of securities in distress (e.g., Ma et al. [1989] and Kaen and Tehranian [1990]). The impact of changing laws and regulations is often through changing the behavior of the agents involved in negotiations during workouts and restructurings (e.g., the LTV Case). The laws regarding distress have not been a foundation of predictability (e.g., absolute priority rulings). Also, regarding existing laws, more recent economic theory applied to bankruptcy law implies that many types of renegotiation which occur for bankrupt firms are inefficient (e.g., Gertner and Scharfstein [1991], and Webb [1991]). Referring to Chapter 11 of the Bankruptcy Code (the "Code"), Webb concluded by stating:

> A major weakness of Chapter 11 in the US is that it provides incentives for the latter, encouraging distributional games, distorting *ex ante* decisions, rather than the realization of value. Significant costs may be incurred and the business severely damaged, rather than the burden of creditors removed.
> Webb [1991, p. 156]

Thus, significant additional costs may be incurred with and without security-holder consent.[1] These costs will be reflected in lower recoveries in bankruptcy (this will be addressed in more detail in Chapter 3). Not only does the bankruptcy code seem expensive for distressed security holders, but there is some evidence indicating that changes in bankruptcy laws during 1978 have increased the cost of bankruptcy (see Bradley and Rosenzweig [1992]). However, more recent changes in the Code may have lessened some of the costs associated with bankruptcy (see Jacob et al. [1994] on the Bankruptcy Reform Act of 1994). Given that all the data used in this study was previous to any recent changes in the Code, the review which follows will emphasise the 1978 Act.

2.1 Before and After the New Code

> Auctions allocate resources to their highest-valued uses. Yet bankruptcy does not use auctions. Instead judges determine a value and parcel out interests on the assumption that this valuation is correct.
> Easterbrook [1990, p. 411]

The Bankruptcy Reform Act of 1978 established the current bankruptcy code. The Bankruptcy Reform Act of 1994 modified some critical sections of the Code. Most of the data in this study was derived after the Bankruptcy Reform Act of 1978 and before the Bankruptcy Reform Act of 1994. The new bankruptcy laws may have increased the complexity and costs of distress for security holders (e.g., see Bradley and Rosenzweig [1992]).[2] In addition, Scott and Smith [1986] found that small businesses incurred higher borrowing costs after the new Code was enacted. Chapter 11 of the Code has given managers more power and latitude than the previous bankruptcy code. Bradley and Rosenzweig [1992] found that both stockholders and bondholders of

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1 In some cases where some explicit or implicit form of government guarantee is in place for the firm's debt, management may purposely cause the firm to incur losses and go bankrupt in order to extract value (see Akerlof and Romer [1993] on what they call "bankruptcy for profit").

2 Some literature has concerned itself with the overall impact of the bankruptcy code on all firms. For example, Hudson [1992] examined average liabilities of bankrupt firms during the period 1952-1989 in an effort to quantify the impact of the new Code on all U.S. firms.

bankrupt firms have lost significantly more after the Code when compared to claimholders before its inception.[3]

The Bradley and Rosenzweig [1992] results contradict a theory of deadweight costs held by White [1983]. White [1983] felt that the deadweight costs associated with the Code were less than those of the old Bankruptcy Act. White's [1983] estimates were based on a model of *ex ante* bankruptcy costs of liquidating versus reorganizing firms. The data used was for firms filing for court protection in the Southern District of New York.[4] None of the Code cases the results were based on had their cases formally closed (White [1983, p. 483]). Also, the payoff rates were undiscounted, which biased the results to find lower bankruptcy costs for later years. There was no statistically significant result, only a rough estimate of deadweight costs. Although, Bhandari and Weiss [1993] found that the Bradley and Rosenzweig [1992] post-1978 filings result was flawed, in that they felt that the post-1978 increase in bankruptcy filings was due to lower profitability and increased leverage, rather than the change in law. In addition, LoPucki [1992, p. 85-91] found that the extra post-1978 bond losses found by Bradley and Rosenzweig [1992] may have been due to the fact that more bonds in their pre-1978 sample were more senior relative to their post-1978 sample.[5]

Whether or not the Code is more expensive for distressed security holders is not of primary importance for this thesis. But, to the extent changes in the Code create uncertainty in the markets for distressed securities, changes in the Code are relevant. Of more importance are the individual laws directly affecting the valuation and distribution of value among distressed security holders. If the bankruptcy laws were invariant with respect to time and case, bankruptcy laws would be of little importance for valuing risky securities. Unfortunately, the Code has changed and laws have not been applied uniformly (e.g., regarding the Doctrine of Absolute Priority).[6]

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[3] Also, the introduction of the Code may have increased the event of bankruptcy. Concerning the increase in bankruptcies during the 1980s, Hudson [1989, p. 69] noted the following: "It is interesting to note that this most recent upturn coincides with the introduction of the new Bankruptcy Code, and it may be that the new code has in some way tended to increase the number of bankruptcies."

[4] The Southern District of New York is significantly different than all other bankruptcy court districts in the U.S. It is not a good district to take a representative sample (see Chapters 3 & 4).

[5] Although, it is possible that for very large companies in the late 1980s and beyond, prepackaged Chapter 11s may result in lower deadweight costs than previous bankruptcy law would have allowed (e.g., see Betker [1995b]). In addition, the LoPucki [1992] criticism applies to all empirical bankruptcy studies, not just the Bradley and Rosenzweig [1992] study.

[6] There have been several proposals to significantly change Chapter 11 of the Code (e.g., see Roe [1983], Bebchuk [1988], and Aghion et al. [1992]).

2.2 The Latest Code Changes

The latest set of modifications to the Code was the Bankruptcy Reform Act of 1994 (the "New Act"). The New Act was passed on October 6, 1994 and signed into law on October 22, 1994. Given that the most recent data series used in this thesis ends on September 30, 1994, it is assumed to not have had an impact on the results of this thesis. It is reviewed here in order to update this chapter's review of the Code.

The primary focus of the New Act has been to increase the rights and remedies of creditors (see Jacob et al. [1994]). In particular, the New Act encourages the election of a trustee in Chapter 11 cases. Therefore, the New Act has, at least in one respect, brought the U.S. Code closer to British insolvency law. The New Act was designed to shift the power away from the debtor toward creditors. At this time, it is not clear that the New Act will have the intended effect.

The following is a partial list of significant amendments made to the Code by the New Act: (1) The New Act is intended to expedite automatic stay relief hearings. The automatic stay (i.e., Section 362(e) of the Code) was amended in the New Act to complete final hearings on motions for stay relief within 30 days with few or no exceptions.
(2) The New Act is intended to expedite the debtor-in-possession's period of exclusivity (i.e., the period under which the debtor has the exclusive right to propose a plan of reorganization). The amendment does not change the period of exclusivity (i.e., 180 days). Rather, it gives any party that is aggrieved by extending the period of exclusivity the right to appeal. How this is supposed to expedite the period of exclusivity is not clear.
(3) The New Act is intended to encourage the appointment of trustees in Chapter 11 cases (section 1104(a)) as has been the case with Chapter 7 cases. The amendment allows creditors to elect their own trustee in Chapter 11 cases, although creditors must show that the continuation of current management is not in the interests of the bankrupt entity.

2.3 Background on Chapter 7 and Chapter 11 Cases

Empirical studies on distress have used the event of bankruptcy as their implicit or explicit definition of distress. Given the reliance on the event of bankruptcy, it is crucial to understand what is legally meant by bankruptcy and the various legal forms of bankruptcy. The different classifications of bankruptcy were a direct result of judicial intent regarding the discrimination between going concerns and liquidations.

> Bankruptcy law can and should help a firm stay in business when it is worth more to its owners alive than dead. That is a far cry, however, from saying that it is an independent goal of bankruptcy law to keep firms in operation.
> Jackson [1986, p. 2]

"The bankruptcy laws are designed to either rehabilitate a financially distressed debtor or to assemble and liquidate his assets for distribution to creditors."[7] In the U.S., the courts require that only "financially distressed" companies file for bankruptcy. A company should not file for business strategy reasons. Bankruptcy court protection is viewed as a means to save viable businesses from liquidation, or businesses that will be liquidated from a "fire sale". Congress has drafted bankruptcy legislation based on the presumption that managers will act in the interest of society to maximize its welfare (see the Code). Also, Congress has assumed that bankruptcy court protection provides creditors with a method of sorting out their relative claims on a debtor's assets.[8]

Currently, court supervised protection under the Code can be obtained under the following four chapters of the Code: Chapter 7, Chapter 11, Chapter 12, and Chapter 13.[9] Chapter 7 of the code, the liquidation chapter of the code, allows an individual to keep certain exempt property. That property which is not exempt (for businesses all property is usually non exempt in Chapter 7) is then sold off by a court appointed

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7 In Flynn, E., "Bankruptcy Statistical Information," The Administrative Office of the United States Courts, September 9, 1991, p. 1.

8 See Jackson [1986, p. 2-192].

9 The following is a short summary of bankruptcy definitions as provided by the Administrative Office of the U.S. Courts, Annual Report of the Director: Bankruptcy is a legal recognition that a company or individual is insolvent and must restructure or liquidate; Petitions 'filed' means the commencement of a proceeding in which the administration has not been completed; Business bankruptcies include those filed under Chapters 7, 9, 11, or 12; Bankruptcies include those filed under Chapters 7, 11, or 13; Chapter 7 is a liquidation of non-exempt assets of businesses or individuals; Chapter 9 is an adjustment of debts of a municipality; Chapter 11 is an individual or business reorganization; Chapter 12 is an adjustment of debts of a family farmer with regular annual income, effective November 26, 1986; Chapter 13 is an adjustment of debts of an individual with regular income; and Section 304 deals with bankruptcy cases ancillary to foreign proceedings.

trustee. Money from the sale is then to be paid to the creditors.[10] Chapter 11 of the Code allows a business to restructure its operations as a going concern rather than be liquidated. Chapter 12 of the Code allows family farmers to restructure their financial obligations and continue farming operations as a going concern.[11] Chapter 13 of the Code allows individuals with regular income to pay their creditors, in full or in part, over a three year period.[12] This thesis will focus on Chapter 11 of the Code (i.e., Chapters 3 and 4), more specifically as it relates to firms which have successfully reorganized under court supervision.

The majority of business bankruptcies are filed under Chapter 7 of the Code, not Chapter 11. This preponderance of Chapter 7 firms is due to the fact that the largest share of businesses filing for bankruptcy are relatively new, small, single product or service firms which generally do not have the financial resources and/or market to continue as going concerns (see Queen and Roll [1987]). The ratio has been about four Chapter 7 cases to every one Chapter 11 case (see Tables 1 and 2). Also, most of the cases filed under Chapter 11 are eventually converted to Chapter 7. Thus, the effective ratio is higher than one to four (see Table 2).

Regarding the status and confirmation rates of Chapter 11 cases in the 1980s, the following can be stated: (1) over 1/4 of the cases filed before 1987 were still pending as of January 31, 1989; (2) approximately 1/2 of the cases filed prior to 1987 have been closed in Chapter 11 without court confirmation[13] or have been closed as "no asset Chapter 7" cases; (3) approximately 1/15th of the cases closed so far were closed after confirmation; (4) approximately 17% of the cases prior to 1987 have been or will be confirmed[14]; (5) the rate of confirmation rose from 13.3% of cases filed in 1982 to 22.4% of cases filed in 1986; (6) Flynn [1989, p. i] estimated that the rate of confirmation for cases filed after 1986 will be 25% to 30%; (7) the pre-1987 confirmation rate was under 10% in some districts and over 40% in the Southern

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[10] In actuality, in some cases little or nothing has gone to creditors. Often in these cases the trustee, the courts, and the various attorneys associated with the case are paid and there is nothing left for the creditors.

[11] Basically, it is a form of Chapter 11 for family farmers. It is a form of "special interest" legislation which attempts to make it easier for family farmers facing Chapter 7 of the Code to remain in operation.

[12] Again, this is a form of Chapter 11, but for individuals with regular incomes. Also, the bankruptcy judge in the case can extend the payment plan up to five years, but three years has been the norm. Interestingly, based on 1991 filing levels, there is an approximately one in ten chance that an individual in the U.S. will file for Chapter 13 at some point in their lifetime.

[13] This is most likely to occur in cases, such as in real estate cases, where there may be no need for filing a plan of reorganization for the business. This might be expected in any case where the business has a single asset.

[14] That is, as of the writing of the report in 1990.

District of New York[15]; (8) the accounting firm which reviewed the cases estimated that 20% to 30% of the cases reviewed contained liquidity plans rather than reorganization plans[16]; and (9) Flynn [1989, p. i] estimated that 10% to 12% of cases result in a successful reorganization of the debtor's business. Also, the probability of maintaining a business in distress through the use of Chapter 11 of the Code has been very low, even during a period of economic expansion.[17]

Chapter 11 has not been as important as other chapters of the Code in terms of the absolute number of cases, but it has been the most important regarding share of estimated asset values. Chapter 11 of the Code has accounted for approximately four percent of all bankruptcy filings since 1979. Although, the total amounts of assets, debts, and creditor payments in Chapter 11 cases was greater than all other cases filed under all other chapters of the Code combined. It has been estimated by the Administrative Office of the U.S. Courts that as of 1991 the combined assets of all businesses filing under Chapter 11 of the Code was in excess of $200 billion. This paper will focus on approximately $12.6 billion of the Chapter 11s that resulted in the confirmation of plans of reorganization (Chapter 4). In terms of asset value, Chapter 11 was and is the most important chapter of the Code.

The status of Chapter 11 cases is very difficult to accurately determine. The following are the nine status categories of Chapter 11 cases: (1) pending in Chapter 11, (2) pending in Chapter 7, (3) pending in Chapter 12 or 13, (4) closed in Chapter 11 after confirmation, (5) closed in Chapter 11 without confirmation, (6) closed in Chapter 7 with creditor payments, (7) closed in Chapter 7 without creditor payments, (8) closed in Chapter 12 or 13 with payments, and (9) closed in Chapter 12 or 13 without payments. Below are some aggregate values regarding the status of Chapter 11 cases as of January 31, 1989.

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15 Many bankruptcy statistics are gathered from the Southern District of New York. This is due in large part to the large number of large companies which file there, and the relative availability of data which results. Given this fact, there is a bias between this bankruptcy court district and all others in the United States.

16 Given that 17% of Chapter 11 cases get confirmed, the adjusted number, taking into account this finding, would be between ten to twelve percent result in reorganization of the filing entity.

17 Obviously, this is in contrast to its stated objectives.

Table 1

Status of Chapter 11 Cases Filed 1979 through 1986*[18]

These values are from the Administrative Office of the United States Bankruptcy Courts: Division of Bankruptcy.

Status of Chapter 11 Filing	Number	Percentage
Pending in Chapter 11	33,768	26.9%
Pending in Chapter 7	12,563	10.0%
Pending in Chapter 12 or 13	396	0.3%
Total still Pending	46,727	37.2%
Total Closed as of January 31, 1989		
Closed in Chapter 11 after Confirmation	5,334	4.3%
Closed in Chapter 11 without Confirmation	43,177	34.4%
Closed in Chapter 7 with Creditor Payments	8,692	6.9%
Closed in Chapter 7 without Creditor Payments	19,948	15.9%
Closed in Chapter 12 or 13 with Payments	701	0.6%
Closed in Chapter 12 or 13 without Payments	1,059	0.8%
Total Closed	78,911	62.8%
Total Chapter 11 Cases Filed	125,638	100.0%

* There is a small discrepancy between cases filed and case status listings filed between 1985 and 1986.

Source: Modified from Flynn, E., "Statistical Analysis of Chapter 11," Administrative Office of the United States Bankruptcy Courts: Division of Bankruptcy, October 1989

The above table illustrates the relatively low confirmation rate of cases prior to 1987. 62.8% of the cases were closed, but of those only a small percentage were closed in Chapter 11 after confirmation. More than eight times as many cases closed in Chapter 11 were closed without confirmation than after confirmation. Over 60% of the cases are either still pending or have been closed outside of Chapter 11. Of the slightly less than 40% of the cases that have been closed under Chapter 11, 34.4% (i.e., 89%) have been closed without confirmation. Apparently most Chapter 11 cases either (1) don't end as a Chapter 11 cases, or (2) don't close.[19] A successful Chapter 11 case has been rare.

The slightly good news for creditors was that even though few cases are confirmed, or projected to be confirmed, some of the Chapter 7 cases have resulted in payments to creditors. Although, in the case where creditors received some value, the numbers shown in the above table do not provide estimated recovery rates per say, only an indication of whether, from the bankruptcy court viewpoint, anything was recovered. This thesis assumes recovery rates in confirmed Chapter 11 cases were higher than closed Chapter 7 cases. Also, these numbers do not indicate the extent to which

[18] Taken and modified from Flynn [1989, p. 6].

[19] Certainly not encouraging numbers, especially if you are concerned with Chapter 11 of the Code being a method to prolong business entities which are encountering temporary problems.

secured creditors were able to file motions for relief from the automatic stay,[20] which was quite common.[21]

Table 2
Status of Chapter 11 Cases Filed 1979 through 1986 by Calendar Year (percentages as of January 31, 1989)*[22]

These values are from the Administrative Office of the United States Bankruptcy Courts: Division of Bankruptcy.

Status of Chapter 11 Filing	1980	1981	1982	1983	1984	1985	1986
Pending in Chapter 11	15.2	17.2	18.6	20.1	25.4	32.2	42.8
Pending in Chapter 7	7.6	8.9	9.1	9.3	10.6	11.4	10.7
Pending in Chapter 12 or 13	0.3	0.2	0.2	0.3	0.3	0.4	0.6
Total still Pending	23.0	26.3	27.9	29.7	36.2	44.0	54.0
Total Closed as of January 31, 1989							
Closed in Chapter 11 after Confirmation	8.5	6.3	5.5	4.7	3.6	4.1	1.4
Closed in Chapter 11 without Confirmation	26.7	31.2	34.7	38.4	36.5	34.8	32.4
Closed in Chapter 7 with Creditor Payments	19.0	14.7	10.6	7.9	5.5	2.5	1.2
Closed in Chapter 7 without Creditor Payments	19.4	19.8	19.3	17.7	17.1	13.4	10.4
Closed in Chapter 12 or 13 with Payments	2.5	0.8	0.9	0.6	0.3	0.2	0.2
Closed in Chapter 12 or 13 without Payments	1.0	1.1	1.1	1.1	0.8	0.6	0.5
Total Closed	77.0	73.7	72.1	70.3	63.8	56.0	46.0
Total Chapter 11 Cases Filed	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Status is as of the calendar year the Chapter 11 case was filed.
Source: Modified from Flynn, E., "Statistical Analysis of Chapter 11," Administrative Office of the United States Bankruptcy Courts: Division of Bankruptcy, October 1989

The numbers in the previous table do not form an image of an quick process. Chapter 11 is a very slow process that has occasionally ended with a confirmation of a plan of reorganization as a going concern. Over the seven years studied, a large percentage of cases remain open after years of bankruptcy court protection.[23] Nevertheless, the overall numbers do give some insight into the absolute effectiveness of Chapter 11 of the Code.[24]

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20 In addition, primarily in the cases of businesses without limited liability (e.g., partnerships and sole proprietorships), secured creditors can file a motion to compel the abandonment of estate property.

21 For example, during 1988, approximately 195,000 of these motions were filed. There are no statistics on the disposition of these motions.

22 Taken and modified from Flynn [1989, p. 8].

23 Keeping in mind that the minimum amount of time passed of the seven years shown was three years (i.e., cases filed in 1986 but not resolved as of 1989).

24 Based on a normal distribution of the 1,516 cases examined, as of June 1990, 0%, 0%, 0.3%, 0.4%, 0.9%, 2.5%, 6.9%, and 16.8% of Chapter 11 cases filed in 1979, 1980, 1981, 1982, 1983, 1984, 1985, and 1986, respectively, could be expected to still be pending with hope of successfully exiting Chapter 11.

> The substantial number of firms emerging from Chapter 11 that are not viable or need further restructuring provides little evidence that the process effectively rehabilitates distressed firms and is consistent with the view that there are economically important biases toward continutation of unprofitable firms.
> Hotchkiss' [1995, p. 3]

Finally, there is additional evidence to suggest that even the larger companies which tend to successfully emerge from court protection do not fare well. Hotchkiss [1995] finds that of a sample of 197 public companies that emerged from Chapter 11[25]: (1) over 40% continued to experience operating losses in the three years following their emergence, and (2) 32% reenter bankruptcy or privately restructure their debt. The general conclusion is that the management responsible for bankruptcy, if left in place, tends to exacerbate negative performance.[26] In addition, the evidence generally supports the view that Chapter 11 is biased toward reorganization over liquidation.

2.4 The Doctrine of Absolute Priority

> Nevertheless, the absolute priority rule and its rhetoric stand in distinct contrast to the distrust of market mechanisms and *ex ante* bargains that pervades both the practice of bankruptcy and discussions of bankruptcy policy.
> Baird and Jackson [1988, p. 738]

The application of the doctrine of absolute priority directly affects the valuation of the securities of distressed firms.[27] The doctrine of absolute priority calls for the administrative expenses of the bankruptcy to be paid first (e.g., court fees and legal bills), priority claims second (e.g., unpaid taxes, wages, and social security payments),

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25 The 197 firms were derived from an initial sample of 806 public firms filing for Chapter 11 between October 1979 and September 1988. Therefore, only 24% emerged from bankruptcy and continued to file financial statements with the Securities and Exchange Commission (SEC). See Hotchkiss [1995, p. 6-7] for sample details.

26 Khanna and Poulsen [1995] find that managers of bankrupt firms are not responsible for bankruptcy (i.e., Chapter 11). They find that, three years previous to filing for Chapter 11, bankrupt firm managers' actions do not differ significantly from non-bankrupt firm managers' actions. Although, their results do not explain the fact that firms which go bankrupt, by definition, tend to economically underperform their competitors.

27 Although, there has been a study examining the ability of firms to shift relative priorities through time by forming captive finance subsidiaries (see Kim et al. [1977]). Kim et al. [1977, p. 808] found the following: "the empirical evidence indicates that stockholders have on average earned excess returns and old bondholders have suffered windfall losses when firms have formed captive finance subsidiaries." Kim et al. found that "creditors' income claims may be abridged not only through formation of captive finance companies, but also through other financial manipulations that do not violate 'normal' indenture agreements." In short, violation of priority can occur well before distress ensues.

unsecured creditors third (e.g., low-grade debt and trade debt), and equity last, if anything remains. Secured creditors have a right to claim their security (e.g., a particular asset such as a machine), and are therefore outside the ordering. In theory, those with higher priority should be fully satisfied before lower priority creditors are satisfied. In the U.S. this rarely happens, except in smaller bankruptcies.[28] The figure below provides a clear list of the priority of claimants in Chapter 11. Indirectly, this thesis will be particularly concerned with the recovery in or out of bankruptcy of unsecured claimants.

Figure 1

Hierarchy of Claims in Chapter 11 (Most Senior to Most Junior)

Hierarchy of Claims in Chapter 11

1) Secured claims
2) Superpriority claims (e.g., debtor-in-possession financing)
3) Priority claims
   - 3a) Administrative expenses (including legal and professional fees incurred in the case)
   - 3b) Wages, salaries, or commissions
   - 3c) Employee benefit claims
   - 3d) Claims against facilities that store grain or fish produce
   - 3e) Consumer deposits
   - 3f) Alimony and child support
   - 3g) Tax claims
   - 3h) Unsecured claims based on commitment to a federal depository institutions regulatory agency
4) General unsecured claims
5) Preferred stock
6) Common stock

Source: Gilson, S., "Investing in Distressed Situations," Financial Analysts Journal, November-December 1995, p. 10

In the U.S. the doctrine of absolute priority has not been strictly followed by the courts. Legal scholars often point to the decision rendered in the case of Northern Pacific Railway versus Boyd[29] as a justification for this result. In that case a group of subordinated creditors was "frozen out" while a group of former shareholders were granted some ownership rights (see Baird and Jackson [1988, p. 744-747]). It is the observation that managers often combine with bank debt to the economic detriment of intermediate creditors and the firm which seems to indicate suboptimal behavior for

28 See White [1991] for a good treatment of the differences between the U.S. and European bankruptcy codes, and their theoretical effects on incentives by large and small companies to file.
29 228 U.S. 482 (1913).

society,[30] and poor recoveries for bondholders. Historic low-grade debt recovery rates and step-downs would indicate this ruling still influences negotiated and nonnegotiated settlements in distress.

As the literature in the area is reviewed, it will be clear that deviations from absolute prioity are the rule in large bankruptcies. Therefore, it is clear that risky securities are impacted by court rulings which tend to encourage or discourage deviations from absolute priority. This thesis is not primarily concerned with the social impact of deviations from the legal doctrine of absolute priority (e.g., Scott [1977]).[31] This thesis is indirectly concerned with the impact and predictability of deviations from absolute priority over time and across seniority of instrument (i.e., specifically, impacts which might affect the pricing of risky debt in particular).

The first published work to study low-grade debt and deviations from absolute priority was by Hickman in 1958.[32] Even though deviations from absolute priority were not the focus of the study, Hickman [1958] reported default losses by lien position (i.e., secured versus unsecured debt). Whereas Hickman detailed recoveries after default for senior and unsecured debt, the majority of the finance literature which followed his work reported and analyzed deviations from absolute priority for equity versus bonds in the reorganization plans of Chapter 11 firms.

Warner [1977b, p. 331] found that "there are substantial deviations from the doctrine of 'absolute priority'", but that the bond markets generally seem to price bankrupt debt appropriately with respect to its risks. Although, Warner [1977b, p. 364] found that "while the market appears to have been characetrized by an absence of gross inefficiencies in the 1935-1939 and 1943-1955 periods, *ex ante* profit opportunities may well have been available to investors who bought the sample bonds in the early 1940's." Warner's sample was based on 73 bonds of 20 railroad companies which filed under Section 77 (a special railroad section of the bankruptcy code, this Amendment was enacted in 1933) of the Bankruptcy Act of 1898. The sample included railroads

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30 Absolute priority among the senior securities of related companies may not even hold. That is, the senior debt of a parent holding company may not be as relatively valuable as the subordinated securities of an operating subsidiary (see Monaghan and Ross [1989, p. 2-4])

31 In addition, Eberhart and Senbet [1993] argue that absolute priority violations are useful in reducing agency conflicts between stockholders and bondholders caused by financial distress. Using CCA, they show that absolute prioity violations can be useful in controling risk-shifting caused by financially distressed firms (i.e., specifically stockholder-oriented management taking on risky projects that they wouldn't take on if they couldn't shift the risk to bondholders). Although this may be true within the context of simplified CCA approach, it still begs the point that it may be more efficient from a social welfare perspective to enforce creditor claims and absolute priority in the first place.

32 This study emphasized bond returns to rating (see Hickman [1958]).

which had initiated and terminated bankruptcy proceedings between 1930 and 1955, and had bonds traded on the NYSE after 1925 and at some point prior to filing for bankruptcy. The focus of the study was determining whether distressed bonds were efficiently priced. That is, whether deviations from absolute priority were impounded into security prices before and after the bankruptcy filing. Market efficiency would imply that the probability of bankruptcy and possible deviations from absolute priority should be impounded into pricing. It was found that by buying the sample railroad bonds in the month following the bankruptcy petition, abnormal returns were generated over a period of a year (Warner [1977b, p. 355-361]). These abnormal returns were explained as being the result of changes in regulations over the period 1940 through 1942. Warner made reference to two specific court cases which he felt may have significantly impacted bankrupt bond pricing during the study period (i.e., the DuBois case, and especially the Milwaukee case), because they resulted in "unanticipated" transfers of wealth between claimants (bondholders and shareholders). Interestingly, the deviations from absolute priority occured prior to the Code (i.e., 1978), which is generally believed to favor creditors more than stockholders.

Franks and Torous [1989] also found large deviations from absolute priority. Unlike previous studies, their study focused on analyzing deviations from the perspective of stockholders receiving consideration from bondholders (see e.g., Bebchuk and Chang [1992] on the dynamics as to how stockholders and managers are able to extract value from bondholders during Chapter 11). Their study is based on a sample of 30 firms which emerged from Chapter 11 (or its pre-1978 equivalent Chapter X) during 1970 through 1984. Note, that like all finance work in the area, the sample is baised toward large public companies. Two general arguments are put forward to explain these deviations in favor of stockholders. First, it is suggested that certain debtor rights, for example the period of exclusivity, confer upon stockholder-oriented management the implicit threat to impose costs which creditors must pay to avoid (i.e., an equity option(s) argument). Therefore, deviations represent creditors purchasing the option(s) before expiration in order to avoid certain costs being imposed. Alternatively, based on Baird and Jackson [1988], it is suggested that these extractions of value from bondholders are the result of stockholder-oriented management's ability to preserve firm value. Thus, the deviations represent a recontacting between creditors and stockholders which recognizes stockholder-oriented managements' ability to preserve value. Given the evidence of the preformance of entrenched management in large publicly traded bankrupt firms, it is unlikely the Baird and Jackson [1988] rationale is a realistic one (see e.g., Hotchkiss [1995]). By their definition of deviation, 21 of 27 firms experienced deviations from absolute priority. Also, Franks and Tourous [1989,

p. 754] may not have picked up other deviations because seniority is sometimes unclear. In short, one problem with all of the absolute priority studies which attempt to specify deviations from priority is the difficulty of defining seniority itself, which may result in biased and/or inaccurate results. It is clear that, at least for large publicly-traded firms, large deviations do exist.

Weiss [1990] examined 37 large publicly traded firms which filed under Chapter 11 of the Code between November 1979 and December 1986. Following Franks and Torous' [1989] analysis of stockholder/bondholder deviations, he found that absolute priority was violated in 29 of 37 cases. In addition, Weiss extended the analysis to break out secured and unsecured creditors. As expected, the violations of absolute priority tended to occur between unsecured creditors and stockholders. Secured creditors claims were upheld in 34 of 37 cases. Weiss [1990, p. 296] stated that: "lawyers indicate that two factors, firm size and location of bankruptcy, are important in predicting whether priority of claims will be violated."[33] Larger bankruptcies are considered to be more complex and thus present smaller lower priority creditors with more opportunities to extract concessions from other creditors. Lawyers claim that different bankruptcy courts and judges treat different classes of debtors differentially. Therefore, even though federal bankruptcy law was intended to be applied uniformally, different judges are expected to sytematically skew deviations from absolute priority in their own way (e.g., the Southern District of New York).

Eberhart et al. [1990] analyzed whether equity markets forecast deviations in absolute priority, and attempted to explicitely model the stockholder delay option mentioned in Franks and Torous [1989]. Their study was based on a sample of 30 large publicly held companies which filed under and emerged from Chapter 11 of the Code over the period 1979 through 1986. Unlike Franks and Torous [1989] who used a measure of deviation focusing on the creditor deficit, Eberhart et al. [1990] used a measure of deviation which measured deviations from the proportion of firm value distributed to common stockholder in excess of that specified by absolute priority. Like the previous stockholder based studies on absolute priority deviation, they found numerous and significant deviations from absolute priority for stockholders. In addition, they found support for the hypothesis that equity markets generally forecast deviations from absolute priority. Based on their own methodology, Eberhart et al. [1990, p. 1468] found only "modest support for the notion that shareholders are paid more for forfeiting their delay option early." Although, they pointed out that errors in

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33 Also, see Weiss [1991].

measurement of their delay variable may have caused the statistical significance of their findings for the delay option to be understated.

Eberhart and Sweeney [1992] examined the efficiency of the corporate bond markets with respect to Chapter 11 filings for 74 large publicly traded firms (187 bonds) which filed for Chapter 11 protection after October 1, 1979 and emerged from court protection between 1980 and 1990. In addition, they examined the degree to which the corporate bond markets, as of the bankruptcy filing month, anticipated departures from absolute priority. Although large deviations from the initial estimates are found and there appears to be some positive bias, they do not appear to be significantly positively or negatively biased. Also, based on average cumulative abnormal return (ACARs) and price unbiasedness tests, they concluded that the market for bankrupt corporate bonds is informationally efficient. Although, they provide some results which contradict the conclusion of informational efficiency. In addition, their estimates of market model alphas seem to drive their results (see Eberhart and Sweeney [1992, p. 970-975]). Overall, it is difficult to comment on the impact of the study on research in the area.

Fabozzi et al. [1993] examined the deviation from absolute prioity for the following three broadly defined groups of creditors: (1) secured creditors, (2) unsecured creditors, and (3) equityholders. The sample consisted of 26 firms which emerged from Chapter 11 between September 1988 and March 1990. Based on Weiss' [1990] group classification methodology, they found that absolute priority was violated in 22 of 26 cases. Absolute priority between secured and unsecured creditors was violated in 10 of 22 cases, and between unsecured creditors and equityholders in 20 of 22 cases. In addition, Fabozzi et al. [1993, p. 7-8] point out that net operating losses (NOLs) can have a significant impact on reorganization plan payouts. As long as there is no ownership change a firm's pre-petition NOLs will not be limited post-petition (this will be covered in more detail later in the chapter). Therefore, it is possible that violations of absolute priority are also affected by the tax laws addressing NOL carryovers.

Franks and Torous [1994] compared deviations from absolute priority for firms which had confirmed restructuring plans under Chapter 11 of the Code and firms which completed distressed out-of-court restructurings. The sample was composed of 45 distressed exchanges and 37 Chapter 11 reorganizations over the period 1983 through 1988. Again, the sample was composed of large publicly traded companies. Not only are recoveries for creditors higher in out-of-court restructurings than in-court restructurings (i.e., formal Chapter 11s), but equity/bondholder deviations from absolute priority are greater for out-of-court restructurings than in-court restructurings. Franks and Torous [1994, p. 362] find that, on average, equity holders receive 2.3% of the reorganized firm for in-court restructurings versus 9.5% for out-of-court restructurings. The determinants of the cross-sectional variation of equity deviations from absolute priority were hypothesized to include: (1) the value of shareholder-oriented management's option to delay repayment of creditor claims, (2) management turnover (which is higher in Chapter 11s than out-of-court restructurings), and (3) the complexity of bargaining. Equity deviations were found to be primarily positively determined by firm size (as measured by liabilities) and negatively determined by whether it was an in-court rather than an out-of-court restructuring. Therefore, the larger the firm the greater the expected positive deviation from absolute priority in favor of stockholders, and there seems to be an added benefit to stockholders by avoiding formal bankruptcy. Oddly, stockholders seem to be able to garner more benefit by avoiding that which gives them formal bargaining power (i.e., Bankruptcy Court protection). In addition, given that equity deviations tended to increase with firm size, this suggests that larger firms have relatively more to lose by not recontracting with shareholder-oriented management in a timely fashion. Thus, the relative costs of distress must be higher for larger firms.

Betker [1995a] examines the cross-sectional determinants of absolute priority violations in favor of equity for 75 firms which emerged from Chapter 11 during 1982 through 1990. Betker [1995a, p. 162] notes that it is usually assumed that managers act in the interests of stockholders during the Chapter 11 process (e.g., Bulow and Shoven [1978], Brown [1989], and Giammarino [1989]). In actuality, there may be agency problems between stockholders and managers. The Betker [1995a] study extends the research on the determinants of absolute priority violations performed by Eberhart et al. [1990] and Franks and Torous [1994] (both of which had significant results for firm size). Absolute priority violations are modeled as a function of the following: (1) relative allowed claims (i.e., claims divided by the estimated value of all securities on emergence), (2) percentage of claims held by priority, secured, and bank creditors, (3) total assets prior to emerging from bankruptcy (i.e., firm size), (4) number of creditor classes, (5) creditor concentration (a Herfindahl index of creditor claims), (6) Southern District of New York dummy, (7) percentage of firm shares held by the pre-reorganization plan CEO, (8) original CEO replaced dummy, (9) original CEO shares, (10) replacement CEO shares, (11) CEO pay dummy (if CEO pay increased during plan confirmation period), (12) equity committee dummy, (13) creditors firing CEO dummy, and (14) lost exclusivity dummy. The regression results suggest that absolute priority violations in favor of equity are at least in part determined by: (1) relative allowed claims (- relationship, p-Value < 1%), (2) percentage of claims held by priority creditors (- relationship, p-Value < 1%), (7) percentage of shares held by CEO (+ relationship, p-Value = 1%) or (9) original CEO shares (+ relationship, p-Value = 1%), (11) CEO pay dummy (- relationship, p-Value ≤ 1%), and (14) lost exclusivity dummy (- relationship, p-Value ≤ 6%). Of more interest might be those variables which were not statistically significant. For example, in Betker's broader model, equity violations were not determined by firm size, creditor concentration, or creditor claims complexity. In addition, the positive relationship between CEO shares and absolute priority violations in favor of equity gives strong support to the argument that managers do exercise considerable power in the renegotiation of claims in bankruptcy. Overall, the results support the critics of the Chapter 11 process as one which appears too lenient on incumbent management (see Betker [1995a, p. 182]).

2.5 Default Recovery Rates by Capital Priority

Given the importance of low-grade debt to this thesis, this section will present some values on default[34] recoveries for various levels of seniority. The following two tables provide some background on the loss rate of various defaulted low-grade bonds, according to seniority in the capital structure, and year of default. Note that historically, assuming issuance at par, the price decline of defaulting issues from January of the year default occurred to the default date has been approximately 40% over an average number of 5.73 months before default, compared with an approximately 61% decline from the original issue date to the date of default (Altman [1987, p. 22]).

[34] Default here is generally defined to include any stoppage of coupon payment(s), which is not cured within 30 days (e.g., see Gomez et al. [1991]).

Table 3

Original Issue Low-Grade Debt Default Losses (Salomon Brothers' Numbers)

These values are from Salomon Brothers.

	Debt Seniority in Capital Structure					
Year	Senior Secured	Senior Unsecured	Senior Subordinated	Subordinated	Junior Subordinated	Overall
1979	NA	NA	NA	$38.00	NA	$38.00
1980	NA	NA	NA	43.00	NA	43.00
1981	NA	NA	NA	40.00	NA	40.00
1982	NA	$41.50	$40.00	36.00	NA	38.14
1983	NA	NA	NA	36.75	NA	36.75
1984	$43.00	NA	35.00	36.42	NA	36.83
1985	83.00	77.00	31.41	33.25	NA	36.53
1986	62.00	41.33	29.67	39.32	NA	37.91
1987	57.00	49.57	41.71	38.11	NA	43.73
1988	87.00	81.42	30.83	36.91	$55.00	43.03
1989	70.88	35.51	32.84	25.76	35.38	36.30
1990	42.79	34.30	32.30	20.55	16.63	30.63
1991	41.20	31.85	38.43	30.26	8.25	33.42
77-91	$54.76	$40.18	$34.08	$31.26	$22.97	$35.54

Source: Salomon Brothers, Original-Issue High-Yield Default Study - First Half of 1991, High Yield Research Department, August 2, 1991

Table 4

Average Recovery Prices for Low-Grade Defaulted Debt (Altman's Numbers)

These values are from Merrill Lynch Corporation.

	Debt Seniority in Capital Structure				
Year	Secured	Senior	Senior Subordinated	Subordinated Cash Pay	Subordinated Non-Cash Pay
1985	$74.25	$34.81	$36.18	$41.45	NA
1986	48.32	37.09	37.74	31.58	NA
1987	12.00	70.52	53.50	40.54	NA
1988	67.96	41.99	30.70	35.27	NA
1989	82.69	53.70	19.60	23.95	NA
1990	35.04	32.02	24.04	17.93	$18.99
1991	54.50	58.15	34.62	20.28	21.06
1985-1991	$60.51	$52.28	$30.70	$27.96	$19.51
Observations	(41)	(164)	(107)	(158)	(16)

Source: Merrill Lynch, "Defaults and Returns on High Yield Bonds," High Yield Securities Research, March 6, 1992. These values were based on a study done by Altman.

Over the last 13 years, the actual recovery percentages obtained by holders of defaulted low-grade debt were approximately 36 cents on the dollar. Note, at times seniority did not guarantee larger payments for legally more secure debtholders. Neither table has a security class which had larger recovery values than a lower class in every year. Over the 1980s, capital priority did not strictly determine the recoveries for the various classes of low-grade debt. In addition, average step-downs over the 13 year period of the first table seem to run counter to the doctrine of absolute priority.[35] The fact that legal seniority did not guarantee recovery seniority is an area for future research.

2.6 The Doctrine of Fraudulent Conveyance

> Unsecured creditors are increasingly likely to use fraudulent conveyance statutes to attempt to reduce or eliminate bank's senior secured position in failed LBOs. Smith [1991, p. 1]

The doctrine of fraudulent conveyance is another legal doctrine affecting the valuation of distressed securities. Although, it has not received as much attention in the finance literature as the doctrine of absolute priority (actually, to date no empirical finance studies have focused on this doctrine).

Essentially, fraudulent conveyance is a transfer of value from one creditor(s) with intent to defraud that creditor(s).[36] The situation of fraudulent conveyance exists whenever a transfer of value from a creditor(s) occurs and the value received in consideration was not of an equal value, which then renders the debtor insolvent (see Weil et al. [1991a] for an example where the ruling required rendering of insolvency even though the transfer of value was fraudulent). This is typically the case in leveraged buyouts ("LBOs") where fraudulent conveyance issues can occur due to the technique of using the assets of the company being acquired to repay all or part of the old stockholders' interests.[37] The future earnings of the acquired company are typically used to pay off debtholders (see Ammidon and Doyle [1989]). Obviously, if future operating earnings become insufficient to pay off creditors (i.e., an event of default), fraudulent conveyance is a strong possibility. Ultimately, in the case of a failed LBO, the question of fraud is often one of the accuracy of the business projections made by the acquiring firm (see Michel and Shaked [1990, p. 45-49] for

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35 The step-downs from senior secured to senior unsecured, senior unsecured to senior subordinated, senior subordinated to subordinated, and subordinated to junior subordinated were approximately 73%, 85%, 92%, and 73% respectively.

36 See Landy et al. [1992] for a general description of fraudulent transfers and various remedies and/or courses of action available to low-grade bondholders.

37 For additional background on LBOs as they relate to low-grade debt financing in the 1980s: (1) see Ammidon and Doyle [1989] for background on the degree of financial risk in the early stages of a low-grade debt financed LBO; (2) see Hanley et al. [1988] for deal structure; (3) see Ross [1988] regarding negative pledge clauses which in theory increase the value of low-grade debt; (4) see Muscarella and Vetsuypens [1990] regarding the profitability of what they incorrectly call "reverse LBOs", and (5) Kaplan and Stein [1990] for a thorough study of the change in equity betas during and after an LBO.

an example of a case). A large number of low-grade securities are those of former failed LBOs.

Although sections 544 and 548 of the Code deal with alleged fraudulent conveyances, they have not been implemented to the extent that the Uniform Fraudulent Transfer Act and the Uniform Fraudulent Conveyance Act have.[38] In much the same way prepackaged Chapter 11s have recently changed the Chapter 11 process for creditors, fraudulent conveyance[39] has had some influence on the Northern Pacific v. Boyd ruling regarding absolute priority. "According to the floor statements concerning 1129(b) of the Bankruptcy Code, it always violates the absolute priority rule to 'skip over' a dissenting class (Baird and Jackson [1989, p. 776-777])." Fraudulent conveyance is an effective method of not only enforcing absolute priority (i.e., enforcing 1129(b)), but also achieving a new level of priority for a victorious bondholder. In cases where fraudulent conveyance is found, claims are then "equitably subordinated" to those of the injured party's.[40] Since the Code's inception, there has been an attempt by some low-grade bondholders to enforce the fraudulent conveyance laws which have existed on the books for some time and appear to contradict the Northern Pacific v. Boyd ruling (see Smith [1991]). The most successful cases for subordinated bondholders have been applying fraudulent conveyance to LBO situations. By definition, almost any failed LBO can be considered a fraudulent conveyance (see Michel and Shaked [1990] regarding this particular point and an extreme example of a successful fraudulent conveyance case for unsecured creditors).

Fraudulent conveyance risk hinges in large part upon the differential between GAAP and legal definitions of insolvency. The Uniform Fraudulent Conveyance Act defines insolvency as:

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38 It is hard not to comment on the notion of two "uniform" acts. Apparently, the more recent act is the more applicable of the two.

39 Historically, the following three sets of laws have been attributed with the responsibility for establishing the legal doctrine of fraudulent conveyance: (1) Statute of 13 Elizabeth [1571], Uniform Fraudulent Conveyance Act [1918], and (3) Uniform Fraudulent Transfer Act [1985].

40 That is, the doctrine of equitable subordination is applied. Section 510(c) of the Code authorizes the use of the doctrine of equitable subordination, but leaves its specific application to the discretion of the bankruptcy judge (see Weil et al. [1991b, p. 3-6]). It was intended to be applied to claims of the same type.

> A business is insolvent when the present fair saleable value of its assets in a reasonably prompt sale is less than the amount that will be required to pay its probable liability on its existing debts as they become absolute and matured. For the purpose of this definition all debts are considered whether mature or unmatured, liquidated or unliquidated, absolute, fixed or contingent.
> Uniform Fraudulent Conveyance Act [1918]

Essentially, the legal definition of insolvency includes off-balance-sheet items and real intangibles.[41] In cases where there are relatively high levels of off-balance-sheet items and high levels of real goodwill, the spectre of fraudulent conveyance appears. The typical LBO of the 1980s fits that description (again, see Ammidon and Doyle [1989]). If the risk of fraudulent conveyance has an impact on security valuation it should appear in market valuations, particularly for distressed low-grade debt which include a large number of failed LBOs. As Smith accurately stated:

> Whenever there is a Chapter 11 or a Chapter 7 filing, the creditors-the creditors committee in particular-look back in time at transfers and transactions that occurred prior to the filing, and see if there is a potential claim of fraudulent conveyance that they can bring against some deep pocket. And then when the course of the Chapter 11 proceeding is being worked out, in a plan, for instance, usually those claims are then resolved and releases are exchanged.
> Smith [1991, p. 2]

Previous studies have failed to point out the wide array of laws contributing to the uncertainty facing distressed security holders in the U.S. In addition to absolute priority and fraudulent conveyance, there are other parts of the Code which can affect valuation.

2.7 Debtor-in-Possession ("DIP") Financing

The Code (sections 364(b) and 364(c)) allows for the subordination of prepetition claims to postpetition debt, commonly referred to as DIP financing.[42] In cases where DIP financing is applied to cases where negative net present value projects are being

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41 Michel and Shaked [1990, p. 45] also make this point. They seem to indicate that in order for an LBO's secured creditors to protect themselves from equitable subordination they should "make a good faith effort to determine the fair saleable value of the firm's assets and its total liabilities as of the date of the LBO." In reality, this is easier said than done. Much of the law in this area is so contestable because it is hardly ever clear what the "fair" value of the assets are.

42 This is known as "priming", or coming ahead in priority of the prepetition debt.

taken on, it suboptimally reduces the value of prepetition claims.[43] Although DIP debt is issued when Chapter 11 occurs, it is not clear whether it should be considered distressed debt. DIP debt enjoys the next highest priority, just behind the government, and normally has a very short maturity (see Altman [1991b]).[44] Its importance to the low-grade debt of very distressed companies lies in the presumption that it is required to work a company out of bankruptcy.[45]

DIP financing is often intended to be used in situations where a bankrupt firm's senior and subordinated debt are at the holding company level, while trade debt is at the operating company level (see Rohman and Policano [1990, p. 98]). Subordinated debt covenants typically prohibit any other debt at the operating subsidiary level. These covenants are effectively nullified once a company enters Chapter 11. Through bankruptcy court approval, Chapter 11 effectively takes security away from subordinated lenders and frees it up to be pledged to senior secured lenders. DIP financing is an extension of the theory that large firms with assets pledged to subordinated lenders should be allowed to continue to operate. It may also be a partial explanation behind some of the findings in Chapter 4. Often, firms which have elected to enter the court protection afforded by Chapter 11 of the Code have already lined up DIP financing before filing.[46] DIP financing would seem to be another tool given to management which may tend to reduce the value of prepetition debt, particularly unsecured subordinated debt. As Rohman and Policano [1990, p. 99] point out: "the mere fact of having a new lender ready to provide financing on the eve of a Chapter 11 filing puts management in a stronger position relative to existing lenders."

"A typical DIP loan is an oversecured, revolving credit facility with a maturity of up to two years (Altman [1991b, p. 28])." Can a loan be "oversecured" and still be of real economic value to a company in Chapter 11? More specifically, does the ability of a firm to receive DIP financing indicate a higher than average probability for emergence

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43 This is due in large part to the bankruptcy judge's assumption that managers are better informed than creditors to decide on DIP financing. In practice, this often happens (e.g., Microband, which filed under Chapter 11 of the Code was allowed DIP financing which later received almost all the liquidated value of the company).

44 This short maturity may not just be due to the premise that it is only required to overcome a temporary liquidity crisis. Section 546(a) of the Code places a two year statute of limitations on a trustee's ability to recover property previously transferred by the debtor (Weil et al. [1991b, p. 10]). The tendency for the DIP loan to have a maturity of two years may be in large part to avoid questions of prepetition or postpetition fraud.

45 DIP financing has never been academically studied, even though "during the first nine months of 1990, over $43 billion of DIP financing for bankrupt firms" was arranged (Altman [1991b, p. 29]). It is a large financial market with little public information. Also, due to tax reasons, many of the firms operating in the U.S. are overseas banks.

46 This is known as "filing on a pillow."

from Chapter 11? That is, does DIP financing help creditors, or does it signal management's willingness to prolong bankruptcy? These issues have not been researched. The issue of the economic value of DIP financing is an area for future research, but one that is beyond the scope of this thesis.[47] Besides specific laws affecting valuation, certain cases have had significant impacts on valuation. The most significant may be the LTV Case.

2.8 The LTV Case

The July 17, 1986 filing of bankruptcy by the LTV Steel Company was a watershed for efforts to restructure companies in the wake of many failed low-grade debt LBOs of the 1980s, and like the Penn Central bankruptcy it generated a large amount of research. At the time it was one of the largest restructurings, and as of 1986 the largest bankruptcy in U.S. history.[48] It discouraged the use of restructurings, and contributed to the later switch to prepackaged Chapter 11s (see Ma et al. [1989] and Tashjian et al. [1996, p. 154-155]). Essentially, the LTV bankruptcy court ruling required marking to market any claims exchanged in a restructuring, at the time of the restructuring, but maintained the status of nonexchanged securities. Thus, as was the case with the LTV Company, if an exchange is made but the company subsequently files for bankruptcy, all exchanged debt will be marked to market at discounted market prices as of the restructuring while all nonexchanged debt will remain at par value when the plan of reorganization is made and proposed payments to creditors are decided upon in that plan. The problem only occurs if subsequent to an exchange the debtor files for bankruptcy.

The LTV ruling effectively applied original issue discount ("OID") to the securities of restructured companies. Normally, OID is the difference between the amount exchanged for a debt instrument and its face amount. Applying OID to bankrupt company debt was the result of applying Paragraph (2) of Section 502(b) of the Code.

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47 Prior beliefs on the matter tend toward the belief that DIP financing is a net real detriment to large bankruptcies, and a net real positive for smaller firms filing under Chapter 11. Managers of larger firms may tend to use the extra time gained to their advantage and to the detriment of creditors.

48 The LTV bankruptcy filing has another less heralded claim to fame. It is responsible for section 1114 of the Code, which gives retirees retroactive priority in bankruptcy. After entering bankruptcy, the LTV corporation announced the termination of all medical and life insurance benefits of all of its retirees. "Section 1114 gives retirees special priority status - they're allowed to stand ahead of unsecured creditors (Lyons [1991, p. 104])." This is just another example of the volatile nature of claims under the U.S. Bankruptcy Code. One day a claim is subordinate, the next it has superpriority and all other claims are worthless.

This part of the Code disallows claims for the accrual of interest, since a bankruptcy petition accelerates principal and suspends the accrual of interest (see Chapman and Cutler [1990, p. 26] for details and case rulings on the matter). To illustrate, consider the following example: an exchange is made for a bond with a par amount of $500 for a bond with a par amount of $1,000 which subsequently trades at $250. If a bankruptcy ensues, based on the LTV ruling, that claim would be valued at $250 plus accrued interest. Nontendering bondholders could claim $1,000 per bond plus accrued interest. The LTV ruling discouraged the use of out-of-court restructurings, and thereby exacerbated the holdout problem.[49]

Ma et al. [1989] studied the "resiliency" of the low-grade debt market by examining implied default rates before and after the LTV bankruptcy. They found a significant increase in implied default premiums which lasted approximately six months after the bankruptcy filing date. The Ma et al. [1989] study supported the contention that whether transitory or permanent, the effects on the valuation of low-grade debt of large bankruptcy filings are real. Also, large bankruptcy court case decisions probably have a large impact on perceived probabilities of negotiated settlements, which in turn have an impact on security valuation in distress. This later possibility has not been researched, and is beyond the scope of this thesis. It is important to note that not only do specific laws impact valuation, but cases do as well. Also, in addition to court cases, certain S.E.C. rules affect low-grade security valuation.

2.9 Rules Regarding the Trading of Private Placements (S.E.C. Rules 144A, Amended Rule 144, and Regulation S)

The U.S. private placement market is one of the largest financial markets in the world. The relevant low-grade portion of that market is estimated to be larger than the relevant low-grade portion of the public corporate debt market (Altman [1991b, p. 4-12]). Given that private placement securities are not traded on public exchanges, rules restricting trading are very important to liquidity available in that market.[50] To the

49 In theory it is possible to avoid the OID problem by either of the following two types of legal methods: (1) amend the existing indenture in an attempt to claim there has been no exchange, and (2) get a court order stating that there is no OID.

50 See Silber [1991a & 1991b] regarding the overwhelming influence of Rule 144 on the pricing of restricted equities. His "results indicate that marketing a large block of illiquid securities requires significant price concessions to investors, even firms with substantial creditworthiness [p. 11]." He indicates that he is not quite sure why any firm would offer securities restricted by Rule 144 in the first place, given the cost.

extent that the low-grade debt market includes low-grade private placements, rules 144, 144A, and Regulation S are very important to the low-grade market.[51]

To provide some background as to the size of the market, Tice [1989, p. 4] reported that in 1980, 968 issues were placed with an average transaction size of $16 million (i.e., about $15 billion), in 1988, 3,516 issues were placed with an average size of $57 million (i.e., about $200 billion). Most of these issues were not and are not rated by the ratings agencies. Many of the issues in this market are considered low-grade.

The Securities Act of 1933 established the basic foundation for the private placement market, but it did not provide for the trading of privately placed securities to individuals which were considered "unsophisticated". Institutions, particularly insurance companies, dominate the private placement market.[52] Rule 144 of the 1933 Act created an exemption for the trading of publicly registered private placements between institutions, after a holding period of at least two years. In 1988 a proposal to update Rule 144 was made by the S.E.C.

In 1988, the S.E.C. published for comment Rule 144A, which would exempt registration requirements for institutional investors. This would eliminate the holding period requirement and the inability to resell privately placed securities for institutions. It would generally increase the liquidity in the market.[53] Since the original publishing of Rule 144A, the S.E.C. has subdivided institutional buyers into tiers based on investment portfolio size.

Also in 1988, the S.E.C. published for comment an amendment to Rule 144 and Regulation S. Currently, each time a private placement is sold, the holding period is reset. Therefore, after purchasing a security that was held over two years, the institution purchasing the security must wait another two years before they are permitted to sell the security. The proposed amended Rule 144 would eliminate the practice of beginning new periods each time a private placement is sold. The holding period would be counted once from time of original issuance. Regulation S would exempt the resale of U.S. private placements outside the U.S. Thus, Regulation S would make it relatively easy for foreign investors to purchase U.S. private placements as long as they were issued outside the U.S. These proposals would

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[51] For details on these rules see Tice [1989].

[52] Zwick [1980, p. 24-25] stated that life insurance companies hold "about two thirds" of private placements and essentially dominate the market.

[53] Zwick [1980, p.23] found that over the period 1961 through 1977 the average spread between privately placed bonds and comparable publicly issued bonds was approximately 50 basis points.

substantially increase the liquidity of the private placement market for low-grade and high-grade debt.

2.10 Prepackaged Chapter 11s, Reorganizations, and Restructurings

Section 1126 of the Code allows for both out-of-court restructurings and prepackaged Chapter 11s (see Salerno and Hansen [1991]).[54] Under Chapter 11 a plan of reorganization is approved by the bankruptcy court (a "Chapter 11 Plan"), while under Section 1126 the plan may be approved by a vote of creditors. The difference between plan approval by creditors under a restructuring scenario versus a prepackaged Chapter 11 is that the indentures governing the securities govern the voting rules outside of court approval, whereas the prepackaged Chapter 11 takes advantage of using the bankruptcy court's "cram down" powers to force dissenting and nonvoting holders to accept the plan if more than 2/3 in amount and more than 1/2 in number of each class agree on the plan, regardless of the indenture provisions specifying voting majorities required to amend the covenants.[55]

Essentially, a prepackaged Chapter 11 is a Chapter 11 bankruptcy petition with a creditor accepted plan of reorganization attached (see Chapman and Cutler [1990, p. 25] for practical details of the procedure). It's primary economic reasons for existence seem to be to avoid free rider problems and reduce the direct and indirect costs of bankruptcy. Particularly in large bankruptcies with complex capital structures and large numbers of holders, it is clear to small holders that their individual agreement to a plan of restructuring will have little impact on the outcome of a restructuring exchange offer for their bonds.[56] Collectively, these small holders may make or break a restructuring exchange offer, but individually this may not be the case. Given that it is most economic in larger bankruptcies, which have higher probabilities of survival in the first place, there should be a tendency for there to be a higher survival rate among corporations using prepackaged Chapter 11s rather than restructurings.[57]

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[54] Also, even more specifically, they are often referred to as "1126b filings".

[55] They also have certain real tax advantages if structured properly (see section on accounting and tax rules of restructurings and workouts, covered later in this chapter).

[56] For example, assume the following: (1) there are three holders of the only issue of debt, (2) the company is economically insolvent, and (3) two holders control 49.9% of the issue each. Given that the two holders together can in or out of court complete a restructuring, the 0.2% holder has little incentive to accept an offer which diminishes the value of his or her securities.

[57] Essentially, the increasing use of "prepacks" may have resulted in higher confirmation rates and quicker times to plan of reorganization confirmation.

The largest practical benefit to a prepackaged Chapter 11 is that the free rider problem can be avoided (see Tashjian et al. [1996, p. 153-154]).[58] The downside is that although it does not result in the common form of bankruptcy, technically it is still a Chapter 11.[59] There may still be a stigma associated with Chapter 11 petitions even if they are prepackaged plans of bankruptcy. That is, the abnormal price decline found on Chapter 11 announcement dates may apply equally on prepack announcement dates. In "prepack" cases where the plan includes an immediate exit from Chapter 11 protection, prepackaged Chapter 11 is economically equivalent to a restructuring. The differences are: it is easier to get creditor approval (i.e., a lower percentage of approval is required), and the free rider problem is almost completely avoided.[60]

Betker [1995b] examined 49 prepacks which were filed between 1986 and 1993. The reasons given for favoring prepacks over out-of-court restructurings were: (1) elimination of the hold-out or free-rider problem, and (2) preservation of NOL carryovers (i.e., ala Fabozzi et al. [1993]). Possible avoidance of cancellation of indebtedness income (COD) was also given as an advantage of prepacks over out-of-court restructurings, but Betker [1995b, p. 11-12] concluded that no firm in the sample would have benefited from one form of reorgaization over the other (i.e., specifically as it relates to current tax benefits). In 27 cases, the COD income was less than the firm's insolvency. In the other 17 cases with values estimated, the firm had sufficient NOLs to offset the taxable gain. Therefore, regardless of Betker's conclusion, there were 17 cases with a potential future benefit caused by the treatment of COD income in a prepack versus an out-of-court restructuring. Although, regarding NOL carryovers, prepacks may no longer have a clear economic advantage over out-of-court restructurings after January 1, 1995 when the Stock-for-Debt Exception is repealed (see Betker [1995b, p. 18]). Betker [1995b, p. 4] stated that "on most dimensions prepacks provide benefit between what previous authors have reported for workouts and traditional bankruptcies." In particular, it was suggested that prepacks had about the same direct costs as formal Chapter 11s, but their indirect costs were lower, and that they were similar in total costs to out-of-court restructurings.

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58 See McConnell [1991] for a rare general discussion of the benefits of prepackaged Chapter 11s. Although, much of the article is based on conjecture and other parts are clearly wrong.

59 Gilson et al. [1990, p. 325] state that "in practice prepackaged filings are extremely rare." Their sample covers 1978 through 1987. As of 1987 there has been a tremendous increase in the use of prepackaged plans of reorganization over restructurings for the types of firms Gilson et al. studied (e.g., Southland).

60 Although, it is possible for a class of creditors (which requires that at least two creditors from the same class agree) to object to the plan of reorganization if they declare and can prove they are being treated unfairly as a class under the proposed plan of reorganization (e.g., this happened in the largest prepack case in U.S. history, Southland).

Tashjian et al. [1996] examined 49 prepacks which were filed between 1986 and 1993. The following were some of the findings: (1) compared to Warner's [1977b] and Weiss' [1990] values on formal Chapter 11s, prepacks result in lower direct costs of bankruptcy; (2) compared to Weiss' [1990], Gilson et al.'s [1990], and Franks and Torous' [1994] values on formal Chapter 11s, prepacks result in less time spent in reorganization and formal bankruptcy; (3) compared to Franks and Torous' [1994] values on formal Chapter 11s, prepacks result in higher recovery rates by creditors; (4) compared to Weiss' [1990] values on formal Chapter 11s, prepacks result in fewer incidences of absolute priority violations; and (5) compared to Gilson's [1990] and Weiss' [1990] values on formal Chapter 11s, prepacks have similar transfer of control to creditors. Therefore, the study would tend to view prepacks as a relatively inexpensive substitute for formal Chapter 11. Although, as pointed out by the authors, the evidence presented is not capable of determining whether prepacks can be substituted for formal Chapter 11s or out-of-court restructurings. The traditional view has been one of assuming that the three basic legal tools for restructuring a firm are looked upon by creditors and debtors as a continuum, with the "proper" tool used being that which provides the greatest benefit at the least cost. Although, if this were strictly true, one would not expect to see a surge in the use of one particular method of reorganization as has been witnessed with prepacks relative to formal Chapter 11s. In addition, Tashjian et al. [1996] examined the distinction between "pre-voted" and "post-voted" prepacks. They found that pre-voted prepacks spent significantly less time in bankruptcy and insignificantly more time in pre-bankruptcy negotiations.

The Penn Central bankruptcy is considered to be a seminal successful Chapter 11 bankruptcy (see Fridson [1991a]). It is in large part responsible for spawning what could loosely be referred to as the financial distress field of financial economics. Gordon [1971] was one of the first to attempt to explain the meaning and implications of the term "financial distress". Murray [1971] was one of the first financial economists to suggest that the Penn Central case was evidence of the weak form of efficient markets not holding in distress. Weston [1971] was one of the first financial economists to emphasize the importance of understanding the regulatory and legal aspects of the Penn Central case of distress. The size and publicity associated with the Penn Central case highlighted the lack of very basic levels of informational efficiency in the case of distress, and the importance of laws and regulations in cases of distress. Aside from the work resulting from the Penn Central bankruptcy in 1970, much of the empirical work in the field is relatively recent.

Two more recent studies which have provided some empirical background to firms restructuring out-of-court and in-court were by Gilson et al. [1990] and Asquith et al. [1991].[61] As Baldwin and Mason [1983, p. 505] stated: "The resolution of claims in these situations often differs from what is predicted by legal rules or standard theoretical models." The Gilson et al. [1990] study reviewed some of the legal advantages and disadvantages of out-of-court restructuring over Chapter 11 reorganization.[62] Based on their sample of 169 publicly traded companies which restructured their debt between 1978 to 1987 (89 filed for Chapter 11 and 80 restructured their debt outside of formal bankruptcy), they found that formal Chapter 11 is more likely to result the more classes of debt are outstanding; while formal Chapter 11 is more likely to be avoided the more of the firm's assets are intangible and/or the more debt is owed to banks. Asquith et al. [1991] examined 102 distressed low-grade debt issuers (generally, distress is defined to occur when estimated internally generated cash flow is less than reported interest expense after issuing low-grade debt) and found the following: (1) restructuring bank debt alone is not a sufficient condition for avoiding bankruptcy (i.e., the firm is required to restructure its public debt to have a chance of avoiding formal bankruptcy); (2) banks almost never forgive principal[63] or provide new financing; (3) asset sales are an important means of avoiding formal bankruptcy, but they are at least in part dependent on industry factors[64]; (4) "complex" capital structures tend to be associated with formal bankruptcy; and (5) financial performance has little or no impact on a firm's ability to avoid formal bankruptcy, sell assets, or decrease capital expenditures (all of which seem to be important in avoiding Chapter 11). At a minimum, these results tend to confirm the view that distress in general creates complex agency problems.

In addition, it should be noted that a central argument of the Gilson et al. [1990] study was that there was not a strong holdout problem for out-of-court restructurings versus formal Chapter 11s. They did not provide a very convincing argument. The following

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61 In addition, a study by DeAngelo and DeAngelo [1990] focused on dividend policy and financial distress.

62 They define (Gilson et al. [1990, p. 326]) a successful restructuring to be a restructuring in which there is no bankruptcy filing within one year of the declared restructuring date. Often the negotiations continue for years beyond the declared restructuring date (e.g., Leaseway Transportation), then end in the filing for protection under Chapter 11 of the Code. It is not clear that one can distinguish between restructurings and reorganizations in the first place, particularly for the predominantly large firms being studied by academics such as Gilson et al. Furthermore, it is not clear that Chapter 11 reorganizations clearly and necessarily result in worse economic outcomes than restructurings.

63 Only in one case did banks forgive principal. This company was one which the former president of the U.S. was formerly associated with (i.e., Zapata Oil).

64 Asquith et al. make reference to Shleifer and Vishny concerning this point. Shleifer, A., and R. Vishny, "Asset Sales and Debt Capacity," manuscript, University of Chicago, 1991.

is a table which will aid in illustrating the magnitude of the holdout problem for low-grade debt restructurings.

Table 5
Percentage Exchanged and Returns One Year after the Exchange Date[65]
These values are from the First Boston Corporation.

	"Old" Security			"New" Security
Security Type	Return	Exchanged	Not Exchanged	Return
Distressed[66]	12.20%	67.86%	32.14%	-10.64%
Nondistressed	20.03	74.33	25.67	8.37
Average	14.97%	70.15%	29.85%	-3.91%

Source: First Boston Corporation, High Yield Handbook, High Yield Research Group: CS First Boston, January 1990

It may or may not be profitable to restructure out-of-court, but it is certainly profitable to holdout. From this table, the more interesting question is not why negotiations breakdown, but rather, why they succeed? Unfortunately, regarding valuing distressed low-grade debt, there is not much insight to be had from the Gilson et al. [1990] article, other than the reiteration of practitioner contentions that low levels of intangible assets and high levels of bank debt tend to discourage out-of-court restructurings.

Given the foregoing discussion, it should be clear that financial economists have recently categorized distressed restructurings into the following three general types: (1) formal Chapter 11s, (2) out-of-court restructurings, and (3) prepackaged Chapter 11s. Prepacks, like out-of-court restructurings, are a form of negotiated settlement dependent on a certain level of creditor approval. Unlike most restructurings, they usually require a relatively low level of acceptance. For the purposes of this thesis, it is important to note that the variety of types of "bankruptcy" increase the illiquidity of distressed security markets by increasing the uncertainty of bankruptcy itself.

65 This study covers the period 1985 through 1990. 130 issues for 49 different issuers were studied.
66 First Boston defines distress "as any transaction where the value of the consideration received by holders was less than the par amount of the securities for which there was a tender or exchange offer (First Boston [1992])."

3 Bond Covenants

> Since strong traditional covenants protect bondholders from wealth losses in LBOs, the declining use of such covenants in the 1980s and the introduction of new covenants seem anomalous.
> Asquith and Wizman [1990, p. 196]

Regarding leverage buyouts, strong bonds covenants protect prebuyout bondholders from wealth losses (also, see Laber [1992] and Kahan and Tuckman [1993]). Additionally, the use of protective covenants had declined during the 1980s (see Asquith and Wizman [1990]). Even though the intent of many bond covenants was to protect bondholders in the event of corporate financial distress, it is unknown if strong covenants actually protected distressed bondholders from wealth losses in times of distress.[67] Although possibly a useful study, it is not the purpose of this thesis to investigate the hypothetical effect of protective bond covenants on distressed corporations (e.g., see Black and Cox [1976][68] for a contingent claims approach to valuation regarding four general bond covenants). This thesis assumes that protective covenants limit wealth losses for bondholders of financially distressed corporations. Therefore, while not a principal focus of this thesis, bond covenants are assumed to be significant factors in the pricing of distressed and nondistressed bonds.[69]

The objective of this section is to present an overview of the covenants and indenture provisions which are common for low-grade bonds (also, see Smith and Warner [1979] for an agency theory overview of some covenants). Given that most of the data used in this thesis are derived from low-grade bonds of varying levels of distress, knowledge of low-grade bond covenants and indenture provisions should be useful detailed information. The remainder of this section will review ten of the more

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67 There has been limited theoretical work in related areas. For example, see Berlin and Mester [1990] regarding an agency theory rationalization of the observation that private debt tended to have more restrictive covenant protection than public debt. Also, see Ho and Singer [1982] for a theoretical option pricing treatment of four common indenture provisions (e.g., maturity date).

68 The four covenants analyzed by Black and Cox [1976] were: (1) "safety covenants"; (2) "subordination arrangements"; (3) "restrictions on the financing of interest"; and (4) "restrictions on the financing of dividends".

69 Indirectly, studies have shown that bondholders may be hurt by the weakening of covenants. For example, Kahan and Tuckman [1993] have shown that relative to bondholders, shareholders receive positive abnormal returns around dates of bondholder accepted covenant changes. Although not a conclusion of that study, this would suggest that bondholders gave up significantly more value by agreeing to weakened covenants, thus implying a significant level of coercion on the part of management and/or shareholders.

important low-grade bond covenants, then additional related covenants and indenture provisions will be listed.[70]

3.1 Common Low-Grade Bond Covenants

As stated above, the first part of this section presents an overview of ten common low-grade bond covenants. Although, the emphasis is on low-grade bonds, the covenants reviewed equally apply to high-grade bonds (i.e., all corporate, and municipal, debt obligations).

3.1.1 Restrictions on Mergers

A restrictions on mergers covenant is intended to restrict the ability of a firm to merge to the detriment of bondholders. Asquith and Wizman [1990] have confirmed the economic importance of these covenants. Asquith and Wizman found [1990, p. 201] "abnormal returns are 2.6% for strong covenant protection, -0.7% for weak protection, and -5.2% for no protection." Coverage tests and net worth tests are commonly part of a restrictions on merger covenant.[71] This type of covenant was the most common and oldest of the change of control provisions.

3.1.2 Limitation on Dividends and Restricted Payments

Limitations on dividends and restricted payments are intended to stop creditors with lower priority from making payments which effectively increase their priority at the expense of higher priority creditors. Net worth tests are commonly part of this type of covenant. Also, the size of a payment can be strictly defined as a maximum percentage of defined net income figure. Exceptions are often specified for certain payments.

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70 This list was taken from Yamarone and Chen [1989].

71 The purpose of these tests is to avoid LBO type mergers, where the target company is often levered to the detriment of pre-merger bondholders. For example, net worth tests typically specify that the post merger net worth must be greater than pre-merger net worth, or the merger is disallowed.

> My evidence indicates that the stockholders do not pay out all the allowed amount of debt and investment financed dividends. All the firms in my sample maintain reservoirs of substantial magnitude.
> Kalay [1982, p. 227-228]

Corporate dividend policy has been the focus of much financial research. Although, with the exception of the Kalay [1982] study, dividend limitations as set forth by bond indentures have received limited attention. Kalay's evidence on this particular type of bond covenant suggests that limitations on dividends are not exercised to their legal limit. It is not clear that distressed firms act in a similar way. The examination of stockholder-bondholder conflict and limitations on dividends and restricted payments is a promising area for future research. Actually, the Kalay type of analysis applied to distressed, and nondistressed, corporations would provide for substantial future research opportunities.

3.1.3 Limitation on Additional Indebtedness

Limitations on additional indebtedness are intended to avoid excessive debt. It is an anti-layering provision with standard exemptions made for senior debt (i.e., bank debt). In order to take on additional indebtedness, a coverage test (e.g., a "fixed charge ratio") is often used to measure the level of additional indebtedness which can be issued. Foreign subsidiary debt is often not covered by the standard covenant of this type.[72]

3.1.4 Limitation on Liens (Negative Pledge)

Limitations on additional liens are intended to avoid the pledging of unpledged property. As with limitations on additional indebtedness, bank debt is exempted. An example of this covenant was provided by the 4% prior lien bonds due in 1997 and 3% general lien bonds due in 2047 issued by the Northern Pacific Railroad (see Laber [1992] regarding a case study of these bonds).

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72 Smith and Warner [1979] analyzed some "standardized provisions" within the context of Agency Theory. Smith and Warner analyzed a document produced by the American Bar Foundation called "Commentaries on Indentures", which included a standard debt contract.

3.1.5 Use of Asset Sale Proceeds

Covenants restricting the use of the proceeds from asset sales are limited to significant asset sales. The level of significance is strictly specified within the indenture. Also, what is defined as an "asset sale" is strictly specified within the indenture. Proceeds from significant "asset sales" can be specified to be devoted to the following types of activities: (1) repayment of the most senior debt, (2) investment in new acquisitions, or (3) capital investments.

3.1.6 Maintenance of Net Worth

This covenant is used as an early warning sign. "Tangible" or "adjusted" net worth is specified within the indenture as of a specified time period (e.g., every two quarters). GAAP net worth is "adjusted" in order to approximate economic value. Highly levered firms often require the relaxation of this covenant in times of financial distress.

3.1.7 Change of Control Provisions

Change of control provisions give bondholders a put option on their bonds. The put option is exercised when a "change of control" occurs. A change of control is strictly defined within the indenture (e.g., over 50% of the assets of the business are sold). This type of provision is directly related to the restriction on mergers covenant.

3.1.8 Transactions with Affiliates

The purpose of this provision is to specify the extent to which funds can be upstreamed and/or downstreamed from parent to subsidiary. This is of particular concern for LBOs where the corporate structure is often dominated by a parent holding company which has no tangible assets. A working definition of affiliate is specified within the indenture. Also, a "fairness" test is applied to the transaction in order to evaluate whether it was detrimental to the company which issued the bond. Director approval and/or independent valuation of affiliate transactions can be specified within the indenture.

3.1.9 Limitations on Senior Subordinated Indebtedness (Anti-layering)

Like covenants limiting additional indebtedness, limitations on senior subordinated indebtedness were designed to limit the layering of debt. In short, low-grade bondholders can be subordinated below their current level of priority by allowing debt to be placed in the capital structure between themselves and the senior debt. Anti-layering provisions are designed to stop the layering of both senior and subordinated debt.

3.1.10 Subsidiary Restrictions

Like provisions limiting transactions with affiliates, provisions limiting subsidiaries are intended to limit fraudulent transfers between units within a company. This type of provision by its nature must be well defined. Also, the definition of a wholly owned subsidiary can be problematic for large corporations with complex holdings.

3.2 Other Covenants and Indenture Provisions

The following table lists other bond covenants and indenture provisions not addressed by the preceding discussion.

Figure 2
Other Covenants and Indenture Provisions

Other Covenants and Indenture Provisions

(1) Basic Covenants
- (1) Payment of Principal and Interest
- (2) Maintenance of Office
- (3) Maintenance of Existence
- (4) Waiver of Usury Laws

(2) Information Rights
- (1) Quarterly and Annual Reports
- (2) Compliance Certificates

(3) Additional Covenants
- (1) Limitation on Acquisitions
- (2) Restriction on Board of Director Composition
  - (1) Independent Directors
  - (2) Board Seats for Bond Holders
- (3) Sinking Funds[73]

(4) Default Provisions/Cure Periods
- (1) Payment Defaults
- (2) Major Covenant Defaults
- (3) Minor Covenant Defaults

(5) Acceleration

(6) Subordination
- (1) Importance
- (2) Blockage Periods
- (3) Bankruptcy

(7) Registration Rights
- (1) Purpose
- (2) Shelf Registration and Duration
- (3) Liquidated Damages/Penalty Interest
- (4) Filing and Effectiveness Deadline

Source: Yamarone, C., and E. Chen, "Covenants: presentation on bond covenants," August 25, 1989

At the most basic level, the indentures must specify the amount and timing of interest and principal. The provision and timing of financial statements are commonly

[73] See Dyl and Joehnk [1979] and Kidwell et al. [1989] for examples of research on the effect of sinking funds on the cost of corporate debt. Generally, the studies in the area suggest that sinking funds reduce the cost of debt by decreasing default risk and increasing liquidity.

specified within indentures. Although more common for equity, provisions regarding the composition of the board of directors can be added to low-grade bond indentures. For some companies issuing low-grade bonds, default provisions can restrict most major payment and investment decisions. In short, low-grade bond covenants can be extensive and restrictive.

4 Tax and Accounting Considerations of Debt Restructurings

In addition to strict economic considerations (e.g., industry capacity and relevant market demand), the value of distressed and nondistressed companies, and their securities, are affected by tax[74] and accounting[75] laws and regulations. For example, Kim and Schatzberg [1987, p. 313-314] state that voluntary liquidations can in large part be attributed to "tax considerations". Given that a large part of this thesis is concerned with low-grade debt, the following section is intended to present background on the principal tax and accounting laws affecting distressed U.S. corporate debt.[76]

4.1 U.S. Federal Income Tax Consequences of Restructuring Debt

There are three principal tax considerations impacted by federal tax laws regarding distressed corporations. Specifically, those tax considerations are the following: (1) OID, (2) NOL carryovers, and (3) COD. Depending on a distressed company's circumstances, all three tax considerations can affect the valuation of that company's securities, particularly subordinated debt.

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[74] The tax discussion is in part based on Boshkov's [1991, p.214-227] detailed discussion of the tax consequences of debt restructurings after the Revenue Reconciliation Act of 1990. Therefore, for a more detailed discussion see Boshkov [1991].

[75] The accounting discussion is primarily based on Kieso and Weygandt's [1991, p. 718-726] accounting textbook treatment of "troubled debt restructurings". Therefore, for a more detailed discussion see Kieso and Weygandt [1991].

[76] Although, the discussion that follows equally applies to the equities of distressed corporations. The federal government has attempted to but been unable to distinguish debt from equity regarding COD issues (see Boshkov [1991, p. 215]).

4.1.1 Original Issue Discount

If new securities are exchanged for old securities and there exists a reduction in value as a result of the exchange, OID tax laws apply. In most cases, the amount of OID is the net difference between the original issue price ("OIP") of the security plus any accrued interest and the offering price of the new security or package of securities. Also, in cases where issues are not publicly traded, any original or secondary issue will be priced by the first buyer.[77] Whereas when an issue is publicly issued and traded, its value will be set at its market value as of issue and exchange in order to calculate OID. Generally OID is considered to be income to the firm making the exchange and a loss to the investor, and treated as such for tax purposes.[78]

4.1.2 Net Operating Loss Limitations

The economic usefulness of NOL carryovers can be limited in cases where there is an ownership change as defined by Section 382 of the Revenue Reconciliation Act of 1990. Although, there is a special rule applied to corporations which are under bankruptcy court protection. A loss of NOL carryovers can be avoided if the corporation is owned by at least 50% of the existing creditors and shareholders of a bankrupt company immediately before a change in ownership.[79] In that case the existing NOL carryovers can be used by an acquiring entity without annual limitations.

There are some notable exceptions to the exception to limitations on NOL carryovers. With the exception of trade creditors, creditors which did not hold their debt for at least 18 months prior to the bankruptcy filing date are not considered to be existing creditors and/or shareholders. A substantial amount of debt and/or shares held by these ineligible creditors may make it impossible to carryforward any NOLs, thus making an acquisition uneconomic. Also, disallowance of all interest deductions for the three years prior to the ownership change can substantially reduce NOLs for highly levered corporations attempting to reduce their current leverage by means of a restructuring.

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77 Specifically, pricing is determined by Section 1274 of the U.S. Internal Revenue Code of 1986.

78 Although, for U.S. insurance companies OID is measured by certain reductions in par value, not market value.

79 The 50% cutoff is by both voting rights and value of securities. Also, see Fabozzi et al. [1993, p. 7-8] on the issue of NOL carryovers and IRS limitations and rules.

4.1.3 Cancellation of Indebtedness Income

OIDs cause COD for corporations participating in restructurings or workouts. NOLs can be used to offset the COD from OIDs caused by the acquisition of a distressed corporation. Distressed companies interested in restructuring their obligations and/or being acquired have an economic interest to avoid as much COD income as possible and to carryforward as high a level of NOL as possible (e.g., Southland Corporation and Allied & Federated Stores).

4.1.4 Examples

The following are three basic types of distressed exchanges possible: (1) debt for debt, (2) stock for debt, and (3) debt and stock for debt. Generally, the significant economic differences within each of the three types of exchanges are determined by whether the exchange is legally viewed as an out-of-court restructuring or an exchange consummated under bankruptcy court protection. The remainder of this sub-section will be used to review examples of the three types of distressed exchanges.

As an example of exchange type #1, assume the following for a bond exchange: (1) the old bond had an OIP of $1,000, (2) the old bond carried a market rate of interest, (3) the new bond will have a face value of $500, (4) the new bond will carry a substantially reduced rate of interest set at the current applicable federal rate[80] ("AFR"), (5) the new bond will have an issue price of $250, (6) the old bond was not publicly traded, (7) the new bond will be publicly traded, and (8) it is an out-of-court restructuring. The company issuing the new bond will have $750 of COD. The creditor will have to report an OID of $250 over the term of the new bond and the company issuing the new bond can report a deduction of this amount over the term of the new bond. If the new bond were not publicly traded, then its issue price would be its face value of $500 and COD would be $500. Assuming the first seven assumptions and that the exchange is pursuant to a plan of reorganization, there would be no COD or OID. However, there would be $500 of "bond issue premium" to be recognized by the issuing company over the term of the new bond.

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[80] That is, this is the statutory specific minimum federal rate as determined under Section 1274.

As an example of exchange type #2, assume the following for a stock for bond exchange: (1) the old bond had an OIP of $1,000, (2) the old bond carried a market rate of interest, (3) the new stock will have a "fair" market value of $500, (4) the old bond was not publicly traded, (5) the new stock will be publicly traded, and (6) it is an out-of-court restructuring. If the newly issued stock has a fair market value equal to that of the newly issued bond in example #1, then there is no difference in the tax treatment of the stock for debt in this example versus the debt for debt exchange above. Although, if the company is under bankruptcy court protection, no COD may result. Generally, in bankruptcy, a company can shelter its exchange generated COD to the point at which it is insolvent. Therefore, if the COD were $750 and the company was at least $750 insolvent, then no COD need be reported. This could in part explain the popularity of stock for debt exchanges for bankrupt companies. The primary exception to this exception is the case of disqualified stock (e.g., most preferred stock doesn't count as stock). Attributes of disqualified stock include one or more of the following: (1) a *de minimus* or token amount of stock offered in exchange for debt, (2) stock with a fixed redemption date, and (3) stock which can be redeemed one or more times by the holder.

An exchange of stock and bonds for bonds can be illustrated by combining examples #1 and #2. All the exceptions and exceptions to the exceptions of examples #1 and #2 apply. Again, the critical issues depend on whether the bonds and/or stock are publicly or privately placed and whether the stock exchanged represents a change in control. Generally it can be stated that the tax laws discourage the use of preferred stock and high coupon bonds in such exchanges. In addition, the tax laws generally encourage privately placed securities in out-of-court restructurings and publicly traded securities in bankruptcy court supervised restructurings. These laws and their effects on restructuring corporations are an obvious area for future research.

4.2 Accounting for Debt Restructurings (FASB Statement No. 15)

As mentioned before, in the U.S. financial obligations are often "restructured" in order to permit the debtor to continue as a going concern. Restructurings occur when creditors for economic and/or legal reasons grant certain concessions to the debtor. The most common concessions granted are to reduce the interest and/or the principal of the obligations being restructured (e.g., see Asquith et al. [1991]). These effects are especially commonplace in the low-grade debt market (see Gomez et al. [1991]). Given that a large part of this thesis is concerned with low-grade debt, the following section is intended to present background on the principal accounting law affecting distressed U.S. corporate debt.

FASB Statement of Financial Accounting Standards No. 15 is the principal accounting law affecting distressed U.S. corporate debt. Statement No. 15 was intended to achieve a level of symmetry between the debtor's gain and the creditor's loss for a distressed restructuring. As Kieso and Weygandt [1991, p. 719] state, "although the objective of FASB Statement No. 15 was to achieve symmetry between the entries recorded by the debtor and creditor, symmetry is not always attained." Asymmetry is the result of the fact that Statement No. 15 must be separately applied by each party to the restructuring. After accounting for creditor or debtor specific circumstances, it is possible that only one party will record a "troubled debt restructuring" (i.e., typically COD for the debtor).

The critical distinction for the creditor is whether the "fair market value" of the security or package of securities is less than the "carrying amount" of the original security. For example, assume all the assumptions of exchange type #1 hold, and the creditor had written down the bond to a net book value of $350. In this case since the market value is $250, an additional loss of $100 will need to be recognized by the creditor for that bond and an entry will need to be made for the extraordinary loss on restructuring of debt. If the market value was determined to be $350 or more, no loss would be recognized by the creditor. If there was a modification of the terms of the current security (e.g., the maturity date was extended) then no settlement exists and no gain or loss need be recognized (in this case a loss). The act of exchanging securities necessitates the recognition of a loss or gain. Particularly in the case of out-of-court restructurings, this aspect of Statement No. 15 should tend to encourage holdouts.

4.3 Low-Grade Company Financial Statements

The original Securities and Exchange Act of 1934 exempts firms that have publicly issued securities which have fewer than 300 holders from releasing financial statement information. That rule was later modified to state that a firm which has publicly issued a security with fewer than 300 security holders must file financial statements with the S.E.C. at least through the first year after issuance (see Norris [1990]). These rules have significantly increased the monitoring costs for holders of some very large companies' low-grade debt (e.g., Ampex Group, Stop & Shop, and Revlon: see Jereske [1991, p. 68]).

Apparently, some companies have refused to release financial statement information in efforts to decrease liquidity, and consequently the bid prices, of their low-grade debt in order to purchase them back at a discount (see Jereske [1990] and Merrill Lynch [1991]). Many original issue low-grade debt issues are still held by fewer than 100 institutional holders. In 1990 approximately $5 billion par value of debt changed their policy to one of non-disclosure in order to take advantage of this fact.

Does the lack of financial statement information have an impact on price? If it does, has the low-grade debt market become less informationally efficient as a result of the 1990 trend in nondisclosure by firms which had issued original issue low-grade debt in great numbers during the late 1980s? Even if there were an effect, given that most of the original issue low-grade companies still issue financial statements to investors, it would be very difficult to detect. In this thesis, it will be important to take note of this caveat concerning the availability of financial statements from many low-grade debt issuers, particularly distressed ones.

If disclosed, low-grade company financial statements may be useful, but the financial statements of low-grade companies which have reorganized under Chapter 11 of the Code have not been viewed, at least by the accounting profession, as useful. This state of affairs prompted the American Institute of Certified Public Accountants to issue Statement of Position 90-7, entitled "Financial Reporting by Entities in Reorganization Under the Bankruptcy Code (see Weil et al. [1991a, p. 14-16] for details)." Their purpose was to require consistent prepetition and postpetition standards. The following is a list of Chapter 11 reporting requirements: (1) estimate reorganization value, using discount "rates reflecting the business and financial risks involved"; (2) for the balance sheet, list prepetition liabilities subject to compromise, not subject to compromise, and postpetition liabilities; (3) distinguish in the statement of operations between reorganization items, such as professional fees, and nonreorganization items; (4) encourages use of "direct cash methods" applied to the statement of cash flows; and (5) generally encourages care with statement preparation for affiliated corporate entities which have also filed for Chapter 11. These all seem useful, but they have yet to be universally applied. The result is that the financial statements of companies filing under Chapter 11 of the Code require a great deal of discounting and interpretation of the information provided, if provided. This caveat applies to all finance studies which rely on distressed firm financial statements to derive their results.

CHAPTER 3

BACKGROUND ON THE BANKRUPTCY COST ISSUE

1 Introduction

The objective of this chapter is to review the issue of bankruptcy costs. The emphasis of the review will be on the empirical finance literature in the field. In addition, given its importance to the motivation behind research on the bankruptcy cost issue, a brief review of bankruptcy costs and optimal capital structure will be made. This chapter is required as background and motivation to Chapter 4, which is an empirical study on the total losses incurred during bankruptcy.

2 Optimal Capital Structure and Bankruptcy Costs

> The capital structure puzzle is tougher than the dividend one.
> Myers [1984, p. 575]

There are essentially the following three sets of capital structure theories: (1) signalling theory, (2) agency theory, and (3) theories which trade-off the tax advantage of debt with the costs of bankruptcy. Signalling theory applied to capital structure suggests that capital structures convey signals from management to shareholders regarding management's expected future prospects for the firm (see Ross [1977]). In addition, signalling theories are generally considered to imply a "pecking order" framework for capital structure, where internal is preferred to external financing and debt to equity (see Myers [1984]). Agency theory applied to capital structure suggests that agency costs cause optimal capital structures (see Jensen and Meckling [1976], Myers [1977], and Barnea et al. [1981]). There are agency costs associated with both debt and equity, such that ownership structure and the firm's financial prospects are not independent. Debtholders must trade-off possible wealth expropriation by stockholders (both internal and external) against the *ex ante* yield they demand, and external stockholders must trade-off the costs of monitoring manager/co-owners with the percentage of equity raised externally.[1] Finally, the most popular approach suggests that there are costs to leverage which at some point overwhelm the tax advantage of debt (see e.g., Scott [1976]). This final approach is the principal approach which has motivated research in the field of bankruptcy cost estimation and Chapter 4.

In the final approach, the effect of bankruptcy costs is critical to the argument for an optimal capital structure. Although, the existence of bankruptcy costs themselves are not a sufficient argument for them to have a significant impact on the determination of the optimal capital structure for the firm. According to this approach, in order for there to exist a possibility that there is an optimal capital structure which contains debt and equity, bankruptcy costs must usually be "nontrivial". The standard non-signalling theory and non-agency theory argument trades the tax advantage of debt against the nontrivial cost of bankruptcy. Therefore, the central issue of concern for empirical research in the field is the absolute level of bankruptcy costs and not merely their existence.

2.1 Tax Shield/Bankruptcy Cost Trade-off Models

Since the theory of capital was first established by Modigliani and Miller [1958 & 1963], one of the central questions regarding the cost of capital has focused on the realized costs of bankruptcy. Assuming no costs of bankruptcy, no personal taxes, and various other simplifying assumptions, Modigliani and Miller [1958] established that the market value of the firm is independent of its capital structure. Although, if the tax rate is above zero, the tax deductibility of debt payments would result in the firm taking on 100% debt (i.e., at the risk-free rate). In addition, given perfect and complete capital markets without bankruptcy costs, the percentage of debt or equity does not effect the value of the cash flow of the firm. Therefore, whether debt is risky or risk-free does not effect the value of the cash flow of the firm or the value of the firm. Ignoring the maturity structure of debt, observed capital structures suggest that there may be some optimal trade-off between debt and equity financing which is not

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[1] It should be noted that agency theory does not preclude the importance of various costs of bankruptcy for the contracts negotiated between clients, employees, and creditors (see Titman [1984]).

captured by the Modigliani and Miller [1958 & 1963] result (e.g., Scott [1972] and Castanias [1983]).

Assuming costly bankruptcy, Baxter [1967] was one of the first to suggest that as leverage increases for the firm, there is a point at which the increase in the volatility of earnings will result in an increased risk of bankruptcy which will cause the net value of the firm to decrease at some point. Therefore, there would be an optimal capital structure for the firm at least in part determined by the expected probability and cost of bankruptcy.

Early studies addressing the issue of the trade-off between the tax shield on debt and the costs of bankruptcy tended to argue for the irrelevance of the costs of bankruptcy. After Baxter [1967], early theory on capital structure implied that bankruptcy costs had to be of greater value than the tax shield of debt that resulted from the Modigliani and Miller [1963] model (see e.g., Kraus and Litzenberger [1973], Scott [1976], and Kim [1978]). Furthermore, citing early research on the administrative costs of bankruptcy, Miller [1977] argued that bankruptcy costs are small and irrelevant. In addition, Haugen and Senbet [1978, p. 392] stated: "bankruptcy costs, which affect the capital structure decisions, must be trivial or non-existent if one merely assumes that capital market prices are competitively determined by rational investors." Haugen and Senbet [1978] argued that assuming standard no arbitrage/efficient capital market conditions, the costs of bankruptcy will equal the lower of the costs of transferring ownership among the classes of claimholders (e.g., equity- to debtholders) or the cost of issuing new equity.[2] Therefore, one must assume imperfect markets and/or imperfectly rational agents in order to develop models where the costs of bankruptcy can significantly impact capital structure.

Capital structure models assuming asymmetric or incomplete information and/or large indirect costs of bankruptcy have shown that the bankruptcy costs can affect the capital structure decision (e.g., see Titman [1984] and Webb [1987]). Titman [1984] questioned some of assumptions made by Haugen and Senbet [1978] as not realistic. For example, Haugen and Senbet [1978] implied that recoveries on assets are the same whether the firm is in bankruptcy or not. In addition, Haugen and Senbet [1978] argued that liquidation is a capital budgeting decision independent of the state the firm finds itself in (i.e., solvency or bankruptcy). If the agency costs of bankruptcy are

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2 Whited [1992] presents empirical results which suggest that "financially unhealthy" firms are constrained by access to capital markets, particularly debt markets.

large, one could conclude that the Haugen and Senbet [1978] arguments begin to break down.

Clearly, the arguments made by strong opponents of the relevance of the costs of bankruptcy are not without apparent problems (i.e., Miller [1977] and Haugen and Senbet [1978]). Especially problematic are the issues relating to agency costs caused by asymmetric information, especially during financial distress. Therefore, the next issue to address is the different possible costs incurred by firms in bankruptcy.

2.2 The Costs Incurred by Bankrupt Firms

There are many more potential costs of bankruptcy than administrative expenses. This subsection is intended to present a relatively comprehensive list of the costs firms may incur before, during, and after bankruptcy. Many of these costs are indirectly or directly related to agency costs incurred due to distress (e.g., see Giammarino [1989] on distress related costs of asymmetric information and judicial discretion). This list of costs is based on a study by Scherr [1988], who reviewed the literature in the field. As noted by Scherr [1988] many of these costs may occur more than once during a bankruptcy.

1) Administrative Costs. These types of costs include the following: bankruptcy court filing fees, other bankruptcy court costs, attorney fees, trustee fees, and other professionals' fees (e.g., appraisers and auctioneers). These expenses are typically fees paid to third parties to work the bankrupt firm through Chapter 11 and/or Chapter 7 of the Code (see e.g., Ang et al. [1982]).

2) Liquidation Losses. The sale of assets by a firm experiencing financial distress tends to bring lower values than if the assets were sold under non distress conditions. As mentioned in Chapter 2, the option of filing under Chapter 11 of the Code is an attempt to at least partially avoid such losses (i.e., the focus of U.S. bankruptcy laws is to salvage going concerns through Chapter 11 of the Code).

3) Lost Sales. This type of cost is particularly relevant for producers of consumer durables (also capital goods producers) and/or providers of services which require long term commitments of time. Although, Baldwin and Mason [1983, p. 512] point out that it is difficult to identify the extent to which sales reductions, and operating inefficiencies, are the result of financial distress or the result of the poor management

which may have brought on the financial distress in the first place. Regardless of the direction of causality, it is assumed that bankruptcy, particularly the threat or realization of Chapter 7, will result in lost value to consumers, which will reduce prices and sales (see e.g., Altman [1984]).[3] Rational consumers trade-off the probability of bankruptcy and the price of the goods and/or services they are considering purchasing. In addition, in the case of implied or explicit warranties, consumers will trade-off the probability of the warranty being voided and the estimated value of that warranty (see e.g., Scherr [1988, p. 154]). The higher the relative value of the implied and/or explicit warranty(ies), the greater the potential in lost sales and/or reduced sales prices for the distressed firm.

4) Missed Profitable Opportunities. When a firm experiences financial distress its manager(s) may be forced to conserve cash and/or be unable to raise cash in the financial markets. As a result, the firm may miss profitable investments (see Castinias [1983]). In addition, during a distress period the firm's manager(s) may be unable to devote sufficient time to seek out and evaluate profitable investments (this is related to #7). The lost opportunity value of these investments not taken are a cost of bankruptcy.

5) Lost Tax Shields. If a firm goes Chapter 7, all tax credits stop. Therefore, a liquidation of the firm will reduce the value of future amortization and depreciation deductions, operating loss carry forwards, investment tax credits, etc. to zero (see e.g., Ang et al. [1982]). Assuming tax outflows or potential tax outflows, these tax shields would have value in reducing tax payments. Specifically, as mentioned in Chapter 2, NOL carryovers can mean the difference between maintaining going concern status versus liquidation.

6) Intangible Asset Losses. If a firm goes Chapter 7, the value of firm specific intangibles will be lost. The following is a partial list of the potential intangible asset losses incurred by liquidating the firm: (1) lost value due to the dismissal of personnel with firm specific training and/or skills (see e.g., Ang and Chua [1981])[4], (2) lost

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3 Directly related to this cost is a cost associated with the agency cost of debt. As leverage increases, the ability of the firm to effectively compete will diminish during distress. That is, distress related reduced sales can also be a result of the pure agency cost of increased leverage. Opler and Titman [1994] find highly levered firms lose "substantial market share" and equity losses during industry downturns.

4 It could be argued that in the case of management turnover caused by financial distress, that any manager time spent unemployed in search of employment is an indirect cost of distress. Indeed, Gilson [1989] finds that managers of large publicly held firms fired for defaulting or filing bankruptcy take at least three years to find comparable employment.

goodwill (e.g., advertising investments lose value), and (3) lost research and development costs (e.g., valuable R&D projects which stop due to financial distress or liquidation). As pointed out by Cornell and Shapiro [1987, p. 7-8], implicit or intangible claims (e.g., firm specific employee skills) "cannot be unbundled and sold apart from the firm's other business dealings". Therefore, the risk associated with such assets is difficult to diversify away and, by definition, the firm is not able to sell them even at distressed prices. This in turn implies that intangible assets are particularly vulnerable to bankruptcy and especially liquidation.

7) Management Time Losses. This is an opportunity cost argument (see e.g., Warner [1977a]). As a firm becomes more distressed, the management spends an increasing amount of its efforts and time attempting to correct the causes of distress. This can include increased time spent analyzing the causes of the problem(s), negotiating with suppliers, calming and comforting customers, etc. The argument is that this time spent on attempting to control and correct the problem(s) could be spent creating value for the firm rather than attempting to control losses. In addition, management time lost can increase the firm's vulnerability to its competitors (see Weiss [1990, p. 289]).

8) Disruption of Supplier Relationship(s). As a firm becomes more insolvent, its suppliers will tend to make the terms of purchase more demanding (see e.g., Altman [1984]). For example, a firm that was given a discount for timely payment may suddenly be charged a premium. In addition, cash in advance may be required for a firm which is perceived by a supplier to be insolvent. The extra costs associated with dealing with suppliers who view the firm as insolvent or potentially insolvent in the near future are a cost of bankruptcy.

9) Renegotiation and/or Issuance Costs. When faced with insolvency, a firm can renegoitate payments to creditors or issue new securities to raise more capital. Both methods have costs associated with them. In addition, the issuance of new shares would provide a negative signal to the equity markets which would in turn reduce the price of the issued shares (see Myers and Majluf [1984]). Given the costs of distressed issuance, few firms in financial distress issue new securities.

10) Increased Labor Costs. Assuming the level of work doesn't affect a worker's possibility of dismissal, that worker may decrease effort as the perception of an exogenously determined dismissal increases. According to Cornell and Shapiro [1987], this would be a rational response for a corporate stakeholder, such as an employee, to take. Also, if distress causes the dismissal of some workers and the

relocation of others (see Scherr [1988, p. 155]), the relocated workers will be less productive while they learn the new job and the dismissed workers represent an intangible loss ala #6. Distress and internal restructuring(s) can lead to increased labor costs.

It should be noted that it has been pointed out that there are possible benefits to bankruptcy and/or reorganization (see Wruck [1990, p. 435-436]), especially in regard to improvements in capital structure. In addition, based on a case study on Federated Department Stores, Kaplan [1994, p. 134] claimed that the "financial and anecdotal evidence in Federated's case illustrate the basic argument in Wruck (1990) that Chapter 11 (and, more generally, financial distress) provides benefits to as well as imposes costs on distressed firms."[5] However, there is no strong evidence that there are benefits to bankruptcy beyond those accruing to the debtor and management.

Of the empirical research focusing on the direct costs of bankruptcy, most studies have measured the administrative costs of bankruptcy.[6] Even though the list of possible indirect costs of bankruptcy is rather lengthy compared to the list of direct costs, there has been very little research on the indirect costs of bankruptcy. However, two studies measuring the total costs of bankruptcy have concluded that the total costs of bankruptcy are nontrivial (see Altman [1984] and James [1991]).[7] The following section reviews the empirical results of studies measuring the costs of bankruptcy.

3 Review of Empirical Studies on Bankruptcy Costs

Modigliani and Miller [1958] showed that, given some strong assumptions, the market value of the firm is independent of its capital structure. One assumption made was that bankruptcy is costless. Bankruptcy cost research has been directed at proving not just that bankruptcy costs exist, rather research has attempted to prove or disprove the contention that the costs of bankruptcy are non trivial. Beginning with Warner

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5 Yagil [1989] suggests that the expected value of bankruptcy costs is lower after a merger due to a coinsurance effect and a diversification effect.

6 Although, a study by Lang and Stulz [1992] examined the effect of bankruptcy announcements on the equity value of the bankrupt firm's competitors. They found a small negative effect for firms in highly levered industries and a small positive effect for firms in concentrated, low leverage industries. That type of study should have picked up some of one type of indirect cost of bankruptcy (i.e., costs and/or benefits to the industry as a result of bankruptcy).

7 A case study of the Texaco-Pennzoil case found an approximately 60% loss rate (i.e., 30% of the joint value of the two companies before the dispute) for the transfer of wealth between the two firms under study (see Cutler and Summers [1988]). This adds some anecdotal support to the argument that the total costs of distress are nontrivial.

[1977a], empirical studies of bankruptcy cost have attempted to determine the magnitude of bankruptcy costs in order to provide evidence for the debate on the relevance of bankruptcy costs in the theory of capital structure.[8] At this time, there is still no consensus on the magnitude of bankruptcy costs or its theoretical ramifications.

Most empirical studies indicate that if only explicit costs for non financial companies are counted, costs are small, and probably trivial.[9] If all relevant costs are included, then costs are likely non trivial by any definition. Finance academics have assumed that "bankrupt firms are inherently less profitable subsequent to the bankruptcy filing (Gilson et al. [1990, p. 345])," but there has been no empirical confirmation or measure of this assumption.

In addition to the size of the costs of bankruptcy, there is the question of the impact of possible scale effects. If bankruptcy costs are nontrivial for most firms in most industries, but there are significant scale effects, the costs of bankruptcy for larger firms may be trivial. There is evidence to suggest that there is a scale effect to the administrative costs of bankruptcy (see e.g., Ang et al. [1982]).

The remainder of this literature review section is divided into two sub-sections. The first section reviews bankruptcy and distress cost literature. The second section reviews the results from the first section which apply to the scale effects of the costs of bankruptcy.

3.1 Bankruptcy and Distress Cost Literature

Beginning with Stanley and Girth [1971], there has been a line of research focusing on the actual costs of bankruptcy. The following table summarizes the results of some of the empirical bankruptcy cost studies performed.

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8 Also, there has been some work on attempting to measure the costs of bankruptcy for the U.S. (see White [1989]). The White [1989] article assumed that the costs of bankruptcy can be measured by the spread between debt instruments of varying qualities.

9 See discussion by E. Altman and W. Taylor on several articles related to bankruptcy and financial distress (Altman and Taylor [1983, 517-523]).

Table 1

Empirical Studies on the Costs of Bankruptcy and Distress

See relevant text and footnotes for background details.

Study	Time Period	Industry	Mean/Median Firm Size	Sample Size	Costs %	Costs as a % of Equity
Stanley & Girth [1971]	1964	Diverse	0.168	1,675	24.9%	NA
Dipchand & George [1977]	1965-75	Diverse	0.046	48	40.6%	72.6%
Warner [1977a]	1933-55	Railroads	50.000	11	NA	5.3%
Ang et al. [1982]	1963-78	Diverse	0.109	86	7.5%	NA
White [1983]	Unknown	Unknown	1.600	90	1.3%	NA
White [1983]	Unknown	Unknown	2.600	96	1.6%	NA
Altman [1984]	1970-78	Nonfinancial	92.789	18	6.2%	NA
Altman [1984]	1970-78	Nonfinancial	92.789	18	16.7%	NA
Weiss [1990]	1979-86	Nonfinancial	239.182	31	3.7%	20.6%
Guffey & Moore [1991]	1970-85	Trucking	9.800	16	9.1%	NA
James [1991]	1985-88	Banking	32.575	412	30.5%	3,135.0%

Although the Stanley and Wirth [1971] study was primarily concerned with individual and sole proprietorship bankruptcy and not corporate bankruptcy, there was a large part of the sample which consisted of bankrupt firms. Of the sample of 1,675 cases, 1,277 were personal cases of bankruptcy (i.e., 398 were corporate and sole proprietorship cases). Therefore, if sole proprietorships differ significantly from the corporate form regarding their costs of bankruptcy, the results for Chapter 11 cases may not be representative of the costs of corporate bankruptcy. Eight bankruptcy court districts were examined, including Southern New York. The sample was limited to cases which were closed in 1964. Median firm size as measured by median assets was $0.168 million. The administrative costs of bankruptcy for Chapter 11 cases were estimated to be approximately 24.9% of court reported assets.

The Dipchand and George [1977] study measured the administrative costs of bankruptcy for 48 Nova Scotian businesses over the period 1965 through 1975. Dipchand and George [1977, p. 29] found a "strong linear relationship between liquidation proceeds and administrative costs." The higher liquidation proceeds, the higher were the administrative costs of bankruptcy. As measured by total reported assets, and excluding one large outlier, the average firm size was $0.046 million. Relative administrative costs were measured as total administrative costs relative to total liquidation proceeds, and were estimated to be 40.6% for the full sample. The remainder of the liquidation proceeds went to creditors (i.e., 59.4%). Measured as a percentage of unsecured liabilities, the administrative costs of bankruptcy were approximately 72.6%.

The Warner [1977a] study measured the administrative costs of bankruptcy for 11 railroads over the period 1933 through 1955 (i.e., filing under Section 77 of the Bankruptcy Act). As measured by the market value of all publicly traded securities as of the month of filing for bankruptcy protection, the average market value of the firm was approximately $50 million. One limitation of using publicly traded securities is that not all securities are publicly traded. Seven years before filing for bankruptcy protection, the average market value of publicly traded securities for the sample firms was approximately $251 million. Relative administrative costs were measured as total administrative costs relative to the market value of publicly traded securities. As of the month of filing for bankruptcy protection, the estimated cost of bankruptcy was approximately 5.3%, and 1.0% seven years before filing.

The Ang et al. [1982] study measured the administrative costs of bankruptcy for 86 Western District of Oklahoma corporations over the period 1963 through 1978. The sample included "several machine tool manufacturers, construction firms, retail and wholesale furniture outlets, restaurants, hair styling salons, plumbing supply distributors, and at least one each of the following: an ice distributor, a janitor supply distributor, a mobile home retailer, an oil distributor, and so on (Ang et al. [1982, p.221])." As measured by the total debts listed at the bankruptcy filing, the median size of the firm was $0.109 million and the mean size of the firm was $0.205 million. The median and mean values for total payments from liquidation were estimated at $0.058 million and $0.109 million, respectively. Relative administrative costs were measured as administrative fees relative to the total liquidating value of the firm. The mean and median relative administration costs of bankruptcy were estimated to be 7.5% and 1.7%, respectively.

The White [1983] study estimated the "*ex-post* or transactions" bankruptcy costs for reorganizing and liquidating firms from the Southern District of New York before and after the new Code (i.e., White [1983] uses 1980 as the cut-off). White [1983, p. 484] reports *ex post* bankruptcy cost results only for firms filing for bankruptcy before 1980. The number of firms liquidated (i.e., Chapter 7) and reorganized (i.e., Chapter 11) are 90 and 96, respectively. As measured by total liabilities, the mean size of liquidating and reorganizing firms was $1.6 and $2.6 million, respectively. Estimated "*ex-post*" bankruptcy costs were, by definition, very low (see White [1983, p. 483-484]). Relative *ex post* bankruptcy costs were measured as *ex post* bankruptcy costs relative to total liabilities. The ratio of total *ex post* bankruptcy costs to total liabilities for liquidating and reorganizing firms was 1.3% and 1.6%, respectively.

The Altman [1984] study was the first study to estimate indirect bankruptcy costs for a sample of 12 retailers (one of which did not have any bankruptcy cost values) and 6 industrial firms filing for bankruptcy over the period 1970 through 1978. In addition, Altman [1984] estimated the administrative or direct costs of bankruptcy for a sample of 11 retailers and 7 industrial firms filing for bankruptcy over the period 1970 through 1978. The value of the firm was estimated by adding the market value of equity to the market value of debt plus the book value of other debt plus the capitalized value of financial leases. As of the bankruptcy filing month, the mean value of the firm for the sample of 11 retailers was $140.5 million and $10.7 million for the sample of 7 industrial firms. Indirect costs of distress were measured by estimating lost sales for each firm three years prior to filing for bankruptcy. Based on sales 13 to 4 years previous to filing for bankruptcy (i.e., 10 years), regressions were run to estimate lost sales for the three year period. Based on these estimates and historic profit margins, unexpected losses were estimated. Relative total costs of bankruptcy were measured as the total costs of bankruptcy (i.e., direct costs and estimated indirect costs) relative to the estimated value of the firm. As of the bankruptcy filing month, the relative total costs of bankruptcy and the administrative costs of bankruptcy were estimated to be approximately 16.7% and 6.2%, respectively. As of the bankruptcy filing month, the relative total costs of bankruptcy for the retail and industrial sample were estimated to be approximately 12.2% and 23.7%, respectively (the comparable figures for administrative costs were 4.0% and 9.8%).

The Weiss [1990] study estimated the administrative costs of bankruptcy for 31 firms filing for bankruptcy over the period 1979 through 1986. Mean firm size, as measured by the book value of assets at the fiscal year-end prior to the bankruptcy filing, was estimated to be $239.2 million. As measured by the ratio of the administrative costs of bankruptcy to the book value of assets, the relative total cost of bankruptcy was approximately 3.7% for the full sample. As measured by the ratio of the administrative costs of bankruptcy to the market value of equity at fiscal year-end prior to the bankruptcy filing, the relative total cost of bankruptcy was approximately 20.6% for the full sample.

The Guffey and Moore [1991] study measured the administrative costs of bankruptcy for 16 trucking firms over the period 1970 through 1985. As measured by book value of assets as of the year prior to the bankruptcy petition year, the average firm size was approximately $9.8 million. Relative administrative costs were measured as total administrative costs relative to total book assets prior to bankruptcy, and were estimated to be 9.2% for the full sample. In addition to estimating the costs of bankruptcy for trucking firms, Guffey and Moore [1991, p. 230-233] found that trucking, retail, industrial, and trucking firms have significantly different costs of bankruptcy (i.e., as measured by the ratio of bankruptcy costs to total assets). This suggests that there are industry specific effects on the administrative costs of bankruptcy.

The James [1991] study measured the losses realized for 412 banks which where placed under Federal Deposit Insurance Corporation ("FDIC") receivership over the period 1985 through 1988. This study was unique in that it focused on financial firms (i.e., banks only) and, like the Altman [1984] study, it went beyond estimating only the administrative costs of distress (i.e., in this case bank failure and liquidation by the FDIC). Loss was measured as the difference between the book value of bank assets at the time of its closure and the value of its assets in an FDIC receivership or the value of the assets to an acquirer. In Chapter 4 a similar measure will be used to measure losses. As measured by the book value of assets at the time of bank failure, the average firm size was approximately $32.6 million. Relative losses were measured as the ratio of loss to the book value of assets at the time of bank failure, and were estimated to be 30.5% for the full sample. The ratio of liquidation costs to the book value of equity capital was 3,135%.

The Altman [1984] and James [1991] studies were the only two studies reviewed which included costs other than the administrative costs of bankruptcy.[10] These two studies suggest that the total costs of distress are nontrivial. Although, there are several limitations of the Altman [1984] and James [1991] results. The James [1991] results were not strictly bankruptcy costs, and the sample consisted solely of finance firms (i.e., banks). In addition, all bank failures were administered by the FDIC not a district bankruptcy court. The Altman [1984] indirect cost results relied on forecasts. Given some of the limitations of the Altman [1984] and James [1991] studies, the question remains whether the total costs of bankruptcy are trivial outside of FDIC insolvent banks. Chapter 4 will contribute to the short list of studies estimating and analyzing the total costs of distress.

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[10] Also, Hoshi et al. [1990] presented indirect evidence from Japan regarding significant indirect costs of distress. They found that firms in Japan with capital structures making distress renegotiation difficult among creditors suffered substantially higher indirect costs of distress than firms with more "harmonious" capital structures (i.e., capital structures which tend to avoid free-rider problems and information asymmetries).

3.2 Scale Effects of Bankruptcy

Four of the reviewed studies support the notion of a bankruptcy scale effect. Warner [1977a, p. 74] states that the: "evidence suggests that there are substantial fixed costs associated with the railroad bankruptcy process, and hence economies of scale with respect to bankruptcy costs." Ang et al. [1982] found strong evidence of a scale effect for the administrative costs of bankruptcy. Guffey and Moore [1991, p. 233] find a scale effect for the administrative costs of bankruptcy for trucking firms. James [1991, p. 1225] stated that there "are however, significant economies of scale with respect to direct costs of liquidation." All support the notion of economies of scale for the costs of distress, but only for the administrative costs of distress.

Regarding economies of scale for the administrative or direct costs of bankruptcy, Warner [1977a] was the first to find some scale effect for railroad company bankruptcies. Ang et al. [1982] found a scale effect for the administrative costs of bankruptcy in the Western District of Oklahoma. The question remains, outside of the Western District of Oklahoma and railroad bankruptcies, are there significant scale effects? Chapter 4 will contribute to this short list of studies examining whether there is a scale effect for firms filing under the Code.

CHAPTER 4

THE LOSSES REALIZED IN SUCCESSFUL CHAPTER 11

1 Introduction

> On the other hand, a comprehensive and detailed study of data from all regions of the country and for firms of all sizes is prohibitively expensive for one set of researchers.
> Ang et al. [1982, p. 225]

Although not all capital structure theories rely on the costs of bankruptcy, the importance of the costs of bankruptcy as a determinant of firm finance policy has a long history. Beginning with Robichek and Myers [1966] and Baxter [1967], financial economists have argued that, regarding debt financing, bankruptcy costs may represent a significant offset to the tax-deductibility of interest payments. Since those seminal theoretical studies, others have explicitly modelled the process whereby firms increase debt financing to the point at which the marginal present value of the future tax shield equals the marginal present value of the future bankruptcy costs (e.g., see Kraus and Litzenburger [1973], Scott [1976], and Kim [1978]). Based in large part on the theoretical models which rely on the bankruptcy cost/tax shield trade-off, empirical work in the area of bankruptcy costs has been conducted.

Based upon Chapter 3, there are several issues worth further examination within the empirical literature on the bankruptcy cost issue. Included are the following three objectives of this chapter: (1) an estimate of the total losses of successful Chapter 11; (2) a test for scale effects of the total losses of successful Chapter 11; and (3) an analysis of some of the determinants of the total losses in successful Chapter 11. This chapter is intended as an extension to the following studies: Ang et al. [1983], Altman [1984], and James [1991]. In this chapter, evidence will be presented on the losses incurred during Chapter 11. These values will be assumed to represent a proxy for total costs of Chapter 11.

Regarding the issue of the total costs of bankruptcy/distress, the literature is sparse. To this author's knowledge only Altman [1984] and James [1991] have tackled the subject. In addition, although a path breaking study, the Altman [1984] study values were heavily reliant on forecast sales figures to estimate the indirect costs of bankruptcy[1]. Also, the sample size used by Altman [1984] was relatively small (i.e., 18 firms), which would significantly decrease the generalizability of the results. The James [1991] study avoided the sample size problem (i.e., 412 firms), but the sample was composed of only banking firms. In addition, the bank failures examined by James [1991] were not Chapter 11s. Therefore, the James [1991] sample has some generalizability problems of its own. Namely, the James [1991] results can only tentatively be extended to non finance Chapter 11 firms. Clearly, extensions to the two previous total costs of bankruptcy studies could broaden the field.

Regarding the scale effect of the total costs of bankruptcy, there is no literature in the area.[2] Clearly, by the same logic applied which makes the scale effect of the administrative costs of bankruptcy important applies to the total costs of bankruptcy. If larger firms encounter relatively lower total costs of bankruptcy, then any potential bankruptcy cost/tax shield trade-off will be less important in determining firm financing the larger the firm. In addition, the principal study examining the scale effect of the administrative costs of bankruptcy by Ang et al. [1982] lacks generalizability. Specifically, the sample consisted of 86 firms from the Western District of Oklahoma. As Ang et al. [1982, p. 22] pointed out: "without comparison with data from other regions of the country, we have no way of determining if these results can be generalized." The size of the sample in this chapter allows a more detailed analysis of firm size and total bankruptcy costs.

Regarding some of the determinants of the total losses in Chapter 11, there is no literature in the area. Although, a recent article by Alderson and Betker [1995] does use a similar measure of total losses as is used in this chapter.[3] But that study focuses

[1] Although, a study by Lang and Stulz [1992] examined the effect of bankruptcy announcements on the equity value of the bankrupt firm's competitors. They found a small negative effect for firms in highly levered industries and a small positive effect for firms in concentrated, low leverage industries. That type of study should have picked up some of one type of indirect cost of bankruptcy (i.e., costs and/or benefits to the industry as a result of bankruptcy).

[2] Of course, this ignores the James [1991] study on bank failures.

[3] They are essentially identical, except Alderson and Betker [1995] call their measure liquidation costs.

on the determinants of post-Chapter 11 capital structures for a sample of 88 firms which "successfully" emerged from Chapter 11. This chapter is interested in examining the losses incurred by firms during Chapter 11 and some determinants of those losses.

This chapter examines a subset of firms within the set of "bankrupt" firms. Those firms which have entered and exited from Chapter 11 are studied. These firms are generally considered to be the "successful" firms within the legally defined set of distressed firms. These firms have entered and exited court protection, thus avoiding liquidation. This chapter will examine the successful failure of $12.646 billion in asset value of firms successfully entering and exiting Chapter 11 of the Code.

In this chapter the total losses realized during successful Chapter 11s are examined. Losses are measured as the difference between the estimated value of assets reported by the company filing for Chapter 11 protection net of the value of proposed payments confirmed by the Bankruptcy Court. This chapter produces the following findings: (1) the losses of successful Chapter 11 are large, representing about 24% of asset value; (2) at certain asset levels, some contradictory evidence regarding the "scale effect" of the costs of bankruptcy; and (3) some of the determinants of the total losses associated with successful bankruptcy include firm size, time spent under court protection, and the relative level of debt.

Assuming that bankrupt going concerns encounter lower costs of distress by maintaining their going concern status rather than by liquidating, the measure of the cost of distress reported here will be lower than that for bankrupt liquidated firms. Therefore, this subsample of bankrupt firms would be expected to have lower costs of distress than that of any other set of bankrupt firms.[4] Based on studies reviewed in Chapters 2 and 3, it is expected that as one moves from out-of-court restructurings to Chapter 11 to Chapter 7, the costs of distress increase. Thus, the losses caused by bankruptcy for a sample of "successful" bankrupt firms should be a lower bound estimate for all bankrupt firms (i.e., going concerns versus liquidations).

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[4] Baldwin and Mason [1983, p. 505] note that "the restriction of samples to legally bankrupt firms thus introduces a potential selection bias. The bias is especially troubling in cases where an attempt is made to infer the magnitude of the costs of financial distress, since many of such costs may be incurred in the process of avoiding formal bankruptcy." Thus, it is possible that firms successfully avoiding bankruptcy may incur higher costs than those actually filing for court protection.

The remainder of the chapter is divided into four sections. The second section presents the measure for estimating the total losses of successful bankruptcies and presents values regarding the relationship between the losses of bankruptcy and firm size (and describes the data set). The third section presents the results and analysis of the "scale effect" of successful bankruptcy. The forth section presents a general model of the total cost of distress, and presents the results and analysis of several models used to test the specified relationships. The conclusions are summarized in the last section.

2 Losses Realized during Chapter 11 Protection

> The substantial number of firms emerging from Chapter 11 that are not viable or need further restructuring provides little evidence that the process effectively rehabilitates distressed firms and is consistent with the view that there are economically important biases toward continuation of unprofitable firms.
> Hotchkiss [1995, p. 3]

This chapter uses as its measure of loss a measure which is similar to the measure used by James [1991], but the measure does not change from bankruptcy to bankruptcy. James [1991, p. 1226] measured the loss on assets as the difference between the book value of the failed bank's assets and the approximate value of the assets at the time of failure resolution. The measure James [1991] used varied for each type of resolution made by the FDIC.[5]

In addition, the measure used here has some of the characteristics of the Alderson and Betker [1995] measure of "liquidation costs" in successful Chapter 11s. Alderson and Betker [1995, p. 46] "define the cost of liquidation as the excess of going-concern value over liquidation value". Both values are contingent on firm values given to the Bankruptcy Court (see Alderson and Betker [1995, p. 51]). By definition, firm managers must show that their estimated liquidation value of the firm is less than their estimated going-concern value (i.e., unless they would prefer to file under Chapter 7 of the Code). Therefore, there is an expectation that the values must be biased toward showing the firm to be of greater value as a going-concern rather than liquidated (i.e., it is in the interests of those reporting the going-concern and liquidation values to the courts to do so). Indeed, Hotchkiss [1995, p. 11-14] has shown that successful Chapter 11 firms make substantial systematic overestimations of post-bankruptcy

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[5] In most cases (i.e., 287 of 412) loss was estimated as the difference between the book value of the failed bank's assets and the later sale value of the bank.

performance.[6] Therefore, it is clear that in order to improve its chances of emerging from Chapter 11, a firm must bias the net differential between estimated going-concern value and estimated liquidation value upward. In this chapter, although both are also court reported values, the two values used to calculate losses do not suffer from the same inherent biases.

Total listed assets net of total proposed payments ("PP") is the measure used to calculate the loss associated with successful Chapter 11. This chapter assumes the following: (1) listed assets are an unbiased estimate of the realizable value of the firm when it files for court protection, and (2) PP are an unbiased estimate of expected payments to owners. Over the whole sample, the estimated total losses incurred during successful court supervised Chapter 11 cases relative to total assets is approximately 23.8%. Total costs relative to total debts is approximately 23.5%. The loss values do not account for firms which fail to make their PP and/or ended up back in bankruptcy.

As of the bankruptcy filing the value of the firm's assets is an estimate of the value of the firm (i.e., given that the automatic stay is in effect) and as of the reorganization plan confirmation PP are a negotiated estimate of the value of the firm (i.e., the residual value of the firm as a going concern)[7]. Given that, prior to the bankruptcy filing, the value of the firm is equal to its residual or equity value, and as of bankruptcy filing equity value is zero (ignoring its option value due to the lack of enforcement of absolute priority), the value of the firm as of the bankruptcy filing is equal to the sum of its asset values. Given that as of the bankruptcy filing date, creditors are intended to own the firm while claims are stayed, the value of the firm as a going concern after emergence from court protection is approximated by the total value of PP agreed upon by the debtor and its creditors.[8]

As is standard methodology in the cost of bankruptcy literature, the measure of loss used in this chapter is based upon values derived from bankruptcy court documents. The bankruptcy judge, creditors, and debtors are responsible for determining asset and

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6 For example, for operating income during the year the plan is confirmed, one year after confirmation, and two years after confirmation, actual performance lags management projections by -58%, -81%, and -72% respectively (see Hotchkiss [1995, Table IV on p. 13]). In addition, Hotchkiss [1995, p. 11, 14] points out that management "concerned with the firm's survival, may need to convince creditors and the court that the firm value is high enough to warrant reorganization rather than liquidation."

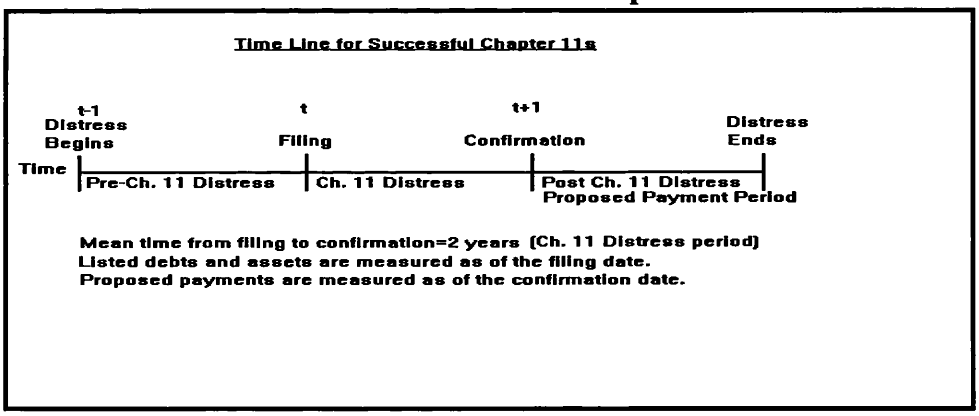
7 Kaplan [1994, p. 123] notes that "the post-bankruptcy value includes all direct and indirect costs of bankruptcy and financial distress."

8 To the extent that equity holders have the ability to extract value during the Chapter 11 process, this would only lend support to the notion of the above measure of loss being a lower bound estimate.

PP values. PP are normally based on a management restructuring proposal, voted upon by the company's creditors. Creditors and management have an incentive to agree to a level of proposed payments which are high enough to satisfy the creditors, but not so high as to put the company back under court protection. Listed assets are management's responsibility while total claims or total debts are creditors' responsibility, but there is bankruptcy court oversight of each to ensure that total assets and total debts are not under or overstated (see Franks and Torous [1989] for a review of creditor and debtor rights under Chapter 11). If assets are overestimated, creditors and/or the bankruptcy court judge will demand more in the restructuring proposal. If assets are underestimated, the bankruptcy court judge and/or creditors will be justified in replacing management for putting forth an unrealistic restructuring proposal.[9]

The following figure illustrates the timing associated with successful Chapter 11 and critical values reported to the bankruptcy court.

Figure 1
Time Line for Successful Chapter 11s



Explicitly, costs are measured by the following: $Loss_{t+1} = Assets_t - PP_{t+1}$. Estimates of assets and debts are submitted to the bankruptcy court at the time of filing. The level of PP includes projected losses after plan confirmation and any equity value (i.e., reissued stock). The courts are provided with PP which represent future values, not present values. Therefore, PP would be expected to overestimate the value of creditor claims, thus underestimating losses.[10]

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[9] In addition to assets and PPs, is the category of listed debts. Listed debts are creditors' responsibility. Creditors have no economic reason to underestimate what is owed them. If they overestimate debts, management and/or the bankruptcy court judge can strike down claims which aren't based on real legal claims against the debtor.

[10] The accountants who calculated the values used in this study did not base their estimates of the total proposed payments under the plan of reorganization on present values. The values they used were

To the extent realistic plans of reorganization are confirmed by the bankruptcy courts, by using PP to estimate firm value as of plan confirmation date, the measure of losses presented in this chapter picks up undiscounted losses beyond the plan confirmation date. That is, all explicit costs and many implicit costs were reflected in the asset values and court approved PP.[11] For example, in the U.S. the firm filing for court protection pays all legal and administrative fees; therefore, these values should be accounted for when drafting a plan of reorganization. Thus, the loss values reported include all direct costs and many indirect costs of bankruptcy.

2.1 Data - The SARD Sample

> As nearly one-half of all Chapter 11 cases filed since inception of the Bankruptcy Code are still pending , limitations imposed by the current statistical reporting system have prevented a full understanding of the results of the Chapter 11 process. In the first ten years of the Bankruptcy Code (October 1, 1979 through September 30, 1989) there were about 176,500 Chapter 11 cases initiated nation-wide. To date little summary information has been available on the outcomes and status of these Chapter 11 cases.[12]
> Flynn [1989]

All the values used in this chapter came from the Statistical Analysis and Reports Division ("SARD") of the Administrative Office of the United States Courts. The SARD maintains court administrative data on Chapter 11 cases.[13] The clerks of the court are required to submit the following three types of reports depending on the status of a particular case: (1) a case opening report, (2) a case change report (i.e., if the case is converted to another chapter of the Code), and (3) a case closing report.

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absolute values (i.e., a proposed payment the day after the plan of reorganization was confirmed was treated the same as a proposed payment twenty years after confirmation). Ed Flynn of the Bankruptcy Division of the Administrative Office of the United States Courts believes "the proposed payments would have been 10 to 20 percent lower if the study had discounted future payments to determine their true present value." Therefore, it would seem that proposed payments under confirmed plans of reorganization were biased upwards.

11 This is the nature of the bankruptcy process. For example, post petition court costs for the debtor and its creditors are "carved out" from the assets listed as of the petition date. Also, any D.I.P. financing is also taken into account.

12 Flynn, E., "Statistical Analysis of Chapter 11", The Administrative Office of the United States Courts, October 1989.

13 The focus of these statistics is principally on the timing of court procedures within the bankruptcy process itself (e.g., whether the case was terminated or is still pending).

SARD Chapter 11 values are the result of a study made on their behalf by Ernst & Young.

Before the study performed by Ernst & Young, Inc. to examine confirmed Chapter 11 cases[14] was conducted, questions such as the percentage of Chapter 11 cases eventually confirmed and how long confirmation takes were not known. In 1989 a study was performed on 2,395 confirmed cases in 15 bankruptcy court districts in order to answer these and other questions. The cases examined were those filing for court protection over the period October 1, 1979 through December 31, 1986 and exiting court protection March 5, 1980 through July 29, 1989. The following is a list of case data gathered by the accounting firm performing the study: (1) filing date, (2) confirmation date, (3) total listed assets[15], (4) total listed liabilities[16], (5) number of related cases, and (6) total proposed payments under the plan of reorganization. Fifteen bankruptcy court districts were chosen out of a total of ninety.[17] The 2,395 cases represent 1,516 actual firms filing under Chapter 11 of the Bankruptcy Code (the "Code").

This same data set is used in this chapter. Of the 1,516 firms, two firms are excluded from the analysis due to one having no listed assets and the other no listed debts. The principal intent of the SARD study was to provide background on the frequency and geographic distribution of bankruptcy, whereas, the principal intent of this chapter is to use the SARD data to measure and examine the losses associated with successful bankruptcy.

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[14] These "confirmed Chapter 11 cases" did not include cases filed under another chapter of the Code then converted to Chapter 11, only cases originally filed under Chapter 11 of the Code.

[15] Taken from the A schedule of the business filing under Chapter 11 of the Code. The accountants did not include assets which were listed as "unknown", "unliquidated", or "undetermined".

[16] Taken from the B schedule of the business filing under Chapter 11 of the Code. The accountants did not include liabilities which were listed as "unknown", "unliquidated", or "undetermined".

[17] Also included in the U.S. totals are the territories of Puerto Rico, Guam, the Virgin Islands, the Northern Marianas Islands, and the District of Columbia. Ten of the fifteen districts were selected at random, while the other five were selected based on the prior belief on the part of the Statistical Analysis and Reports Division of the Administrative Office of the United States Courts that they had "potentially unique characteristics of their caseload." The five non-random selections were the following: (1) the Central District of California, (2) the Southern District of New York, (3) the District of New Jersey, (4) the Southern District of Texas, and (5) the Northern District of Illinois. As of September 30, 1988, combined, the five non-random selections accounted for approximately 22.6% of all cases pending nationally.

2.2 Sample Description

The size of the sample analyzed in this chapter allowed a ranking by size to better analyze the relationship between firm size and the cost of successful bankruptcy. Except for the James' [1991] study of 412 failed banks, this was not previously possible. Larger firms seem to incur more losses than smaller firms filing under and exiting Chapter 11 of the Code.[18] This result holds even though larger firms appear to be more financially solvent upon entering bankruptcy than smaller firms.[19] The following tables provide some background to this observation.

Table 1
Values of Relative Loss, DAR, PPDR, PPAR, TTC, and RC by Deciles Ranked by Size

Except for related cases, all values are median values.

	Loss %	DAR	PPDR	PPAR	TTC	RC	Obs
Full Sample	33.54%	1.24	0.58	0.66	642	1.58	1514
Decile 1 - largest	51.21	0.95	0.53	0.49	613	4.72	152
Decile 2	55.46	0.92	0.58	0.45	657	1.61	152
Decile 3	52.40	0.96	0.55	0.48	624	1.32	152
Decile 4	44.57	1.06	0.58	0.55	728	1.24	152
Decile 5	38.17	1.15	0.59	0.62	637	1.21	152
Decile 6	33.45	1.28	0.57	0.67	681	1.18	152
Decile 7	19.84	1.50	0.57	0.80	682	1.13	152
Decile 8	14.32	1.44	0.59	0.86	637	1.20	152
Decile 9	5.31	1.78	0.63	0.95	592	1.09	151
Decile 10 - smallest	-142.08	4.79	0.65	2.42	610	1.10	147

Loss is equal to total listed assets as of the date the firm filed for court protection less the total value of proposed payments in the court approved plan of reorganization divided by total listed assets as of the date the firm filed for court protection. DAR is the ratio of total debts to total assets. PPDR is the ratio of total proposed payments to total debts. PPAR is the ratio of total proposed payments to total assets. TTC is the total time, in days, from filing for court protection to plan confirmation. RC is the related number of cases.

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18 This sample of firms would seem to confirm findings by Hudson [1992] that in the U.S. the relative size and number of the very largest bankruptcies has increased, but the relative size and number of the generally large bankruptcies has decreased. That is, it seems that there are quit a few very large bankruptcies, but there seems to be a large size gap between these very large bankruptcies and the next biggest bankruptcies.

19 One old hand of the bankruptcy process explained this apparent conundrum as follows: "If you owe the bank $100,000 and are unable to pay next week, you have a real problem. If you owe the bank $100,000,000 and can't pay, the bank has a real problem." For whatever reasons, creditors and the courts encourage the continuance of insolvent large companies.

Table 2

Values of Relative Loss, DAR, PPDR, PPAR, TTC, and RC by Deciles Ranked by Size (Weighted by Assets)

All values are weighted mean values, weighted by total assets.

	Loss %	DAR	PPDR	PPAR	TTC	RC
Full Sample	23.78%	1.01	1.22	0.76	879	6.26
Decile 1 - largest	22.27	0.89	1.30	0.78	897	6.98
Decile 2	45.39	1.63	0.62	0.55	753	1.59
Decile 3	41.92	1.84	0.62	0.58	738	1.33
Decile 4	25.77	1.74	0.65	0.74	825	1.24
Decile 5	23.99	1.81	0.60	0.76	745	1.21
Decile 6	22.53	2.04	0.68	0.77	766	1.18
Decile 7[20]	-15.21	3.69	1.86	1.15	764	1.13
Decile 8	-18.67	2.80	0.65	1.19	739	1.21
Decile 9	-67.46	3.28	1.40	1.67	715	1.09
Decile 10 -smallest	-257.53	9.19	0.72	3.58	663	1.09

Loss is equal to total listed assets as of the date the firm filed for court protection less the total value of proposed payments in the court approved plan of reorganization divided by total listed assets as of the date the firm filed for court protection. DAR is the ratio of total debts to total assets. PPDR is the ratio of total proposed payments to total debts. PPAR is the ratio of total proposed payments to total assets. TTC is the total time, in days, from filing for court protection to plan confirmation. RC is the related number of cases.

As opposed to past evidence on the direct costs of distress, the median and mean loss values for larger firms indicate that larger firms incur relatively more bankruptcy losses than smaller firms. For example, the largest decile of firms (i.e., decile 1) has a median loss value of 51.21%, while the smallest decile of firms has a median loss value of negative 142.08%. However, the very largest firms do not incur the highest costs during court protection. The negative value for the smaller firms indicates a gain for creditors from court supervised protection under Chapter 11 of the Code. When weighted by total assets the relationship between cost and firm size is also clear (i.e., Table 2). The smallest firms have a mean loss value of negative 257.53%, but the largest firms realize a median loss value of 22.27%. Regarding costs, the most consistent result is the most striking. That is, the few successful small firm bankruptcies[21] appear to do better than their larger counterparts even though they tend to be more highly levered (i.e., DARs were highest for the smallest firms).

The ratio of PP to debts and PP to assets are heavily influenced by several very high relative values for PP (compare PPDR and PPAR from Tables 1 and 2). This may be due to data collection errors and/or businesses with very high levels of equity which

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20 This decile was heavily skewed due to one observation. Assets were listed at 293,000, debts at 557, and proposed payments at 118,430. There was no way of knowing whether this was a typographical error on the part of the data entry person, or whether total debts were really that small.

21 That is, relatively fewer small firms are able to both enter and exit Chapter 11 in the first place.

successfully pay back equity holders. For example, the highest relative pay back is from an observation in decile 7 where PP are $118,430 and debts are $557 (i.e., a ratio of PP to debts of 212.62). Although, median values for PPDR and PPAR show a relative increase in PP as the size of firm decreases. PPDR and PPAR values weakly support a diseconomies of scale in the losses incurred during successful Chapter 11s.

Total time to plan of reorganization plan confirmation is relatively equal across firm size decile, while the largest firms have a significantly higher number of related cases compared to all other deciles. The median number of related cases for the largest decile of firms is 4.72 versus 1.61 for the next highest decile. In short, there seems to be a strong relationship between firm size and the number of related cases.

The following table more clearly shows where there are significant differences by asset size decile.

Table 3

Means Tests for Relative Loss, DAR, PPDR, PPAR, TTC, and RC by Asset Size Deciles (remaining nine decile mean versus the decile mean)

Loss is equal to total listed assets as of the date the firm filed for court protection less the total value of proposed payments in the court approved plan of reorganization divided by total listed assets as of the date the firm filed for court protection. DAR is the ratio of total debts to total assets. PPDR is the ratio of total proposed payments to total debts. PPAR is the ratio of total proposed payments to total assets. TTC is the total time, in days, from filing for court protection to plan confirmation. RC is the related number of cases.

	Loss %	DAR	PPDR	PPAR	TTC	RC
Decile 1 - largest	-4.07****	4.12****	1.33	4.07****	-0.50	-3.31**
Decile 2	-3.94****	3.17**	1.58	3.94****	0.08	-0.15
Decile 3	-3.84****	2.50*	1.60	3.84****	0.10	1.89
Decile 4	-3.32***	3.11**	1.38	3.32***	-1.67	2.87**
Decile 5	-3.25**	3.09**	1.72	3.25**	0.32	2.94**
Decile 6	-3.16**	2.65**	1.15	3.16**	-0.67	3.27**
Decile 7	-1.84	0.12	-0.90	1.84	-0.47	3.90****
Decile 8	-1.78	1.61	1.46	1.78	0.33	3.16**
Decile 9	0.06	0.70	1.19	-0.06	0.81	4.33****
Decile 10 -smallest	2.93**	-2.69**	0.65	-2.93**	2.43*	4.23****

The t-test used here is an approximate t statistic for testing the null hypothesis that the means of two groups are equal. Under the assumption of unequal variances, the approximate t is computed as:

$t = (\bar{x}_1 - \bar{x}_2) / \sqrt{(\sigma_1^2 / n_1) + (\sigma_2^2 / n_2)}$.

**** denotes significance at the 0.01% level of significance, *** denotes significance at the 0.1% level of significance, ** denotes significance at the 1% level of significance, and * denotes significance at the 5% level of significance.

Regarding loss %, deciles 1 through 6 have significantly higher (i.e., greater positive values) means while decile 10 has a significantly lower (i.e., negative value) loss %

value than the mean for all other deciles. Regarding DAR, deciles 1 through 6 have significantly lower means while decile 10 has a significantly higher mean DAR value than the mean for all other deciles. Regarding PPDR, there is no significant difference between the mean for each decile and the mean for all other deciles. Regarding PPAR, deciles 1 through 6 have significantly lower means while decile 10 has a significantly higher mean PPAR value than the mean for all other deciles (i.e., as expected, a similar result as for DAR and the opposite of loss %). Regarding TTC, only decile 10 shows a significant difference between its mean and that of all other deciles (i.e., a shorter time to plan confirmation). Regarding RC, deciles 4 through 10 have a significantly lower mean number of related cases than the mean for all other deciles, whereas decile 1 has the opposite relationship.

Some further comment is warranted for the TTC result for the smallest firms. It has been pointed out that "the most efficient reorganization procedure is that which creates or preserves the greatest value net of all costs. Unfortunately, efficiency cannot be observed directly. However, a number of indirect measures of efficiency, such as length of time required to reorganize" can be observed directly (see Tashjian et al. [1996, p. 136]). Therefore, from this perspective smaller firms more efficiently negotiate the Chapter 11 process than larger firms. This TTC evidence for small firms contradicts the administrative costs of bankruptcy evidence presented by Warner [1977a] and Ang et al. [1982], which would suggest, from an efficiency perspective, the administrative costs of bankruptcy favor larger firms.

3 The Scale Effect of the Losses of Bankruptcy

> For small firms, the direct costs of the bankruptcy proceedings can easily consume the entire corpus (an apt term), but they are essentially fixed costs and hence represent only a small portion of the recoveries in the larger cases.
> Miller [1991, p. 10]

With respect to the administrative costs of bankruptcy, Warner [1977a] and Ang et al. [1982] have found evidence supporting an economies of scale argument. Regarding a scale effect for the direct costs of bankruptcy, the most direct and comprehensive analysis was made by Ang et al. [1982]. Ang et al. [1982, p. 225] concluded that the significance of their results was dependent upon "the role of the administrative costs of bankruptcy as an ingredient of total bankruptcy costs." In addition to the administrative costs of bankruptcy limitation, Ang et al. [1982] were reluctant to generalize their results because of the generally small size of the 55 firms in their sample, and because all 55 firms filed for bankruptcy in the Western District of Oklahoma. This chapter does not suffer from the above limitations noted by Ang et al. [1982], but it is limited by the fact that the sample is exclusively composed of successful Chapter 11 firms in fifteen bankruptcy court districts.

Based on the Ang et al. [1982] methodology, this section will analyze whether the scale effect result applies to the losses of successful bankruptcy. In this section, the following null hypothesis will be tested:
H_0: there is no scale effect on the losses from successful Chapter 11.
Ang et al. [1982, p. 223] used two functional forms to test for a scale effect for the administrative costs of bankruptcy. Based on Ang et al. [1982], the two functional forms were as follows:
(1) $Loss = \alpha_0 + \beta_1 \times Assets + \beta_2 \times Assets^2$ and
(2) $\ln(Loss) = \alpha_0 + \beta_1 \times \ln(Assets)$.
Equation 1 is the quadratic function and equation 2 the logarithmic function. According to the scale effect hypothesis, the signs of the coefficients of equation 1 are as follows: $\alpha_0 = 0$, $\beta_1 > 0$, and $\beta_2 < 0$, and the signs of the coefficients of equation 2 are as follows: $\alpha_0 = 0$ and $1 > \beta_1 > 0$ (see Ang et al. [1982]). The results are provided in the following table.

Table 4

Regression Results: Chapter 11 Loss as a Function of Total Assets

T-statistics are below the estimated coefficient values.

Equation	$\hat{\alpha}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	F-Value	Adj. R^2	Obs.
(1) OLS	-1,290,097	0.8925	-9.8337E-10	189.97****	0.1999	1,514
	-0.81	13.30****	-17.52****			
(1) WLS	-0.2803	0.6013	3.0138E-10	7,869.67****	0.9123	1,514
wtd. by debts	-4.23****	125.19****	0.50			
(2) OLS (log model)	-2.2569	1.0959		5,481.30****	0.8390	1,053
positive losses	-10.80****	74.04****				

**** denotes significance at the 0.01% level of significance.

Due to heteroskedasticity in the OLS quadratic regression, estimates of a weighted least squares ("WLS") model are reported. To correct for heteroskedasticity in the quadratic model, each variable was weighted by total court reported debts.[22]

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[22] Total debts were chosen for the following reasons: (1) the error variances of the quadratic OLS model varied directly with the independent variable; (2) total debts varied directly with the independent variable; and (3) by using total debts to weight each variable, the error term became

Therefore, the results of the OLS quadratic model are only reported in order to compare the SARD sample results directly with Ang et al. [1982].

Given that 461 of the 1,514 loss values are negative, the logarithmic regression results are limited to the 1,053 positive values. Therefore, the logarithmic regression results are based on larger firms than the full sample results. The mean size of the positive loss firms is $10.205 million in asset value versus $4.123 million in asset value for the negative loss firms, and the mean loss for the positive loss firms is $5.456 million versus -$5.938 million for the negative loss firms.

In both quadratic regressions, the estimated intercept term is negative, but it is statistically significant for the WLS regression. The estimated intercept of the logarithmic regression is also significantly negative. The estimated intercept terms of the WLS and logarithmic regressions (i.e., the regressions not showing problems with heteroskedasticity) strongly contradict the scale effect theory.

Overall, the results of the WLS quadratic regression suggest that the scale effect hypothesis does not describe the data generation process for successful Chapter 11 losses well. First, the estimated intercept is negative and statistically significant at below the 0.01% level of significance. Second, the estimated coefficient for the asset value is positive, but it is over twenty times larger than that estimated by Ang et al. [1982, p. 224]. Third, although not statistically significant, the estimated coefficient for asset value squared is positive. Thus, there is a point at which the costs incurred by large firms is greater than unity (i.e., diseconomies of scale due to loss being a convex function of asset value).

Overall, the results of the logarithmic regression strongly suggest the scale effect hypothesis does not hold. First, the estimated intercept is negative and statistically significant at below the 0.01% level of significance. Second, the estimated coefficient for the natural log of asset value is greater than unity and statistically significant at below the 0.01% level of significance.

As a final caveat, there is a strong difference in the scale effect for successful bankrupt firms experiencing negative losses and those experiencing positive losses during

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homoscedastic (i.e., according to the Goldfeld Quandt test used to test for the presence of heteroskedasticity).

Chapter 11. Two sets of unreported regressions were run using the WLS quadratic model on two samples composed of positive and negative cost firms, respectively. The size of the estimated coefficient for asset value for the negative loss sample and positive loss samples suggests a structural difference between the two samples (i.e., -1.1640 and 0.6007, respectively). The negative estimated coefficient for asset value for the negative loss sample suggests that larger successful bankrupt firms experience relatively fewer savings than smaller successful bankrupt firms. In the case of positive losses, larger successful bankrupt firms experience relatively slightly fewer losses than smaller successful bankrupt firms. Given that the negative loss sample is principally composed of smaller firms, this would suggest that small successful bankruptcies do not conform well to the scale effect hypothesis.

Also, although less than unity, the estimated coefficient for asset value in the full sample OLS quadratic regression is over 31 times greater than that in a comparable regression made by Ang et al. [1982, p. 224]. Thus, if the full sample OLS quadratic regression results are reliable, the total losses of successful bankruptcy have only a slight scale effect and are approximately thirty times greater than the direct costs of bankruptcy. Given that the full sample OLS quadratic regression has major problems with heteroskedasticity, the results of the OLS quadratic regression should be viewed with caution.

4 The Determinants of Losses incurred during Successful Bankruptcy

Empirical work has attempted to estimate the direct and indirect costs associated with bankruptcy.[23] [24] The direct costs of bankruptcy include all administrative expenses (e.g., all the court costs and filing fees, lawyers' fees, accounting costs, etc. associated

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23 See Altman [1984] and Kalaba et al. [1984] on attempts to estimate the indirect costs of bankruptcy. Thus far, only Altman [1984] has used real data to do so. Although, Baxter [1967] seems to have been the first to discuss and present evidence on the indirect costs of bankruptcy.

24 See Hudson [1989] on a separate issue, that of the birth and death of firms. He finds that the unemployed are the primary entrepreneurs of the U.S. economy, and the majority of these new ventures fail. The cost involved with shifting from the protection of a failed firm to the failure in a start-up firm can be considered an indirect cost of bankruptcy. Those few unemployed entrepreneurs that succeed, are indirect benefits of corporate failure. To this author's knowledge no academic has mentioned this possible indirect benefit of corporate failure, the focus of this chapter and other studies has typically been on the magnitude of the costs of failure. Although, Wruck [1990, p. 433-436] provided a partial review of the following practitioner mentioned benefits of Chapter 11: (1) changes in top management, (2) changes in strategy and/or structure, (3) the automatic stay, and (4) D.I.P. financing.

with bankruptcy). The direct costs are the explicit costs of reorganization or liquidation.

Implicit or indirect costs of bankruptcy are much harder to define and measure. Indirect costs are typically defined as all costs which result in a real loss in firm value and are caused by the threat of a negative event, such as bankruptcy (e.g., managers' lost time due to reorganization negotiations, lost suppliers and customers due to the threat of bankruptcy, the cost of retraining laid off workers, etc.).[25] An increasingly popular belief among theoretical financial economists is that the implicit costs of bankruptcy, or those of less dramatic events, are great (e.g., Cornell and Shapiro [1987]). In addition, it has been noted that even if the implicit costs can be measured by lost cash flow, that measured lost value will tend to underestimate actual losses.

> In summary, stakeholder theory implies that shocks, such as product recalls, production delays, litigation and the like, will have a larger negative impact on the value of the firm than is indicated by the actual cash outlays involved. In such cases, the prices of implicit claims fall and stakeholders may even require that tacit 'understandings' be replaced by explicit contracts.
> Cornell and Shapiro [1987, p. 13]

The results of this chapter would support this view of bankruptcy; but it should be noted that successful distressed large firms are generally more negatively impacted than successful distressed small firms.

Given that there are significant losses during bankruptcy, the question remains as to what factors determine the losses during bankruptcy. In addition to firm size, this section is intended to explicitly test for some of the determinants of the losses during successful bankruptcy. The remainder of this section is organized as follows: (1) a reconciliation of past direct cost of bankruptcy results with the results of this chapter; (2) establishing possible factors causing the losses of bankruptcy; and (3) modelling, results, and analysis.

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25 Essentially, these are the opportunity costs of being and seeming bankrupt. Baldwin and Mason [1983, p. 511] provide the following list, which was taken from Litner, J., "Some New Perspectives on tests on CAPM and Other Capital Asset Pricing Models and Issues of Market Efficiency," in Blume, Crockett and Taubman (ed.) Economic Activity and Finance (Ballinger 1982): "(1) increases in agency and monitoring costs with increasing debt, (2) the loss of 'financial flexibility', (3) the loss of sales due to weakened assurance of delivery, (4) increasing inability to undertake otherwise profitable future investment opportunities, and (5) increasing probabilities of costly violations of restrictive indenture provisions and of incurring dead-weight bankruptcy costs." Also, see Chapter 3.

4.1 Reconciling Past Research with Current Findings

This section is intended to reconcile past empirical bankruptcy costs research, which imply that there are economies of scale with respect to the administrative or direct costs of bankruptcy, with the findings of this chapter, which indicate that the absolute losses incurred during a successful bankruptcy have an inverted scale effect (i.e., small firms, not large firms, incur fewer relative losses). Regarding the economies of scale of the direct costs of bankruptcy, the results of this chapter do not necessarily contradict past empirical work. This can be explained by the fact that even though there may be economies of scale for the direct costs of bankruptcy, the indirect costs of bankruptcy are relatively higher for larger firms and these indirect costs swamp the scale effect of the direct costs. That is, direct costs, such as court fees, are small relative to the amount of assets that are lost through such indirect costs as decreased worker productivity and lost customers due to filing for bankruptcy, even in the case of successful Chapter 11 firms.

Given the industry and geographic focus of most past studies on the administrative costs of bankruptcy, it is possible that past studies have been so industry and geographically specific that they have failed to pick up more general bankruptcy cost patterns. Also, it may be that under the current Code small firm management interests are more in line with maximizing creditor value than the management of larger firms. At the extreme, sole proprietors may be much more successful at stopping the erosion of asset value than managers of larger firms.[26]

The bankruptcy cost question can be addressed by the following identity: SBC = DC + IC, where SBC = successful bankruptcy costs, DC = Direct Costs, and IC = Indirect Costs. From the Chapter 3 review of bankruptcy costs, DC = Administrative Costs and IC = f(Size, Court Specific Factors, Length of Period of Distress, Creditors, Customers, Suppliers, Managers, Employees, Product, Capital Structure), and IC > DC (see Altman [1984]). DC are the sum of all administrative costs, while the relationship between some IC may be less than clear. It is important to note that there are no *a priori* reasons to believe that the relationship between indirect costs and the

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26 Although, Ang and Chua [1981, p. 73] found a size effect for job losses among top level managers which suggests smaller firm management has less to fear than larger firm top level managers in bankruptcy. "The lower job loss among top executives in smaller companies could not be explained by a difference in the rate of successful reorganization." Apparently, smaller firm management performed better without the same level of fear of job loss as managers from larger firms.

various factors affecting it are linear in nature. Also, it is likely that the factors affecting indirect costs have effects on each other.[27] For example, the size of a firm seems to be of importance in determining the cost of bankruptcy, but it also can be related to the length of court protection. Managers' time lost due to financial distress may increase the number of lost customers, increase the number of lost suppliers, and reduce employee morale. Many factors may be partly subsumed within size itself. For example, a small firm may not incur as relatively high a level of IC due to capital structure, given that smaller firms generally do not have as complex capital structures as larger firms.[28]

This chapter has found that the total relative losses incurred during successful Chapter 11 generally increase as firm size increases. Alternatively, for example, Altman [1984] finds that the direct costs of bankruptcy decrease as firm size increases. At a minimum, the fact that the results of this chapter show the opposite firm value/bankruptcy loss relationship than those examining the firm value/administrative costs of bankruptcy relationship suggests that the total costs of bankruptcy include substantial amounts of indirect costs.

This chapter finds that for successful Chapter 11 bankruptcies the total losses during supervised Chapter 11 increase as the size of the firm increases. These losses peak for the largest firms, but there is a large range over which they increase as firm size increases (i.e., deciles 10 through 2). Direct costs show a different pattern. Generally, it has been found that direct costs decrease as the size of the firm increases (e.g., Warner [1977a and Ang et al. [1982]). The evidence presented would support the notion that the indirect costs of bankruptcy increase substantially as the size of the firm increases. At least empirically, it would appear that indirect costs increase with firm size in such a way as to swamp the scale effects of the direct costs of bankruptcy. For all but the very smallest firms and finance firms, the direct costs of bankruptcy may be relatively trivial after all. For a distressed situation investor it would seem more profitable, but possibly much more difficult, to identify small firms successfully exiting Chapter 11 than large ones. Therefore, much of the inverse scale effect for smaller firms may be in large part due to a selection bias among successful small firm Chapter 11s. If there are economies of scale in Chapter 11, it is one of volume not size.

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27 It is important to note that DC can also be in part a function of variables such as size, court district, and time in distress.

28 That is, agency problems, ala Jensen and Meckling [1976], do not cause many indirect costs for smaller firms.

4.2 Explaining the Losses Incurred during Successful Bankruptcy

As discussed in the previous section, the relationship between the losses incurred during successful bankruptcy can be expressed as a function of the direct and indirect costs of the bankruptcy. Given that DCs are linearly additive, but the relationship between IC factors, DCs, and ICs themselves is unknown, this section is intended to provide evidence on the factors affecting the DCs and ICs of successful bankruptcy (i.e., the total losses incurred during successful bankruptcy). Unfortunately, the data allowed only limited direct tests of all the factors listed in the previous section. Of these, proxies for size, court and case specific factors, and length of distress exist.

Researchers have theorized about the possibility of the indirect costs of bankruptcy (e.g., Baldwin and Mason [1983] and Cornell and Shapiro [1987]), but only Altman [1984] has directly addressed the issue. In the previous section this chapter has suggested that, among others, the indirect cost of bankruptcy may be in part a function of firm size, court specific factors, and time in distress. This section is intended to analyze these possibilities with respect to the losses incurred during successful bankruptcy. For example, is there a correlation between loss and court district or does firm size seem to be the primary determinant of the losses incurred during successful bankruptcy? This chapter is not intended to analyze all possible factors determining the losses incurred during Chapter 11. Therefore, other factors remain an area for possible future research.

4.2.1 Firm Size

This chapter and past empirical research has established the importance of firm size in determining the costs of distress. In addition, in the case of successful Chapter 11, size appears to have been a very important determinant of reorganization plan confirmation, even though with increased size there is a tendency for increased case complexity. As Flynn [1989] wrote "I believe that the most predictive single piece of information reported would be the amount of assets listed by the debtor on its schedules." A case with over $1 million in assets listed was almost five times more likely to be confirmed than a case with less than $100,000 in assets listed (i.e., a small firm non selection bias).

The following table provides evidence regarding the following two hypotheses: (1) there is no relationship between time in bankruptcy and bankruptcy losses; and (2) there is no relationship between loss and firm size. Among other observable measures, Tashjian et al. [1996, p. 136] discuss the expected relationship between time in bankruptcy and the efficiency of the bankruptcy process (i.e., the difference between the value of the firm preserved and the costs of bankruptcy during bankruptcy). The shorter the time in bankruptcy the lower the expected costs of bankruptcy and the higher the value of the firm which is preserved. Regarding total costs and firm size, Warner [1977a], Ang. et al. [1982], and Miller [1991] have suggested that the total costs of bankruptcy are relatively higher for smaller firms.

Table 5

Correlation Coefficients and the Significance Probability for Ho: $\rho = 0$ by Asset Decile

These are Pearson correlation coefficients. The null hypothesis is Rho = 0.

	Loss and TTC		Loss and Total Assets		
Decile	Estimated ρ	Significance Prob.	Estimated ρ	Significance Prob.	Obs.
	-0.02962	24.95%	-0.19629	0.01%****	1,514
1	-0.09694	23.48	-0.23350	0.38%**	152
2	0.18755	2.07*	0.29095	0.03***	152
3	0.20507	1.13*	0.12212	13.39	152
4	0.14112	8.29	0.00285	97.22	152
5	0.08109	32.06	0.02629	74.78	152
6	0.07236	37.57	0.24935	0.19**	152
7	-0.11105	17.32	-0.07587	35.29	152
8	0.09902	22.49	0.06542	42.33	152
9	0.10262	20.99	0.13165	10.71	151
10	-0.10677	19.80	0.07709	35.34	147

**** denotes significance at the 0.01% level of significance, *** denotes significant at the 0.1% level of significant, ** denotes significance at the 1% level of significance, and * denotes significance at the 5% level of significance.

Except for deciles 2 and 3, there isn't a strong relationship between loss and TTC. As suggested by the last section, there is a strong relationship between loss and firm size, but it is negative. Although, this relationship is stronger for the larger firms than the smaller firms.

The largest firms seem to be driving the sign of the correlation coefficient between loss and total assets. The correlation coefficient for loss and total assets for the largest decile is negative, and statistically significant. Among the very largest firms filing under Chapter 11, the losses incurred during bankruptcy decline as firm size increases.

4.2.2 Court District

> The lawyers I spoke with both in Florida and Illinois insisted that judges and lawyers in their jurisdictions are significantly more willing to freeze out equity holders than judges and lawyers in New York.
> Weiss [1991, p.77]

By law, large firms have an option as to the court district in which they choose to file for court protection. Most large corporations in the U.S. are incorporated in the state of Delaware, yet they rarely file for protection there. By law, a business can file for bankruptcy anywhere it has business interests. Many large firms have some interests in the city of New York. This tends to be one of the districts of choice in which to file for Chapter 11 status, and why it was selected by the SARD as one of its non random district selections.

The Southern District of New York (i.e., district 10) was qualitatively different than other court districts. The average number of cases per record was 3.77 in the Southern District of New York and 1.58 in the other 14 districts. A case filed in district 10 was more than twice as likely to be comprised of at least two cases.[29] Approximately 21.0% of the records in district 10 had at least three cases, while the other 14 districts had approximately 6.3% of their records with at least three cases. District 10 had more than twice as many cases filed there than any other district over the study period, and it had the longest median time to filing confirmation of any district in the study. Cases filed there were at least twice as likely to be confirmed than in the other 14 districts. Nationally, it accounted for more than twenty percent of PP confirmed.[30] In the study, it accounted for over half the PP confirmed. District 10 appeared to be unique among the 15 districts the Administrative Office of the United States Courts collected data on. Why was district 10 such a focal point for large, solvent Chapter 11 filings? Was this due to the type of firm filing there, the judges and trustees presiding over cases there, or both? These questions may provide useful focus for future research.

Even though this chapter is primarily concerned with the effect of filing in certain court districts, it is interesting to note that, it may be that larger distressed firms with

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29 Also, they were more than three times as likely to contain at least three cases. As an aside, half of the cases containing nine or more cases were in the Southern District of New York, including one record containing 129 cases.

30 The Southern District of New York tends to have larger and more solvent firms filing for bankruptcy there. Although the Southern District of Texas also appears to have a similar bias. District 10 is a popular place for large, solvent firms to file for Chapter 11.

shareholders in control have an economic incentive to file in the Southern District of New York. Weiss [1991] found that both larger firms and firms filing for bankruptcy in New York were "more likely" to violate the absolute priority rule ("APR") than smaller firms and firms filing for bankruptcy outside of New York. Weiss [1991] indicated that the New York bias was likely to be the result of court and lawyer attitudes towards violation of the APR, and shareholders' interest in attaining a share of the reorganized company in excess of their legally prescribed amount. This may in part explain why there was a tendency for larger more solvent firms to file for bankruptcy in New York than the other districts examined in this chapter.

Systematic industry differences across districts may have also significantly influenced the estimated loss values across districts. Given that this is a large sample of successful bankruptcies, it is assumed that systematic industry differences between districts did not exist. The data did not allow this premise to be tested. For the sample, the industry of each firm was unknown.

The following table provides values by district.

Table 6

Values of Relative Loss, DAR, PPDR, PPAR, TTC, and RC by District

Except for related cases, all values are median values.

District	Loss %	DAR	PPDR	PPAR	TTC	RC
1	42.50%	1.03	0.56	0.57	558	1.42
2	24.14	1.51	0.56	0.76	722	1.30
3	12.04	1.56	0.62	0.88	575	1.22
4	34.85	1.35	0.54	0.65	724	1.32
5	15.25	1.16	0.75	0.85	527	1.09
6	38.32	1.07	0.67	0.62	505	1.21
7	32.52	1.43	0.57	0.67	497	1.12
8	66.38	1.32	0.40	0.34	935	2.09
9	19.79	1.57	0.55	0.80	708	1.53
10	21.08	1.46	0.48	0.79	596	3.77
11	28.38	1.01	0.75	0.72	906	1.24
12	37.90	1.08	0.62	0.62	459	1.85
13	49.46	1.11	0.45	0.51	743	1.33
14	33.67	1.18	0.56	0.66	683	1.27
15	36.69	1.08	0.62	0.63	686	1.18

Loss is equal to total listed assets as of the date the firm filed for court protection less the total value of proposed payments in the court approved plan of reorganization divided by total listed assets as of the date the firm filed for court protection. DAR is the ratio of total debts to total assets. PPDR is the ratio of total proposed payments to total debts. PPAR is the ratio of total proposed payments to total assets. TTC is the total time, in days, from filing for court protection to plan confirmation. RC is the related number of cases.

Of the fifteen districts only the Southern District of New York was known (i.e., district 10), all other fourteen court districts were anonymous. The majority of the largest firms in the largest decile (i.e., those in decile 1) are from the Southern District of New York.

Bankruptcy court districts differ substantially in terms of losses incurred during bankruptcy. Districts 3 and 5 have relatively low loss values, while district 8 has a relatively high level of loss values. Except for the number of related cases, the other variables did not differ substantially from district to district.

Table 7

Means Tests for Relative Loss, DAR, PPDR, PPAR, TTC, and RC by District (remaining fourteen district mean versus the district mean)

Loss is equal to total listed assets as of the date the firm filed for court protection less the total value of proposed payments in the court approved plan of reorganization divided by total listed assets as of the date the firm filed for court protection. DAR is the ratio of total debts to total assets. PPDR is the ratio of total proposed payments to total debts. PPAR is the ratio of total proposed payments to total assets. TTC is the total time, in days, from filing for court protection to plan confirmation. RC is the related number of cases.

	Loss %	DAR	PPDR	PPAR	TTC	RC
District 1	-2.99**	1.49	1.41	2.99**	2.77**	0.68
District 2	1.09	0.59	-1.32	-1.09	-0.99	2.08*
District 3	0.44	-0.83	1.26	-0.91	0.24	2.43*
District 4	0.64	-0.76	1.99*	-0.64	-1.93	1.85
District 5	-2.07*	1.71	0.49	2.07*	0.98	3.86****
District 6	-0.77	2.53*	0.86	0.77	1.93	2.66**
District 7	-0.97	0.84	0.97	-0.95	5.77****	3.64***
District 8	-2.56*	0.01	1.85	2.56*	-2.00	-0.87
District 9	0.35	-0.40	1.80	-0.35	-1.37	0.34
District 10 (SDNY)	-1.14	1.88	0.84	1.14	1.81	-2.22*
District 11	-2.26*	3.50***	0.62	2.26*	-5.34****	1.53
District 12	-2.32*	0.75	1.63	2.32*	7.72****	-0.85
District 13	-3.14**	2.24*	2.46*	3.14**	-0.95	1.70
District 14	0.85	0.48	1.60	-0.85	-1.05	2.47*
District 15	-2.32*	1.79	1.18	2.32*	-1.70	3.29***

The t-test used here is an approximate t statistic for testing the null hypothesis that the means of two groups are equal. Under the assumption of unequal variances, the approximate t is computed as:

$$t = (\bar{x}_1 - \bar{x}_2) / \sqrt{(\sigma_1^2 / n_1) + (\sigma_2^2 / n_2)}.$$

**** denotes significance at the 0.01% level of significance, *** denotes significance at the 0.1% level of significance, ** denotes significance at the 1% level of significance, and * denotes significance at the 5% level of significance.

Regarding loss %, districts 1, 5, 8, 11, 12, 13, and 15 have significantly higher means than the mean for all other districts. Regarding DAR, districts 6, 11, and 13 have significantly lower means than the mean for all other districts. Regarding PPDR, districts 4 and 13 have significantly lower means than the mean for all other districts.

Regarding PPAR, districts 1, 5, 8, 11, 12, 13, and 15 have significantly lower means than the mean for all other districts (i.e., as expected, a similar result as for DAR and the opposite of loss %). Regarding TTC, districts 1, 7, and 12 have significantly lower means than the mean for all other districts, while only district 11 has a significantly higher mean than the mean for all the other districts. Regarding RC, districts 2, 3, 5, 6, 7, 14, and 15 have a significantly lower mean number of related cases than the mean for all other districts, whereas district 10 has the opposite relationship.

Given that bankruptcy is a legal framework, it should not be surprising that institutional factors may play a role in determining the costs and/or timing of bankruptcy. If it is the case that the cost and timing of a successful bankruptcy is in part determined by district, then the optimal initiation of bankruptcy proceedings is not just a function of when the case is filed[31], but also where it is filed. This institutional point concerning choice of venue was first made in the law literature (see LoPucki and Whitford [1991]).[32]

The following table provides evidence regarding the following two hypotheses: (1) there is no relationship between time in distress and loss; and (2) there is no relationship between loss and firm size.

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31 See Van Horne [1976] regarding a dynamic programming solution to the optimal timing of bankruptcy from the debt holders' perspective.

32 Although, Johnson and Abbott [1991] have noted that some of the abnormal benefit derived from merging with financially distressed firms may be determined by the size of the net operating loss ("NOL") tax shield available to the acquiring firm. Unfortunately, their sample would, by the standards of this study, be considered only slightly distressed. Also, they find diversification and asset revaluation to be the primary determinants of abnormal gains from "distressed" acquisitions, not the size of NOLs available to the acquirer.

Table 8

Correlation Coefficients and the Significance Probability for Ho: ρ = 0 by District

These are Pearson correlation coefficients. The null hypothesis is Rho = 0.

	Loss and TTC		Loss and Total Assets		
District	Estimated ρ	Significance Prob.	Estimated ρ	Significance Prob.	Obs.
1	-0.03949	74.19%	0.97125	0.01%****	72
2	-0.05994	57.69	0.96725	0.01****	89
3	0.08471	39.96	0.91844	0.01****	101
4	-0.04195	62.26	0.82292	0.01****	140
5	-0.14666	51.49	0.03560	87.50	22
6	0.10241	37.87	0.99897	0.01****	76
7	0.18531	8.76	0.90146	0.01****	86
8	0.10202	57.85	0.99963	0.01****	32
9	-0.07440	39.84	0.93275	0.01****	131
10	-0.16986	4.25*	-0.80054	0.01****	143
11	0.35962	0.03***	0.56919	0.01****	97
12	0.10346	26.49	0.99410	0.01****	118
13	0.20908	4.67**	0.93363	0.01****	91
14	0.00105	98.85	0.98897	0.01****	192
15	0.20397	2.31*	0.87557	0.01****	124

**** denotes significance at the 0.01% level of significance, *** denotes significant at the 0.1% level of significant, ** denotes significance at the 1% level of significance, and * denotes significance at the 5% level of significance.

Districts 10, 11, 13 and 15 had statistically significant coefficients at the 5%, 0.1%, 1%, and 5% levels of significance, respectively, for loss and TTC. Over the full sample, and in most districts loss and TTC show no statistically significant relationship.

The loss and total asset results are more striking. All but district 5 had statistically significant coefficients at the 0.01% level of significance for loss and total assets. Only in district 10 is the same negative correlation between loss and total assets found as was found in size decile 1. Therefore, the large district 10 firms are responsible for most of the economies of scale in large Chapter 11 firms. District 10 is an unusual district. The large district 10 firms are unlike the other large firms in the SARD sample. Large district 10 firms actually display a scale effect most other large firms do not display.[33]

[33] As a final note, given the peculiarity of the relationship between firm size and costs in district 10, data samples drawn from district 10 should be viewed with caution (e.g., White [1983] draws a sample from the Southern District of New York). That is, generalizations about all court districts based on district 10 should be avoided.

4.2.3 Case Complexity

Ceteris paribus, the more complex a bankruptcy is, the more costly it is. Therefore, this chapter hypothesizes that case complexity positively impacts the losses incurred during successful Chapter 11. Regarding the SARD sample, related cases (i.e., RCs) are used to proxy for case complexity. Related cases are typically cases where a subsidiary files for protection under Chapter 11 of the Code in conjunction with a parent company filing for court protection. Both parent and subsidiary(ies) file separate plans of reorganization. This variable is intended to be a measure of the complexity of the bankruptcy case itself. More related cases would be expected to prolong the period to confirmation and the cost of bankruptcy itself. Therefore, RC should be positively related to the time to plan confirmation and the losses incurred during Chapter 11.

4.2.4 Time in Distress (Time to Case Confirmation)

> Another indicator of bankruptcy costs is the length of time that the bankruptcy procedure takes.
> White [1989, p. 147]

Ceteris paribus, the faster a going concern is able to enter and exit Chapter 11, the lower its costs of bankruptcy. Regarding the SARD sample, time to confirmation (i.e., TTC) is used to proxy for distress time. TTC is the measure of time (in days) from the filing of bankruptcy until the date the plan of reorganization is confirmed by the bankruptcy court. The time to confirmation is a measure of the speed, or lack thereof, of the Chapter 11 process. The longer a firm is under court supervised protection, the worse the expected condition of the firm, *ceteris paribus*.[34] Therefore, the longer the bankruptcy takes, the larger the expected losses incurred during bankruptcy.

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[34] As suggested by the Ernst & Young, Inc. study, at the very least, the more likely the case turns into a Chapter 7.

4.2.5 Agency Theory

> And, given our costly and cumbersome court-supervised bankruptcy process, it seems clear that far more of this operating value can be preserved by privately resolving conflicts among the firm's claimants rather than filing under Chapter 11.
> Jensen [1991, p. 24]

Agency theory (Jensen and Meckling [1976]) suggests that highly levered firms, through increased levels of monitoring, incur fewer agency costs than less levered firms. It has also been theorized that relatively high levels of debt give creditors the ability to "discipline" managers in times of distress, which has the affect of decreasing the costs of distress (e.g., see Harris and Raviv [1990]). Is there a leverage effect in the case of successful Chapter 11s? That is, are relatively high levels of debts associated with lower levels of losses incurred during bankruptcy?

For the successful bankruptcies studied, the smaller the business, as measured by assets listed, the lower was the likelihood of filing before debts were greater than assets. 90.7% of the businesses with under $100,000 in listed assets filed after debts exceeded assets, whereas 21.1% of the businesses with over $100 million in listed assets filed after debts exceed assets. Generally, in terms of solvency, larger businesses filed for Chapter 11 protection earlier than smaller businesses. One reason for this may have been to extend the tenure of managers. Although, data on the longevity of managers in these cases was not available. Another reason for quick filing on the part of managers of large companies may have been to preempt creditors from gaining control of the business.[35] Given the losses incurred during Chapter 11, especially for larger businesses outside of district 10, early filing was not an economically beneficial move from the perspective of the company and its creditors (i.e., the data supports a positive relationship, particularly for larger firms, between loss and length of bankruptcy).

Relative solvency is proxied by the amount owed to creditors relative to the amount of assets of the firm. Given that under the court supervision the automatic stay is in

[35] There are as many arguments as there are stars in the night sky; but it is likely that those people controlling the Chapter 11 filings of large businesses were attempting to seek protection for other reasons than those of the managers of smaller businesses. Given that smaller businesses tend to have a greater share of ownership in the hands of management than larger businesses, it is unlikely that small business owners are not acting in the interests of shareholders by waiting longer to file for Chapter 11 protection.

effect, the liquidity of the firm should not be as important in measuring the solvency of the firm as is its long term ability to pay back its creditors.

4.3 Modelling & Analysis of the Losses Incurred during Successful Chapter 11

Based on the preceding discussion, the following is the general model used:

$Loss_i = f(Size_i, TTC_i, RC_i, Solv_i, District_i)$

where:

$Size_i$= size of bankrupt firm as measured by total assets as of bankruptcy filing (size variable),

TTC_i= total time from bankruptcy filing to plan of reorganization confirmation (court specific),

RC_i= total number of related cases (firm and case specific variable),

$Solv_i$= relative firm solvency (capital structure variable), and

$District_i$= district firm filed bankruptcy petition (court specific variable).

The models tested were as follows:

(3) $Loss_i = \alpha_0 + \beta_1 \times Assets_i + \beta_2 \times Assets_i^2 + \beta_3 \times TTC_i + \beta_4 \times RC_i + \beta_6 \times DVD10_i + e_i$

(4) $\ln(Loss_i) = \alpha_0 + \beta_1 \times \ln(Assets_i) + \beta_3 \times \ln(TTC_i) + \beta_4 \times \ln(RC_i) + \beta_5 \times \ln(DAR_i) + \beta_6 \times DVD10_i + e_i$

where: Assets, TTC, RC, and DAR were defined earlier; DVD10 = dummy variable for bankruptcy court district 10 equal to 1 if district 10, 0 otherwise; and e is the error term. Equation 3 is the WLS regression equation and equation 4 the logarithmic regression equation. The natural logarithm of all nondummy variables was taken in the logarithmic equation.

From the previous section, some of the expected relationships can be summarized by the following hypotheses:

H_{01}: for equations 3 and 4, $\alpha = 0$.

H_{02}: for equation, 3 $\beta_1 > 0$, and for equation 4, $1 > \beta_1 > 0$.

H_{03}: for equation 3, $\beta_2 < 0$.

H_{04}: for equations 3 and 4, $\beta_3 > 0$.

H_{05}: for equations 3 and 4, $\beta_4 > 0$.

H_{06}: for equation 4, $\beta_5 < 0$.

H_{07}: for equations 3 and 4, $\beta_6 \neq 0$.

The following table provides the regression results.

Table 9
Determinants of Loss - WLS and OLS Logarithmic Regression Results

WLS Model		Logarithmic Model	
Variable	Estimated Coefficient	Variable	Estimated Coefficient
Intercept	-0.2569	Intercept	-2.9027
t-statistic	-3.73***		-8.24****
Assets	0.7266	ln(Assets)	1.0788
t-statistic	28.91****		66.41****
Assets Squared	-2.5654E-10		
t-statistic	-0.42		
Time to Confirmation	56.9556	ln(Time to Confirmation)	0.1396
t-statistic	2.60**		3.25**
Related Cases	-79,414	ln(Related Cases)	-0.0398
t-statistic	-7.79****		-0.70
		ln(Debt to Assets Ratio)	-0.1708
t-statistic			-5.73****
District 10 Dummy	-0.1348		-0.1086
t-statistic	-0.61		-1.18
Observations	1,514		1,053
F-Value	3,231.999****		1,156.832****
Adjusted R-squared	0.914		0.846

**** denotes significance at the 0.01% level of significance, *** denotes significance at the 0.1% level of significance, and ** denotes significance at the 1% level of significance.

The first three estimated coefficients of the WLS regression support the results of the WLS scale effect regression, and the first two estimated coefficients of the logarithmic regression support the results of the logarithmic scale effect regression. In both regressions, the estimated intercept term is negative, and statistically significant. Again, the estimated intercept terms of the WLS and logarithmic regressions strongly contradict the scale effect theory. Thus, H_{01} is rejected. Regarding H_{02}, the WLS regression results generally support some scale effect and the logarithmic regression results reject a scale effect. Also, as with the WLS scale effect regression, the estimated coefficient for assets squared is not statistically different from zero. Thus, H_{03} is rejected. None of the results of the first sets of regressions differ in the full model results.

Regarding the estimated coefficient for TTC, the results of regression models 3 and 4 support H_{04}. Logically, longer bankruptcies cost more. For successful Chapter 11 cases, the time spent under court supervision has a significant positive impact on the losses incurred during bankruptcy.

Regarding the estimated coefficient for RC, the results of the WLS model contradict H_{05}, and the results of the logarithmic regression are indeterminate. For the WLS regression, the negative coefficient for RC indicated that, contrary to expectations, the more complex the bankruptcy (as measured by the number of related cases) the lower the losses incurred during bankruptcy. Given that the sample used in the logarithmic regression is composed of generally larger firms than the full sample, the small firms are driving the WLS regression results. The WLS regression results contradict expectations regarding case complexity and losses incurred during successful bankruptcies.

Regarding the estimated coefficient for DAR, the result of the logarithmic regression supports H_{06}. In the case of successful bankruptcy, as suggested by agency theory, the higher levels of monitoring associated with relatively higher levels of debt seem to decrease the agency costs associated with distress. Therefore, the higher DAR is for a successful Chapter 11, the lower its losses during the legally defined bankruptcy period.

Regarding the estimated coefficient for the district 10 dummy variable, neither regression supports H_{07}. Even though there is a significant level of correlation between losses in district 10 and assets, there is no significant district 10 effect, after controlling for the various determinants of loss. There is an obvious bias in the size and solvency of district 10 firms, but there doesn't appear to be a significant benefit to filing for bankruptcy in the Southern District of New York.

5 Summary and Conclusions

The total losses incurred during successful bankruptcy are nontrivial. From a large sample set of successful Chapter 11 cases, size, time in distress, and long run solvency are important factors in determining the losses incurred during bankruptcy. Regarding a "scale effect" for the losses incurred during successful bankruptcy, the results of this chapter contradict the scale effect theory of direct bankruptcy costs. Actually, for all but the very largest firms, the relative size of losses of successful Chapter 11 increase as firm size increases.

There is one bankruptcy court policy implication of this chapter. However, this implication may not apply for the very largest firms and smallest firms filing for Chapter 11, which do not encounter the same level of relative losses as other sizes of firms. Because there is a positive relationship between the costs incurred under court protection and time under court protection, it may be economically advantageous to encourage large firms to file prepackaged Chapter 11 versus Chapter 11 in order to decrease their time under court protection (see McConnell [1991], Salerno and Hanson [1991], and Tashjian et al. [1996]).

CHAPTER 5

BACKGROUND TO THE LOW-GRADE BOND EMPIRICAL EXAMINATIONS IN THIS THESIS

1 Introduction

> Empirical and theoretical research aimed at understanding the returns process of low-grade bonds is sparse.
> Shane [1994, p. 79]

The following are the primary questions addressed by this thesis in the following three empirical chapters: (1) do low-grade corporate bonds as an asset class show evidence of possessing a higher proportion of calls and/or weaker call protection than high-grade corporate bonds; and (2) do low-grade corporate bonds as an asset class demonstrate a return generation process which would suggest that changes in risk-free interest rates and/or the economy account for a significant amount of the relative return variation in the low-grade market overall? Regarding question #1, the analysis is extended to low-grade municipal versus high-grade municipal bonds and convertible corporate bonds versus straight low-grade corporate bonds. Regarding question #2, the analysis is extended to low-grade municipal versus high-grade municipal bonds and convertible corporate bonds versus straight low-grade corporate bonds. In general, the results presented in Chapters 6 through 8 support the basic hypotheses presented in this chapter.

Generally, Chapters 6 through 8 of this thesis test the hypothesis that the returns of low-grade bonds as an asset class are significantly affected (i.e., relative to its high-grade or straight low-grade bond asset class) during periods when significant changes in interest rates and/or the economy occur. The periods used to examine the processes being examined are directly related to the principal options embedded in the risky bond security types studied (i.e., straight low-grade bonds, straight high-grade bonds, and convertible bonds). This methodology is intended to analyze several unresolved questions regarding low-grade and high-grade corporate bonds, and generally extend research on the returns generation processes of relatively under researched asset classes (i.e., low-grade municipal bonds and convertible corporate bonds). In addition, the essential arguments which can explain the returns behavior of low-grade bonds relative to high-grade bonds can be found in CCA pricing models for risky debt which assume an underlying stochastic process for both the firm value and the risk-free rate of interest (e.g., Longstaff and Schwartz [1995]).

Beginning with Hickman [1958], there has been a relatively long, although "sparse", history of financial research on the subject of whether low-grade corporate bonds outperform high-grade corporate bonds. The primary research questions motivating these studies have been the hypotheses that low-grade corporate bonds have or may have returned significantly more than high-grade corporate bonds (e.g., Fraine and Mills [1961], Joehnk and Nielsen [1975], and Weinstein [1987]); and whether the default experience of low-grade corporate bonds suggests that low-grade bonds have been systematically underpriced (e.g., Altman [1989] and Asquith et al. [1989]). For example, Cornell and Green [1991] motivate their study by stating:

> One of the arguments used by Drexel Burnham Lambert to promote the sale of low-grade or 'junk' bonds is that the risk adjusted returns are greater than those for more highly rated bonds. Though Drexel's hypothesis is of keen interest to both academics and practitioners, definite tests have proved difficult to conduct because junk bonds are traded over-the-counter by a limited number of market makers so that reliable transaction data are rarely available.
> Cornell and Green [1991, p. 29]

This "Drexel hypothesis" is merely a restatement of one of Hickman's [1958] results. Beginning with Fraine and Mills [1961], several studies have countered Hickman's [1958] original claim (e.g., Fridson [1994]), while others have supported it (e.g., Fitzpatrick and Severiens [1978]). Generally, these differences between studies are due primarily to methodology and secondly to sample period.

In addition to the fact that there have been few studies concerned with analyzing the return generating process for low-grade bonds and the above standard motivations given, this thesis has at least two other motivations which have been generated by the Blume et al. [1991] and Cornell and Green [1991] studies. First, there is the following issue:

> The standard deviation of low-grade bond returns is frequently less than the standard deviation of high-grade bond returns. Blume, Keim and Patel attribute this to the fact that low-grade bonds typically have a shorter duration. The effective duration of low-grade bonds is lower than that for high-grade bonds and Treasury bonds because the coupons are higher and because low-grade bonds are often called earlier. Early calls occur more often for low-grade bonds because they generally have weaker call protection than their high-grade counterparts and because the credit quality of low-grade bonds is more likely to rise.
> Cornell and Green [1991, p. 39]

Although, it is generally true that low-grade corporate bonds have a lower duration than high-grade corporate bonds, this thesis will show that calls alone cannot be the principal explanation for their shorter duration, and subsequent lower standard deviation, for low-grade corporate bonds relative to high-grade corporate bonds. In fact, it will be shown that defaults have had a greater impact on the duration of low-grade bonds than calls. Defaults and the probability of default have a greater impact on low-grade bonds than high-grade bonds. Therefore, it is the relative lack of defaults for high-grade bonds which make them more volatile relative to low-grade bonds. In addition, as a by-product of the method developed in this chapter, the above assertion that low-grade bonds are called more often and/or earlier will be tested.

Second, there is the following seemingly anomalous finding:

> The finding that low-grade bonds are more sensitive to interest rates during recessions is more difficult to understand. One possibility is that as the probability of default rises, bond prices react more strongly to economic conditions. However, this explanation implies that low-grade bond prices should become more sensitive to both interest rates and the market, but only the former is observed.
> Cornell and Green [1991, p. 44]

Cornell and Green [1991] find that low-grade corporate bonds become significantly more sensitive to Treasury bond market movements during recessionary periods, but this result does not reconcile with CCA models of risky bond pricing which do not account for changes in the risk-free rate of interest. A more simplified CCA risky debt valuation model would suggest that low-grade corporate debt should become increasing more sensitive to the equity market as credit quality declines during recessionary periods. This issue will be further examined by the methodology employed and will be examined for low-grade municipal bonds.

The remainder of the chapter is divided into four sections. Section 2 summarizes previous low-grade corporate bond return research and unresolved low-grade versus high-grade corporate bond issues of interest to this thesis, and reviews some CCA risky debt pricing models of interest to this thesis. Section 3 presents the relevant implications of CCA for this thesis and the importance of embedded options in explaining the return generation process for risky bonds. Section 4 presents the research method and statistical model used in Chapters 6 through 8. Section 5 reviews and summarizes the risky bond asset classes analyzed in this thesis.

2 A Summary of Previous Research and Unresolved Low-Grade vs. High-Grade Corporate Bond Issues

> More important, from the portfolio manager's perspective, is one point that all of the studies have agreed on: High yield bonds have produced higher returns than investment grade bonds over the long run, net of all credit related losses.
> Altman et al. [1990, p. 4]

This section is divided into the following three sections: (1) a low-grade corporate bond return literature review, (2) a review of the low-grade bond return literature as it relates to this thesis, and (3) a review of several CCA risky debt pricing models which can explain seemingly abnormal low-grade corporate bond empirical results. There is no comparable set of convertible corporate bond return or low-grade municipal bond return literature. Therefore, the empirical literature review which follows is based on past low-grade corporate bond research only.

2.1 Low-Grade Corporate Bond Returns Literature Review

Whether low-grade corporate bonds as an asset class have outperformed high-grade corporate bonds became a more popular area of research among academics with the large increase in the size of the low-grade corporate bond market in the early to mid 1980s (e.g., Bierman [1990]).[1] The more recent academic consensus has been that,

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[1] A surge in practical research has also accompanied the surge in new issues (e.g., Cherry and Fridson [1991], Fridson [1991b], and Goodman [1990]). Although, the Cherry and Fridson [1991] article was more concerned with the issue of positive abnormal returns for securities of the Penn Central Transportation Corporation rather than low-grade bonds as an asset class.

after accounting for risk with a particular factor model, low-grade corporate bonds' performance as an asset class was not abnormal.

Most of low-grade corporate bond return literature is not directly linked to the question of the abnormality of low-grade corporate bond returns. The exceptions to this are the following studies: (1) Blume and Keim [1987], (2) Weinstein [1987], (3) Cornell and Green [1991], and (4) Blume et al. [1991]. The one result which is consistent among those directly and indirectly linked to the abnormality of low-grade bond returns is that the various results seem to be inconsistent. The following table is intended to highlight the academic work in the field.

Table 1

Studies Examining the Abnormality of Low-Grade Bond Returns

These represent academic studies and one speech in the area.

Study	Sample	Period	Method of Risk Measurement	Compare HG vs. LG	Abnormal
Hickman [1958]	Financial Manuals	1900-1943	Realized Yield	Yes	+
Fraine & Mills [1961]	NBER Sample	1900-1943	Realized Yield	Yes	-/0
Joehnk & Nielsen [1975]	RR & Industrial	61:01-71:12	Realized Yield	Yes	-
Fitz. & Severiens [1978]	S&P	65:12-76:06	Realized Yield	Yes	+
Blume & Keim [1987]	Constructed Index	77:01-86:12	One Factor Model	Yes	0
Weinstein [1987]	Unknown	62:06-74:07	One Factor Model	Yes	0
Fons [1987]	702 bonds	80:12-84:06	One Factor Model	Yes	+
Altman [1989]	S&P	71:01-87:12	None	Yes	+
Asquith et al. [1989]	S&P & Moody's	77:01-88:12	None	Yes	0
Kaplan & Stein [1990][2]	8 to 12 LBOs	1985-1988	One Factor Models	No	-
Cornell & Green [1991]	Mutual Funds	60:01-89:12	Two Factor Model	Yes	0
Blume et al. [1991]	Constructed Index	77:01-89:12	One Factor Model	Yes	0
Cornell [1993]	Mutual Funds	78:01-89:12	Two Factor Model	Yes	0/+

"Compare HG vs. LG" refers to whether the study compared the performance of high-grade bonds to that of low-grade bonds. What is defined as "abnormal" is contingent upon the methodology used to control for risk.

[2] The Kaplan and Stein [1990] study examined the betas of 12 leveraged recapitalizations before and after recapitalization. The period studied covered a four year period (1985-1988). Kaplan and Stein [1990, p. 244] concluded that "debtholders in our sample do not receive adequate compensation for the risk they bear." This result was based on the assumption that interest on the debt accrued at a fixed rate with certainty over the estimation period (i.e., interest payments were ignored in the beta calculations). Given its risky nature, this may not have been a reasonable assumption to be made for low-grade bonds. In addition, especially in the first two years following a recapitalization, the success of a low-grade bond issue is heavily dependent on a paydown of debt (see Altman and Smith [1990]). The great changes in leverage during the first few years of a typical LBO of the late 1980s makes the pricing and estimation of Betas problematic. Regarding the Kaplan and Stein study, the following issues were problematic: (1) the small size of the sample, (2) the period under study, (3) the shortness of the period under study, (4) assumptions made, and (5) the very specific type of transaction under study.

The classic Hickman [1958] study was the first and most complete study of corporate bonds ever made. The study was based on a complete set of financial manuals provided by the four rating agencies existing at the time (i.e., Moody's, Fitch, Standard Statistics, and Poor's). The study was divided into the following parts: (1) aggregate investor experience, (2) agency ratings, (3) municipal bonds, (4) the market's implied ability to rate bonds, and (6) a comparison of the various ratings systems. Regarding this thesis, Hickman's conclusions regarding investor experience are the more relevant results of his study. Of Hickman's [1958] fourteen primary conclusions, the following were the most relevant: (1) over all corporate bonds the net loss rate was zero, (2) capital gains and losses varied significantly from period to period, (3) low-grade bonds outperformed high-grade bonds over long periods, (4) high-grade bonds were more liquid than low-grade bonds, and (5) a "wide disparity of performance was the rule for minor groupings and for bonds held over short investment periods." Therefore, Hickman indicated that comparisons between high-grade and low-grade bonds should be made over long periods; and liquidity may be a partial explanation as to why low-grade bonds have outperformed high-grade bonds over long periods.

The Fraine and Mills [1961] study was a follow-up to the Hickman [1958] study. The period under study was the same period Hickman [1958] had studied (i.e., 1900 through 1943). They noted that during the later part of the sample period "most of the bonds extinguished during this period were extinguished by call", and suggested that the abnormal realized yields found by Hickman [1958] were in large part due to the end of period effect that low 1943 interest rates had on corporate bonds. After "modifying" yields for undefaulting bonds by substituting the contractual yield for the yield realized over the period, Fraine and Mills [1961] found that low-grade bonds had "realized" lower yields than high-grade bonds. Thus, Fraine and Mills' [1961] results contradicted the Hickman [1958] comparative corporate bond conclusion. Although, this result was caused by the exclusion of issues affected by out-of-court restructurings (see Fridson [1994, p. 50-52]).

The Joehnk and Nielsen [1975] study was a stand alone study on the investment performance of "speculative grade corporate bonds" from railroads and industrial sectors. No defaulted or upgraded bonds were included in the sample of low-grade bonds. The quarterly realized yields of low-grade corporate bonds were compared to those of investment grade (i.e., high-grade) corporate bonds over the periods: (1) January 1961 through December 1964, and (2) January 1968 through December 1971. After controlling for risk as measured by the standard deviation of return, Joehnk and

Nielsen [1975, p. 39] concluded: "on average, speculative grade bonds provided totally unsatisfactory investment outlets" and there is "little or no justification for investing in speculatives, on the average."

The Fitzpatrick and Severiens [1978] study was a follow-up to the Hickman [1958] and Fraine and Mills [1961] study. Fitzpatrick and Severiens [1978, p. 54] noted that both the Hickman [1958] and Fraine and Mills [1961] studies were essentially one period studies and they choose to study the period December 1965 through June 1976 because "the ten-year span embraces both economic recessions and expansions." Convertible bonds and the bonds of "issuers affected by government control" were excluded from the sample (e.g., railroads, airlines, and utilities). After subtracting the annual default rate[3] from the yield to maturity, Fitzpatrick and Severiens [1978, p. 57] found that "a low quality bond will have a higher realized yield to maturity than a higher rated bond." Thus, Fitzpatrick and Severiens [1978] contradicted the Fraine and Mills [1961] results and supported the Hickman [1958] results.

The Blume and Keim [1987] study covered the period January 1977 through December 1986. The return series was essentially a spliced series. The values prior to 1982 came predominantly from the S&P Bond Guide and those after 1981 were derived from average returns used to compile the Salomon Brothers and Drexel Burnham Lambert lower-grade indexes. The following was the risk model used: $LGR_t = \alpha_0 + \beta_{Mkt} \times SP500R_t + e_t$, where LGR = low-grade bond return, α_0 = the "alpha coefficient" (i.e., the measure of abnormal return, after accounting for market risk), β_{Mkt} = "beta" (i.e., the measure of asset return covariability with the "market" return), SP500R = S&P 500 equity index return (i.e., return on the "market"), and e = the error term. The estimated alpha was insignificantly positive.

The Weinstein [1987] study was a follow-up to the Blume and Keim [1987] study. The principal difference in this study was the earlier time period studied (i.e., 62:06 through 74:07 versus 77:01 through 86:12 for Blume and Keim [1987]). Using the Blume and Keim [1987] market model, Weinstein found significant positive abnormal returns for low-grade bond returns. In addition, Weinstein found significantly positive abnormal returns when regressing the return difference between low-grade and high-grade bonds, suggesting low-grade bonds returned significantly more than high-grade

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[3] This was the actual default rate for the year and did not account for the actual recovery rate. Therefore, this would imply that defaulted bonds had zero value upon defaulting. Furthermore, by not adjusting for actual default recovery rates which exceed zero, the study underestimates realized yields.

bonds over the period under study. Although, using more restricted definitions of high-grade and low-grade (see Weinstein [1987, p. 76-77]) resulted in a positive but insignificant estimated alpha. Finally, Weinstein [1987, p. 78] adjusted the returns of high-grade and low-grade bonds for "yield curve effects" by the following model: $BR_i = \beta_0 + \beta_1 \times Coupon_i + \beta_2 \times Term_i + \beta_3 \times Dur_i$, where BR_i = return on bond i, $Coupon_i$ = the coupon rate on bond i, $Term_i$ = the term to maturity on bond i, and Dur_i = the duration on bond i.[4] The residuals derived from these regressions were used to proxy for "term structure corrected" returns. Although still positive, these residuals for low-grade and high-grade bonds no longer showed a statistically significant estimated alpha. Weinstein [1987, p. 80] concluded by stating that low-grade bonds "appear to be fairly priced."

The Fons [1987] study focused on the default premium associated with low-grade bonds. Fons [1987, p. 84-86] developed a risk-neutral model for estimating yield based on the previous work of Bierman and Hass [1975], Yawitz [1977], and Yawitz et al. [1985]. Given that the model was driven by default risk adjusted payment streams, Fons [1987] tested for the ability of the model's derived default rate to mimic the actual default rate. The following was the model used to evaluate the market's ability to accurately price default prone low-grade bonds: $IDR_t = \alpha_0 + \beta_1 \times ADR_t + e_t$, where IDR = implied default rate (i.e., model based), and ADR = actual default rate. Therefore, Fons [1987] attempted to establish a relationship between the default premium and actual default rates. The expectation was that the estimated alpha would be equal to zero. Over the period 80:12 through 84:06 the estimated alpha was significantly positive at well below the 1% level of significance. Fons [1987, p. 93] suggested two possible conclusions: (1) "the market for low-rated debt is inefficient in that arbitrage opportunities exist", and/or (2) "the risk-neutral model used here (and elsewhere) is deficient." In addition, Fons [1987, p. 93-96] unsuccessfully attempted to use "macroeconomic surprises" to account for the abnormal performance.

The Altman [1989] study was primarily concerned with default rates. Although, Altman [1989, p. 920] made the following strong point: "the results show that investors have been more than satisfactorily compensated for investing in high-risk securities. Indeed, if expected default losses are fully discounted in the prices (and yields) of securities, our return spreads should be insignificantly different than zero.

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4 There is likely to be a high degree of multicollinearity between the duration and coupon and term to maturity (i.e., given that duration is at least in part a function of the coupon rate and term to maturity). This might have introduced biases in the estimated parameters, which may have affected the final conclusion made by Weinstein [1987].

The fact that the spreads are so positive has a number of possible explanations, none of them easily corroborated." Among other explanations, Altman [1989, p. 920-921] mentioned market inefficiency, liquidity risk, and market segmentation as possible explanations. Later, in an article primarily reconciling the Altman [1989] and Asquith et al. [1989] default rate results[5], Altman [1990] was less bullish on the return pattern of low-grade bonds. Actually, Altman [1990, p. 92] stated: "there is scant evidence today of 'abnormal' returns.[6] Those differences in returns that cannot be explained as a 'default risk premium' can be reasonably accounted for as reflecting a number of other factors, such as differences in liquidity."

The Asquith et al. [1989] study was also primarily concerned with default rates. Although, Asquith et al. [1989, p. 940-943] reviewed the low-grade bond return results of the Blume and Keim [1987] study and several others. Within their review of low-grade bond return results, Asquith et al. [1989, p. 940] indicated that they felt the Blume and Keim [1987] results were the best to that date, but "their results are mixed." Asquith et al. [1989, p. 943] concluded by stating "what is needed is accurate transaction-based return data over a full range of economic and capital market conditions and a complete (or random) sample of high yield bonds." In large part due to problems associated with matrix pricing, Asquith et al. [1989] did not find the Blume and Keim low-grade bond return series to be an adequate measure of low-grade returns.

The Kaplan and Stein [1990] study focused on the impact of LBOs on the riskiness of debt. Kaplan and Stein [1990] derived an implicit estimate of the post LBO debt beta based on systematic equity risk pre- and post-recapitalization. Based on daily returns, Kaplan and Stein [1990, p. 218 & 229] found that market model estimates of beta rose from an average of 1.01 prior to the acquisition to an average of 1.38 after the acquisition. Kaplan and Stein [1990, p. 218] expected a much larger increase. Kaplan and Stein [1990] found the following average post-recapitalization betas: (1) 0.65, assuming the asset beta is unchanged; (2) 0.40, assuming the entire market adjusted premium in the LBO represents a reduction in fixed costs; and (3) 0.89, assuming low-grade debt has twice the beta of bank debt. Based on their estimates, Kaplan and Stein [1990, p. 244] "suggest that debtholders in our sample do not receive adequate compensation for the risk they bear." In addition, Kaplan and Stein [1990, p. 235 &

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[5] Also, see Bierman [1990] for another reconciliation of the Altman [1989] and Asquith et al. [1989] default rate results.

[6] Later, Altman [1992, p. 85] updated his results on the "risks and returns of low-grade bonds to include 1990". Altman [1992] somewhat contradicted his previous update.

234, respectively] found that (1) "nonsynchronous trading does not have a large effect on our implicit beta estimates" (i.e., which does not support the use of an adjustment for nontrading by Cornell and Green [1991], especially given that their data was monthly not daily), and (2) their beta "estimates exceed the 0.25 found by Blume, Keim, and Patel" (i.e., thus not supporting the significantly lower estimates of beta found by Blume et al. [1991]).

The Cornell and Green [1991] study was principally concerned with determining whether low-grade bonds showed abnormally positive returns. Unlike all other studies on low-grade bond returns, the low-grade bond return series used was constructed from low-grade bond mutual funds and were net of management fees and all transactions costs. Of all the studies in the field, the Cornell and Green time series was the longest and best return series used. To their surprise, Cornell and Green [1991, p. 43-45] found that low-grade bonds were more sensitive to changes in interest rates during recessions than high-grade bonds. The model used to test for return abnormality was of the form:
$BR_t = \alpha_0 + \beta_1 \times TBR_{t+1} + \beta_2 \times TBR_t + \beta_3 \times TBR_{t-1} + \beta_4 \times SP500R_{t+1} + \beta_5 \times SP500R_t + \beta_6 \times SP500R_{t-1} + e_t$ where TBR = Treasury bond return. The lead and lag terms were included in order to "take account of the potential impact of nontrading" (Cornell and Green [1991, p. 41]). Although positive, neither high-grade bonds or low-grade bonds showed estimated alphas significantly greater than zero. Therefore, Cornell and Green [1991, p. 47] concluded that "low-grade bonds are fairly priced relative to high-grade bonds."

The Blume et al. [1991] study was directly concerned with determining whether low-grade bonds showed abnormally positive returns. The low-grade bond return series used was the same series used in the Blume and Keim [1987] study, except the sample was extended through 1989. The following is a list of some findings: (1) Blume et al. [1991, p. 65] stated that "age does not appear to be a significant factor in explaining realized returns", which partially contradicted Altman [1989] and Asquith et al. [1989]; (2) Blume et al. [1991, p. 67] stated "low-grade bonds exhibit some of the characteristics of high-grade bonds and some of the characteristics of stocks"; (3) Blume et al. [1991, p. 65] found a January effect; (4) Blume et al. [1991, p. 65] found an October 1987 effect; and (5) Blume et al. [1991, p. 71] found that low-grade bonds were not over- or under-priced. The model used to test for return abnormality was of the form: $BR_t = \alpha_0 + \beta_{Mkt} \times [(0.75 \times SP500R_t) + (0.20 \times HGR_t) + (0.05 \times LGR_t)] + e_t$, where HGR = high-grade bond return. Over the full period for both low-grade and high-grade bonds the estimated alpha was negative, but not significantly negative.

The Cornell [1993] study was a follow-up to the Cornell and Green [1991] study. The same sample and model were used to test for the presence of abnormal returns each year during the period 1978 through 1989. Cornell [1993] found that low-grade bond returns during 1982 and 1983 showed significant positive abnormal performance. Cornell [1993] attributed this to the possibility of significant increases in liquidity for low-grade bonds during those years.

2.2 Review of the Low-Grade Corporate Bond Returns Literature as it Relates to the Thesis

Since 1986, there has been literature directly and indirectly addressing the question of the abnormality of low-grade corporate bond returns. The consensus has predominantly been that low-grade corporate bonds are fairly priced. Although, the consensus has seemed to generally shift with the direction of the low-grade bond market itself. For example, after the dramatic decline in the low-grade corporate market in late summer 1989 the Journal of Finance published the two most thorough low-grade corporate bond return studies in the same issue (i.e., the Cornell and Green [1991] and the Blume et al. [1991] studies, respectively), both of which suggested low-grade bonds were fairly priced and both of which ended their respective sample periods during the year low-grade bonds had their worst performance ever (i.e., 1989). Previous to the decline, and ignoring studies concerned primarily with default rates, most studies either supported the view that low-grade corporate bonds possessed positive abnormal returns (i.e., Hickman [1958] and Fitzpatrick and Severiens [1978]) or the view low-grade corporate bonds were fairly priced (i.e., Fraine and Mills [1961], Blume and Keim [1987], and Weinstein [1987]). One of the two studies to suggest that low-grade corporate bonds (i.e., in LBOs) were overpriced was based on data derived from the period when low-grade corporate bonds were sustaining a period of substantial price decline (i.e., August 1989 through 1990). Beginning in 1991 low-grade corporate bonds have sustained a period of substantial price appreciation, and the most recent study by Cornell [1993] has indicated that there are periods (i.e., 1982 and 1983) when low-grade corporate bonds seem underpriced.

Although a by-product of the method employed, this thesis is not primarily interested in studying whether low-grade bonds have returned significantly more than high-grade bonds. This issue is in part a motivating factor for researching the topic, but it is not the focus of the tests and method developed. This should become clearer in the next section.

Matrix prices and the "selection bias problem" have plagued low-grade corporate bond return research. Unlike the Blume and Keim [1987], Weinstein [1987], and Blume et al. [1991] studies, the Cornell and Green [1991] study was not dependent on matrix prices (see Cornell and Green [1991, p. 30-32]). Also, the Cornell and Green [1991] study avoided the "selection bias problem" associated with bonds dropped due to default. Based on various problems associated with matrix pricing, of all the recent studies the Cornell and Green [1991] study possessed the best time series of low-grade corporate bond returns to date. Although, Cornell and Green [1991, p. 32 & 40-41] felt that nontrading was also a problem for returns based on low-grade corporate mutual funds. This thesis uses open-end mutual values to derive indices with which to test its various asset class hypotheses.

In addition to sample time period and matrix pricing, Alderson and Zivney [1994] point out that reported low-grade bond returns may be dramatically impacted by the method with which returns are computed. The focus of their criticism focuses on assumptions regarding reinvestment of assumed coupon income, and how calls and exchanges are dealt with. This criticism is not relevant for studies using mutual fund data.

Finally, there are two other issues which surfaced in the Blume et al. [1991] and Cornell and Green [1991] studies which will be addressed. First, there is the issue of the impact of interest rate calls[7] on the relative sensitivity of the two corporate bond asset classes. Second, there is the issue of the seemingly abnormal behavior of low-grade corporate bond returns to periods of recession. These two side issues of the return generating process for low-grade bonds will be tested and used in part to motivate the research and methodology which follows.

[7] There is a considerable literature providing background on the theory and motivation behind interest rate calls (e.g., see Boyce and Kalotay [1979], Brick and Wallingford [1985], Vu [1986], and Fischer et al. [1989]), and some early studies on the value and effect of interest rate call risk (e.g., see Pye [1967], and Jen and Wert [1967]).

2.3 Review of CCA Literature Implications which are of Significance to the Thesis

> We have developed a corporate bond valuation model which incorporates some important real world features. We have modelled stochastic interest rates and the importance of cash flow shortages in precipitating bankruptcy. The payoffs in the real world are very complex.
> Kim et al. [1993, p. 130]

Three chapters of this dissertation (Chapters 6 through 8) analyze the financial performance of several risky bond asset classes, and since CCA is used in part to frame the empirical tests which follow, a brief review of the contingent claims literature on risky bond valuation is therefore appropriate. The review is not intended to be complete, but it is intended to cover some essential studies on risky bond valuation.

The first academic study of options was attributed to Louis Bachelier in 1900. The field didn't become active again until the 1960s. Then in 1961 Sprenkle constructed a warrant pricing model. After Sprenkle [1961], there were a series of warrant pricing model studies (e.g., Ayres [1963] and Samuelson [1965]).[8] Also, Boness [1964] derived a more general option pricing model, and Poensgen [1965 & 1966] and Baumol et al. [1966] derived convertible bond pricing models.[9] Although, it wasn't until 1973 that the field began to blossom. The general equilibrium model developed by Black and Scholes [1973] and the extensions made by Merton [1973] laid the foundation for all subsequent work in the field.

The foundation for the theory of option pricing was established by Black and Scholes [1973] and Merton [1973]. They derived closed form solutions for the value of European put and call options when the underlying stock pays no dividend or the option is protected against dividends. Of particular note was the Black and Scholes [1973] insight that corporate liabilities can be viewed as combinations of put and call options. Based on this insight, the subsequent generalization by Merton [1974] of option pricing is now known as CCA.

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[8] Chen [1970] extended the Samuelson [1965] model, which was the first to address American warrant pricing (i.e., the possibility that the warrant could be optimally exercised before maturity), by examining finite time warrants.

[9] Also, see Brigham [1966], Weil et al. [1968], and Walter and Que [1973] for early analyses and modelling of convertible bond valuation.

The Black and Scholes [1973] study was the first explicit general equilibrium solution to the option pricing problem for European puts and calls. The following assumptions were made in deriving their model: (1) no transactions or information costs, (2) no taxes, (3) trading in the underlying stock is continuous and the prices follow continuous and stationary stochastic processes, (4) the underlying stock pays no dividends, (5) no restrictions on short sales, (6) the option can only be exercised at the terminal date of the contract, (7) the risk-free interest rate is nonstochastic or constant, and (8) Ito dynamics: the value of the underlying stock or firm satisfies a stochastic differential equation.

The value of the option is a function of the following five variables[10]:

(1) the current underlying stock price - S,

(2) the instantaneous variance of the underlying stock price (which can be approximated by past variance) - σ^2,

(3) the exercise price of the option - X,

(4) the time to maturity of the option - T, and

(5) and the risk-free interest rate - r.

Therefore, the functional form for the value of a call option is the following: $O = f(S,\sigma^2,X,T,r)$. The partial derivatives of the call option value, C, with respect to the five pricing factors are the following: $\frac{\partial C}{\partial S} > 0$, $\frac{\partial C}{\partial \sigma^2} > 0$, $\frac{\partial C}{\partial X} < 0$, $\frac{\partial C}{\partial T} > 0$, and $\frac{\partial C}{\partial r} > 0$. All five partial derivatives have intuitive interpretations. The value of the call option is an increasing function of the stock price, an increasing function of the variance of the stock price, a decreasing function of the strike price, an increasing function of the time to maturity, and an increasing function of the risk-free interest rate. The partial derivatives of the put option value, P, with respect to the five pricing factors are the following: $\frac{\partial P}{\partial S} < 0$, $\frac{\partial P}{\partial \sigma^2} > 0$, $\frac{\partial P}{\partial X} > 0$, $\frac{\partial P}{\partial T} >< 0$, and $\frac{\partial P}{\partial r} < 0$. The value of the put option is an decreasing function of the stock price, an increasing function of the variance of the stock price, an increasing function of the strike price, an indeterminate function of the time to maturity, and a decreasing function of the risk-free interest rate.

10 Sprenkle [1961] derived a warrant pricing model which theorized that warrant prices were a function of all the Black and Scholes [1973] factors but the risk-free rate of interest (i.e., Warrant=f(ratio of the mean expected stock price to the present price, recent standard deviation of the stock price, ratio of the exercise price to mean expected price, time to maturity of the warrant, and the risk preferences of the investor).

The original Black and Scholes model has been found to be quit robust with respect to the relaxation of the assumptions it was based upon. Merton [1973] in particular showed the robustness of the model with respect to the relaxation of basic assumptions under which it was derived (e.g., a stochastic interest rate). Among other extensions, later research has extended this option valuation model to take account of noncontinuous trading (Rubinstein [1976]) and jumps in security values (e.g., see Cox and Ross [1976]).

As noted, Black and Scholes [1973] suggested that their analysis could provide the basis for analyzing the value of other contingent claims whose values may be a non-linear function of another asset or liability. It is this insight which is attributed with the development of the CCA of risky debt valuation. In particular, the Merton [1974] study on the effects of risk on the value of corporate debt laid the foundation for CCA of risky debt. For example, Black and Cox [1976] extended Merton's [1974] study by explicitly modelling some indenture provisions.

Merton [1974] was the first to rigorously apply CCA to the analysis of corporate debt, and Merton's [1974] risky bond valuation analysis was a direct extension of his 1973 study.

> The value of a particular issue of corporate debt depends essentially on three items: (1) the required rate of return on riskless (in terms of default) debt (e.g., government bonds or very high grade corporate bonds); (2) the various provisions and restrictions contained in the indenture (e.g., maturity date, coupon rate, call terms, seniority in the event of default, sinking fund, etc.); (3) the probability that the firm will be unable to satisfy some or all of the indenture requirements (i.e., the probability of default).
> Merton [1974, p. 449]

Merton [1974] was the first to systematically emphasize the probability of default in the pricing of corporate bonds. The following is a list of the assumptions made to derive the risky debt valuation model: (1) no transactions or information costs, (2) no taxes, (3) trading in the underlying asset is continuous and the values follow continuous and stationary stochastic processes, (4) homogeneous investors with homogeneous beliefs which do not impact values, (5) no restrictions on short sales, (6) borrowing and lending at the same rate of interest is possible, (7) the term structure is flat and known with certainty (i.e., the risk-free interest rate is nonstochastic or constant), (8) the value of the firm is invariant with respect to its capital structure (i.e., the Modigliani-Miller theorem applies), (9) Ito dynamics: the value of the underlying stock or firm satisfies a stochastic differential equation, (10) no bankruptcy costs is implied, (11) investor risk neutrality is implied, and (12) return serial independence is implied (this is based on the form of the valuation equation used). As is the standard for CCA, the value of the firm, V, through time is described by a Gauss-Weiner stochastic process with stochastic differential equation (assumption 9): $dV = (\alpha V - C)dt + \sigma V dz$, where α is instantaneous rate of return on the firm per unit of time, C is the total payments by the firm per unit of time to all claimholders (i.e., dividends to shareholders and coupons to bondholders) if positive and total payments received by the firm per unit of time from new financing if negative, σ is the instantaneous standard deviation of the return on the firm per unit of time, and dz is a standard Gauss-Weiner process. The same form of equation was applied to the dynamics of security valuation: $dY = (\alpha_y Y - C_y)dt + \sigma_y Y dz_y$, where Y is the market value of the security at any point in time whose functional form is the following: Y=F(V,t). This type of valuation derivation requires that the returns on the securities valued be serially independent. Many other assumptions made were for expositional convenience (e.g., assumption 7 was used to focus on the impact of default risk rather than interest rate risk and assumption 8 is proved) and others could be weakened without necessarily changing the results (assumptions 1, 2, 4, 5, 6). This confirms the robustness of the results.

Given the importance of Merton's [1974] study and derivation of a model to value risky debt to CCA, a short review of the derivation is appropriate. Merton [1973] established the standard method by which contingent claims model derivations are made. By applying Ito's Lemma to the stochastic differential equation, and following the Merton [1973] derivation of the Black and Scholes [1973] model by forming a no arbitrage net zero investment portfolio consisting of the firm, the security, and riskless debt, Merton derived the following parabolic differential equation for F:

$0 = \frac{1}{2}\sigma^2 V^2 F_{vv} + (rV - C)F_v - rF + F_\tau + C_y$, where r is instantaneous return on the riskless asset. Merton [1974, p. 452-455] applied this to a simple case of risky debt pricing for a firm with one class of zero coupon debt and one class of residual claims (i.e., equity). The firm cannot issue new claims on the firm, pay dividends or repurchase shares, and if the debt is not paid on maturity the debtholders become the residual claimholders. Given C=0, if F is the value of the debt issue, the above equation becomes $0 = \frac{1}{2}\sigma^2 V^2 F_{vv} + rVF_v - rF - F_\tau$. By definition,

$V \equiv F(V,\tau) + f(V,\tau)$, where f is the value of the residual claims. Given two boundary conditions (i.e., F and f can only be non-negative and debt must be less than or equal to the value of the firm) and applying the Black and Scholes [1973, p. 643] equation, the following valuation equation for debt follows:

$F[V,\tau] = Be^{-r\tau}[\Phi h_2(d,\sigma^2\tau)] + \frac{1}{d}\Phi[h_1(d,\sigma^2\tau)]$, where $d \equiv \frac{Be^{-r\tau}}{V}$,

$h_1(d,\sigma^2\tau) \equiv -[\frac{1}{2}\sigma^2\tau - \log(d)]/\sigma\sqrt{\tau}$, and $h_2(d,\sigma^2\tau) \equiv -[\frac{1}{2}\sigma^2\tau + \log(d)]/\sigma\sqrt{\tau}$. The risk premium on risky debt is a function of (1) the variance of the firm's operations and (2) the debt to firm value ratio (i.e., d). Therefore, based on the Merton [1974] derivation, the functional form for the value of a risky zero coupon debt is the following: $D = F(V,\sigma^2,B,\tau,r)$, which is identical to the Black Scholes [1973] functional form (i.e., except that firm value is substituted for stock price and bond payments are substituted for exercise price). The partial derivatives of the debt value, D, with respect to the five pricing factors are the following: $\frac{\partial D}{\partial V} \geq 0$, $\frac{\partial D}{\partial \sigma^2} < 0$, $\frac{\partial D}{\partial B} > 0$, $\frac{\partial D}{\partial \tau} < 0$, and $\frac{\partial D}{\partial r} < 0$. Essentially, all but the first of the five partial derivatives are the inverse of those associated with the Black and Scholes [1973] result and have intuitive interpretations. The value of the zero coupon risky debt is an increasing function of the firm value, a decreasing function of the variance of the firm's operations, an increasing function of the bond payments, a decreasing function of the time to maturity, and a decreasing function of the risk-free rate of interest. Given that, by definition, anything which increases the value of residual claims tends to decrease the value of debt, it follows that the partials have the aforementioned relationships.

Based on the zero coupon (i.e., "pure discount") bond derivation, Merton [1974, p. 467-469] extended the analysis to the pricing of risky coupon bonds. Merton [1974, p. 467] pointed out that the critical problem to modelling risky coupon bonds: "if a firm defaults on a coupon payment all subsequent payments (and payments of principal) are also defaulted on." Therefore, it is not possible to value each subsequent coupon as a zero coupon bond and sum all the values (Selby [1983] addresses this problem). In short, one default before maturity is not an independent event. Merton [1974] solved the problem by modifying the indenture condition to require continuous coupon payments at a coupon rate per unit of time (i.e., $C = C_y = \bar{C}$). Therefore, the risky coupon bond value will satisfy the following partial differential equation:

$0 = \frac{1}{2}\sigma^2 V^2 F_{vv} + (rV - \bar{C})F_v - rF - F_\tau + \bar{C}$. Essentially, the original zero coupon bond solution applies.

For the purposes of this thesis, it is important to focus on Merton's [1974] risky debt model assumption regarding the risk-free interest rate being nonstochastic or constant has important implications (i.e., no interest rate risk). If the risk-free interest rate cannot vary over time, then, by definition, it will have no impact on the valuation of the firm or out-of-the-money interest rate calls. That is, since firm value cannot be a function of a constant risk-free interest rate there can be no interaction between changes in the risk-free interest rate and changes in the underlying firm value (i.e., since the risk-free interest rate doesn't change). Since the risk-free interest rate is constant, out-of-the-money interest rate call options have zero value, and in-the-money interest rate call options have constant value. Therefore, there can be no interaction between changes in in-the-money call options and other option values (specifically, the put value). Clearly, a risky debt model which does not incorporate a stochastic risk-free interest rate into the model will not be affected by changes in the risk-free interest rate on firm value or embedded option values which would be expected to be a function of interest rate risk (e.g., interest rate calls).

Black and Cox [1976] extended the Merton [1974] analysis by analyzing the effects of the following three general types of bond covenants: (1) default, (2) subordination, and (3) restricted payments provisions. Black and Cox [1976] make the same general assumptions and use the same valuation equation as Merton [1974]. Black and Cox [1976, p. 357] show that in the case of default provisions, it is in the bondholders' interests to be able to contractually declare bankruptcy as fast as possible (e.g., debt acceleration). Of course, this result is contingent upon being able to perfectly predict bankruptcy, and again assumes the cost of bankruptcy is zero. Assuming two classes of bonds, Black and Cox [1976, p. 358-361] find that the junior bonds have the risk/return (i.e., variance of return and expected return) characteristics of both debt and equity. The closer the firm is to bankruptcy, the more junior bonds take on the risk/return characteristics of equity; the farther the firm is from bankruptcy, the more the junior bonds take on the risk/return characteristics of senior bonds. Of course, this assumes that strict capital priority is maintained. Regarding the restricted payment covenant, Black and Cox [1976, p. 362-366] find that financing restrictions are most valuable for bondholders when the firm value is low.[11] In sum, Black and Cox [1976] find that all three types of covenants increase the value of the bonds which contain them in the indenture. Again, it is important to note that the Black and Cox [1976] model assumes that the risk-free interest rate is constant.

Geske [1977] extended CCA by applying a compound option valuation technique to value risky subordinated debt. The Geske [1977] study differs from the Black and Cox [1976] study, in that Black and Cox [1976] value continuous coupon paying bonds for a square root process while Geske [1977] values finite maturity coupon paying bonds for a lognormal diffusion process. Essentially, the Geske [1977] study extends the Black and Cox [1976] study. Again, it is important to note that the Geske [1977] model assumes that the risk-free interest rate is constant.

Ingersoll [1977a & 1977b] extended CCA to convertible bonds.[12] In addition to the usual CCA assumptions, regarding the equity call feature the following assumptions were made: (1) constant conversion terms, (2) no call notice (i.e., when the bond is called, the owners must immediately surrender their bonds for redemption or convert to equity), and (3) the convertible issue is the only bond issue and the only other issue is the common stock issue. Ingersoll [1977a] established the optimal call policy of the firm: call a convertible bond at that point when its conversion value is equal to its call price. Although, Ingersoll [1977b, p. 466] finds that of 179 issues called between 1968 to 1975, the median company waited until the conversion value of its debentures was 43.9% in excess of the call price. Based on the relaxation of several assumptions, Ingersoll [1977b] still could not theoretically reconcile the actual call policies of firms with his valuation model (see Asquith [1995] for contradictory evidence). Again, it is important to note that the Ingersoll [1977a & 1977b] model assumes that the risk-free interest rate is constant. Actually, for convertible bond valuation models, the assumption of a constant risk-free interest rate makes the derivation much more tractable by excluding the possibility of interest rate calls which could force equity conversion (e.g., Ingersoll [1977b, p. 292]).

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11 Note, given that the analysis of a restricted payments covenant required Black and Cox [1976] to assume a series of payments rather than a zero coupon bond, there was no closed form equation.

12 Ingersoll was not the first to derive a pricing model for convertible bonds. Poensgen [1965] is attributed with the first pricing model for convertible bonds. Ingersoll [1977a, p. 289-290] criticised earlier models for either not allowing for conversion before maturity (i.e., American call option versus European) and/or basing discounted values on an unspecified discount rate. Although, Ingersoll [1977a & 1977b] assumes no dividends for most of his results and doesn't explicitly allow for stochastic interest rates.

Contemporaneously with Ingersoll [1977a], Brennan and Schwartz [1977] derived a contingent claims pricing model for convertible bonds. The primary difference between the two models is that Brennan and Schwartz [1977] derived a general algorithm whereas Ingersoll [1977a] derived closed form solutions to several convertible bond problems. Brennan and Schwartz's [1977, p. 1700] model allowed for the following: (1) coupon payments on the bond, (2) dividend payments on the stock, (3) the bond can be converted at any point in time, (4) if called by the firm, the bondholder can either convert the bond or redeem it at the call price, and (5) default may occur prior to or at maturity. One significant result is that for high firm values an increase in the variance rate increases the value of the convertible bond by increasing the value of the conversion option. Although concerned with convertible bonds, as Brennan and Schwartz [1977, p. 1714] state: "it should be apparent that the analysis captures many of the most important aspects of risky coupon-paying straight bonds, and thus represents a significant generalization of Merton's [1973] path breaking analysis of risky bonds, which was restricted only to discount bonds." Again, it is important to note that the Brennan and Schwartz [1977] model assumes that the risk-free interest rate is constant.

Brennan and Schwartz [1980] extended their 1977 study, and that of Ingersoll [1977b], by allowing explicitly for the uncertainty of interest rates. Allowing for stochastic interest rates substantially increased the complexity of the model.[13] Although, Brennan and Schwartz [1980, p. 926] state that the added accuracy of the stochastic interest rate model does not seem to outweigh the benefits of using the simpler nonstochastic interest rate version. This is a seminal article in that it is the first published CCA risky debt model which incorporated a stochastic risk-free rate of interest. Given the two types of risk (i.e., firm value and interest rate risk) explicitly incorporated into the model, the correlation between changes in the risk-free rate of interest and firm values ($\rho_{r,V}$) enters into the convertible risky debt valuation formula (see the appendix in Brennan and Schwartz [1980]). Although the example used by the authors does not explicitly show the impact of $\rho_{r,V}$ (i.e., given their example, it is implicitly assumed to be 0) on the valuation of convertible bonds assuming a stochastic risk-free rate of interest versus assuming a constant risk-free rate of interest, it is possible that their conclusion regarding the differential between the simpler and

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[13] On the surface, the most complex asset class analyzed in this thesis is convertible bonds. The other bond types analyzed are subsumed within that bond type. Therefore, relative to the other literature, particular emphasis should be placed on the literature reviewed which analyzes the valuation of convertible bonds.

more complex CCA models might be modified if the potential impact of $\rho_{r,V}$ were taken account of.

Jones et al. [1984] modelled and tested the applicability of their contingent claims model for valuing high-grade and low-grade corporate bonds. Jones et al. [1984] make the same general assumptions and use the same valuation equation as previous studies using the Merton [1974] methodology. Unlike previous contingent claims models, Jones et al. [1993, p. 613] introduce the presence of sinking fund provisions on valuation. Also, unlike Merton [1974], multiple traunches of bonds, callability, and coupons are assumed. Even though the general result is that the derived contingent claims model does not have superior explanatory power over the naive riskless model tested for high-grade corporate bonds, it is an incremental improvement for low-grade corporate bond pricing. No explanation other than the possibility of tax effects or a year effect is posited to explain the high-grade/low-grade corporate bond differential in model valuation success (see Jones et al. [1984, p. 622-624]). In sum, the Jones et al. [1984] results suggest that contingent claims valuation may be more effective for valuing lower grade corporate bonds than high-grade corporate bonds. Again, it is important to note that the Jones et al. [1984] model assumes that the risk-free interest rate is constant.

Ramaswamy and Sundaresan [1986] applied CCA modelling to the valuation of floating-rate instruments, including corporate floating-rate instruments with default risk. Their evidence tends to support the hypothesis that floating-rate instruments tend to be undervalued. Their model assumes a stochastic risk-free rate of interest. Regarding the valuation of corporate floating-rate instruments with default risk, they assume that $\rho_{r,V} = 0$. Therefore, although they assume the risk-free rate of interest is not constant, their floating-rate CCA risky debt valuation model does not find any important interaction effect between changes in the risk-free rate of interest and changes in firm values.

Motivated by the apparent contradiction in observed corporate bond yield spreads and those estimated based on Merton's [1974] risky debt valuation model[14], Kim et al.

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[14] See Sarig and Warga [1989] for an empirical investigation of the "risk structure of interest rates" developed by Merton [1974] and further refined by Lee [1981] and Pitts and Selby [1983]. Based on a sample of zero coupon bonds, it turns out that a graph of the actual values closely mirror the graph derived by Pitts and Selby [1983].

[1993] extended the model developed by Brennan and Schwartz [1980][15] and estimated yield spreads which are consistent with observed levels. Kim et al. [1993] make some of the same general assumptions and use the same valuation equation as previous studies using the Merton [1974] methodology. But unlike most previous risky debt contingent claims models, Kim et al. [1993] assume that the firm can default on its coupon obligations, as opposed to maturity default only, and specify a stochastic process for the evolution of the short rate of interest. Therefore, as with Brennan and Schwartz [1980], firm value risk and interest rate risk are incorporated into the risky bond valuation model. Given no closed-form solution to the valuation equation, numerical solutions were estimated. The critical result with direct application to this thesis is that Kim et al. [1993, p. 125-126] find that "interactions between default risk and the call provision play an important role in determining the total spread defined in this way." In most realistic scenarios estimated, the majority of the yield spread (callable corporate bonds against comparable non-callable Treasury bonds) is determined by default risk, but a large portion is determined by the interaction between the stochastic firm value and the stochastic risk-free interest rate. It was found that the interaction effect of default risk with interest rate call risk decreases as interest rates increase and increases as interest rates decrease. In addition, the interaction effect of default risk with interest rate call risk decreases as the maturity decreases and increases as the maturity increases. Specifically, after assuming $\rho_{r,V}$ = -0.2 and close to insolvent firm values, there were very large risky debt yield differences between the Kim et al. [1993] risky debt model which assumes a stochastic risk-free interest rate and the Merton [1974] risky debt model which does not. Clearly, $\rho_{r,V}$ can have an affect of risky debt valuation.

Shimko et al. [1993] explicitly examine the pricing of risky debt when the risk-free interest rate is stochastically generated. They extend the Merton [1973] model for the pricing of options with stochastic interest rates to risky debt and combine this with the term structure model of Vasicek [1977].[16] The study refines and extends the analysis presented in Kim et al. [1993] by specifically analyzing the impact of a stochastic risk-free interest rate on credit spreads. The general implication is that low-grade bonds can seem to become more bond-like and less stock-like when changes in the risk-free interest rate are negatively correlated with changes in the value of the firm

[15] Their model was also based in part on the Black and Cox [1976] model, and their study was at least in part motivated by the Jones et al. [1984] study.

[16] The Vasicek [1977] model assumes that the short-term risk-free rate of interest is mean-reverting to the long-run mean and the instantaneous volatility is constant. See Chan et al. [1992] for a thorough review and analysis of the various short-term interest rate models.

(i.e., the Cornell and Green [1992] seemingly anomalous result may not be after all). Partial derivatives show credit spread to be: (1) positively impacted by the level of leverage; (2) the sign for interest rate volatility is dependent on whether $\rho_{r,V}$ is negative or positive (i.e., if $\rho_{r,V}$ is positive it is positively impacted by interest rate volatility); (3) the sign for asset volatility is dependent on maturity and leverage (i.e., generally it is positively impacted unless leverage is very high); and (4) positively impacted by $\rho_{r,V}$ (i.e., the credit spread may not increase with maturity if $\rho_{r,V}$ is strongly negative). Shimko et al. [1993, p. 64] conclude by stating that in theory "the correlation between interest rate movements and the returns on the underlying asset is clearly an important variable in determining the credit spread on risky debt."

Like Shimko et al. [1993], Longstaff and Schwartz [1995] explicitly examine the pricing of risky debt when the risk-free interest rate is stochastically generated. They extend the Black and Cox [1976] risky debt model to include both default and interest rate risk. Also like Shimko et al. [1993], the short-term riskless interest rate model employed is that of Vasicek [1977]. The risky debt model is applied to the valuation of fixed-rate and floating-rate debt and closed-form valuation expressions are derived. As the correlation between changes in the value of the firm and changes in the level of the risk-free rate of interest increases, credit spreads increase. By using actual corporate bond yield averages, Longstaff and Schwartz [1995, p. 791] "find that credit spreads are strongly negatively related to the level of interest rates. Furthermore, changes in interest rates account for the majority of the variation in credit spreads for most bonds in the sample." Clearly, the correlation of changes in firm value with changes in the risk-free rate of interest can have significant affects on the valuation of risky debt.

3 The Importance of Embedded Options in Explaining the Return Generation Process for Risky Bonds

The primary purpose of Chapters 6 through 8 is to examine the importance of embedded options in explaining the relative sensitivity of low-grade bond returns to movements in the government debt and the private equity markets during periods when options embedded in low-grade bonds (i.e., both straight and convertible) would be expected to be exercised and/or increase in value. This is done to test whether the relationships as implied by more recent risky debt pricing models hold.

3.1 CCA Implications and the Thesis

As mentioned earlier, the foundation for the theory of option pricing was established by Black and Scholes [1973] and Merton [1973]. They derived closed form solutions for the value of European put and call options when the underlying stock pays no dividend or the option is protected against dividends. Of particular note was the Black and Scholes [1973] insight that corporate liabilities can be viewed as combinations of put and call options.

Assuming one debt issue with the same terms and maturity (i.e., the debt issue is the only liability of the firm), CCA views equity as a call option on the value of the firm (V = value of the firm) while debt can be viewed as a portfolio comprised of the risk-free asset (B = bondholders' payment) and a put on the value of the firm. Due to limited liability, at the maturity of the debt issue, equity receives Max[V-B,0], while the bondholders receive Min[V,B]. The further the value of the firm is from its exercise price (i.e., the more valuable the equity of the firm is relative to the debt payment), the greater the probability the bondholders will receive B. Conversely, the closer (or more negative) the value of the firm is to the exercise price B, the greater the probability that the bondholders will receive V. Therefore, as the probability of default or bankruptcy increases, the higher the expected covariability of the firm's debt with its equity.[17]

Initially, equity is equal to the market value of the firm less the present value of any senior claims on the firm. In this case, at maturity the value of equity is equal to Max[V-B,0] (i.e., given that the exercise price is B, the end-of-period call value). Conversely, the bondholders receive Min[V,B] (i.e., B-Max[V-B,0] = Min[V,B]). Clearly, the value of the two securities are contingent on the value of the underlying firm.

This textbook case (see Copeland and Weston [1988, p. 249]) of the simple levered firm, which has one equity issue and one zero coupon bond issue with payment B due at maturity, can be used to put into perspective the anomalous finding by Cornell and Green [1992]. The table below is intended to illustrate the dynamics of the put option

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[17] As an alternative but equivalent view of this case, instead of the stockholders possessing a call option on the value of the firm, the bondholders have written a put option on the value of the firm. Effectively, the bondholders are long a risk-free bond and short an equity put option (i.e., where the stock price is V and the exercise price is B).

embedded in risky bonds ("RB"). The bondholders' will only take control of the firm in bankruptcy. Given that the payment to bondholders is fixed, as the value of the firm approaches zero, the risky bonds would be expected to behave more and more like the residual claim on the firm (i.e., equity). As the value of the firm increases, the risky bonds would be expected to behave more and more like risk-free bonds. Therefore, risky bonds would be expected to covary with the equity of the firm more and more as distress nears. Conversely, risky bonds would be expected to covary with risk-free bonds more and more as the value of the firm increases.

Table 2
Stakeholders' Payoffs at Maturity for a Firm where Shareholders can Put the Firm to Bondholders

	States of the World	
	State 1 If $V \leq B$	State 2 If $V > B$
Shareholders:		
Equity	0	(V-B)
Bondholders:		
Risk-free Bond	B	B
Put Option	-(B-V)	0
Bondholders' Position	V	B
	Evaluation of Bond Position	
	↓Solvency	↑Solvency
	As $V \rightarrow 0 \Rightarrow$ $B \rightarrow V$ $\Rightarrow RB \rightarrow V$ Equity	As $V \rightarrow \infty \Rightarrow$ $B \rightarrow B$ $\Rightarrow RB \rightarrow B$ Risk-free Bnd

Furthermore, based on the above analysis, the closer a firm approaches insolvency (i.e., V-B=0), the closer its debt will be to being valued as its equity. Therefore, the distribution of returns for a firm's debt will converge toward the distribution of returns for its equity as it approaches bankruptcy. Conversely, the further a firm's value moves away from B, the distribution of returns for a firm's debt will converge toward the distribution of returns for the risk-free asset.

Given this analysis, which excludes interest rate call options, the Cornell and Green [1991] result that low-grade corporate bond returns are relatively more sensitive to government bond returns is anomalous. This simplified terminal value CCA suggests that the lower credit quality bonds should be less sensitive to government bond risk and more sensitive to equity market risk during periods when bankruptcy risk is increasing. Therefore, the CCA null hypothesis of specific interest to the thesis is the following: H_0: during periods when the general credit quality is declining, low-grade bonds should become relatively more sensitive to Treasury bond market movements and less sensitive to stock market movements. In essence this is the Cornell and Green [1991] hypothesis.

Although the above example illustrates the basic theory behind the credit risk of risky bonds (i.e., the embedded put option), it is missing at least one other important option embedded in most risky bonds. Most firms issue bonds with the right to call the bonds at some price over the par value of the bonds at some time in the future. Effectively, bondholders write interest rate call options on the bonds they purchase. Based on the previous analysis, and in order to simplify the following analysis, the following assumptions are made: (1) bondholders write a European interest rate call option which matures the same day as B, (2) B is no longer constant (it is solely a negative function of the risk-free rate of interest), and (3) C is the exercise price of the interest rate call (C is greater than the original par value of B). Therefore, at maturity the value of the interest rate call option to the shareholders is equal to Max[B-C,0]. Conversely, at maturity bondholders will receive Min[B,C] (i.e., B-Max[B-C,0] = Min[B,C]).

The table below is intended to illustrate the dynamics of the interest rate call option embedded in risky bonds. As interest rates increase and the value of the bond payment approaches zero, the bonds would be expected to behave more and more like risk-free bonds. As interest rates decline and the value of the bond payment increases, the bonds would be expected to be called at the constant C. Therefore, the bonds would be expected to covary with the risk-free bond as interest rates rise. Conversely, the bonds would be expected to covary less with the risk-free bond as interest rates decline and their value approaches their call value.

Table 3

Stakeholders' Payoffs at Maturity for a Firm where Shareholders cannot Put the Firm to Bondholders, but Shareholders can Call the Bonds from Bondholders

	States of the World	
	State 1 If B≤C	State 2 If B>C
Shareholders:		
Equity	(V-B)	(V-B)
Interest Rate Call	0	(B-C)
Shareholders' Position	V-B	V-C
Bondholders:		
Risk-free Bond	B	B
Int. Rate Call Option	0	(C-B)
Bondholders' Position	B	C
	Evaluation of Bond Position	
	↑ Rates	↓ Rates
	As i→∞ ⇒	As i→0 ⇒
	B→0	B→∞
	⇒Debt→B	⇒Debt→C
	Risk-free Bnd	Called Bnd

Clearly, a bond with embedded interest rate call option would be expected to be less like the risk-free bond than a bond without an interest rate call options. Therefore, the comment about low-grade bonds' having relatively significantly more callable bonds and/or weaker call protection than high-grade bonds can be tested by testing the following hypothesis: H_0: if low-grade bonds have weaker call protection than high-grade bonds, then during periods when interest rates are declining, low-grade bonds should become relatively less sensitive to Treasury bond market movements.

Of course, most risky bonds have both an embedded put and an embedded interest rate call. Based on the combination of the two previous examples, the following table presents the four possible payoffs available to stakeholders if the firm issues risky debt with an embedded interest rate call option.

Table 4

Stakeholders' Payoffs at Maturity for a Levered Firm

	States of the World			
	State 1 If V≤B≤C	State 2 If V≤B>C	State 3 If V>B≤C	State 4 If V>B>C
Shareholders:				
Equity (i.e., put option)	0	0	(V-B)	(V-B)
Int. Rate Call	0	(B-C)	0	(B-C)
Shareholders' Position	0	B-C	V-B	V-C
Bondholders:				
Risk-free Bond	B	B	B	B
Put Option	-(B-V)	-(B-V)	0	0
Int. Rate Call Option	0	(C-B)	0	(C-B)
Bondholders' Position	V	V+C-B	B	C
	Evaluation of Risky Bond ("RB") Position			
	↓ Solvency & ↑ Rates	↓ Solvency & ↓ Rates	↑ Solvency & ↑ Rates	↑ Solvency & ↓ Rates
	As V-B→0 ⇒ RB→V and as i→∞ ⇒B→0 ⇒RB→V	As V-B→0 ⇒ RB→V and as i→0 ⇒B→∞ ⇒RB→ V/C-B?	As V-B→∞ and as i→∞ ⇒B→0 ⇒RB→B	As V-B→∞ and as i→0 ⇒B→∞ ⇒RB→C
	Equity	Ambiguous	Risk-free Bnd	Called Bnd

In State 1, the shareholders exercise their put option, but do not exercise their interest rate call option. As V declines relative to B, the debt of the firm will behave more like equity. Clearly, the embedded put option causes risky bonds to behave more like equity as the credit quality of the firm declines.

In State 2, the shareholders exercise both options. In State 2, the bondholders end up with essentially the worst of all possible states of the world. That is, in State 2 the bondholders must take control of the firm and pay the former shareholders the difference between the C and B. Although, as B increases in value and V declines relative to B, it is not clear as to the general behavior of the bonds. The firm is declining in value relative to the bonds which were issued, but given that the firm may be increasing in value as well (although not as fast), the stock and bonds of the firm will tend to move in the same direction as risk-free interest rates decline. Although no expression for V has been provided, this effect would be accentuated if V were a negative function of the level of risk-free interest rates. Therefore, State 2 illustrates the following point: because one could hypothesize that if there were some significant degree of a natural hedge inherent in risky bonds it would tend to be most dramatic during periods when the embedded put and interest rate call would simultaneously move deeper into-the-money and/or be exercised. That is, it is possible that the return generation process of risky bonds, especially less credit worthy bonds, is significantly affected by its embedded options especially during periods when both option values would be expected to increase in value. From the risky bondholders' perspective, default and interest rate calls combined may provide a useful hedge. This point will be elaborated upon in the next several sections.

In State 3, the shareholders do not exercise either option. As V increases relative to B, the debt of the firm will behave more like a risk-free bond. In this state of the world, both options move further and further out-of-the-money and the risky bonds covary more and more with the risk-free bond.

In State 4, the shareholders exercise their interest rate call option, but do not exercise their put option. As B increases and V increases relative to B, the debt of the firm will tend toward the constant C. As risk-free rates rise, the embedded interest rate call option causes risky bonds to truncate their value at their call price, and causes bondholder losses as risk-free rates cause bond values to rise above their exercise price.

In the case of convertible bonds, not only is the owner short an embedded put and interest rate call, but the owner is also long an equity call option. Therefore, because there are three embedded options, there are eight possible states of the world (i.e., 2^3 versus 2^2). In addition to the assumptions used in the previous example of a straight risky bond, where the holder is short an interest rate call and put option, some additional complications are required. As before, assume all embedded options are European options with the same maturity dates. If the equity call option is exercised ("conversion"), assume that the bondholders receive gV, where g is the dilution factor (i.e., $g = n/(n+N)$, where $n + N$ = the number of shares after exercise). Therefore, the equity call option will be exercised if $gV>B$. Assume that the equity call option embedded in the convertible bond will only be exercised when the value of the firm is greater than or equal to some critical value ($V^* = B/g$).

The following table presents the four possible payoffs available to stakeholders if the firm issues convertible debt and the equity call option never ends up being in-the-money (i.e., the same possible states of the world as the case of a risky bond without the equity call option).

Table 5

Stakeholders' Payoffs at Maturity for a Levered Firm with Convertible Debt (when the equity call option is out-of-the-money - V*>V)

	States of the World			
	State 1 If V*>V≤B≤C	State 1 If V*>V≤B>C	State 3 If V*>V>B≤C	State 4 If V*>V>B>C
Shareholders:				
Equity (i.e., put option)	0	0	(V-B)	(V-B)
Int. Rate Call	0	(B-C)	0	(B-C)
Equity Call	0	0	0	0
Shareholders' Position	0	B-C	V-B	V-C
Bondholders:				
Risk-free Bond	B	B	B	B
Put Option	-(B-V)	-(B-V)	0	0
Int. Rate Call Option	0	(C-B)	0	(C-B)
Equity Call Option	0	0	0	0
Bondholders' Position	V	V+C-B	B	C
	Evaluation of Risky Bond ("RB") Position			
	↓ Solvency & ↑ Rates & ↓ Firm Value	↓ Solvency & ↓ Rates & ↓ Firm Value	↑ Solvency & ↑ Rates & ↓ Firm Value	↑ Solvency & ↓ Rates & ↓ Firm Value
	As V-B→0 ⇒ RB→V and as i→∞ ⇒B→0 and as V→0⇒E→0 ⇒RB→V	As V-B→0 ⇒ RB→V and as i→0 ⇒B→∞ and as V→0⇒E→0 ⇒RB→ V/C-B?	As V-B→∞ and as i→∞ ⇒B→0 and as V→0⇒E→0 ⇒RB→B	As V-B→∞ and as i→0 ⇒B→∞ and as V→0⇒E→0 ⇒RB→C
	Equity	Ambiguous	Risk-free Bnd	Called Bnd

In the above four states of the world the value of the firm is less than the critical conversion value V*. In these four states of the world the results are equivalent to the previous table results for the straight risky bond.

The following table presents the four possible payoffs available to stakeholders if the firm issues convertible debt and the equity call option ends up being in-the-money.

Table 6

Stakeholders' Payoffs at Maturity for a Levered Firm with Convertible Debt (the additional four payoffs possible for a levered firm with convertible debt - V*≤V)

	States of the World			
	State 5 If V*≤V≤B≤C	State 6 If V*≤V≤B>C	State 7 If V*≤V>B≤C	State 8 If V*≤V>B>C
Shareholders:				
Equity (i.e., put option)	0	0	(V-B)	(V-B)
Int. Rate Call	0	(B-C)	0	(B-C)
Equity Call	-gV	-gV	-gV	-gV
Shareholders' Position	-gV	B-C-gV	V-B-gV	V-C-gV
Bondholders:				
Risk-free Bond	B	B	B	B
Put Option	-(B-V)	-(B-V)	0	0
Int. Rate Call Option	0	(C-B)	0	(C-B)
Equity Call Option	gV	gV	gV	gV
Bondholders' Position	V+gV	V+C-B+gV	B+gV	C+gV
	Evaluation of Risky Bond ("RB") Position			
	↓ Solvency & ↑ Rates & ↑ Firm Value	↓ Solvency & ↓ Rates & ↑ Firm Value	↑ Solvency & ↑ Rates & ↑ Firm Value	↑ Solvency & ↓ Rates & ↑ Firm Value
	As V-B→0 ⇒ RB→V and as i→∞ ⇒B→0 and as V→∞⇒E→∞ ⇒RB→V	As V-B→0 ⇒ RB→V and as i→0 ⇒B→∞ and as V→∞⇒E→∞ ⇒RB→ V/C-B?	As V-B→∞ and as i→∞ ⇒B→0 and as V→∞⇒E→∞ ⇒RB→B/V?	As V-B→∞ and as i→0 ⇒B→∞ and as V→∞⇒E→∞ ⇒RB→C/V?
	Equity	Ambiguous	Ambiguous	Ambiguous

In the above four states of the world the value of the firm is greater than or equal to the critical conversion value V*. In these four states of the world the results are equivalent to the straight risky bond results with gV added.

In State 5, the shareholders exercise their put and bondholders their equity call option, but shareholders do not exercise their interest rate call option. As V declines relative to B, the debt of the firm will behave more like equity. Clearly, the embedded put option causes risky bonds to behave more like equity as the credit quality of the firm declines. As V increases to the point where the equity call is in-the-money, the debt of the firm will behave more like equity (i.e., levered equity - V+gV). Although, it is unlikely that the firm would decrease in value relative to B such that shareholders would exercise their put option but increase overall so that the bondholders would find it advantageous to exercise their equity call option.

In State 6, the shareholders exercise both options and the bondholders exercise their equity call option (i.e., all three options are exercised). As in the straight risky bond State 2, the bondholders must take control of the firm and pay the former shareholders the difference between the C and B. Although, as B increases in value and V declines relative to B but increases relative to V*, it is not clear as to the general behavior of the bonds. The firm is declining in value relative to the bonds which were issued, but given that the firm may be increasing in value as well (although not as fast), the equity and bonds of the firm will tend to move in the same direction as risk-free interest rates decline. As with State 5, it is unlikely that the firm would decrease in value relative to B such that shareholders would exercise their put option but increase overall so that the bondholders would find it advantageous to exercise their equity call option. Nevertheless, in State 6 the bonds should behave as some combination of levered equity and the short value of an interest rate call option (i.e., C-B).

In State 7, the shareholders do not exercise either option, but the bondholders exercise their equity call option. As V increases relative to B, the debt of the firm will behave more like a risk-free bond, but as V increases relative to V* the debt of the firm will behave more like equity. In this state of the world, both shareholder options move further and further out-of-the-money while the bondholder option moves further into-the-money. In State 7 the bonds should behave as some combination of equity (i.e., gV) and the risk-free bond.

In State 8, the shareholders exercise their interest rate call option and the bondholders exercise their interest rate call option, but the shareholders do not exercise their put option. As B increases and V increases relative to B and V*, the debt of the firm will tend toward the constant C and gV. As risk-free interest rates rise, the embedded interest rate call option causes risky bonds to truncate their value at their call price, and causes bondholder losses as risk-free interest rates cause bond values to rise above their exercise price. Although, as the value of the firm increases and the equity call moves further and further into-the-money, the bonds will behave more like equity. In State 8 the bonds should behave as some combination of equity (i.e., gV) and the constant C. Therefore, because C is a constant, the bonds will tend to covary with the firm's equity movements. In practice, in State 8 bondholders would have to choose between C and gV.

Finally, given that risky bonds are some combination of debt and equity, CCA would imply that an appropriate simple asset pricing model for risky debt should control for equity risk and risk-free asset risk. This is done in this thesis by using a simple two-factor model which controls for equity market and government bond or Treasury market risk. This type of model is a compact means of controlling for relevant risks and testing the relationships at issue in Chapters 6 through 8.

3.2 Expected Return and Variance of Risky Bonds

As noted by Ambarish and Subrahmanyam [1989, p. 3], the put option in risky corporate bonds "has important implications for the measurement of the expected return and standard deviation of return on corporate bonds, the duration and the convexity of such bonds, and the interpretation of comparative time-series sample statistics of realized returns on corporate bonds and Treasury bonds." *Ceteris paribus*, generally the greater the number of embedded options whose price changes are negatively correlated with the underlying bond's price changes, the further out-of-the-money the embedded options which positively covary with their underlying bond price movements are, and/or the further in-the-money the embedded options which negatively covary with their underlying bond price movements are, the lower the expected volatility of the portfolio or asset class. This section will review the portfolio aspects of embedded options in risky bonds which significantly effect their return generation process. In order to simplify the analysis which follows, the first part of the section will focus on the effect of puts and interest rate calls on risky bond valuation.

Assume there are two types of bonds, those with credit risk and those without.[18] The expected return of the bond without credit risk is defined as:
$E[R^{HG}] = whg_{Rf}\,E[R_{Rf}] - whg_C E[R_C]$, where $E[R^{HG}]$ = the expected return on the high-grade bond, $E[R_{Rf}]$ = the expected return on the equivalent risk-free bond, $E[R_C]$ = the expected return on the embedded interest rate call option; whg_{Rf} = B/(B-C) = the high-grade bond portfolio weight of the equivalent risk-free bond, where B = the value of the equivalent risk-free bond and C = the value of the embedded interest rate call option, and whg_C = C/(B-C) = the high-grade bond portfolio weight of the embedded interest rate call option. Furthermore, $whg_{Rf} > 1$, $whg_C > 0$, and whg_{Rf} - $whg_C = 1$. The expected return of the bond with credit risk is defined as:
$E[R^{LG}] = w\lg_{Rf}\,E[R_{Rf}] - (w\lg_C\,E[R_C] + w\lg_P\,E[R_P])$, where $E[R^{LG}]$ = the expected return on the low-grade bond, $E[R_P]$ = the expected return on the embedded put

[18] In reality there exits a continuum, but to illustrate a point the analysis will be simplified by making this clear distinction between the two.

option; $w\lg_{Rf}$ = B/(B-C-P) = the low-grade bond portfolio weight of the equivalent risk-free bond, where P = the value of the embedded put option, $w\lg_{C}$ = C/(B-C-P) = the low-grade bond portfolio weight of the embedded interest rate call option, and $w\lg_{P}$ = P/(B-C-P) = the low-grade bond portfolio weight of the embedded put option. Furthermore, $w\lg_{Rf} > 1$, $w\lg_{C} > 0$, $w\lg_{P} > 0$, and $w\lg_{Rf} - w\lg_{C} - w\lg_{P} = 1$.

Given that the sum of the weights for each bond type equals one, the following expressions can be substituted into the two expected return equations: $whg_{Rf} = 1 + whg_{C}$ and $w\lg_{Rf} = 1 + w\lg_{C} + w\lg_{P}$. For the high-grade bond the expected return equation can be simplified to equal: $E[R^{HG}] = E[R_{Rf}] + whg_{C}(E[R_{Rf}] - E[R_{C}])$; and for the low-grade bond the expected return equation can be simplified to equal: $E[R^{LG}] = E[R_{Rf}] + w\lg_{C}(E[R_{Rf}] - E[R_{C}]) + w\lg_{P}(E[R_{Rf}] - E[R_{P}])$. Again, by definition, the embedded option weights are positive. In addition, the expected return spread between the risk-free interest rate and each embedded option is generally positive (see Cox and Rubinstein [1985]).[19] Therefore, even if expected returns for the risk-free asset or the various embedded options are invariant with respect to time, higher values for any embedded option will increase that option's weight and hence its impact on the expected return (i.e., *ceteris paribus*). For example, the lower the quality of the bond, the greater the expected return weight given to the embedded put option.

From the above equations it is clear that the expected return spread between a risky bond and a risk-free bond is equal to the expected return spread between the risk-free bond and the embedded options of the risky bond. By definition, the lower the quality of bond, the greater the impact the embedded put option would be expected to have on the expected return spread between the risky bond and a comparable risk-free bond. Although, unlike Blume et al. [1992] and Cornell and Green [1992], there is no prior expectation that the embedded interest rate call options of lower quality bonds would

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19 The expected return of the embedded interest rate call option is a function of the term structure of risk-free rates, the value of the interest rate call option, and the hedge ratio of the embedded call option and the risk-free rate (see Hull [1989, p. 186-194] regarding "delta" hedging). The expected return of the embedded put option is a function of the value of and expected return on the firm, the value of the embedded put option, and the hedge ratio of the embedded put option and the risk-free rate. The expected return of the options are never greater than the risk-free rate (see Cox and Rubinstein [1985, p. 210-211]).

have any greater impact on the expected return spread between a risky bond and a comparable risk-free bond than a higher quality bond.

The expected return of a bond with credit risk and an equity conversion option is defined as: $E[R^{CN}] = wcn_{Rf} E[R_{Rf}] - (wcn_C E[R_C] + wcn_P E[R_P] - wcn_{EC} E[R_{EC}])$, where $E[R^{CN}]$ = the expected return on the convertible low-grade bond, $E[R_{EC}]$ = the expected return on the embedded equity call option; wcn_{Rf} = B/(B-C-P+EC) = the convertible low-grade bond portfolio weight of the equivalent risk-free bond, where EC = the value of the embedded equity call option, wcn_C = C/(B-C-P+EC) = the convertible low-grade bond portfolio weight of the embedded interest rate call option, wcn_P = P/(B-C-P+EC) = the convertible low-grade bond portfolio weight of the embedded put option, and wcn_{EC} = EC/(B-C-P+EC) = the convertible low-grade bond portfolio weight of the embedded equity call option. Furthermore, $wcn_{Rf} > 1$, $wcn_C >$ 0, $wcn_P > 0$, $wcn_{EC} > 0$, and $wcn_{Rf} - wcn_C - wcn_P + wcn_{EC} = 1$. Again, given that the sum of the weights for each bond type equals one, the following expression can be substituted into the expected return equation for convertible low-grade bonds: $wcn_{Rf} = 1 + wcn_C + wcn_P - wcn_{EC}$. Therefore, for the convertible low-grade bond the expected return equation can be simplified to equal:

$$E[R^{CN}] = E[R_{Rf}] + wcn_C(E[R_{Rf}] - E[R_C]) + wcn_P(E[R_{Rf}] - E[R_P]) - wcn_{EC}(E[R_{Rf}] - E[R_{EC}]).$$

From the above equation and the preceding discussion on risky bonds, the expected return spread between a convertible risky bond and straight risky bond would be generally attributable to the expected return spread between the risk-free bond and the embedded equity call option. By definition, the more solvent the firm, the greater the impact the embedded equity call option would be expected to have on the expected return spread between the convertible low-grade bond and a comparable straight low-grade bond.

Based on textbook portfolio theory (see e.g., Elton and Gruber [1991]), the following are the relationships for the variance of return on a high-grade bond and a low-grade bond: $\sigma_{HG}^2 = whg_{Rf}^2 \sigma_{Rf}^2 + whg_C^2 \sigma_C^2 + 2 whg_{Rf} whg_C \sigma_{B,C}$ and

$$\sigma_{LG}^2 = wlg_{Rf}^2 \sigma_{Rf}^2 + wlg_C^2 \sigma_C^2 + wlg_P^2 \sigma_P^2 + 2(wlg_{Rf} wlg_C \sigma_{B,C} + wlg_{Rf} wlg_P \sigma_{B,P} + wlg_C wlg_P \sigma_{C,P})$$

where σ_{HG}^2 = the variance of return on the high-grade bond, σ_{LG}^2 = the variance of return on the low-grade bond, σ_{Rf}^2 = the variance of return on the equivalent risk-free bond, σ_C^2 = the variance of return on the embedded interest rate call option, σ_P^2 = the variance of return on the embedded put option, $\sigma_{B,C}$ = the covariance between the return on the equivalent risk-free bond and the embedded interest rate call option, $\sigma_{B,P}$ = the covariance between the return on the equivalent risk-free bond and the embedded put option, and $\sigma_{C,P}$ = the covariance between the return on the embedded interest rate call option and the embedded put option.

The following is the relationship for the variance of return on a convertible low-grade bond:

$$\sigma^2_{LG} = wcn^2_{Rf}\sigma^2_{Rf} + wcn^2_C\sigma^2_C + wcn^2_P\sigma^2_P + wcn^2_{EC}\sigma^2_{EC} +$$
$$2(wcn_{Rf}wcn_C\sigma_{B,C} + wcn_{Rf}wcn_P\sigma_{B,P} + wcn_{Rf}wcn_{EC}\sigma_{B,EC} + wcn_Cwcn_P\sigma_{C,P} + wcn_Cwcn_{EC}\sigma_{C,EC} + wcn_Pwcn_{EC}\sigma_{P,EC})$$

where σ^2_{EC} = the variance of return on the embedded equity call option, $\sigma_{B,EC}$ = the covariance between the return on the equivalent risk-free bond and the embedded equity call option, $\sigma_{C,EC}$ = the covariance between the return on the embedded interest rate call option and the embedded equity call option, and $\sigma_{P,EC}$ = the covariance between the return on the embedded put option and the embedded equity call option.

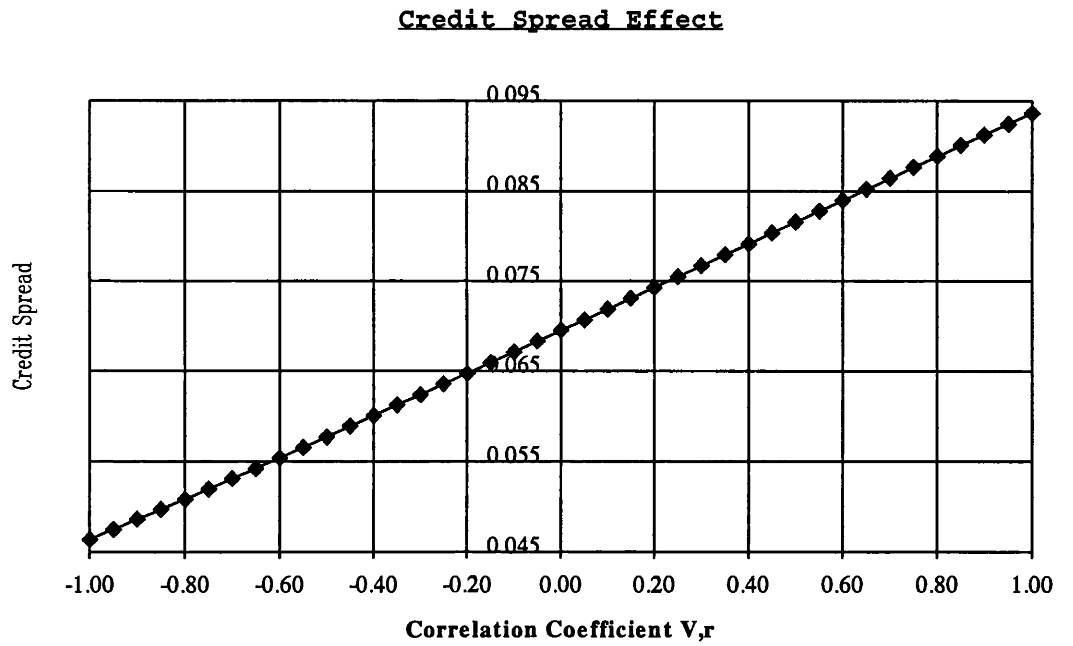
Given that interest rate calls and the value of an equivalent risk-free bond are a function of the risk-free rate of interest (i.e., the interest rate call effectively truncates the positive side of the returns distribution of a high-grade bond), a digression on the possible affect that put returns might have on the return generation process for low-grade bonds is in order. Clearly, it is possible that the return generation process for low-grade bonds may be significantly impacted by the covariance between the embedded put returns and the equivalent risk-free bond returns as well as the returns on the embedded interest rate call option. Furthermore, even without an embedded interest rate call option, if the put option embedded in the low-grade bond sufficiently negatively covarys with the risk-free asset, the variance associated with a low-grade bond may be less than that of an equivalent risk-free bond (i.e., one with the same maturity and coupon).

Based on CCA pricing models which incorporate a time varying risk-free rate of interest, if changes in the value of the firm and changes in the risk-free rate of interest positively covary, an increase in the risk-free rate of interest will cause a decline in the value of the embedded put option and the equivalent risk-free bond (*ceteris paribus*). Hence, the possibility that changes in the risk-free rate of interest cause positive covariation between returns on the embedded put option and the equivalent risk-free bond. But if risk-free rates of interest and firm values are correlated, a change in the risk-free rate of interest can cause the value of the embedded put to change. If risk-free rates of interest and firm values are positively correlated, an increase in the risk-free rate of interest will be associated with an increase in the value of the firm and hence a decrease in the value of the put option. Conversely, if risk-free rates of interest and firm values are negatively correlated, a decrease in the risk-free rate of interest will be associated with an increase in firm value and hence a decrease in the value of the put option. Therefore, it is possible that risk-free rates of interest and firm values are negatively correlated enough to cause the return generation process for low-grade bonds to display return patterns which would cause low-grade bond returns to covary more with risk-free bond returns during periods when simple CCA would suggest that they covary more with equity returns. For example, the Cornell and Green [1991] observation that low-grade bond returns should have covaried more with equity returns during recessions than they did, may at least in part be working through the effect that risk-free interest rates and/or the economy has on the principal options embedded in low-grade bonds. This is a central hypothesis tested in Chapters 6 through 8.

3.3 Comparative Statics for High-Grade and Low-Grade Bonds

From the above discussion, it should be clear that CCA risky debt valuation models which do not incorporate interest rate risk (i.e., in addition to default risk) would not expect risky debt values to be significantly affected by changes in the level of the risk-free rate of interest. Furthermore, the sign and magnitude of the correlation between changes in the risk-free rate of interest and firm value can be critical in determining credit spreads. Therefore, CCA risky debt valuation models which incorporate interest rate risk may offer insights into the seemingly anomalous behavior of low-grade corporate bonds relative to high-grade corporate bonds. Based of Longstaff and Schwartz's [1995, p. 795-797] closed form expression for a risky discount bond, the following figure depicts credit spreads for a risky bond holding all else constant but $\rho_{r,V}$.

Figure 1
The Credit Spread Effect



The assumptions are as follows: (1) r = 4% (riskless rate of interest), (2) X = 2 (leverage ratio = V/k, where k is the threshold value when distress occurs, see Black and Cox [1976]), (3) w = 0.5 (1-w = recovery rate), (4) $\alpha = 0.06$ (the sum of short-term riskless interest rate parameter ζ and a constant representing the market price of interest rate risk), (5) $\beta = 1$ (the other short-term riskless interest rate parameter (see Vasicek [1977]), (6) $\sigma_V^2 = 4\%$ (variance of the firm's assets), (7) $\sigma_r^2 = 0.1\%$ (variance of the short-term riskless rate of interest), (8) C = 8% (rate on the bond), and (9) T = 10 (maturity in years).

The credit spread is an increasing function of $\rho_{r,V}$. Therefore, in the more complex CCA risky debt models, the correlation between changes in the risk-free rate of interest and firm value is a potentially important determinant of the sensitivity of risky debt values to risk-free bond and equity values. If the more complex CCA model for risky debt is applicable, there are the following three basic possibilities with relevance to the empirical examinations which follow this chapter: (1) the correlation between changes in the risk-free rate of interest and firm value is significantly positive to cause the returns of risky debt to be more sensitive to equity returns and/or less sensitive to risk-free bond returns particularly during periods when interest rates are changing and/or the economy is in recession; (2) the correlation between changes in the risk-free rate of interest and firm value is close enough to zero to cause the returns of risky debt to behave as in the more simple CCA risky debt valuation models; and (3) the correlation between changes in the risk-free rate of interest and firm value is significantly negative enough to cause the returns of risky debt to be significantly less sensitive to equity returns and/or more sensitive to risk-free bond returns particularly during periods when interest rates are changing and/or the economy is in recession. It is this final case that is of interest to this thesis.

Assuming the correlation between changes in the risk-free rate of interest and firms value is significantly negative, State of the World 2 (i.e., where solvency and the risk-free rate of interest decline) is no longer as ambiguous as before. As before, as the firm becomes less solvent and as the risk-free rate of interest declines, thus increasing the value of the risk-free bond, the value of the put option increases (i.e., V declines and B increases). Unlike before, as the risk-free rate of interest declines the value of the firm tends to increase, thus tending to decrease the value of the put option. This final effect will tend to make more risky debt behave less like equity and more like the risk-free bond than debt which is less risky. Essentially, in the more complex CCA risky debt models which incorporate $\rho_{r,V}$, the value of the embedded put can be significantly affected through changes in the risk-free rate of interest, not just through B but also through V. Thus, in the particular case where $\rho_{r,V}$ is significantly negative enough to affect changes in firm value through changes in the risk-free rate of interest, more risky debt can be expected to be more bond-like and less equity-like than less risky debt as the risk-free rate of interest declines (i.e., more risky means that the embedded put is closer to being or deeper in-the-money than the less risky bond).

Regarding convertible bonds, the more complex CCA risky debt models may also provide some significant insights with respect to convertible bond behavior relative to risky bonds which do not possess the equity call option (i.e., straight risky bonds). In the case of straight risky debt the focus was on the put option, while in the case of convertible bonds the focus will be directed at the equity call option. In the case of straight risky bonds, *ceteris paribus*, as the risk-free rate of interest decreases the value of the stockholders' put option is reduced if the value of the firm increases as a result (i.e., the case where $\rho_{r,V}$ is significantly negative). Thus, during periods of declining interest rates risky bonds can act less equity-like and more bond-like. In contrast, in the case of the convertible bonds, *ceteris paribus*, as interest rates decline the value of the firm increases and the exercise price of the equity conversion option approaches the strike price of the option (i.e., V approaches V*). Therefore, like the interest rate call option, as the value of the underlying security approaches the strike price the option becomes less sensitive to movements in the underlying security. Thus, in the case of the equity call option of a convertible bond, if the value of the firm is significantly affected by movements in the risk-free rate of interest (i.e., the case where $\rho_{r,V}$ is significantly negative), as interest rates decline, it would be expected that the value of a convertible bond may become less sensitive to equity market movements and possibly more sensitive to movements in the risk-free bond market. Specifically, if one compares convertible bond market movements to movements in the straight risky bond market, it is expected that this effect should be observable during periods when the equity call option is increasing in value and the value of the interest rate call option is increasing in value (i.e., States of the World 6 and 8). Otherwise, this effect might also be observable during periods when the equity call option is increasing in value (i.e., States of the World 5, 6, 7, and 8), but it would not be expected to be as strong as in the two cases where there is the combination of increasing interest rate and equity call values.

Therefore, assuming that periods of downgrades can be proxied by periods of declining credit quality or recession, the following null hypothesis for recessionary periods results: H_0: during periods when the general credit quality is declining, low-grade bonds should become relatively less sensitive to Treasury bond market movements and more sensitive to stock market movements.

Therefore, assuming that periods of interest rate calls can be proxied by periods of declining interest rates, the following null hypothesis for interest rate call periods results: H_0: during periods when interest rates are declining, low-grade bonds should become relatively less sensitive to Treasury bond market movements and more sensitive to stock market movements. This follows from the Cornell and Green [1991] expectation that low-grade bonds do not possess as high a level of interest rate call protection as high-grade bonds.

In addition, states of the world when both interest rates are declining and the economy is weakening may tend to accentuate the strictly lower interest rate call rate for lower grade bonds relative to higher grade bonds. For example, as the economy performs poorly and perceived credit quality declines, the put option which tends to be more in-the-money for lower grade bonds than higher grade bonds tends to act to offset increases in the value of the bond as interest rates decline and put pressure on the bond to be called away (e.g., ala Kim et al. [1993]). Therefore, it is hypothesized that an added put/call hedge effect for low-grade bonds relative to high-grade bonds will occur during periods when interest rate call options are moving into-the-money (i.e., periods of declining interest rates) and periods of declining credit quality (i.e., as proxied by recessionary periods). Therefore, assuming that periods of interest rate calls can be proxied by periods of declining interest rates and periods of declining credit quality can be proxied by recessionary periods, the following null hypothesis for combination interest rate call and recessionary periods results: H_0: during recessionary periods when interest rates are declining, low-grade bonds should become relatively less sensitive to Treasury bond market movements and more sensitive to stock market movements.

Finally, the testable hypotheses developed above can be summarized by the following table which provides expectations for the straight low-grade versus high-grade bond asset classes (i.e., corporate and municipal):

Table 7
Expectations for Straight Low-Grade vs. High-Grade Bonds

Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds	Expectation for Sensitivity to Equities
Simple CCA:		
Interest Rate Call Periods	0	0
Put Periods	- or 0	+
Combination Periods (Call & Put Periods)	- or 0	+
CCA with Interest Rate Risk:		
Interest Rate Call Periods	0 or +	0 or -
Put Periods	0 or +	0 or -
Combination Periods (Call & Put Periods)	+	-

These expectations will be tested in Chapters 6 and 7 for straight low-grade and high-grade bonds, and an extended set will be tested for convertible and straight low-grade corporate bonds in Chapter 8. Given the possible importance of put/call hedge effects and the need to address convertible bonds, the next section will address the issue of convertible bonds.

3.4 Convertible Corporate Bond Asset Class Implications and the Thesis

Convertible corporate bonds are generally composed of low-grade bonds (see Altman [1988]). Therefore, certain significant effects which are expected to occur between straight low-grade and high-grade bonds would not be expected to occur between convertible corporate bonds and straight low-grade corporate bonds. Although, there is an additional option embedded in convertible bonds which might create an additional effect relative to straight low-grade bonds.

Convertible bonds are a type of corporate bond which the owner typically has the option to exchange the bond (at par) for common stock (at the exercise price) of the issuing entity. A straight corporate bond doesn't have an equity call option. Ignoring illiquidity, the following is a simplified contingent claims view of the general equations of the five types of securities analyzed in this study:

(1) $TBND_i = B_i$, where TBND is the value of Treasury bond i, and B is the value of risk-free bond i;

(2) $HGC_i = B_i - C_i^{IR}$, where HGC is the value of high-grade corporate bond i[20], and C^{IR} is the value of interest rate call option i;

(3) $LGC_i = B_i - C_i^{IR} - P_i^{Dflt}$, where LGC is the value of low-grade corporate bond i, and P_i^{Dflt} is the value of default or put option i;

(4) $CNVRT_i = B_i - C_i^{IR} - P_i^{Dflt} + C_i^{Eqty}$, where CNVRT is the value of convertible corporate bond i, and C_i^{Eqty} is the value of equity call option i; and

(5) $EQTY_i = P_i^{Dflt} + C_i^{Eqty}$, where EQTY is the value of equity security i. Clearly, from an option pricing viewpoint, convertible bonds appear to be the most complex security listed. They are composed of all four of the building blocks which form all five security types. Treasury bonds are the most simply security type listed, and, by definition, are an element of all of the bond security types.

As one works down the above security hierarchy, certain options distinguish one bond or asset type from another. As can be seen, what distinguishes a HGC from a TBND is C^{IR}, what distinguishes a HGC from a LGC is P^{Dflt}, and what distinguishes a CNVRT from a straight LGC is C^{Eqty}. In addition, as the value of the equity call option increases (moves deeper into-the-money), the value of a convertible bond approaches the following: $CNVRT_i = B_i - C_i^{IR} - P_i^{Dflt} + EQTY_i$, which reduces to $CNVRT_i = B_i - C_i^{IR} + C_i^{Eqty}$. Therefore, it is not clear that as equity call options increase in value and the convertible bond becomes more equity-like, that the convertible bond will respond to its embedded put option. Again, this only illustrates the complexities involved with evaluating the financial performance of complex risky bonds. This thesis evaluates the financial performance of convertible bonds during periods when its three embedded options would be expected to increase in value. Therefore, it is critical to identify when these embedded options are exercised and/or the probability of exercise increases. Regarding direct comparisons of financial performance, convertible bonds will be evaluated against low-grade bonds.

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[20] Note that high-grade corporate bonds have put options, but they are, by definition, so far out of the money they are dropped from the equation to simplify the analysis.

Based on the foregoing analysis convertible bonds are not expected to differ from low-grade bonds in their interest rate call propensities or put propensities. Therefore, relative to low-grade bonds, convertible bonds would not be expected to be relatively more or less sensitive to Treasury bond markets movements or more or less sensitive to equity market movements during interest rate call or put periods. Although, given that straight low-grade bonds do not possess an equity call option, convertible bonds might be expected to at least be more or less sensitive to equity market movements during equity call periods. These same expectations apply to combination periods. Although, the interaction effect(s) between the various embedded options may dominate during combination periods as to render some expectations invalid, but it is difficult to know *a priori* what expectations may not hold.

The following table provides the relevant expectations regarding the comparison of convertible versus straight low-grade corporate bond returns.

Table 8
Expectations for Convertible vs. Straight Low-Grade Corporate Bonds

Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds	Expectation for Sensitivity to Equities
Interest Rate Call Periods	0	0
Put Periods	0	0
Equity Call Periods	0 or +	0 or -
Combination Periods:		
Interest Rate Call & Put Periods	0	0
Interest Rate Call & Equity Call Periods	0 or +	0 or -
Put & Equity Call Periods	0 or +	0 or -
Both Calls & Put Periods	0 or +	0 or -

Clearly, possible significant differences are expected to occur during equity call periods only.

4 The Research Method and Statistical Model

Critical to this thesis is the identification of periods when bond calls and puts would be expected to be exercised and/or their probability of exercise significantly increases relative to all other periods. For interest rate call periods, this thesis uses periods of declining interest rates. Bonds would be expected to be called, and/or their probability of exercise increases, when interest rates decline. For put/default periods, this thesis uses periods of recession. Credit quality generally declines and defaults increase during recessionary periods. For equity call periods, this thesis uses periods when equities outperform straight risky bonds. The equity call option would be expected to be exercised and/or the probability of exercise increases when equity values increase more rapidly than bond values.

Most of the tests in Chapters 6 through 8 employ a simple two factor model (also used by Cornell and Green [1991]) which controls for Treasury bond and stock market movements. This approach is also compatible with the standard CCA (see Bookstaber [1991, p. 243-245]) view of risky bonds. This simple asset pricing model approach is used to: (1) control for the risks associated with risky bonds, and (2) examine the sensitivity of the asset classes under study to Treasury bond and stock market risk during the periods of interest. The regression equation used is as follows:

$$RBAC_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times PDV_t + \beta_4 \times SMR_t \times PDV_t + \beta_5 \times PDV_t + e_t$$

where RBAC = Risky Bond Asset Class return series, TBR = Treasury bond return series, SMR = stock market return series, PDV = Period Dummy Variable, and e = the error term. This is the general model used to test for significant risky bond asset class effects. Specifically, estimated coefficients β_3 and β_4 are used to measure significant shifts in sensitivity during the periods under study. In addition, the estimated intercept term is used to measure any abnormal returns associated with the return series under study, after controlling for the aforementioned risks.

Finally, given the above statistical model and methodology, the following two tables summarize the principal tests for Chapters 6 through 8.

Table 9
Expectations for Straight Low-Grade vs. High-Grade Corporate and Municipal Bonds

Expectations Period under Study	Expectation for Sensitivity to Treasury Bonds Estimated β_3	Expectation for Sensitivity to Equities Estimated β_4
Interest Rate Call Periods	0 or +	0 or -
Put Periods	0 or +	0 or -
Combination Periods (Call & Put Periods)	+	-

Table 10
Expectations for Convertible vs. Straight Low-Grade Corporate Bonds

Expectations Period under Study	Expectation for Sensitivity to Treasury Bonds Estimated β_3	Expectation for Sensitivity to Equities Estimated β_4
Interest Rate Call Periods	0	0
Put Periods	0	0
Equity Call Periods	0 or +	0 or -
Combination Periods:		
Interest Rate Call & Put Periods	0	0
Interest Rate Call & Equity Call Periods	0 or +	0 or -
Put & Equity Call Periods	0 or +	0 or -
Both Calls & Put Periods	0 or +	0 or -

5 The Risky Bond Asset Class Studies in the Thesis - A Summary

The following are three sets of asset classes studied in this thesis: (1) low-grade and high-grade corporate bonds, (2) low-grade and high-grade municipal bonds, and (3) convertible and straight low-grade corporate bonds. The choice of asset classes is intended to accomplish the following two objectives of this thesis: (1) analyze the possibility of significant embedded option effects for each set of asset classes studied, and (2) generally extend research on risky bond asset classes. Regarding the second objective, for example, to date no academic study has been performed on low-grade municipal bonds.

Chapter 6, The Effect of Embedded Options on the Financial Performance of Low-Grade Corporate Bonds, compares low-grade corporate bond returns to high-grade corporate bond returns. This is a version of a paper published in the Financial Analysts Journal during 1994. The methodology developed in this chapter was applied.

Table 11
Results for Straight Low-Grade vs. High-Grade Corporate Bonds*

Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds Estimated β_3	Expectation for Sensitivity to Equities Estimated β_4
Interest Rate Call Periods	0	0
Put Periods	+	-
Combination Periods (Call & Put Periods)	+	-

* cut-off at the 5% level of significance.

The results generally support arguments made in this chapter. Specifically a relatively strong negative correlation between the risk-free rate of interest and firm values can at least in part explain the results.

Chapter 7, The Effect of Embedded Options on the Financial Performance of Low-Grade Municipal Bond Funds, compares low-grade municipal bond returns to high-grade municipal bond returns. This is a version of a paper conditionally accepted by Financial Management. Again, the methodology developed in this chapter was applied.

Table 12
Results for Straight Low-Grade vs. High-Grade Municipal Bonds*

Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds Estimated β_3	Expectation for Sensitivity to Equities Estimated β_4
Interest Rate Call Periods	+	-
Put Periods	0	0
Combination Periods (Call & Put Periods)	+	-

* cut-off at the 5% level of significance.

Again, the results generally support the arguments made in this chapter. Although, unlike corporate bonds the recession period effect is not as pronounced. This can be explained by the fact the municipal bonds, due to the high concentration of essential service industries, are generally less sensitive to equity market movements than corporate bonds. In addition, because of the smaller size of the low-grade municipal market when compared to the low-grade corporate market, the low-grade municipal asset class is less "low-grade" than its comparable corporate counterpart. Therefore, embedded low-grade municipal bond put options are effectively only slightly more in-the-money relative to high-grade municipal bonds.

Chapter 8, The Effect of Embedded Options on the Financial Performance of Convertible Bond Funds, compares convertible corporate bond returns to straight low-grade corporate bond returns. This is a version of a paper which was published in the Financial Analysts Journal during 1996. Again, the methodology developed in this chapter was applied.

Table 13

Results for Convertible vs. Straight Low-Grade Corporate Bonds*

Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds Estimated β_3	Expectation for Sensitivity to Equities Estimated β_4
Interest Rate Call Periods	0	0
Put Periods	0	0
Equity Call Periods	0	0
Combination Periods:		
Interest Rate Call & Put Periods	0	0
Interest Rate Call & Equity Call Periods	+	-
Put & Equity Call Periods	0	-
Both Calls & Put Periods	0	-

* cut-off at the 5% level of significance.

Again, the results generally support arguments made in this chapter. Given that the two asset classes are both low-grade corporate bonds, the only expected differences would be during equity call periods.

CHAPTER 6

THE EFFECT OF EMBEDDED OPTIONS ON THE FINANCIAL PERFORMANCE OF LOW-GRADE CORPORATE BONDS

1 Introduction

The primary objectives of this chapter are the following: (1) generally extend the empirical literature on low-grade corporate bond financial performance, and (2) provide evidence to support more complex CCA models of risky bond pricing. The analytic approach used in this chapter is to examine the performance of low-grade corporate bond returns relative to high-grade corporate bond returns within the context of the principal options embedded in them. In the case of low-grade corporate bonds, analysis will focus on interest rate call and put periods. As outlined in Chapter 5, the primary objectives of this chapter are a by-product of the approach and method employed.

As the low-grade corporate bond literature review in Chapter 5 showed, over certain periods low-grade corporate bonds have had a higher return and a lower standard deviation than high-grade corporate bonds. Previous studies have suggested that this is due to the higher frequency of calls for low-grade corporate bonds relative to high-grade corporate bonds. Calls alone cannot explain the relatively lower volatility associated with low-grade corporate bonds. In fact, it has been shown that defaults have had a greater impact on the duration of low-grade bonds than calls (see Kihn [1994]). The lower volatility of low-grade bonds relative to high-grade bonds is in part due to the effect of options on low-grade debt. Therefore, it is the relative absence of defaults, not calls, for high-grade corporate bonds which make them more volatile relative to low-grade corporate bonds.

This chapter examines the return experience of low-grade and high-grade corporate bond funds over a long period (i.e., 1/60 through 9/94) in order to shed some light on the central controversy which has seemed to create great interest in low-grade corporate bonds as an asset class. Specifically, the observation that, relative to high-grade corporate bonds, low-grade corporate bonds have generated a higher return at a lower risk.

Table 1

Mean Monthly Return and Standard Deviation for the Low-Grade and High-Grade Corporate Bond Asset Classes (1/60 through 9/94)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.

1960:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate
Observations = 417		
Mean	0.6836%	0.5547%
Standard Deviation	2.4199%	1.7943%

Although the original "Drexel hypothesis" no longer seems to hold (i.e., the standard deviation for low-grade corporates is higher than that for high-grade corporates), as mentioned in Chapter 5, there are several other seemingly anomalous findings which are addressed by this chapter. Specifically, the following issues are examined: (1) do low-grade corporate bonds as an asset class show evidence of possessing a higher proportion of calls and/or weaker call protection than high-grade corporate bonds; and (2) do low-grade corporate bonds as an asset class demonstrate a return generation process which would suggest that changes in risk-free interest rates and/or the economy account for a significant amount of the relative return variation in the low-grade corporate bond market overall?

The remainder of this chapter is divided into four sections. Section 2 presents background on the data and provides summary statistics. Section 3 reviews the expectations/hypotheses developed in Chapter 5 which are of relevance to low-grade corporate bonds. Section 4 presents the low-grade and high-grade corporate bond regression results. The conclusions are summarized in the last section.

2 Data and Summary Statistics

The corporate bond data set is derived from open-end mutual funds tracked by Morningstar during the period from January 1960 through September 1994. These returns are net of all but front-end and back-end charges. The Treasury bond series is a spliced series based on the Cornell and Green [1991] Treasury bond series (01/60 through 12/88) and Salomon Brothers' long bond series (01/89 through 09/94).[1] The stock series is derived from the Standard and Poor's 500 return index ("S&P 500"). Therefore, unlike the return series derived from mutual fund returns, the stock and Treasury bond series are gross returns.

Like the Cornell and Green [1991] study on low-grade corporate bonds, this thesis uses monthly open-end mutual fund data to derive asset class return series. Lipper Analytical Services asset class definitions are used for all asset class return series reported. Shares of open-end mutual funds are traded on the basis of net asset value ("NAV"). Monthly returns are based on the following calculation: $\mathrm{Re}\,turn_t = [(NAV_t - NAV_{t-1}) + IncDist_t + CapGainDist_t] / NAV_{t-1}$. In addition, these returns take account of 12b-1 fees and management fees but not front-end loads, back-end loads, or redemption charges.

Each mutual fund based asset class return series was constructed following the method used by Cornell and Green [1991]. For each asset class, the equally weighted average of all mutual funds each month was calculated. The following were the number of funds as of month-end September 1994 for each asset class series derived from Morningstar data: 101 low-grade corporate bond funds and 149 high-grade corporate bond funds. Table 2 provides background on the asset class return series used in this chapter.

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[1] There was overlap between these two series over the period 04/84 through 12/88. Over that period the correlation between the two series is approximately 0.969.

Table 2

Summary Statistics and Tests of Normality for the Returns of Low-Grade Corporate Bond Funds, High-Grade Corporate Bond Funds, Treasury Bonds, and Equities

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.

1960:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate	Treasury Bonds	S&P 500
Observations = 417				
Moments of the Distribution:				
1st - Mean	0.6836%	0.5547%	0.5676%	0.6145%
2nd - Standard Deviation	2.4199%	1.7943%	2.9033%	4.2506%
3rd - Skewness	0.1218	0.7443	0.6865	-0.3540
4th - Kurtosis	1.9892	3.1875	2.8587	2.9932
Minimum	-7.0880%	-4.7600%	-8.4600%	-23.9440%
Maximum	10.9500%	9.4353%	15.2400%	16.3050%
Tests of Normality#:				
T-Statistic: Mean = 0	5.7685	6.3130	3.9925	2.9520
Prob>T	0.0001	0.0001	0.0001	0.0033
W: Normal	0.9668	0.9509	0.9656	0.9856
Prob<W	0.0001	0.0001	0.0001	0.6152

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

First, it should be noted that the low-grade corporate bond series is essentially an extension of the Cornell and Green [1991] series. Based on the period of overlap (i.e., 01/78 through 12/88)[2], the correlation between the Cornell and Green [1991] low-grade series and the one used in this study was approximately 0.995. As stated in the introduction, over the study period (i.e., 01/60 through 09/94), low-grade corporate bonds have had higher returns at a higher level of risk, as measured by standard deviation, than high-grade corporate bonds. This contrasts with previous research based on earlier periods (e.g., see Blume et al. [1991] and Cornell and Green [1991]). The relatively recent increase in the volatility of low-grade corporate bonds relative to high-grade corporate bonds is due to increased volatility from 1988 through the early 1990's. Although, low-grade corporate bonds have returned more than Treasury bonds at a lower level of risk. All three bond asset class return series are slightly positively skewed, while equities (i.e., the S&P 500) are slightly negatively skewed. The kurtosis values indicate that of the three bond asset classes, high-grade corporate

[2] Kevin Green and Alan Williams kindly provided the data from the original Cornell and Green [1991] study, but the data covered the period 01/60 through 12/88, not 01/60 through 12/89 as in the original study.

bonds returns have been distributed the most platykurtically over the period under study.

The test for normality suggests that, at standard levels of statistical significance, only the equity return series is drawn from a random sample from a normal distribution (i.e., the Shapiro-Wilk test). All four asset class return series reject the null hypothesis that mean of each respective distribution is equal to zero. At normal levels of statistical significance, all four asset class return series have means which are significantly positive. Again, three of four return series reject the null hypothesis that the values are drawn from a random sample from a normal distribution.

Table 3 provides correlation and autocorrelations for the asset class return series used in this chapter.

Table 3

Tests for Autocorrelation and Correlation Coefficients for the Returns of Low-Grade Corporate Bond Funds, High-Grade Corporate Bond Funds, Treasury Bonds, and Equities

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.

1960:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate	Treasury Bonds	S&P 500
Autocorrelation at Lag 1	0.253**	0.143**	0.050	0.016
Test for White Noise#:				
12 lags	46.12*	36.52**	23.44*	10.28
Correlation with				
High-Grade Corporate	0.619**			
Treasury Bonds	0.497**	0.829**		
S&P 500	0.698**	0.391**	0.320**	

This is an autocorrelation check for white noise. The null hypothesis is that the autocorrelations sum to zero. The test statistic is at the 12th lag (i.e., one year). Therefore, the null hypothesis for the 12th lag is: $T \times \sum_{k=1}^{12} \hat{r}_k^2 = 0$, where $\hat{r}_k^2$ is the product moment correlation between $\hat{e}_t$ and $\hat{e}_{t-k}$ (k = 1, 2, ..., 12). If the null hypothesis is true, the statistic is distributed as a chi-square with 12 degrees of freedom. If the statistic is not statistically significant, the null hypothesis can be accepted.

* denotes significance at the 5% level of significance, and ** denotes significance at the 1% level of significance.

Both the low-grade and high-grade corporate bond return series show evidence of autocorrelation. This autocorrelation has been interpreted as evidence of nontrading (see Cornell and Green [1991, p. 37-39]). Therefore, several sets of regression results will be presented in order to correct for possible nontrading and/or serial correlation of the error term. As will become clear in section 4, the results do not substantially differ regardless of the correction method employed.

Regarding correlations, low-grade corporate bonds returns are more positively correlated with equity returns than Treasury bond returns. Conversely, high-grade corporate bonds returns are more positively correlated with Treasury bond returns than equity returns. Clearly, compared to high-grade corporate bonds, low-grade corporate bonds have been more exposed to the risks associated with equities than Treasury bonds.

3 Risky Corporate Bond Expectations and Tests

Based on the discussion in Chapter 5, there can be very different expectations for the changing sensitivities of more risky debt (i.e., low-grade corporate bonds) relative to less risky debt (i.e., high-grade corporate bonds) during periods when their principal embedded options would be expected to move deeper in-the-money. Specifically, risky debt valuation models which do not incorporate interest rate risk find that the behavior of low-grade corporate bond returns during recessionary periods seems anomalous; whereas risky debt valuation models which incorporate interest rate risk may be able to explain the behavior of low-grade corporate bond returns during recessionary periods (i.e., assuming $\rho_{r,V}$ is significantly negative).

The following table summarizes the difference in expectations for what is termed CCA "assuming no credit spread effect" and CCA "assuming a strong credit spread effect". The first set of expectations are traditional CCA expectations which do not incorporate interest rate risk, whereas the latter case incorporates interest rate risk and assumes that $\rho_{r,V}$ is significantly negative. Of course, if $\rho_{r,V}$ is zero or close to zero, the two may not differ substantially.

Table 4
Expectations for Periods under Study

Simple CCA Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds	Expectation for Sensitivity to Stocks
Assuming no Credit Spread Effect:		
Interest Rate Call Periods	0	0
Put Periods	- or 0	+
Combination Periods (Call & Put Periods)	- or 0	+
Assuming a Strong Credit Spread Effect:		
Interest Rate Call Periods	0 or +	0 or -
Put Periods	0 or +	0 or -
Combination Periods (Call & Put Periods)	+	-

The null hypotheses which follow are based on CCA risky debt models which do not incorporate interest rate risk. Therefore, during interest rate call periods (i.e., periods of declining interest rates) the relative sensitivity of low-grade corporate bond returns to Treasury bond and equity returns would not be expected to change. Hence,

H_0: during periods when interest rates are declining, low-grade corporate bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.

During put periods (i.e., recessionary periods) the relative sensitivity of low-grade corporate bond returns to equity returns would be expected to increase. Hence,

H_0: during periods when the general credit quality is declining, low-grade corporate bonds should become relatively more sensitive to equity market movements.

During combination interest rate call and put periods the relative sensitivity of low-grade corporate bond returns to equity returns would be expected to increase. Hence,

H_0: during periods when interest rates are declining and the general credit quality is declining, low-grade corporate bonds should become relatively more sensitive to equity market movements (i.e., the put periods hypothesis). Essentially, put periods are the only periods expected to have a significant impact on the relative sensitivities of low-grade corporate bond returns to Treasury bond and equity market returns. In addition, given that puts are of primary importance in the valuation of risky corporate debt, it is expected that only sensitivities to the equity market may change, not the Treasury bond market.

The largest contrast between the two sets of risky debt valuation models occurs during combination periods. Particularly clear is the opposite expectation regarding the relative sensitivity of low-grade corporate bond returns to equity market returns during combination periods. Given that the signs of the two expectations are diametric opposites, this will be the strongest test presented. Therefore, the results for this particular test should be viewed with added interest.

4 Regressions Testing the Impact of Call and Put Periods

This thesis hypothesizes that periods where the volatility and sensitivity (i.e., to the Treasury bond and equity markets) of low-grade corporate bonds relative to high-grade corporate bonds is due in part to the observation by Blume et al. [1991, p. 69] that: "low-grade bonds are complex securities having some of the characteristics of higher grade bonds and some of the characteristics of equities." The question remains as to what causes these periods of relatively low volatility and seemingly anomalous relative sensitivities? It is a central argument of this thesis that one of the primary causes of the seemingly abnormal behavior of low-grade corporate bonds relative to high-grade corporate bonds is that relatively less credit worthy corporate bonds are significantly more affected by the correlation between changes in the risk-free rate of interest and changes in the value of the firm (i.e., $\rho_{r,V}$ is significantly negative) than more credit worthy corporate bonds.

The critical method with which to examine the return behavior of high-grade and low-grade corporate bonds is to isolate periods when calls and puts would be expected to be exercised and/or the probability of exercise significantly increases. This thesis assumes that regarding embedded put options (i.e., defaults and outright bankruptcies) the appropriate periods to examine are recessionary periods, while for calls the appropriate periods to examine are those of declining interest rates. By examining low-grade and high-grade corporate bond returns during these periods, the impact that puts and calls have on the relative returns of the two corporate bond asset classes can be examined.

As a baseline to the regression analysis which follows, the following regression models were run to evaluate the sensitivity of low-grade and high-grade corporate bonds to Treasury bond and equity market movements:

(1) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

(2) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

(3) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

where LGR = low-grade corporate bond return, HGR = high-grade corporate bond return, TBR = Treasury bond return, SMR = stock market return (i.e., the return of the S&P 500 index), and e is the error term. This equation was designed to take account of Treasury bond and equity market risk via TBR and SMR.

Besides standard OLS regressions, three additional regressions were run to check the robustness of the OLS results. In the regressions which follow, a Dimson [1979] adjustment was made in order to counteract for the possible presence of nontrading. These results are reported alongside the straight OLS results.[3] In addition, since the Dimson adjustment does not always control for the presence of nonsynchronous trading (e.g., see Fowler and Rorke [1983]) and the fact the prices for corporate bonds may not change that often (e.g., see Lo and MacKinlay [1990])[4], Yule-Walker and maximum likelihood regressions were run based on the premise that the error term was not independent across time (i.e., autoregressive errors). If autocorrelation is present, the OLS parameter estimates will not be efficient and the standard error estimates may be biased. Given the data was monthly, for both the Yule-Walker and maximum likelihood methods, the autoregressive process was initially checked for up to order 12 and the significance level criterion was set at a 5% cutoff value. Given that the Yule-Walker estimates are used as starting values for the maximum likelihood method, the maximum likelihood method is computationally equivalent to or better than the Yule-Walker method. However, the various results will show that there is little or no difference between any regression method employed.

[3] In fact, Bartholdy and Riding [1994] find that neither the Dimson [1979], Scholes and Williams [1977], or Fowler et al. [1980] methods reduce the potential bias more than simple OLS. In addition, many studies analyzing nonsynchronous trading tend to suggest that monthly data does not possess nearly the same magnitude of the problem as weekly and especially daily data (e.g., see Perry [1985], Shanken [1987], and Lo and MacKinlay [1990]). In addition, portfolio betas tend to be "extremely stable" relative to individual betas (see Dimson and Marsh [1983]). Therefore, regardless of the correction for suspected nontrading, monthly portfolio data can be viewed as a significantly more reliable source of estimating betas than individual daily data.

[4] That is, it may be that nonsynchronicity is the result of economic forces. Thus, the serial dependence in bond returns may be the result of economic forces not mismeasurement. Therefore, what is assumed to be evidence of nontrading may not be nontrading at all. Although, regarding asset prices, it is usually assumed that serial dependence is the result of institutional features.

Table 5

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Corporate Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated A or higher.

Model 1960:01 to 1994:09 Explanatory Variables	1/2/3 Expected Sign#	(1) Low-Grade Corp.	(2) High-Grade Corp.	(3) Return Spread	Dimson (1) Low-Grade Corp.	Dimson (2) High-Grade Corp.	Dimson (3) Return Spread
Intercept	?/?/0	0.0033**	0.0024**	0.0009	0.0020*	0.0020**	0.0000
		(4.138)	(4.970)	(1.127)	(2.547)	(4.027)	(0.012)
TBR (Lag 1)					0.0040	0.0043	-0.0003
					(0.146)	(0.247)	(-0.010)
TBR	+/+/-	0.2537**	0.4845**	-0.2308**	0.2572**	0.4778**	-0.2206**
		(8.956)	(27.811)	(-8.484)	(9.305)	(27.460)	(-8.165)
TBR (Lead 1)					0.1037**	0.0772**	0.0265
					(3.767)	(4.455)	(0.986)
SMR (Lag 1)					0.0354	0.0132	0.0222
					(1.885)	(1.116)	(1.210)
SMR	+/+/+	0.3421**	0.0593**	0.2828**	0.3324**	0.0552**	0.2772**
		(17.681)	(4.985)	(15.220)	(17.581)	(4.637)	(15.005)
SMR (Lead 1)					0.0634**	-0.0186	0.0820**
					(3.374)	(-1.570)	(4.463)
Adj. R^2		0.569	0.705	0.370	0.607	0.716	0.404
F-Statistic		275.228**	494.058**	123.102**	107.364**	175.144**	47.772**
Dependent Mean		0.007	0.006	0.001	0.007	0.006	0.001
Root MSE		0.016	0.010	0.015	0.015	0.010	0.015
DW Statistic		1.729	1.994	1.735	1.700	1.988	1.728
Observations		417	417	417	415	415	415

expected signs are based on risky bond expectations (i.e., for the intercept, TBR coefficient, and SMR coefficient) and simple CCA expectations (i.e., for all other coefficient expectations).

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 6

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Corporate Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.

Model 1960:01 to 1994:09 Explanatory Variables	1/2/3 Expected Sign#	YW (1) Low-Grade Corp.	YW (2) High-Grade Corp.	YW (3) Return Spread	ML (1) Low-Grade Corp.	ML (2) High-Grade Corp.	ML (3) Return Spread
Intercept	?/?/0	0.0035**	0.0025**	0.0009	0.0035**	0.0025**	0.0009
		(3.821)	(5.594)	(0.956)	(3.763)	(5.612)	(0.939)
TBR	+/+/-	0.2406**	0.4808**	-0.2275**	0.2387**	0.4808**	-0.2274**
		(8.590)	(28.209)	(-8.417)	(8.539)	(28.196)	(-8.413)
SMR	+/+/+	0.3291**	0.0559**	0.2645**	0.3272**	0.0558**	0.2629**
		(17.282)	(4.919)	(14.688)	(17.155)	(4.889)	(14.564)
AR Parameters:							
Lag 1		-0.1335**		-0.1231*	-0.1534**		-0.1372**
		(-2.738)		(-2.532)	(-3.137)		(-2.825)
Lag 7			0.1178*			0.1194*	
			(2.454)			(2.482)	
Lag 10			0.1295*			0.1258**	
			(2.582)			(2.604)	
Lag 11			-0.1557**	-0.1189*		-0.1554**	-0.1250*
			(-3.244)	(-2.444)		(-3.223)	(-2.555)
Total R^2		0.579	0.721	0.395	0.580	0.721	0.395
Regression R^2		0.557	0.710	0.360	0.556	0.710	0.359
Root MSE		0.016	0.010	0.015	0.016	0.009	0.015
DW Statistic					1.994	1.944	2.009
Observations		417	417	417	417	417	417

expected signs are based on comparable corporate bond expectations (i.e., for the intercept, TBR coefficient, and SMR coefficient) and simple CCA expectations (i.e., for all other coefficient expectations).
T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The return spread results are of critical importance, and at a general level there is nothing surprising. First, the estimated intercept for the return spread regressions is slightly positive, but not significantly so. This suggests that, after controlling for Treasury bond and equity market risk, low-grade corporate bonds have not significantly outperformed high-grade corporate bonds over the sample period. This supports the Cornell and Green [1991] and Blume et al. [1991] overall conclusion. Second, low-grade corporate bonds are more equity-like than high-grade corporate bonds. Finally, high-grade corporate bonds are more risk-free bond-like (i.e., Treasury bond-like) than low-grade corporate bonds. Again, these last two results only confirm the view of risky debt as a hybrid of equity and pure debt, and that the more risky the debt (i.e., the deeper the embedded put is in-the-money), the more equity-like and less risk-free bond-like it is.

4.1 Call Periods

If low-grade corporate bonds have had significantly less interest rate call protection and/or a higher call rate than high-grade corporate bonds, there should be a significant decline in the sensitivity of low-grade corporate bond returns to risk-free bond returns during periods when the interest rate call option should be exercised (i.e., during periods of declining interest rates). This assertion can be tested by examining the behavior of low-grade corporate bond returns relative to high-grade corporate bond returns during periods of declining interest rates. Specifically, if there is a significant difference, the sensitivity of low-grade corporate bond returns to risk-free bond returns would significantly decline during periods of declining interest rates. The following table presents the return and standard deviations (among other descriptive statistics) associated with periods where the government 10 year constant maturity Treasury bond experienced a decline in yield.

Table 7

Summary Statistics and Tests of Normality for the Returns of Low-Grade Corporate Bond Funds, High-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined (Call Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.
A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

1960:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate	Treasury Bonds	S&P 500	LGC - HGC Spread
Observations = 191					
Moments of the Distribution:					
1st - Mean	1.7903%	1.5653%	2.1932%	1.9489%	0.2250%
2nd - Standard Deviation	2.1921%	1.6886%	2.7153%	3.9086%	1.8568%
3rd - Skewness	0.5869	1.3695	1.3683	0.3503	0.1516
4th - Kurtosis	3.1489	4.5735	4.2406	1.3189	2.5923
Minimum	-6.1500%	-3.6600%	-3.9100%	-11.3860%	-6.9300%
Maximum	10.9500%	9.4350%	15.2400%	16.3050%	6.3790%
Tests of Normality#:					
T-Statistic: Mean = 0	11.2871	12.8110	11.1631	6.8909	1.6748
Prob>T	0.0001	0.0001	0.0001	0.0001	0.0956
W: Normal	0.9533	0.9011	0.9261	0.9843	0.9595
Prob<W	0.0001	0.0001	0.0001	0.6373	0.0003

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Although low-grade corporate bonds were more volatile than high-grade corporate bonds during periods of declining interest rates, low-grade corporate bonds were not significantly more volatile (i.e., at the 10% level of significance). For months when interest rates were declining, the ratio of low-grade to high-grade corporate bond standard deviation is approximately 1.30 versus 1.35 for all months. It seems it would not be correct to state that the greater relative number of calls and/or weaker call protection afforded low-grade corporate bonds relative to high-grade corporate bonds is the cause of their lower volatility. Over the study period, low-grade corporate bonds have been only slightly less sensitive to declining interest rates than high-grade corporate bonds.

In order to further test this contention, the following regression models were run to test for the significance of call periods on the returns of high-grade and low-grade corporate bonds.

(4) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

(5) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

(6) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

where DIR = a dummy variable equal to one if interest rates decline and zero otherwise. The call dummy variable is intended to isolate the effect of periods when calls are more frequent and more probable.

Table 8

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Corporate Bond Returns - Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated A or higher.

These regression results compare the effect of periods of declining interest rates. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

Model 1960:01 to 1994:09 Explanatory Variables	4/5/6 Expected Sign	(4) Low-Grade Corp.	(5) High-Grade Corp.	(6) Return Spread	Dimson (4) Low-Grade Corp.	Dimson (5) High-Grade Corp.	Dimson (6) Return Spread
Intercept	?/?/0	0.0012	0.0009	0.0002	0.0028*	0.0018*	0.0009
		(1.055)	(1.376)	(0.215)	(2.369)	(2.491)	(0.823)
TBR (Lag 1)					0.0121	0.0009	0.0112
					(0.378)	(0.043)	(0.360)
TBR	+/+/-	0.2343**	0.4624**	-0.2281**	0.3028**	0.4839**	-0.1812**
		(5.081)	(16.294)	(-5.110)	(6.400)	(16.279)	(-3.928)
TBR (Lead 1)					0.1081**	0.0768**	0.0312
					(3.875)	(4.385)	(1.148)
SMR (Lag 1)					0.0346	0.0155	0.0191
					(1.812)	(1.290)	(1.026)
SMR	+/+/+	0.3506**	0.0402**	0.3105**	0.3393**	0.0391*	0.3002**
		(14.009)	(2.607)	(12.812)	(13.678)	(2.509)	(12.409)
SMR (Lead 1)					0.0634**	-0.0170	0.0805**
					(3.341)	(-1.427)	(4.346)
TBR x DIR	?/?/0	-0.0478	-0.0212	-0.0267	-0.0673	-0.0252	-0.0421
		(-0.750)	(-0.539)	(-0.432)	(-1.080)	(-0.644)	(-0.693)
SMR x DIR	?/?/0	-0.0426	0.0334	-0.0760*	-0.0126	0.0401	-0.0527
		(-1.076)	(1.371)	(-1.983)	(-0.324)	(1.642)	(-1.391)
DIR	?/?/?	0.0066**	0.0036**	0.0030	-0.0007	0.0003	-0.0010
		(3.570)	(3.147)	(1.687)	(-0.351)	(0.267)	(-0.532)
Adj. R^2		0.579	0.710	0.375	0.605	0.716	0.404
F-Statistic		115.563**	204.885**	50.989**	71.504**	117.031**	32.222**
Dependent Mean		0.007	0.006	0.001	0.007	0.006	0.001
Root MSE		0.016	0.010	0.015	0.015	0.010	0.015
DW Statistic		1.697	2.014	1.711	1.701	2.001	1.723
Observations		417	417	417	415	415	415

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 9

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Corporate Bond Returns - Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.
These regression results compare the effect of periods of declining interest rates. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

		YW	YW	YW	ML	ML	ML
Model		(4)	(5)	(6)	(4)	(5)	(6)
1960:01 to 1994:09	4/5/6	Low-	High-		Low-	High-	
Explanatory	Expected	Grade	Grade	Return	Grade	Grade	Return
Variables	Sign	Corp.	Corp.	Spread	Corp.	Corp.	Spread
Intercept	?/?/0	0.0012	0.0010	0.0002	0.0012	0.0010	0.0001
		(1.022)	(1.648)	(0.128)	(1.017)	(1.649)	(0.119)
TBR	+/+/-	0.2183**	0.4579**	-0.2292**	0.2167**	0.4577**	-0.2293**
		(4.887)	(16.910)	(-5.339)	(4.869)	(16.885)	(-5.357)
SMR	+/+/+	0.3402**	0.0387**	0.2952**	0.3390**	0.0387**	0.2939**
		(13.718)	(2.613)	(12.496)	(13.637)	(2.608)	(12.387)
TBR x DIR	?/?/0	-0.0364	-0.0205	-0.0209	-0.0353	-0.0202	-0.0206
		(-0.578)	(-0.563)	(-0.349)	(-0.561)	(-0.551)	(-0.344)
SMR x DIR	?/?/0	-0.0523	0.0287	-0.0849*	-0.0532	0.0284	-0.0854*
		(-1.367)	(1.246)	(-2.337)	(-1.395)	(1.224)	(-2.355)
DIR	?/?/?	0.0069**	0.0036**	0.0034	0.0069**	0.0036**	0.0035*
		(3.768)	(3.259)	(1.960)	(3.786)	(3.264)	(1.986)
AR Parameters:							
Lag 1		-0.1489**		-0.1351**	-0.1668**		-0.1491**
		(-3.050)		(-2.777)	(-3.408)		(-3.066)
Lag 7			0.1309**			0.1319**	
			(2.719)			(2.720)	
Lag 10			0.1195*			0.1233*	
			(2.481)			(2.536)	
Lag 11			-0.1503**	-0.1249*		-0.1497**	-0.1316**
			(-3.121)	(-2.566)		(-3.090)	(-2.684)
Total R^2		0.595	0.730	0.407	0.595	0.730	0.408
Regression R^2		0.572	0.719	0.373	0.570	0.720	0.372
Root MSE		0.016	0.009	0.015	0.016	0.009	0.015
DW Statistic					1.985	1.962	2.007
Observations		417	417	417	417	417	417

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Again, the estimated intercept can be interpreted as the amount of abnormal return attributed to the dependent return series after adjusting for the various movements of the independent variables. In this case, the results indicate that after controlling for periods of declining interest rates, there is no significant difference in the return performance of the two asset classes.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade corporate bond returns to Treasury bond market returns during call periods, there is reason to reject the hypothesis that low-grade corporate bonds have significantly weaker and/or less interest rate call protection than high-grade corporate bonds. If high-grade corporate bonds were significantly more sensitive to interest rate movements due to better call protection relative to low-grade corporate bonds, then it would be expected that the estimated coefficient β_3 would be significantly greater than the same coefficient for the low-grade corporate bond regression. The fact that this is not the case casts doubt on the contention of the significant difference between the number of calls and/or the call protection associated with the respective asset classes.

Regarding the issue of the risky debt model which explains call period behavior more accurately, the overall results of the above regressions tend to support those models with a strong credit spread effect. Although, these results do not strongly support the strong credit spread effect risky debt models over more traditional risky debt models. In the return spread regressions for all but the Dimson regression, the estimated coefficient β_4 is significant at the 5% level of significance. Clearly, this would not be expected under risky debt valuation models which do not incorporate interest rate risk.

4.2 Put Periods

Regarding low-grade corporate bond puts or defaults, if there was a significant affect of the exercise and/or increase in the probability of exercise of low-grade corporate bond puts relative to high-grade corporate bond puts it will become significant during periods when the economy is performing poorly. If low-grade corporate bonds are significantly more exposed to business cycle risk during recessions, low-grade corporate bond returns should be more sensitive to equity market movements during periods when more defaults would be expected to occur. Therefore, traditional risky debt valuation models would hypothesize that during recessionary periods low-grade corporate bond returns will be significantly more affected by movements in the equity market than at other times, whereas risky debt valuation models which incorporate interest rate risk may not agree with that hypothesis (i.e., especially if interest rates tend to decline during recessions and $\rho_{r,V}$ is assumed negative).

Table 10

Summary Statistics and Tests of Normality for the Returns of Low-Grade Corporate Bond Funds, High-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Recession Months Only (Put Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.
A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

1960:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate	Treasury Bonds	S&P 500	LGC - HGC Spread
Observations = 67					
Moments of the Distribution:					
1st - Mean	0.7084%	1.0493%	1.2955%	0.4051%	-0.3410%
2nd - Standard Deviation	3.8812%	2.8403%	4.0544%	5.7530%	2.3322%
3rd - Skewness	0.4227	0.8258	0.9409	0.1383	0.0286
4th - Kurtosis	-0.1842	0.7361	2.2162	-0.0123	0.4429
Minimum	-6.5820%	-3.4100%	-7.1400%	-11.9330%	-5.7590%
Maximum	10.9500%	9.4350%	15.2400%	16.3050%	6.3790%
Tests of Normality#:					
T-Statistic: Mean = 0	1.494	3.0239	2.6154	0.5764	-1.1965
Prob>T	0.1400	0.0036	0.0110	0.5663	0.2358
W: Normal	0.9688	0.9361	0.9492	0.9795	0.9875
Prob<W	0.2321	0.0026	0.0182	0.6243	0.9219

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Although low-grade corporate bonds were more volatile than high-grade corporate bonds during recesssionary periods, low-grade corporate bonds were not significantly more volatile. For recession months, the ratio of low-grade to high-grade corporate bond standard deviation is approximately 1.37 versus 1.35 for all months. Like interest rate calls, defaults alone cannot explain the volatility differential between high-grade and low-grade corporate bonds. Over the period analyzed, low-grade corporate bonds have been only slightly more sensitive to recessionary periods than high-grade corporate bonds.

It is interesting to note how equity-like low-grade corporate bonds seem to be during recessions. Conversely, it is interesting to note how Treasury bond-like high-grade corporate bonds seem to be during recessions. Low-grade corporate bonds and equities are the only asset classes to have negative kurtosis during recessions. At the 10% level of significance, neither low-grade corporate bonds or equities have a positive mean return during recessions, while high-grade corporate bonds and

Treasury bonds do. The Shapiro-Wilk statistic indicates that the recession return series for both low-grade corporate bonds and equities is a random sample drawn from a normal distribution, while the recession return series for both high-grade corporate bonds and Treasury bonds are not. Clearly, based on descriptive statistics, and relative to high-grade corporate bonds, low-grade corporate bonds are more equity-like than Treasury bond-like during recessionary periods.

In order to test the recession put hypothesis, the following regression models were run to test for the impact of put periods on the returns of high-grade and low-grade corporate bonds.

(7) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

(8) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

(9) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

where Rec = a dummy variable equal to one if the economy is in a recession and zero otherwise. The put dummy variable is intended to isolate the effect of recessionary periods when puts are more frequent and/or more probable for low-grade corporate bonds. These regression models are based on the models used by Cornell and Green [1991, p. 43-45][5].

5 Note, the time period examined in this study is 1960 through 1988 not 1960 through 1989 as in the Cornell and Green study.

Table 11

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Corporate Bond Returns - Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated A or higher.

These regression results compare the effect of recessionary periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

Model 1960:01 to 1994:09 Explanatory Variables	7/8/9 Expected Sign	(7) Low-Grade Corp.	(8) High-Grade Corp.	(9) Return Spread	Dimson (7) Low-Grade Corp.	Dimson (8) High-Grade Corp.	Dimson (9) Return Spread
Intercept	?/?/0	0.0039**	0.0024**	0.0015	0.0030**	0.0021**	0.0008
		(4.680)	(4.676)	(1.841)	(3.502)	(3.994)	(0.981)
TBR (Lag 1)					0.0062	0.0050	0.0012
					(0.232)	(0.295)	(0.045)
TBR	+/+/-	0.1770**	0.4573**	-0.2803**	0.1832**	0.4558**	-0.2726**
		(5.376)	(22.555)	(-8.713)	(5.747)	(22.555)	(-8.655)
TBR (Lead 1)					0.0982**	0.0653**	0.0329
					(3.599)	(3.776)	(1.219)
SMR (Lag 1)					0.0205	0.0084	0.0122
					(1.107)	(0.712)	(0.664)
SMR	+/+/+	0.3183**	0.0325*	0.2858**	0.3187**	0.0327*	0.2860**
		(14.470)	(2.398)	(13.294)	(14.926)	(2.413)	(13.557)
SMR (Lead 1)					0.0600**	-0.0183	0.0783**
					(3.240)	(-1.563)	(4.282)
TBR x Rec	?/?/0	0.2470**	0.0593	0.1877**	0.2587**	0.0510	0.2076**
		(3.993)	(1.555)	(3.106)	(4.267)	(1.328)	(3.466)
SMR x Rec	?/?/+	0.0619	0.0955**	-0.0336	0.0154	0.0831**	-0.0677
		(1.442)	(3.609)	(-0.799)	(0.367)	(3.119)	(-1.630)
Rec	?/?/?	-0.0039	0.0009	-0.0048*	-0.0052*	0.0005	-0.0057**
		(-1.804)	(0.642)	(-2.250)	(-2.456)	(0.341)	(-2.705)
Adj. R^2		0.592	0.719	0.383	0.626	0.727	0.421
F-Statistic		121.925**	213.654**	52.700**	78.133**	123.255**	34.496**
Dependent Mean		0.007	0.006	0.001	0.007	0.006	0.001
Root MSE		0.015	0.010	0.015	0.015	0.009	0.015
DW Statistic		1.698	2.027	1.686	1.689	2.020	1.680
Observations		417	417	417	415	415	415

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 12

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Corporate Bond Returns - Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.
These regression results compare the effect of recessionary periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

		YW	YW	YW	ML	ML	ML
Model		(7)	(8)	(9)	(7)	(8)	(9)
1960:01 to 1994:09	7/8/9	Low-	High-		Low-	High-	
Explanatory	Expected	Grade	Grade	Return	Grade	Grade	Return
Variables	Sign	Corp.	Corp.	Spread	Corp.	Corp.	Spread
Intercept	?/?/0	0.0041**	0.0025**	0.0016	0.0041**	0.0025**	0.0016
		(4.182)	(4.916)	(1.470)	(4.102)	(4.920)	(1.414)
TBR	+/+/-	0.1591**	0.4563**	-0.2876**	0.1569**	0.4564**	-0.2887**
		(4.944)	(23.666)	(-9.239)	(4.892)	(23.625)	(-9.308)
SMR	+/+/+	0.3085**	0.0281*	0.2681**	0.3073**	0.0280*	0.2663**
		(14.393)	(2.172)	(13.036)	(14.376)	(2.137)	(12.966)
TBR x Rec	?/?/0	0.2633**	0.0561	0.2292**	0.2652**	0.0559	0.2338**
		(4.373)	(1.573)	(3.982)	(4.419)	(1.558)	(4.077)
SMR x Rec	?/?/+	0.0511	0.0915**	-0.0471	0.0497	0.0915**	-0.0491
		(1.213)	(3.647)	(-1.166)	(1.181)	(3.627)	(-1.221)
Rec	?/?/?	-0.0037	0.0009	-0.0048*	-0.0036	0.0009	-0.0048*
		(-1.526)	(0.740)	(-2.094)	(-1.480)	(0.738)	(-2.036)
AR Parameters:							
Lag 1		-0.1495**		-0.1472**	-0.1692**		-0.1691**
		(-3.062)		(-3.034)	(-3.460)		(-3.483)
Lag 7			0.0963*			0.1006*	
			(2.002)			(2.077)	
Lag 10			0.1406**			0.1421**	
			(2.914)			(2.904)	
Lag 11			-0.1331**	-0.1340**		-0.1336**	-0.1434**
			(-2.766)	(-2.762)		(-2.759)	(-2.926)
Lag 12			-0.0978*			-0.1009*	
			(-2.027)			(-2.075)	
Total R^2		0.607	0.739	0.420	0.608	0.739	0.420
Regression R^2		0.585	0.731	0.385	0.584	0.731	0.384
Root MSE		0.015	0.009	0.015	0.015	0.009	0.015
DW Statistic					2.003	1.973	2.010
Observations		417	417	417	417	417	417

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The estimated intercept for the return spread regressions does not suggest that, after adjusting for the various movements of the independent variables, low-grade corporate bonds have returned significantly more than high-grade corporate bonds. In this case, the results indicate that after controlling for recessionary periods, there is no significant difference in the return performance of the two asset classes. Also, note that all four regressions generally assign the same sign and level of significance to each comparable estimated coefficient.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade corporate bond returns to Treasury market returns during put periods, there is reason to reject the risky debt valuation models which do not allow for a credit spread effect. That is, risky debt valuation models which do not incorporate interest rate risk cannot explain why more risky debt would become more sensitive to interest rate movements during recessions. In this case, the estimated coefficient β_6 is positive and significant at the 1% level of significance (i.e., for the return spread regression).

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade corporate bond returns to equity market returns during put periods, there is reason to reject risky debt valuation models which do not allow for a credit spread effect. If low-grade corporate bonds were significantly more sensitive to equity market movements during recessions, due to their puts moving deeper into-the-money relative to high-grade corporate bonds, then it would be expected that the estimated coefficient β_7 would be significantly greater than the same coefficient for the high-grade corporate bond regression. Although not significantly lower (i.e., the estimated β_7 coefficients for the model 9 regressions are negative), the fact that this is not the case casts doubt on risky debt valuation models which cannot explain this result.

Regarding the issue of the risky debt model which explains put period behavior more accurately, the overall results of the above regressions support those models with a strong credit spread effect. Overall, the results strongly suggest that during periods when low-grade corporate bonds would be expected to show a great deal more sensitivity to equity prices relative to high-grade corporate bonds, they do not. This implies that high-grade corporate bonds behave more like equities during business cycle contractions than during business cycle expansions. In addition, the results indicate that low-grade corporate bonds act significantly more like government bonds during recessions while high-grade bonds act less like government bonds. During recessions, the two asset classes seem to partially reverse their roles. Low-grade corporate bonds become less equity-like and more Treasury bond-like, while high-grade corporate bonds become more equity-like and less Treasury bond-like.

4.3 Combination Call and Put Periods

Regarding the increased probability of low-grade corporate bond puts and low-grade and high-grade corporate bond interest rate calls, if there was a significant affect of the exercise and/or increase in the probability of exercise of the options of low-grade corporate bonds relative to high-grade corporate bonds it should show up during periods when the economy is performing poorly and interest rates are declining. Therefore, at least relative to high-grade corporate bonds, this thesis hypothesizes that during combination recession and declining interest rate periods, low-grade corporate bond returns will be significantly more sensitive to Treasury bond market movements and less sensitive to movements in the equity market than at other times. Essentially, this will be the strongest test to evaluate the appropriateness of risky debt valuation models which incorporate interest rate risk relative to those which do not.

Table 13

Summary Statistics and Tests of Normality for the Returns of Low-Grade Corporate Bond Funds, High-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined & Recession (Call & Put Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.
A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

1960:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate	Treasury Bonds	S&P 500	LGC - HGC Spread
Observations = 35					
Moments of the Distribution:					
1st - Mean	2.4290%	2.4959%	3.6568%	2.4843%	-0.0670%
2nd - Standard Deviation	3.4140%	2.7212%	3.7289%	4.8937%	2.0065%
3rd - Skewness	0.3837	0.7915	1.4786	0.5480	0.5357
4th - Kurtosis	0.2654	0.5842	2.7307	0.7661	2.6048
Minimum	-4.2660%	-2.8500%	-1.0900%	-6.0550%	-5.2610%
Maximum	10.9500%	9.4350%	15.2400%	16.3050%	6.3790%
Tests of Normality#:					
T-Statistic: Mean = 0	4.2093	5.4262	5.8017	3.0033	-0.1972
Prob>T	0.0002	0.0001	0.0001	0.0050	0.8448
W: Normal	0.9719	0.9329	0.8765	0.9635	0.9536
Prob<W	0.5792	0.0427	0.0007	0.3604	0.1881

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Low-grade corporate bonds were more volatile than high-grade corporate bonds during periods of recession and declining interest rates, but not significantly so. During combination recession and declining interest rate months, the ratio of low-grade to high-grade corporate bond standard deviation is approximately 1.25 versus 1.35 for all months. During months when it is expected that puts and interest rate calls on low-grade corporate bonds will be exercised more frequently than those for high-grade corporate bonds, there is some decline in volatility for low-grade corporate bond returns versus that of high-grade corporate bonds, but that difference is not significant.

In order to test the recession put and declining interest rate call hypothesis, the following regression models were run to test for the significance of combination put and interest rate call periods on the returns of high-grade and low-grade corporate bonds:

(10) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Re}c_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Re}c_t \times DIR_t + \beta_{11} \times \mathrm{Re}c_t \times DIR_t + e_t$

(11) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Re}c_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Re}c_t \times DIR_t + \beta_{11} \times \mathrm{Re}c_t \times DIR_t + e_t$

(12) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Re}c_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Re}c_t \times DIR_t + \beta_{11} \times \mathrm{Re}c_t \times DIR_t + e_t$

These regressions are intended to capture the relative effect of the combination of puts and interest rate calls for low-grade and high-grade corporate bonds. The coefficient β_9 will isolate the effect that changes in government bond prices have on changes in low-grade and high-grade corporate bond prices during periods of recession and declining interest rates. The coefficient β_{10} will isolate the effect changes in equity prices have on changes in low-grade and high-grade corporate bond prices during periods of recession and declining interest rates.

Table 14

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Corporate Bond Returns - Call & Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated A or higher.

These regression results compare the effects of recessionary and declining interest rate periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; and a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

Model 1960:01 to 1994:09 Explanatory Variables	10/11/12 Expected Sign	(10) Low-Grade Corp.	(11) High-Grade Corp.	(12) Return Spread	Dimson (10) Low-Grade Corp.	Dimson (11) High-Grade Corp.	Dimson (12) Return Spread
Intercept	?/?/0	0.0031**	0.0023**	0.0009	0.0022**	0.0020**	0.0002
		(3.859)	(4.646)	(1.112)	(2.709)	(4.059)	(0.219)
TBR (Lag 1)					0.0080	0.0004	0.0076
					(0.291)	(0.025)	(0.281)
TBR	+/+/-	0.2025**	0.4648**	-0.2623**	0.2289**	0.4630**	-0.2341**
		(6.361)	(24.279)	(-8.613)	(7.550)	(24.853)	(-7.862)
TBR (Lead 1)					0.0955**	0.0613**	0.0342
					(3.414)	(3.565)	(1.246)
SMR (Lag 1)					0.0312	0.0066	0.0246
					(1.665)	(0.573)	(1.338)
SMR	+/+/+	0.3452**	0.0403**	0.3049**	0.3283**	0.0370**	0.2912**
		(17.015)	(3.299)	(15.705)	(16.461)	(3.022)	(14.872)
SMR (Lead 1)					0.0610**	-0.0180	0.0790**
					(3.262)	(-1.569)	(4.304)
TBR x DIR x Rec	?/?/0	0.2628**	0.0357	0.2271**	0.2018**	0.0568	0.1450
		(3.186)	(0.719)	(2.877)	(2.594)	(1.188)	(1.898)
SMR x DIR x Rec	?/?/+	-0.0291	0.1694**	-0.1985**	0.0333	0.1517**	-0.1184*
		(-0.473)	(4.586)	(-3.377)	(0.574)	(4.249)	(-2.074)
DIR x Rec	?/?/?	-0.0037	-0.0008	-0.0029	-0.0025	0.0003	-0.0028
		(-0.956)	(-0.351)	(-0.778)	(-0.818)	(0.172)	(-0.941)
Adj. R^2		0.578	0.722	0.388	0.613	0.734	0.408
F-Statistic		114.993**	217.453**	53.708**	73.925**	128.016**	32.749**
Dependent Mean		0.007	0.006	0.001	0.007	0.006	0.001
Root MSE		0.016	0.009	0.015	0.015	0.009	0.015
DW Statistic		1.692	2.032	1.681	1.658	2.000	1.713
Observations		417	417	417	415	415	415

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 15

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Corporate Bond Returns - Call & Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.
These regression results compare the effects of recessionary and declining interest rate periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; and a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

Model 1960:01 to 1994:09 Explanatory Variables	10/11/12 Expected Sign	YW (10) Low-Grade Corp.	YW (11) High-Grade Corp.	YW (12) Return Spread	ML (10) Low-Grade Corp.	ML (11) High-Grade Corp.	ML (12) Return Spread
Intercept	?/?/0	0.0032**	0.0023**	0.0009	0.0032**	0.0023**	0.0009
		(3.453)	(4.823)	(0.874)	(3.369)	(4.832)	(0.834)
TBR	+/+/-	0.1827**	0.4600**	-0.2704**	0.1794**	0.4599**	-0.2719**
		(5.844)	(25.059)	(-9.104)	(5.760)	(25.048)	(-9.183)
SMR	+/+/+	0.3309**	0.0360**	0.2844**	0.3286**	0.0358**	0.2819**
		(16.611)	(3.095)	(15.215)	(16.507)	(3.058)	(15.073)
TBR x DIR x Rec	?/?/0	0.2865**	0.0533	0.2895**	0.2906**	0.0540	0.2968**
		(3.509)	(1.155)	(3.784)	(3.562)	(1.169)	(3.880)
SMR x DIR x Rec	?/?/+	-0.0374	0.1550**	-0.2005**	-0.0385	0.1550**	-0.2008**
		(-0.644)	(4.444)	(-3.675)	(-0.670)	(4.433)	(-3.713)
DIR x Rec	?/?/?	-0.0030	-0.0010	-0.0038	-0.0029	-0.0010	-0.0038
		(-0.773)	(-0.452)	(-1.054)	(-0.743)	(-0.455)	(-1.055)
AR Parameters:							
Lag 1		-0.1525**		-0.1505**	-0.1786**		-0.1753**
		(-3.124)		(-3.107)	(-3.649)		(-3.609)
Lag 7			0.1164*			0.1206*	
			(2.419)			(2.479)	
Lag 10			0.1188*			0.1229*	
			(2.467)			(2.532)	
Lag 11			-0.1364**	-0.1379**		-0.1364**	-0.1481**
			(-2.836)	(-2.847)		(-2.813)	(-3.036)
Lag 12			-0.1118*			-0.1172*	
			(-2.320)			(-2.409)	
Total R^2		0.594	0.743	0.425	0.595	0.743	0.426
Regression R^2		0.571	0.734	0.390	0.569	0.734	0.390
Root MSE		0.016	0.009	0.015	0.016	0.009	0.015
DW Statistic					2.001	1.998	2.009
Observations		417	417	417	417	417	417

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The recession effect is accentuated during periods of decreasing interest rates. That is, during combination business cycle contraction and declining interest rate periods high-grade corporate bonds act even more like equities and less like government bonds than during business cycle contraction periods alone (compare the model 9 and 12 results, particularly for estimated coefficient β_{10}). The sign and significance of the estimated coefficients β_9 and β_{10} for the model 12 regressions suggests that periods of declining interest rates combined with recession significantly affect the return relationship between low-grade and high-grade corporate bonds.

The results indicate a somewhat counterintuitive result. During periods when both interest rate calls and puts should be exercised (i.e., the worst of both worlds) their net effect is reduced due to the fact that as credit quality declines (i.e., bankruptcies and defaults rise) it has the effect of depressing prices sufficiently as to discourage the exercise of the interest rate call option (i.e., moving the price down and away from the strike price), thus partially offsetting the potential call effect and allowing some price appreciation for more credit worthy bonds.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade corporate bond returns to Treasury bond market returns during combination interest rate call and put periods, there is reason to reject risky debt valuation models which do not allow for a credit spread effect. That is, risky debt valuation models which do not incorporate interest rate risk cannot explain why more risky debt would become more sensitive to interest rate movements during combination declining interest rate and recession periods. In this case, the estimated coefficient β_9 is positive and significant at the 1% level of significance (i.e., for all but the Dimson regression).

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade corporate bond returns to equity market returns during combination interest rate call and put periods, there is additional reason to reject risky debt valuation models which do not allow for a credit spread effect. If low-grade corporate bonds were significantly more sensitive to equity market movements during recessions, due to their puts being more in-the-money relative to high-grade corporate bonds, then it would be expected that the estimated coefficient β_{10} would be significantly greater than the same coefficient for the high-grade corporate bond regression. The estimated β_{10} coefficients for the model 12 regressions are significantly negative in all four regressions. Thus, risky debt models which do not incorporate interest rate risk into the their valuation model would expect the estimated β_{10} coefficients for the model 12 regressions to have a positive sign, the fact that the sign is strongly negative casts doubt on risky debt valuation models which cannot explain this result.

Regarding the issue of the risky debt model which explains combination interest rate call and put period behavior more accurately, the overall results of the above regressions strongly support those models with a strong credit spread effect. Overall, the results suggest that during periods when low-grade corporate bonds would be expected to show a great deal more sensitivity to equity market movements relative to high-grade corporate bonds and little or no change in sensitivity to government bond market movements, they do not. During declining interest rate and recessionary periods, the two asset classes seem to partially reverse their roles. Low-grade corporate bonds become less equity-like and significantly more Treasury bond-like, while high-grade corporate bonds become significantly more equity-like and less Treasury bond-like.

Finally, to test the extent to which effect dominates (i.e., interest rate call, put, or combination interest rate call and put), the following regressions were run:

(13) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t +$
$\beta_6 \times TBR_t \times \mathrm{Rec}_t + \beta_7 \times SMR_t \times \mathrm{Rec}_t + \beta_8 \times \mathrm{Rec}_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(14) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t +$
$\beta_6 \times TBR_t \times \mathrm{Rec}_t + \beta_7 \times SMR_t \times \mathrm{Rec}_t + \beta_8 \times \mathrm{Rec}_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(15) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t +$
$\beta_6 \times TBR_t \times \mathrm{Rec}_t + \beta_7 \times SMR_t \times \mathrm{Rec}_t + \beta_8 \times \mathrm{Rec}_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

Risky debt valuation models which include interest rate risk and assume a significantly negative $\rho_{r,V}$ would imply that β_9 and β_{10}, rather than β_3, β_4, β_6, and β_7 should pick up the bulk of any significant changes in the sensitivities of the risky corporate debt return spread.

Table 16

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Corporate Bond Returns - Calls, Puts, and Calls & Puts Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated A or higher.

Model 1960:01 to 1994:09 Explanatory Variables	13/14/15 Expected Sign	(13) Low-Grade Corp.	(14) High-Grade Corp.	(15) Return Spread	Dimson (13) Low-Grade Corp.	Dimson (14) High-Grade Corp.	Dimson (15) Return Spread
Intercept	?/?/0	0.0012	0.0007	0.0005	0.0034**	0.0020**	0.0014
		(1.075)	(0.981)	(0.477)	(2.882)	(2.712)	(1.201)
TBR (Lag 1)					0.0037	-0.0022	0.0059
					(0.117)	(-0.111)	(0.189)
TBR	+/+/-	0.1828**	0.4425**	-0.2598**	0.2391**	0.4662**	-0.2271**
		(3.761)	(14.818)	(-5.407)	(4.993)	(15.568)	(-4.803)
TBR (Lead 1)					0.1068**	0.0617**	0.0451
					(3.837)	(3.543)	(1.642)
SMR (Lag 1)					0.0184	0.0074	0.0110
					(0.967)	(0.624)	(0.584)
SMR	+/+/+	0.3077**	0.0269	0.2808**	0.3227**	0.0154	0.3073**
		(10.922)	(1.552)	(10.084)	(12.175)	(0.931)	(11.740)
SMR (Lead 1)					0.0638**	-0.0154	0.0792**
					(3.349)	(-1.296)	(4.212)
TBR x DIR	?/?/0	-0.1721*	-0.0607	-0.1113	-0.1143	-0.0374	-0.0769
		(-2.354)	(-1.351)	(-1.541)	(-1.817)	(-0.951)	(-1.238)
SMR x DIR	?/?/0	0.0029	-0.0035	0.0064	0.0028	0.0426	-0.0397
		(0.065)	(-0.127)	(0.145)	(0.075)	(1.789)	(-1.058)
DIR	?/?/?	0.0094**	0.0053**	0.0040*	0.0005	0.0003	0.0001
		(4.809)	(4.452)	(2.097)	(0.247)	(0.284)	(0.070)
TBR x Rec	?/?/0	0.2320	0.1047	0.1273	0.3154**	0.0559	0.2594**
		(1.929)	(1.416)	(1.071)	(3.655)	(1.036)	(3.045)
SMR x Rec	?/?/+	0.1259*	0.0427	0.0832	-0.0052	0.0257	-0.0310
		(2.250)	(1.243)	(1.504)	(-0.099)	(0.774)	(-0.590)
Rec	?/?/?	0.0005	0.0023	-0.0018	-0.0031	0.0002	-0.0033
		(0.149)	(1.171)	(-0.577)	(-1.120)	(0.130)	(-1.217)
TBR x DIR x Rec	?/?/0	0.2226	0.0140	0.2086*	0.0098	0.0289	-0.0192
		(1.476)	(0.151)	(1.399)	(0.102)	(0.482)	(-0.202)
SMR x DIR x Rec	?/?/+	-0.1204	0.1436**	-0.2640**	0.0417	0.1302**	-0.0884
		(-1.398)	(2.713)	(-3.101)	(0.584)	(2.911)	(-1.253)
DIR x Rec	?/?/?	-0.0117*	-0.0069*	-0.0048	-0.0050	-0.0012	-0.0039
		(-2.278)	(-2.194)	(-0.941)	(-1.145)	(-0.430)	(-0.887)
Adj. R^2		0.613	0.734	0.401	0.626	0.734	0.422
F-Statistic		60.947**	105.521**	26.348**	47.246**	77.115**	21.138**
Dependent Mean		0.007	0.006	0.001	0.007	0.006	0.001
Root MSE		0.015	0.009	0.015	0.015	0.009	0.015
DW Statistic		1.690	2.080	1.661	1.687	2.031	1.694
Observations		417	417	417	415	415	415

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 17

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Corporate Bond Returns - Calls, Puts, and Calls & Puts Regressions

Model 1960:01 to 1994:09 Explanatory Variables	13/14/15 Expected Sign	YW (13) Low-Grade Corp.	YW (14) High-Grade Corp.	YW (15) Return Spread	ML (13) Low-Grade Corp.	ML (14) High-Grade Corp.	ML (15) Return Spread
Intercept	?/?/0	0.0013	0.0008	0.0004	0.0013	0.0008	0.0003
		(1.029)	(1.149)	(0.301)	(1.012)	(1.150)	(0.280)
TBR	+/+/-	0.1751**	0.4383**	-0.2573**	0.1741**	0.4379**	-0.2570**
		(3.801)	(15.438)	(-5.843)	(3.792)	(15.451)	(-5.884)
SMR	+/+/+	0.2980**	0.0281	0.2616**	0.2969**	0.0280	0.2596**
		(10.988)	(1.683)	(10.092)	(10.959)	(1.672)	(10.050)
TBR x DIR	?/?/0	-0.1644*	-0.0563	-0.1260	-0.1633*	-0.0558	-0.1272
		(-2.356)	(-1.333)	(-1.886)	(-2.347)	(-1.324)	(-1.919)
SMR x DIR	?/?/0	-0.0112	-0.0173	-0.0062	-0.0125	-0.0181	-0.0070
		(-0.263)	(-0.659)	(-0.154)	(-0.296)	(-0.689)	(-0.174)
DIR	?/?/?	0.0093**	0.0053**	0.0050**	0.0093**	0.0053**	0.0051**
		(4.948)	(4.592)	(2.783)	(4.963)	(4.602)	(2.851)
TBR x Rec	?/?/0	0.2534*	0.0846	0.1492	0.2554*	0.0837	0.1505
		(2.214)	(1.195)	(1.354)	(2.236)	(1.183)	(1.375)
SMR x Rec	?/?/+	0.1137*	0.0445	0.0722	0.1124*	0.0448	0.0708
		(2.074)	(1.340)	(1.365)	(2.053)	(1.348)	(1.340)
Rec	?/?/?	0.0011	0.0018	-0.0013	0.0012	0.0018	-0.0012
		(0.334)	(0.928)	(-0.408)	(0.353)	(0.919)	(-0.388)
TBR x DIR x Rec	?/?/0	0.2082	0.0361	0.2478	0.2060	0.0375	0.2524
		(1.407)	(0.410)	(1.743)	(1.389)	(0.427)	(1.781)
SMR x DIR x Rec	?/?/+	-0.1080	0.1451**	-0.2465**	-0.1066	0.1456**	-0.2448**
		(-1.312)	(2.849)	(-3.096)	(-1.301)	(2.862)	(-3.090)
DIR x Rec	?/?/?	-0.0123**	-0.0060*	-0.0072	-0.0124**	-0.0060*	-0.0074
		(-2.603)	(-2.038)	(-1.600)	(-2.632)	(-2.035)	(-1.663)
AR Parameters:							
Lag 1		-0.1480**		-0.1666**	-0.1667**		-0.1868**
		(3.022)		(-3.442)	(-3.387)		(-3.865)
Lag 8				0.1056*			0.1171*
				(2.184)			(2.402)
Lag 10			0.1492**			0.1574**	
			(3.057)			(3.171)	
Lag 11		-0.1093*	-0.1168*	-0.1493**	-0.1180*	-0.1171*	-0.1639**
		(-2.231)	(-2.396)	(-3.087)	(-2.349)	(-2.381)	(-3.334)
Lag 12			-0.0987*			-0.1063*	
			(-2.023)			(-2.154)	
Total R^2		0.638	0.755	0.458	0.638	0.755	0.459
Regression R^2		0.614	0.750	0.414	0.613	0.751	0.415
Root MSE		0.015	0.009	0.014	0.015	0.009	0.014
DW Statistic					2.004	2.054	2.012
Observations		417	417	417	417	417	417

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Except for the Dimson regression, the return spread regression results support the hypothesis that it is the combination of interest rate call and put periods which principally cause more risky corporate bonds to become significantly less sensitive to equity market movements than more credit worthy corporate bonds (i.e., regression model 15, estimated coefficient β_{10}). Therefore, these final regressions would also strongly support risky debt valuation models which incorporate both interest rate risk and a significantly negative $\rho_{r,V}$.

5 Summary and Conclusions

Regarding the overall performance of low-grade corporate bonds, the results presented here do not significantly differ from those of Cornell and Green [1991] and Blume et al. [1991]. By essentially extending the Cornell and Green sample by 4 and 3/4 years there is no significant difference in the overall financial performance of low-grade corporate bonds relative to high-grade corporate bonds. After controlling for government bond and equity market movements, low-grade corporate bonds do not significantly outperform high-grade corporate bonds. Regarding the hypothesis that low-grade corporate bonds have significantly weaker interest rate call protection and/or relatively more interest rate calls, the tests performed in this chapter do not support such an assertion.

During periods of declining interest rates, recession, or combination declining interest rate and recession low-grade corporate bonds do not demonstrate significantly different volatility compared to high-grade corporate bonds. Although, periods of declining interest rates significantly affect the relative sensitivity of low-grade and high-grade corporate bonds to movements in the government bond market. Also, periods of recession significantly affect the relative sensitivity of low-grade and high-grade corporate bonds to movements in the equity market. Finally, periods of declining interest rates combined with recession significantly affect the relative sensitivity of low-grade and high-grade corporate bonds to movements in the both the government bond and equity markets.

The following table provides a summary of the tests conducted.

Table 18

A Comparison of Expectations and Outcomes for Low-Grade versus High-Grade Corporate Bonds

Simple CCA & Credit Spread Effect Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds (est. β_3, β_6, β_9)	Expectation for Sensitivity to Stocks (est. β_4, β_7, β_{10})
Interest Rate Call Periods (i.e., declining interest rates)	0/0 or +	0/0 or -
Put Periods (i.e., recession)	- or 0/0 or +	+/0 or -
Combination Periods (Call & Put Periods)	- or 0/+	+/ -

Realization for Low-Grade vs. High-Grade Bonds (cut-off at the 5% level of significance) 1960:01 through 1994:09	Sensitivity to Treasury Bonds	Sensitivity to Stocks
Interest Rate Call Periods (i.e., declining interest rates)	0	-
Put Periods (i.e., recession)	+	0
Combination Periods (Call & Put Periods)	+	-

During periods of declining interest rates, low-grade corporate bonds become less equity-like compared to high-grade corporate bonds. During business cycle contractions, low-grade corporate bonds become more government bond-like compared to high-grade corporate bonds. During combination periods, both effects occur. These results support risky debt valuation models which incorporate interest rate risk and a significantly negative correlation between changes in interest rates and changes in firm value. If interest rate risk and a significantly negative value for $\rho_{r,V}$ were not of importance in valuing risky corporate bonds, the overall results should have been about the opposite of those found.

CHAPTER 7

THE EFFECT OF EMBEDDED OPTIONS ON THE FINANCIAL PERFORMANCE OF LOW-GRADE MUNICIPAL BONDS

1 Introduction

The primary objectives of this chapter are the following: (1) begin empirical literature on low-grade municipal bond financial performance, and (2) provide evidence to support more complex CCA models of risky bond pricing. As in Chapter 6, the analytic approach used in this chapter is to examine the performance of low-grade bond returns relative to high-grade bond returns within the context of the principal options embedded in them. In the case of low-grade municipal bonds, analysis will focus on interest rate call and put periods. As shown in Chapter 6, the primary objectives of this chapter are a by-product of the approach and method employed. In addition, given that low-grade municipal bonds possess the same principal embedded options as low-grade corporate bonds, the structure and content of this chapter is similar to Chapter 6.

Given the size of the U.S. tax-exempt bond market, there is surprising little research in this area of finance. As of 1993, one estimate of the overall size of the municipal bond market was $1.2 trillion.[1] At a minimum, this chapter is intended to provide a basis for future research on the relative performance of low-grade and high-grade municipal bonds.[2] Figure 1 provides a visual backdrop for the remainder of the introduction.

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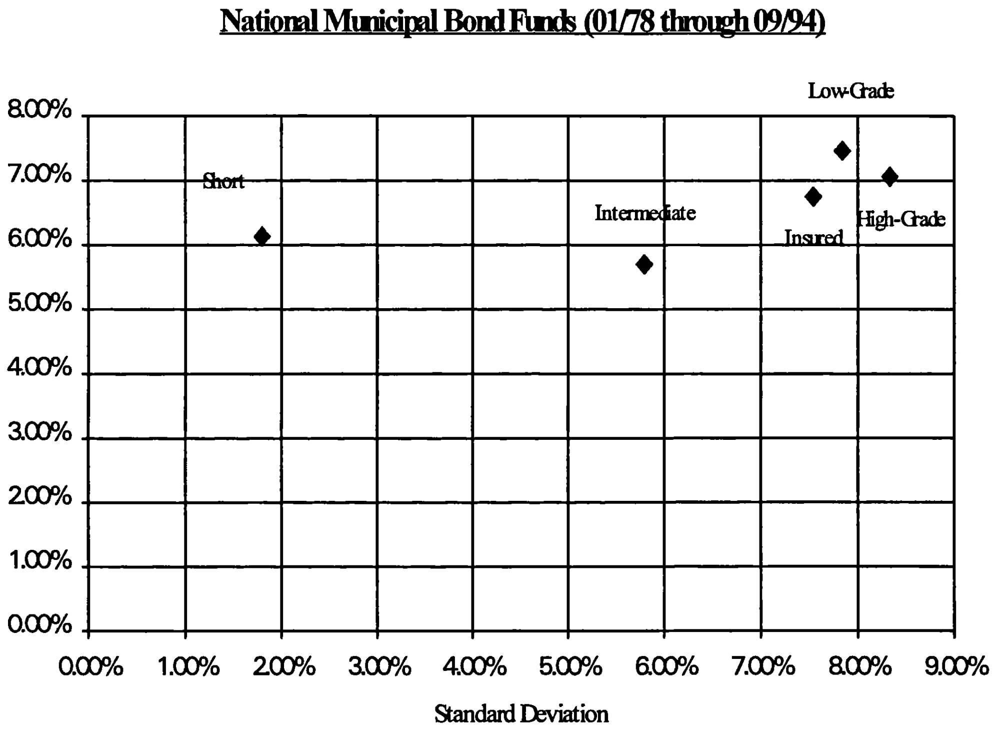
[1] Taken from the Board of Governors of the Federal Reserve (tax-exempt liabilities and assets outstanding).

[2] In addition to the fifty states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam issue municipal bonds which are often held by national municipal bond funds.

Figure 1

Return and Standard Deviation for Tax-Exempt Asset Classes (01/78 through 09/94)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings. Insured municipal bond funds invest at least 65% of assets in insured municipal bond issues. Intermediate municipal bond funds invest in municipal bond issues with weighted average maturities of between 5 and 10 years. Short municipal bond funds invest in municipal bond issues with weighted maturities of less than 5 years. The return and standard deviation values are annualized.



Given standard quadratic utility, and assuming that risk and return are best described by historic standard deviation of return and mean return, low-grade municipal bonds have appeared to dominate high-grade municipal bonds. From 01/78 through 09/94 low-grade municipal bonds have had a higher return at a lower level of risk, as measured by standard deviation, than high-grade municipal bonds. Also, it is trivial to show that linear combinations of short maturity municipal bonds and low-grade municipal bonds dominate intermediate and insured municipal bonds. The apparent anomalous relationship between low-grade and high-grade municipal bonds is one of the issues addressed by this chapter. Although, an equality of means t-test between the two asset class return series is not significant, are risk adjusted low-grade municipal bond returns greater than high-grade municipal bond returns?

This chapter examines the return experience of low-grade and high-grade municipal bond funds over a long period (i.e., 1/78 through 9/94) in order to begin compiling evidence on the financial performance of low-grade municipal bonds, and to generally extend low-grade corporate bond analysis to the municipal market. Although not statistically significant, low-grade municipal bonds have generated a higher return at a lower standard deviation of return over the period examined.

Table 1

Mean Monthly Return and Standard Deviation for the Low-Grade and High-Grade Municipal Bond Asset Classes (1/78 through 9/94)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

1978:01 to 1994:09	Low-Grade Municipal	High-Grade Municipal
Observations = 201		
Mean	0.6268%	0.5989%
Standard Deviation	2.2625%	2.4037%

In a weak sense the original "Drexel hypothesis" seems to hold for the two municipal bond asset classes. In addition to the possible outperformance of low-grade municipal bonds relative to high-grade municipal bonds, as mentioned in Chapter 5, there are several other seemingly anomalous low-grade corporate bond findings extended to municipal bonds which are addressed by this chapter. Specifically, the following issues are addressed: (1) do low-grade municipal bonds as an asset class show evidence of possessing a higher proportion of calls and/or weaker call protection than high-grade municipal bonds; and (2) do low-grade municipal bonds as an asset class demonstrate a return generation process which would suggest that changes in risk-free interest rates and/or the economy account for a significant amount of the relative return variation in the low-grade municipal market overall?

This chapter makes the following contributions: (1) establishes the existence of the low-grade municipal bond asset class; (2) analyzes and extends the low-grade/high-grade corporate bond effect (see Kihn [1994]) to municipal bonds; (3) analyzes the abnormality of the returns for low-grade municipal bonds; and (4) generally extends research on tax-exempt securities. The remainder of this chapter is divided into five sections. Section 2 presents background on the data and provides summary statistics. Section 3 reviews the expectations/hypotheses developed in Chapter 5 which are of relevance to low-grade municipal bonds. Section 4 presents the low-grade and high-grade municipal bond regression results. Section 5 examines the possible effects the January effect and the Tax Reform Act of 1986 might have had on low-grade municipal bond financial performance. The conclusions are summarized in the last section.

2 Data and Summary Statistics

> This preliminary investigation of relative risk in municipal and corporate bonds reveals that in at least two respects they are remarkably similar. First, the measured variances of return for portfolios of comparably rated bonds are virtually identical. Second, the covariances of comparably rated bond portfolios with an index of common stock returns are very close to one another.
> Skelton [1983, p. 633]

The municipal bond and corporate bond data set is derived from open-end mutual funds tracked by Morningstar during the period from January 1978 through September 1994. January 1978 is the first date that low-grade municipal bond funds were listed by the Morningstar database. The Treasury bond series is a spliced series based on the Cornell and Green [1991] Treasury bond series (01/78 through 12/88) and Salomon Brothers' long bond series (01/89 through 09/94). The stock series is derived from the Standard and Poor's 500 return index ("S&P 500"). Therefore, unlike the return series derived from mutual fund returns, the equity and Treasury bond series are gross returns.

Like the Cornell and Green [1991] study on low-grade corporate bonds, this chapter uses monthly open-end mutual fund data to derive asset class return series. Lipper Analytical Services asset class definitions are used for all asset class return series reported. Shares of open-end mutual funds are traded on the basis of NAV. Monthly returns are based on the following calculation: $Return_t = [(NAV_t - NAV_{t-1}) + IncDist_t + CapGainDist_t] / NAV_{t-1}$.[3] In addition, these returns take account of 12b-1 fees and management fees but not front-end loads, back-end loads, or redemption charges.

[3] As a general rule, for municipal bonds, income distributions are tax-exempt while capital gains distributions are taxable. Given that, like corporate bonds, low-grade municipal bonds have a higher incidence of capital loses (e.g., defaults), after tax high-grade municipal bond returns would be expected to be overestimated relative to after tax low-grade municipal bond returns.

Each mutual fund based asset class return series was constructed following the method used by Cornell and Green [1991]. For each asset class, the equally weighted average of all mutual funds each month was calculated. The following were the number of funds as of month-end September 1994 for each asset class series derived from Morningstar data: 101 low-grade corporate bond funds, 149 high-grade corporate bond funds, 34 low-grade municipal bond funds, 180 high-grade municipal bond funds, 43 insured municipal bond funds, 82 intermediate maturity municipal bond funds, and 35 short maturity municipal funds. Table 2 provides background on the comparable corporate bond asset class return series used in this chapter; and Table 3 provides background on the principal asset class return series used in this chapter.

Table 2

Summary Statistics and Tests of Normality for the Returns of Low-Grade Corporate Bond Funds and High-Grade Corporate Bond Funds

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.

1978:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate
Observations = 201		
Moments of the Distribution:		
1st - Mean	0.8399%	0.7262%
2nd - Standard Deviation	2.2726%	1.7076%
3rd - Skewness	0.3475	0.8190
4th - Kurtosis	3.1486	4.0368
Minimum	-6.5360%	-4.1570%
Maximum	10.9500%	9.4353%
Tests of Normality#:		
T-Statistic: Mean = 0	5.2399	6.0297
Prob>T	0.0001	0.0001
W: Normal	0.9560	0.9589
Prob<W	0.0001	0.0001

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Table 3

Summary Statistics and Tests of Normality for the Returns of Low-Grade Municipal Bond Funds, High-Grade Municipal Bond Funds, Treasury Bonds, and Equities

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

1978:01 to 1994:09	Low-Grade Municipal	High-Grade Municipal	Treasury Bonds	S&P 500
Observations = 201				
Moments of the Distribution:				
1st - Mean	0.6268%	0.5989%	0.8042%	0.8891%
2nd - Standard Deviation	2.2625%	2.4037%	3.6029%	4.4117%
3rd - Skewness	-0.6664	-0.4478	0.5662	-0.7540
4th - Kurtosis	3.6491	2.3130	1.5742	4.6516
Minimum	-8.6000%	-7.9250%	-8.4600%	-23.9440%
Maximum	9.1330%	8.2930%	15.2400%	13.1770%
Tests of Normality#:				
T-Statistic: Mean = 0	3.9276	3.5325	3.1647	2.8572
Prob>T	0.0001	0.0005	0.0018	0.0047
W: Normal	0.9280	0.9502	0.9753	0.9694
Prob<W	0.0001	0.0001	0.1033	0.0150

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Over the study period (i.e., 01/78 through 09/94), low-grade corporate bonds have had higher returns at a higher level of risk, as measured by standard deviation, than high-grade corporate bonds. As mentioned in Chapter 6, the relatively recent increase in the volatility of low-grade corporate bonds relative to high-grade corporate bonds is due to the volatility from 1988 through the early 1990's. Overall, the two corporate bond asset classes display similar profiles over the 01/78 through 09/94 and 01/60 through 09/94 periods.

Over the study period, low-grade municipal bonds have had higher returns at a slightly lower level of risk, as measured by standard deviation, than high-grade municipal bonds. Unlike the two comparable corporate bond series, the two municipal bond series are slightly negatively skewed. This negative skewness tends to be more associated with equity returns than bond returns. Also, unlike the two comparable corporate bond series, the two municipal bonds return distributions show the opposite "peakedness" for their respective return distributions. That is, the low-grade corporate bond distribution of returns is less kurtotic than the high-grade corporate bond distribution of returns (i.e., it has a more platykurtic distribution), while the opposite is true of the two municipal bond distributions of returns. Overall, the equity return series has the highest mean, the highest standard deviation, is the most negatively skewed, and the most platykurtic.

The tests for normality suggest that, at standard levels of statistical significance, only the Treasury bond return series is drawn from a random sample from a normal distribution (i.e., the Shapiro-Wilk test).[4] All five other asset class return series reject the null hypothesis that the mean of each respective distribution is equal to zero (i.e., at the 5% level of significance). At normal levels of statistical significance, all the asset class return series presented have means which are significantly positive. Again, five of the six return series reject the null hypothesis that the values are drawn from a random sample from a normal distribution.

Tables 4 and 5 provide correlations and autocorrelations for the asset class return series used in this chapter.

Table 4

Tests for Autocorrelation and Correlation Coefficients for the Returns of Low-Grade Corporate Bond Funds, High-Grade Corporate Bond Funds, Treasury Bonds, and Equities

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher.

1978:01 to 1994:09	Low-Grade Corporate	High-Grade Corporate	Treasury Bonds	S&P 500
Autocorrelation at Lag 1	0.314**	0.215**	0.081	-0.010
Test for White Noise#:				
12 lags	35.86**	31.62**	15.31	14.23
Correlation with				
High-Grade Corporate	0.742**			
Treasury Bonds	0.634**	0.934**		
S&P 500	0.524**	0.366**	0.377**	

This is an autocorrelation check for white noise. The null hypothesis is that the autocorrelations sum to zero. The test statistic is at the 12th lag (i.e., one year). Therefore, the null hypothesis for the 12th lag is: $T \times \sum_{k=1}^{12} \hat{r}_k^2 = 0$, where $\hat{r}_k^2$ is the product moment correlation between $\hat{e}_t$ and $\hat{e}_{t-k}$ (k = 1, 2, ..., 12). If the null hypothesis is true, the statistic is distributed as a chi-square with 12 degrees of freedom. If the statistic is not statistically significant, the null hypothesis can be accepted.
* denotes significance at the 5% level of significance, and ** denotes significance at the 1% level of significance.

[4] Equities may have rejected the normal distribution null hypothesis due to their general run-up during most of the 1980s and early 1990s.

Over the shorter study period, both the low-grade and high-grade corporate bond return series show evidence of autocorrelation. This autocorrelation has been interpreted as evidence of nontrading (see Cornell and Green [1991, p. 37-39]). Regarding correlations between the taxable asset classes, low-grade corporate bond returns are slightly less positively correlated with equity returns than Treasury bond returns. Whereas high-grade corporate bond returns are significantly more positively correlated with Treasury bond returns than equity returns. Clearly, relative to high-grade corporate bonds, low-grade corporate bonds have been more exposed to the risks associated with equities than Treasury bonds.

Table 5

Tests for Autocorrelation and Correlation Coefficients for the Returns of Low-Grade Municipal Bond Funds, High-Grade Municipal Bond Funds, Treasury Bonds, and Equities

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

1978:01 to 1994:09	Low-Grade Municipal	High-Grade Municipal	Treasury Bonds	S&P 500
Autocorrelation at Lag 1	0.159*	0.116*	0.081	-0.010
Test for White Noise#:				
12 lags	36.00**	34.86**	15.31	14.23
Correlation with				
High-Grade Municipal	0.978**			
Treasury Bonds	0.737**	0.772**		
S&P 500	0.413**	0.420**	0.377**	

This is an autocorrelation check for white noise. The null hypothesis is that the autocorrelations sum to zero. The test statistic is at the 12th lag (i.e., one year). Therefore, the null hypothesis for the 12th lag is: $T \times \sum_{k=1}^{12} \hat{r}_k^2 = 0$, where $\hat{r}_k^2$ is the product moment correlation between $\hat{e}_t$ and $\hat{e}_{t-k}$ (k = 1, 2, ..., 12). If the null hypothesis is true, the statistic is distributed as a chi-square with 12 degrees of freedom. If the statistic is not statistically significant, the null hypothesis can be accepted.

* denotes significance at the 5% level of significance, and ** denotes significance at the 1% level of significance.

At normal levels of statistical significance, both municipal bond asset classes show evidence of autocorrelation. Although, the first order autocorrelation associated with low-grade and high-grade corporate bonds is significantly higher than that associated with low-grade and high-grade municipal bonds. If first order autocorrelation is evidence of nontrading, the two municipal bond asset classes show evidence of dramatically lower levels of nontrading than their corporate bond counterparts over the same sample period. In addition, adjusting for municipal bond nontrading does not significantly decrease autocorrelation in the regressions run (see Appendix 1). Regarding the correlations between the municipal bond asset classes and Treasury bonds and equities, the municipal asset classes seem to be very similar.

As with Chapter 6, several sets of regression results will be presented in order to correct for possible nontrading and/or serial correlation of the error term. Again, as with the Chapter 6 results, the results do not substantially differ regardless of the correction method employed.

3 Risky Municipal Bond Expectations and Tests

> We have also carried out tests for other business cycle effects on municipal risk structure, but obtained no significant results. This should not be surprising since municipal bonds, like utility bonds already discussed, should not be appreciably affected by normal business cycle fluctuations.
> Jaffee [1975, p. 318]

Based on the discussion in Chapter 5, there can be very different expectations for the changing sensitivities of more risky debt (i.e., low-grade municipal bonds) relative to less risky debt (i.e., high-grade municipal bonds) during periods when their principal embedded options would be expected to move deeper in-the-money. For example, risky debt valuation models which do not incorporate interest rate risk find that the behavior of low-grade corporate bond returns during recessionary periods seems anomalous; whereas risky debt valuation models which incorporate interest rate risk may be able to explain the behavior of low-grade corporate bond returns during recessionary periods (i.e., assuming $\rho_{r,V}$ is significantly negative). Given that, from the perspective of CCA, low-grade municipal bonds can be generally viewed as a tax-exempt version of low-grade corporate bonds, the empirical analysis applied to low-grade corporate bonds will be extended to low-grade municipal bonds.

Before proceeding, regarding corporate and municipal bond defaults and recoveries, some comments should be made. Defaults and exchanges are events indicating that the firm's or municipal authority's management have exercised the put option equity holders received from bondholders when the bonds were issued. All corporate bonds and municipal bonds are exposed to default risk. Although, for municipal bonds, revenue bonds have a much higher incidence of defaults than general obligation bonds (e.g., see Heide et al. [1994, p. 496][5]). Therefore, it is important to note that it seems that overall municipal bonds have tended to have lower historic default rates than corporate bonds. Historically, revenue bond default reduces prices by more than 50% (e.g., see Cirillo and Jessop [1993]) which is comparable to the figure for corporate bond default (e.g., see Altman [1992]).

The following table summarizes the difference in expectations for what is termed CCA "assuming no credit spread effect" and CCA "assuming a strong credit spread effect". These expectations mirror those derived for risky corporate bonds. The first set of expectations are traditional CCA expectations which do not incorporate interest rate risk, whereas the latter case incorporates interest rate risk and assumes that $\rho_{r,V}$ is significantly negative. Of course, if $\rho_{r,V}$ is zero or close to zero, the two should not differ substantially.

Table 6
Expectations for Periods under Study

Simple CCA Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds	Expectation for Sensitivity to Stocks
Assuming no Credit Spread Effect:		
Interest Rate Call Periods	0	0
Put Periods	- or 0	+
Combination Periods (Call & Put Periods)	- or 0	+
Assuming a Strong Credit Spread Effect:		
Interest Rate Call Periods	0 or +	0 or -
Put Periods	0 or +	0 or -
Combination Periods (Call & Put Periods)	+	-

The null hypotheses which follow are based on CCA risky debt valuation models which do not incorporate interest rate risk. Therefore, during interest rate call periods (i.e., periods of declining interest rates) the relative sensitivity of low-grade municipal bond returns to Treasury bond and equity returns would not be expected to change. Hence,

H_0: during periods when interest rates are declining, low-grade municipal bonds should not become relatively more or less sensitive to Treasury bond and equity market movements.

[5] Historically, revenue bonds have been at least ten times more likely to default than general obligation bonds (also, see Cirillo and Jessop [1993]).

During put periods (i.e., recessionary periods) the relative sensitivity of low-grade municipal bond returns to equity returns would be expected to increase. Hence, H_0: during periods when general credit quality is declining, low-grade municipal bonds should become relatively more sensitive to equity market movements.
During combination interest rate call and put periods the relative sensitivity of low-grade municipal bond returns to equity returns would be expected to increase. Hence, H_0: during periods when interest rates are declining and general credit quality is declining, low-grade municipal bonds should become relatively more sensitive to equity market movements (i.e., the put periods hypothesis). Essentially, put periods are the only periods expected to have a significant impact on the relative sensitivities of low-grade municipal bond returns to Treasury bond market and equity market returns. In addition, given that puts are of primary importance in the valuation of risky municipal debt, it is expected that only sensitivities to the equity market may change, not the Treasury bond market.

The largest contrast between the two sets of risky debt valuation models occurs during combination periods. Particularly clear is the opposite expectation regarding the relative sensitivity of low-grade municipal bond returns to equity market returns during combination periods. Given that the signs of the two expectations are diametric opposites, this is the strongest test presented. Therefore, as was the case in Chapter 6, the results for this particular test should be viewed with added interest.

4 Regressions Testing the Impact of Call and Put Periods

This thesis hypothesizes that periods where the volatility and sensitivity (i.e., to the Treasury bond and equity markets) of low-grade municipal bonds relative to high-grade corporate bonds is due in part to the fact that low-grade bonds are hybrid securities, having both risk-free bond and equity characteristics. It is a central argument of this thesis that one of the possible causes of the seemingly abnormal behavior of low-grade municipal bonds relative to high-grade municipal bonds is that relatively less credit worthy bonds are significantly more affected by the correlation between changes in the risk-free rate of interest and changes in the value of the firm (i.e., $\rho_{r,V}$ is significantly negative) than more credit worthy bonds.

As with corporate bonds, the critical method with which to examine the return behavior of high-grade and low-grade municipal bonds is to isolate periods when calls and puts would be expected to be exercised and/or the probability of exercise significantly increases. This thesis assumes that regarding embedded put options (i.e., defaults and outright bankruptcies) the appropriate periods to examine are recessionary periods, while for calls the appropriate periods to examine are those of declining interest rates. By examining low-grade and high-grade municipal bond returns during these periods, the impact that puts and calls have on the relative returns of the two municipal bond asset classes can be examined.

As a baseline to the regression analysis which follows, the following regression models were run to evaluate the sensitivity of low-grade and high-grade municipal bonds to Treasury bond and equity market movements:

(1) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

(2) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

(3) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

where LGR = low-grade municipal bond return, HGR = high-grade municipal bond return, TBR = Treasury bond return, SMR = stock market return (i.e., the return of the S&P 500 index), and e is the error term. This equation was designed to take account of Treasury bond and equity market risk via TBR and SMR.

Table 7

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Municipal Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

					Dimson	Dimson	Dimson
Model		(1)	(2)	(3)	(1)	(2)	(3)
1978:01 to 1994:09	1/2/3	Low-	High-		Low-	High-	
Explanatory	Expected	Grade	Grade	Return	Grade	Grade	Return
Variables	Sign#	Muni	Muni	Spread	Muni	Muni	Spread
Intercept	?/?/0	0.0021	0.0014	0.0007*	0.0018	0.0011	0.0007
		(1.947)	(1.304)	(2.065)	(1.574)	(1.003)	(1.776)
TBR (Lag 1)					-0.0358	-0.0156	-0.0202*
					(-1.142)	(-0.499)	(-1.992)
TBR	+/+/-	0.4253**	0.4773**	-0.0520**	0.4050**	0.4529**	-0.0479**
		(13.366)	(15.033)	(-5.222)	(12.940)	(14.531)	(-4.729)
TBR (Lead 1)					0.0886**	0.0913**	-0.0027
					(2.808)	(2.907)	(-0.268)
SMR (Lag 1)					0.0698**	0.0583*	0.0115
					(2.725)	(2.286)	(1.386)
SMR	+/+/+	0.0808**	0.0819**	-0.0011	0.0796**	0.0834**	-0.0037
		(3.108)	(3.157)	(-0.135)	(3.119)	(3.279)	(-0.452)
SMR (Lead 1)					-0.0711**	-0.0844**	0.0133
					(-2.761)	(-3.290)	(1.591)
Adj. R^2		0.560	0.612	0.132	0.596	0.645	0.147
F-Statistic		128.047**	158.447**	16.220**	49.683**	60.868**	6.686**
Dependent Mean		0.006	0.006	0.000	0.006	0.006	0.000
Root MSE		0.015	0.015	0.005	0.014	0.014	0.005
DW Statistic		1.820	1.841	2.290	1.832	1.849	2.314
Observations		201	201	201	199	199	199

expected signs are based on comparable corporate bond expectations (i.e., for the intercept, TBR coefficient, and SMR coefficient) and simple CCA expectations (i.e., for all other coefficient expectations).

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 8

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Municipal Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

Model 1978:01 to 1994:09 Explanatory Variables	1/2/3 Expected Sign#	YW (1) Low-Grade Muni	YW (2) High-Grade Muni	YW (3) Return Spread	ML (1) Low-Grade Muni	ML (2) High-Grade Muni	ML (3) Return Spread
Intercept	?/?/0	0.0022*	0.0015	0.0007*	0.0022*	0.0015	0.0007*
		(2.166)	(1.674)	(2.338)	(2.177)	(1.682)	(2.350)
TBR	+/+/-	0.4312**	0.4817**	-0.0551*	0.4312**	0.4818**	-0.0552**
		(15.217)	(15.782)	(-5.726)	(15.200)	(15.793)	(-5.691)
SMR	+/+/+	0.0688**	0.0684**	0.0024	0.0685**	0.0682**	0.0026
		(2.930)	(2.713)	(0.302)	(2.911)	(2.702)	(0.320)
AR Parameters:							
Lag 1				0.1453*			0.1522*
				(2.061)			(2.138)
Lag 2		0.2486**	0.2194**		0.2533**	0.2241**	
		(3.682)	(3.156)		(3.765)	(3.226)	
Lag 7		0.1410*			0.1391*		
		(2.089)			(2.054)		
Lag 10		-0.1551*			-0.1557*		
		(-2.242)			(-2.240)		
Lag 12		-0.2304**			-0.2271**		
		(-3.315)			(-3.243)		
Total R^2		0.622	0.635	0.160	0.622	0.635	0.160
Regression R^2		0.626	0.632	0.157	0.626	0.632	0.157
Root MSE		0.014	0.015	0.005	0.014	0.015	0.005
DW Statistic					1.697	1.770	2.001
Observations		201	201	201	201	201	201

expected signs are based on comparable corporate bond expectations (i.e., for the intercept, TBR coefficient, and SMR coefficient) and simple CCA expectations (i.e., for all other coefficient expectations).
T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The return spread results are of critical importance, and at a general level there is something surprising. Namely, the estimated intercept for the return spread regressions is significantly positive (i.e., at the 5% level for all but the Dimson regression). This suggests that, after controlling for Treasury bond and equity market risk, low-grade municipal bonds have outperformed high-grade municipal bonds over the study period. Second, low-grade municipal bonds are not significantly more equity-like than high-grade municipal bonds. This is a somewhat surprising result, but given that municipal bonds are not in general as equity-like as corporate bonds it is not completely unexpected. Clearly, low-grade municipal bonds may be exposed to additional risk(s) that go beyond corporate equity risk. But given that municipalities do not issue equity, it may be difficult to empirically control for municipal equity risk. Finally, high-grade municipal bonds are more risk-free bond-like (i.e., Treasury bond-like) than low-grade municipal bonds.

4.1 Call Periods

If low-grade municipal bonds have had significantly less interest rate call protection and/or a higher call rate than high-grade municipal bonds, there should be a significant decline in the sensitivity of low-grade municipal bond returns to risk-free bond returns during periods when the interest rate call option should be exercised (i.e., during periods of declining interest rates). This assertion can be tested by examining the behavior of low-grade municipal bond returns relative to high-grade municipal bond returns during periods of declining interest rates. Specifically, if there is a significant difference, the sensitivity of low-grade municipal bond returns to Treasury bond market movements would significantly decrease during periods of declining interest rates. The following table presents the return and standard deviations (among other descriptive statistics) associated with periods where the government 10 year constant maturity Treasury bond experienced a decline in yield.

Table 9

Summary Statistics and Tests of Normality for the Returns of Low-Grade Municipal Bond Funds, High-Grade Municipal Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined (Call Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

1978:01 to 1994:09	Low-Grade Municipal	High-Grade Municipal	Treasury Bonds	S&P 500	LGM - HGM Spread
Observations = 99					
Moments of the Distribution:					
1st - Mean	1.7284%	1.8465%	2.7394%	2.1337%	-0.1180%
2nd - Standard Deviation	1.7177%	1.8358%	3.2342%	3.9549%	0.4555%
3rd - Skewness	1.1169	0.8025	1.1259	0.3981	-0.6125
4th - Kurtosis	3.4628	2.3656	2.8317	0.1939	2.7905
Minimum	-3.1250%	-3.5000%	-3.9100%	-6.0550%	-1.9700%
Maximum	9.1330%	8.2930%	15.2400%	13.1770%	1.1170%
Tests of Normality#:					
T-Statistic: Mean = 0	10.0118	10.0078	8.4278	5.3681	-2.5801
Prob>T	0.0001	0.0001	0.0001	0.0001	0.0114
W: Normal	0.9361	0.9489	0.9380	0.9728	0.9627
Prob<W	0.0001	0.0022	0.0002	0.2167	0.0389

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Although low-grade municipal bonds were less volatile than high-grade municipal bonds during periods of declining interest rates, low-grade municipal bonds were not significantly less volatile. For months when interest rates were declining, the ratio of low-grade to high-grade municipal bond standard deviation is approximately 0.94 versus 0.94 for all months.[6] It seems it would not be correct to state that the greater relative number of calls and/or weaker call protection afforded low-grade municipal bonds relative to high-grade municipal bonds is the cause of their lower volatility. Over the study period, low-grade municipal bonds have not been more or less sensitive to declining interest rates than high-grade municipal bonds.

6 It should be noted that, due to the tax treatment of discount municipal bonds, there is increased volatility associated with discount municipal bonds (e.g., see Mallman [1981], Leibowitz [1981], and Arak and Silver [1984]). This should have little or no impact on the results over the full period, but may produce extra volatility during periods following a general deline in municipal bond market values.

In order to further test this contention, the following regression models were run to test for the significance of call periods on the returns of high-grade and low-grade municipal bonds.

(4) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

(5) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

(6) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

where DIR = a dummy variable equal to one if interest rates decline and zero otherwise. The call dummy variable is intended to isolate the effect of periods when calls are more frequent and more probable.

Table 10

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Municipal Bond Returns - Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
These regression results compare the effect of periods of declining interest rates. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

					Dimson	Dimson	Dimson
Model		(4)	(5)	(6)	(4)	(5)	(6)
1978:01 to 1994:09	4/5/6	Low-	High-		Low-	High-	
Explanatory	Expected	Grade	Grade	Return	Grade	Grade	Return
Variables	Sign	Muni	Muni	Spread	Muni	Muni	Spread
Intercept	?/?/0	0.0009	-0.0002	0.0011*	0.0021	0.0009	0.0012*
		(0.570)	(-0.120)	(2.217)	(1.314)	(0.572)	(2.334)
TBR (Lag 1)					-0.0236	-0.0044	-0.0192
					(-0.762)	(-0.141)	(-1.950)
TBR	+/+/-	0.4544**	0.5197**	-0.0653**	0.4678**	0.5258**	-0.0580**
		(8.905)	(10.204)	(-4.108)	(9.103)	(10.275)	(-3.544)
TBR (Lead 1)					0.0864*	0.0799*	0.0065
					(2.417)	(2.245)	(0.568)
SMR (Lag 1)					0.0571*	0.0486	0.0085
					(2.228)	(1.903)	(1.045)
SMR	+/+/+	0.1325**	0.1107**	0.0218*	0.1295**	0.1117**	0.0178
		(4.063)	(3.403)	(2.144)	(3.978)	(3.447)	(1.712)
SMR (Lead 1)					-0.0698**	-0.0811**	0.0113
					(-2.751)	(-3.209)	(1.394)
TBR x DIR	?/?/0	-0.0894	-0.1419*	0.0525*	-0.1094	-0.1602*	0.0508*
		(-1.255)	(-1.996)	(2.364)	(-1.558)	(-2.292)	(2.272)
SMR x DIR	?/?/0	-0.1338*	-0.0763	-0.0575**	-0.1136*	-0.0601	-0.0535**
		(-2.567)	(-1.466)	(-3.545)	(-2.196)	(-1.166)	(-3.247)
DIR	?/?/?	0.0064*	0.0076**	-0.0011	0.0028	0.0045	-0.0017
		(2.589)	(3.050)	(-1.460)	(1.008)	(1.601)	(-1.840)
Adj. R^2		0.585	0.634	0.190	0.611	0.658	0.206
F-Statistic		57.382**	70.223**	10.356**	35.568**	43.324**	6.691**
Dependent Mean		0.006	0.006	0.000	0.006	0.006	0.000
Root MSE		0.015	0.015	0.005	0.014	0.014	0.005
DW Statistic		1.796	1.887	2.206	1.828	1.911	2.277
Observations		201	201	201	199	199	199

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 11

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Municipal Bond Returns - Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
These regression results compare the effect of periods of declining interest rates. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

Model 1978:01 to 1994:09 Explanatory Variables	4/5/6 Expected Sign	YW (4) Low-Grade Muni	YW (5) High-Grade Muni	OLS (6) Return Spread	ML (4) Low-Grade Muni	ML (5) High-Grade Muni	OLS (6) Return Spread
Intercept	?/?/0	0.0009	0.0001	0.0011*	0.0009	0.0001	0.0011*
		(0.638)	(0.053)	(2.217)	(0.648)	(0.064)	(2.217)
TBR	+/+/-	0.4777**	0.5425**	-0.0653**	0.4787**	0.5437**	-0.0653**
		(10.112)	(11.130)	(-4.108)	(10.086)	(11.122)	(-4.108)
SMR	+/+/+	0.1155**	0.0873**	0.0218*	0.1148**	0.0859**	0.0218*
		(3.662)	(2.698)	(2.144)	(3.633)	(2.645)	(2.144)
TBR x DIR	?/?/0	-0.1114	-0.1736*	0.0525*	-0.1129	-0.1754**	0.0525*
		(-1.700)	(-2.595)	(2.364)	(-1.705)	(-2.619)	(2.364)
SMR x DIR	?/?/0	-0.1094*	-0.0484	-0.0575**	-0.1085*	-0.0468	-0.0575**
		(-2.236)	(-0.962)	(-3.545)	(-2.217)	(-0.926)	(-3.545)
DIR	?/?/?	0.0064**	0.0073**	-0.0011	0.0064**	0.0073**	-0.0011
		(2.854)	(3.166)	(-1.460)	(2.856)	(3.169)	(-1.460)
AR Parameters:							
Lag 2		0.2575**	0.2320**		0.2675**	0.2460**	
		(3.744)	(3.322)		(3.885)	(3.497)	
Lag 12		-0.1759*			-0.1762*		
		(-2.558)			(-2.527)		
Total R^2		0.634	0.664	0.210	0.635	0.664	0.210
Regression R^2		0.639	0.662	0.210	0.640	0.663	0.210
Root MSE		0.014	0.014	0.005	0.014	0.014	0.005
DW Statistic				2.206	1.722	1.876	2.206
Observations		201	201	201	201	201	201

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The estimated intercept term can be interpreted as the amount of abnormal return attributed to the dependent return series after adjusting for the various movements of the independent variables. In this case, the results indicate that after controlling for periods of declining interest rates, there is a significant difference in the return performance of the two asset classes. Therefore, after controlling for Treasury bond and equity market risk, low-grade municipal bonds outperformed high-grade municipal bonds during periods when interest rates are stable and/or increasing.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade municipal bond returns to Treasury bond market returns during call periods, there is reason to reject the hypothesis that low-grade municipal bonds have significantly weaker and/or less interest rate call protection than high-grade municipal bonds. If high-grade municipal bonds were significantly more sensitive to interest rate movements due to greater call protection relative to low-grade municipal bonds, then it would be expected that the estimated coefficient β_3 would be significantly greater than the same coefficient for the low-grade municipal bond regression. The fact that the reverse of this is true casts doubt on the contention of the significant difference between the number of calls and/or the call protection associated with the respective asset classes. If there is a difference regarding asset class interest rate call protection, it is against high-grade municipal bonds not low-grade municipal bonds. The regressions show that high-grade municipal bonds become significantly less government bond-like while low-grade municipal bonds become significantly less equity-like during interest rate call periods.

Regarding the issue of the risky debt model which explains interest rate call period behavior more accurately, the overall results of the above regressions tend to support those models with a strong credit spread effect. These results strongly support the strong credit spread effect risky debt models over more traditional risky debt models. In all the return spread regressions the estimated coefficient β_4 is negative and significant at the 1% level of significance. In addition, in all the return spread regressions the estimated coefficient β_3 is positive and significant at the 5% level of significance. Clearly, these results would not be expected under risky debt valuation models which do not incorporate interest rate risk.

4.2 Put Periods

Regarding low-grade municipal bond puts or defaults, if there was a significant affect of the exercise and/or increase in the probability of exercise of low-grade municipal bond puts relative to high-grade municipal bond puts it will become significant during periods when the economy is performing poorly. If low-grade municipal bonds are significantly more exposed to business cycle risk during recessions, low-grade municipal bond returns should be more sensitive to equity market movements during periods when more defaults would be expected to occur. Therefore, traditional risky debt valuation models would hypothesize that during recessionary periods low-grade municipal bond returns will be significantly more affected by movements in the equity market than at other times, whereas risky debt valuation models which incorporate interest rate risk may not agree with that hypothesis (i.e., especially if interest rates tend to decline during recessions and $\rho_{r,V}$ is assumed significantly negative).

Table 12

Summary Statistics and Tests of Normality for the Returns of Low-Grade Municipal Bond Funds, High-Grade Municipal Bond Funds, Treasury Bonds, and Equities: Recession Months Only (Put Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

1978:01 to 1994:09	Low-Grade Municipal	High-Grade Municipal	Treasury Bonds	S&P 500	LGM - HGM Spread
Observations = 30					
Moments of the Distribution:					
1st - Mean	0.8174%	0.9228%	1.9743%	0.7209%	-0.1050%
2nd - Standard Deviation	4.1374%	4.2296%	5.2237%	5.4695%	0.8236%
3rd - Skewness	-0.5202	-0.3783	0.6705	-0.0854	-0.6970
4th - Kurtosis	0.3945	-0.0987	0.7658	-0.3900	0.6618
Minimum	-8.6000%	-7.9250%	-7.1400%	-10.1790%	-2.2000%
Maximum	9.1330%	8.2930%	15.2400%	11.5980%	1.2880%
Tests of Normality#:					
T-Statistic: Mean = 0	1.0821	1.1950	2.0701	0.7219	-0.7014
Prob>T	0.2881	0.2418	0.0475	0.4761	0.4887
W: Normal	0.9463	0.9588	0.9572	0.9744	0.9583
Prob<W	0.1578	0.3304	0.3015	0.7042	0.3199

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Although low-grade municipal bonds were less volatile than high-grade municipal bonds during recesssionary periods, low-grade municipal bonds were not significantly less volatile. For recession months, the ratio of low-grade to high-grade municipal bond standard deviation is approximately 0.98 versus 0.94 for all months. Like interest rate calls, defaults alone cannot explain the volatility differential between high-grade and low-grade municipal bonds. Over the period analyzed, low-grade municipal bonds have been only slightly less sensitive to recessionary periods than high-grade corporate bonds.

It is interesting to note how during recessions all four asset classes have similar normality test results. At the 5% level of significance, only Treasury bonds have a mean return greater than zero. The Shapiro-Wilk statistic indicates that the recession return series for all four asset classes is a random sample drawn from a normal distribution.

In order to test the recession put hypothesis, the following regression models were run to test for the impact of put periods on the returns of high-grade and low-grade municipal bonds.

(7) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

(8) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

(9) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

where Rec = a dummy variable equal to one if the economy is in a recession and zero otherwise. The put dummy variable is intended to isolate the effect of recessionary periods when puts are more frequent and/or more probable for low-grade municipal bonds.

Table 13

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Municipal Bond Returns - Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
These regression results compare the effect of recessionary periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

					Dimson	Dimson	Dimson
Model		(7)	(8)	(9)	(7)	(8)	(9)
1978:01 to 1994:09	7/8/9	Low-	High-		Low-	High-	
Explanatory	Expected	Grade	Grade	Return	Grade	Grade	Return
Variables	Sign	Muni	Muni	Spread	Muni	Muni	Spread
Intercept	?/?/0	0.0031**	0.0023*	0.0009*	0.0028*	0.0021	0.0007
		(2.762)	(1.982)	(2.341)	(2.407)	(1.770)	(1.867)
TBR (Lag 1)					-0.0255	-0.0060	-0.0195
					(-0.827)	(-0.194)	(-1.874)
TBR	+/+/-	0.3477**	0.4048**	-0.0571**	0.3383**	0.3922**	-0.0539**
		(9.547)	(11.043)	(-4.791)	(9.521)	(10.995)	(-4.494)
TBR (Lead 1)					0.0929**	0.0943**	-0.0014
					(2.987)	(3.022)	(-0.136)
SMR (Lag 1)					0.0546*	0.0443	0.0104
					(2.184)	(1.764)	(1.227)
SMR	+/+/+	0.0784**	0.0799**	-0.0015	0.0823**	0.0842**	-0.0019
		(2.824)	(2.861)	(-0.169)	(3.021)	(3.079)	(-0.206)
SMR (Lead 1)					-0.0675**	-0.0813**	0.0138
					(-2.706)	(-3.247)	(1.639)
TBR x Rec	?/?/0	0.2829**	0.2604**	0.0225	0.2591**	0.2331**	0.0260
		(4.025)	(3.681)	(0.977)	(3.765)	(3.374)	(1.120)
SMR x Rec	?/?/+	-0.0254	-0.0228	-0.0027	-0.0521	-0.0385	-0.0137
		(-0.399)	(-0.355)	(-0.127)	(-0.816)	(-0.600)	(-0.634)
Rec	?/?/?	-0.0078*	-0.0066*	-0.0012	-0.0081**	-0.0073*	-0.0008
		(-2.561)	(-2.149)	(-1.215)	(-2.688)	(-2.402)	(-0.818)
Adj. R^2		0.596	0.637	0.128	0.625	0.665	0.141
F-Statistic		59.965**	71.251**	6.848**	37.647**	44.629**	4.597**
Dependent Mean		0.006	0.006	0.000	0.006	0.006	0.000
Root MSE		0.014	0.014	0.005	0.014	0.014	0.005
DW Statistic		1.751	1.776	2.305	1.783	1.802	2.319
Observations		201	201	201	199	199	199

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 14

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Municipal Bond Returns - Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
These regression results compare the effect of recessionary periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

Model 1978:01 to 1994:09 Explanatory Variables	7/8/9 Expected Sign	YW (7) Low-Grade Muni	YW (8) High-Grade Muni	YW (9) Return Spread	ML (7) Low-Grade Muni	ML (8) High-Grade Muni	ML (9) Return Spread
Intercept	?/?/0	0.0028*	0.0021	0.0009**	0.0028*	0.0020	0.0009**
		(2.535)	(1.864)	(2.711)	(2.530)	(1.866)	(2.729)
TBR	+/+/-	0.3627**	0.4179**	-0.0599**	0.3634**	0.4188**	-0.0600**
		(10.714)	(11.908)	(-5.170)	(10.683)	(11.829)	(-5.185)
SMR	+/+/+	0.0710**	0.0705*	0.0008	0.0705**	0.0697*	0.0009
		(2.712)	(2.594)	(0.089)	(2.695)	(2.564)	(0.103)
TBR x Rec	?/?/0	0.2618**	0.2382**	0.0210	0.2602**	0.2360**	0.0209
		(3.914)	(3.436)	(0.924)	(3.830)	(3.342)	(0.913)
SMR x Rec	?/?/+	0.0069	0.0049	0.0026	0.0084	0.0065	0.0029
		(0.118)	(0.082)	(0.129)	(0.144)	(0.107)	(0.141)
Rec	?/?/?	-0.0062*	-0.0054*	-0.0013	-0.0061*	-0.0053	-0.0013
		(-2.400)	(-1.998)	(-1.413)	(-2.366)	(-1.967)	(-1.422)
AR Parameters:							
Lag 1				0.1527*			0.1612*
				(2.152)			(2.228)
Lag 2		0.1665*	0.1508*		0.1770*	0.1621*	
		(2.398)	(2.140)		(2.521)	(2.264)	
Lag 12		-0.2294**	-0.1647*		-0.2391**	-0.1711*	
		(-3.304)	(-2.336)		(-3.381)	(-2.374)	
Total R^2		0.638	0.664	0.170	0.639	0.664	0.171
Regression R^2		0.646	0.668	0.168	0.648	0.669	0.169
Root MSE		0.014	0.014	0.005	0.014	0.014	0.005
DW Statistic					1.698	1.766	2.008
Observations		201	201	201	201	201	201

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Except for the Dimson regression, the estimated intercept for the return spread regressions does suggest that, after adjusting for the various movements of the independent variables, low-grade municipal bonds have returned significantly more than high-grade municipal bonds. In this case, the results indicate that after controlling for recessionary periods, there is a significant difference in the return performance of the two asset classes. Also, note that all four regressions generally assign the same sign and level of significance to each comparable estimated coefficient.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade municipal bond returns to Treasury bond market returns during put periods, there is no strong reason to reject risky debt valuation models which do not allow for a credit spread effect. That is, risky debt valuation models which do not incorporate interest rate risk cannot explain why more risky debt would become more sensitive to interest rate movements during recessions, but the regressions run do not provide strong evidence of this. In this case, the estimated coefficient β_6 is approximately zero. Actually both asset classes became significantly more government bond-like, but this effect is approximately the same for each asset class.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade municipal bond returns to equity market returns during put periods, there is a weak reason to reject risky debt valuation models which do not allow for a credit spread effect. Risky debt valuation models which do not incorporate interest rate risk would expect that low-grade bonds should become more sensitive to equity market movements during recessions. If low-grade municipal bonds were significantly more sensitive to equity market movements during recessions, due to their puts moving deeper into-the-money relative to high-grade municipal bonds, then it would be expected that the estimated coefficient β_7 would be significantly greater than the same coefficient for the high-grade municipal bond regression. Although not significantly different, the fact that this is not the case casts doubt on the usefulness of risky debt valuation models which cannot explain this result.

These results are unlike the comparable results for low-grade and high-grade corporate bonds, where high-grade corporate bonds behave more like equities during business cycle contractions than during business cycle expansions. Besides being exposed to different kinds of equity risk, another possible explanation for the lack of a recession effect for low-grade and high-grade municipal bonds may be that, unlike corporate bonds, there is no large increase in perceived credit risk during recessionary periods. As some low-grade municipal bonds default, thus removing them from the asset class and lowering duration for the asset class, a relatively equal amount of high-grade municipal bonds are downgraded. During economic booms, high-grade municipal bonds can be upgraded, but upgrades may be a relatively direct function of the length and magnitude of the expansion, and downgrades are a direct function of the length and magnitude of the contraction. Either way, the results suggest that defaults do not significantly affect the two return series under study.

Regarding the issue of the risky debt model which explains put period behavior more accurately, the overall results of the above regressions weakly support those models with a credit spread effect. Overall, the results weakly suggest that during periods when low-grade municipal bonds would be expected to show a great deal more sensitivity to equity market movements relative to high-grade municipal bonds, they do not. Although, high-grade municipal bonds do not behave significantly more like equities during business cycle contractions than during business cycle expansions. In addition, both low-grade and high-grade municipal bonds act significantly more like government bonds during recessions. During recessions, the two asset classes seem to maintain their relative Treasury bond and equity market sensitivities.

4.3 Combination Call and Put Periods

Regarding the increased probability of low-grade municipal bond puts and low-grade and high-grade municipal bond interest rate calls, if there was a significant effect of the exercise and/or increase in the probability of exercise of the options of low-grade municipal bonds relative to high-grade municipal bonds it should show up during periods when the economy is performing poorly and interest rates are declining. Therefore, at least relative to high-grade municipal bonds, this thesis hypothesizes that during recessionary periods with decreasing interest rates, low-grade municipal bond returns will be significantly more affected by interest rate movements and less affected by movements in the equity market than at other times. Essentially, this will be the strongest test to evaluate the appropriateness of risky debt valuation models which incorporate interest rate risk relative to those which do not.

Table 15

Summary Statistics and Tests of Normality for the Returns of Low-Grade Municipal Bond Funds, High-Grade Municipal Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined & Recession (Call & Put Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

1978:01 to 1994:09	Low-Grade Municipal	High-Grade Municipal	Treasury Bonds	S&P 500	LGM - HGM Spread
Observations = 17					
Moments of the Distribution:					
1st - Mean	2.9464%	3.1296%	5.0022%	2.8384%	-0.1830%
2nd - Standard Deviation	2.6565%	2.7685%	4.4116%	4.7606%	0.7868%
3rd - Skewness	0.7794	0.5313	1.2089	0.0478	-0.5242
4th - Kurtosis	0.0918	-0.5323	1.1129	-0.0756	0.2891
Minimum	-0.9000%	-1.1910%	-0.0600%	-6.0550%	-1.9700%
Maximum	9.1330%	8.2930%	15.2400%	11.5980%	1.1170%
Tests of Normality#:					
T-Statistic: Mean = 0	4.5731	4.6609	4.6751	2.4583	-0.9605
Prob>T	0.0003	0.0003	0.0003	0.0257	0.3511
W: Normal	0.9305	0.9456	0.8813	0.9737	0.9787
Prob<W	0.2246	0.3892	0.0331	0.8545	0.9231

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Low-grade municipal bonds were slightly less volatile than high-grade municipal bonds during periods of recession and declining interest rates, but not significantly so. During recession and declining interest rate months, the ratio of low-grade to high-grade municipal bond standard deviation is approximately 0.96 versus 0.94 for all months. During months when it is expected that puts and interest rate calls on low-grade municipal bonds will be exercised more frequently than those for high-grade municipal bonds, there is some increase in volatility for low-grade municipal bond returns versus that of high-grade municipal bonds, but that difference is not significant.

In order to test the recession put and declining interest rate call hypothesis, the following regression models were run to test for the significance of combination put and interest rate call periods on the returns of high-grade and low-grade municipal bonds:

(10) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(11) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(12) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

These regressions are intended to capture the effect of the combination of puts and interest rate calls for low-grade and high-grade municipal bonds. The coefficient β_9 will isolate the effect that changes in government bond prices have on changes in low-grade and high-grade municipal bond prices during periods of recession and declining interest rates. The coefficient β_{10} will isolate the effect changes in equity prices have on changes in low-grade and high-grade municipal bond prices during periods of recession and declining interest rates.

Table 16

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Municipal Bond Returns - Call & Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
These regression results compare the effects of recessionary and declining interest rate periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; and a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

					Dimson	Dimson	Dimson
Model		(10)	(11)	(12)	(10)	(11)	(12)
1978:01 to 1994:09	10/11/12	Low-	High-		Low-	High-	
Explanatory	Expected	Grade	Grade	Return	Grade	Grade	Return
Variables	Sign	Muni	Muni	Spread	Muni	Muni	Spread
Intercept	?/?/0	0.0017	0.0011	0.0007	0.0015	0.0009	0.0006
		(1.570)	(0.957)	(1.961)	(1.343)	(0.829)	(1.592)
TBR (Lag 1)					-0.0304	-0.0128	-0.0176
					(-0.970)	(-0.407)	(-1.755)
TBR	+/+/-	0.3995**	0.4607**	-0.0612**	0.3898**	0.4477**	-0.0579**
		(11.091)	(12.700)	(-5.497)	(11.145)	(12.722)	(-5.182)
TBR (Lead 1)					0.0935**	0.0936**	-0.0001
					(2.915)	(2.902)	(-0.014)
SMR (Lag 1)					0.0660*	0.0555*	0.0104
					(2.587)	(2.165)	(1.281)
SMR	+/+/+	0.1004**	0.0929**	0.0075	0.1006**	0.0955**	0.0050
		(3.706)	(3.405)	(0.895)	(3.769)	(3.558)	(0.591)
SMR (Lead 1)					-0.0696**	-0.0845**	0.0149
					(-2.712)	(-3.273)	(1.821)
TBR x DIR x Rec	?/?/0	0.1011	0.0339	0.0672*	0.0892	0.0163	0.0728*
		(1.047)	(0.349)	(2.252)	(0.954)	(0.174)	(2.439)
SMR x DIR x Rec	?/?/+	-0.2018*	-0.1160	-0.0858**	-0.2111*	-0.1260	-0.0850**
		(-2.312)	(-1.320)	(-3.181)	(-2.491)	(-1.478)	(-3.142)
DIR x Rec	?/?/?	0.0056	0.0061	-0.0006	0.0030	0.0039	-0.0009
		(0.970)	(1.065)	(-0.331)	(0.527)	(0.688)	(-0.519)
Adj. R^2		0.568	0.612	0.169	0.603	0.644	0.185
F-Statistic		53.557**	63.996**	9.109**	34.415**	40.733**	5.999**
Dependent Mean		0.006	0.006	0.000	0.006	0.006	0.000
Root MSE		0.015	0.015	0.005	0.014	0.014	0.005
DW Statistic		1.808	1.870	2.185	1.832	1.885	2.233
Observations		201	201	201	199	199	199

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 17

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Municipal Bond Returns - Call & Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.
These regression results compare the effects of recessionary and declining interest rate periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; and a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

		YW	YW	OLS	ML	ML	OLS
Model		(10)	(11)	(12)	(10)	(11)	(12)
1978:01 to 1994:09	10/11/12	Low-	High-		Low-	High-	
Explanatory	Expected	Grade	Grade	Return	Grade	Grade	Return
Variables	Sign	Muni	Muni	Spread	Muni	Muni	Spread
Intercept	?/?/0	0.0017	0.0012	0.0007	0.0018	0.0012	0.0007
		(1.769)	(1.291)	(1.961)	(1.805)	(1.329)	(1.961)
TBR	+/+/-	0.4194**	0.4792**	-0.0612**	0.4207**	0.4811**	-0.0612**
		(12.602)	(13.848)	(-5.497)	(12.620)	(13.877)	(-5.497)
SMR	+/+/+	0.0893**	0.0789**	0.0075	0.0885**	0.0773**	0.0075
		(3.487)	(2.937)	(0.895)	(3.454)	(2.875)	(0.895)
TBR x DIR x Rec	?/?/0	0.0284	-0.0456	0.0672*	0.0224	-0.0542	0.0672*
		(0.323)	(-0.492)	(2.252)	(0.251)	(-0.579)	(2.252)
SMR x DIR x Rec	?/?/+	-0.1544*	-0.0898	-0.0858**	-0.1542*	-0.0868	-0.0858**
		(-2.029)	(-1.125)	(-3.181)	(-2.024)	(-1.093)	(-3.181)
DIR x Rec	?/?/?	0.0069	0.0074	-0.0006	0.0070	0.0076	-0.0006
		(1.431)	(1.436)	(-0.331)	(1.468)	(1.483)	(-0.331)
AR Parameters:							
Lag 2		0.2437**	0.2101**		0.2616**	0.2350**	
		(3.524)	(2.993)		(3.699)	(3.288)	
Lag 12		-0.1660*			-0.1643*		
		(-2.400)			(-2.319)		
Total R^2		0.616	0.640	0.189	0.616	0.640	0.189
Regression R^2		0.619	0.637	0.189	0.620	0.639	0.189
Root MSE		0.014	0.015	0.005	0.014	0.015	0.005
DW Statistic				2.185	1.743	1.850	2.185
Observations		201	201	201	201	201	201

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The decreasing interest rate effect is accentuated during periods of recession. That is, during combination business cycle contraction and declining interest rate periods low-grade municipal bonds act even less like equities than during business cycle contraction periods alone (compare the model 9 and 12 results for the estimated coefficients β_7 and β_{10}, respectively). The sign and significance of the estimated coefficients β_9 and β_{10} for the model 12 regressions suggests that periods of declining interest rates combined with recession significantly affect the return relationship between low-grade and high-grade municipal bonds.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade municipal bond returns to Treasury bond market returns during combination interest rate call and put periods, there is reason to reject risky debt valuation models which do not allow for a credit spread effect. That is, risky debt valuation models which do not incorporate interest rate risk cannot explain why more risky debt would become more sensitive to interest rate movements during combination declining interest rate and recession periods. In this case, the estimated coefficient β_9 is positive and significant at the 5% level of significance in all regressions.

Based on the estimated coefficient for the sensitivity of the spread between low-grade and high-grade municipal bond returns to equity market returns during combination interest rate call and put periods, there is additional reason to reject risky debt valuation models which do not allow for a credit spread effect. If low-grade municipal bonds were significantly more sensitive to equity market movements during recessions, due to their puts moving deeper into-the-money relative to high-grade municipal bonds, then it would be expected that the estimated coefficient β_{10} would be significantly greater than the same coefficient for the high-grade municipal bond regression. The estimated coefficient β_{10} for the model 12 regression is negative and significant at the 1% level in all four regressions. Thus, risky debt models which do not incorporate interest rate risk into the their valuation model would expect the estimated β_{10} coefficients for the model 12 regressions to have a positive sign. Therefore, the fact that the sign is strongly negative casts doubt on risky debt valuation models which cannot explain this result.

Regarding the issue of the risky debt model which explains combination interest rate call and put period behavior more accurately, the overall results of the above regressions strongly support those models with a strong credit spread effect. Overall, the results suggest that during periods when low-grade municipal bonds would be expected to show a great deal more sensitivity to equity market movements relative to high-grade municipal bonds and little or no change in sensitivity to government bond market movements, they do not. During combination declining interest rate and recessionary periods, the two asset classes seem to partially reverse their roles. Low-grade municipal bonds become less equity-like and significantly more Treasury bond-like, while high-grade municipal bonds become significantly more equity-like and less Treasury bond-like.

Finally, to test the extent to which effect dominates (i.e., interest rate call, put, or combination interest rate call and put), the following regressions were run:

(13) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t +$
$\beta_6 \times TBR_t \times \mathrm{Rec}_t + \beta_7 \times SMR_t \times \mathrm{Rec}_t + \beta_8 \times \mathrm{Rec}_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(14) $HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t +$
$\beta_6 \times TBR_t \times \mathrm{Rec}_t + \beta_7 \times SMR_t \times \mathrm{Rec}_t + \beta_8 \times \mathrm{Rec}_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(15) $LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t +$
$\beta_6 \times TBR_t \times \mathrm{Rec}_t + \beta_7 \times SMR_t \times \mathrm{Rec}_t + \beta_8 \times \mathrm{Rec}_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

Risky debt valuation models which include interest rate risk and assume a significantly negative $\rho_{r,V}$ would imply that β_9 and β_{10}, rather than β_3, β_4, β_6, and β_7, should pick up the bulk of any significant changes in the sensitivities of the risky municipal debt return spread.

Table 18

Coefficients from Two Factor Ordinary Least Squares Regressions of Low-Grade and High-Grade Municipal Bond Returns - Calls, Puts, and Calls & Puts Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

Model 1978:01 to 1994:09 Explanatory Variables	13/14/15 Expected Sign	(13) Low-Grade Muni	(14) High-Grade Muni	(15) Return Spread	Dimson (13) Low-Grade Muni	Dimson (14) High-Grade Muni	Dimson (15) Return Spread
Intercept	?/?/0	0.0012	-0.0002	0.0014**	0.0026	0.0011	0.0015**
		(0.817)	(-0.117)	(2.851)	(1.637)	(0.713)	(2.738)
TBR (Lag 1)					-0.0091	0.0031	-0.0122
					(-0.305)	(0.104)	(-1.210)
TBR	+/+/-	0.3581**	0.4156**	-0.0575**	0.3742**	0.4253**	-0.0511**
		(6.985)	(8.108)	(-3.423)	(7.282)	(8.300)	(-2.945)
TBR (Lead 1)					0.0962**	0.0893*	0.0069
					(2.772)	(2.581)	(0.587)
SMR (Lag 1)					0.0392	0.0319	0.0074
					(1.612)	(1.313)	(0.895)
SMR	+/+/+	0.0980**	0.0875**	0.0105	0.1000**	0.0894**	0.0106
		(2.948)	(2.632)	(0.966)	(3.039)	(2.725)	(0.953)
SMR (Lead 1)					-0.0692**	-0.0793**	0.0101
					(-2.883)	(-3.315)	(1.249)
TBR x DIR	?/?/0	-0.1014	-0.1366	0.0353	-0.1018	-0.1338	0.0319
		(-1.276)	(-1.720)	(1.355)	(-1.303)	(-1.717)	(1.209)
SMR x DIR	?/?/0	-0.0527	-0.0209	-0.0318	-0.0348	-0.0051	-0.0298
		(-0.956)	(-0.379)	(-1.760)	(-0.637)	(-0.093)	(-1.613)
DIR	?/?/?	0.0068**	0.0083**	-0.0015	0.0028	0.0047	-0.0020*
		(2.737)	(3.355)	(-1.884)	(0.980)	(1.686)	(-2.074)
TBR x Rec	?/?/0	0.5761**	0.6740**	-0.0979*	0.5778**	0.6628**	-0.0850
		(4.064)	(4.756)	(-2.107)	(4.124)	(4.744)	(-1.795)
SMR x Rec	?/?/+	0.0773	0.0074	0.0699**	0.0580	0.0061	0.0519
		(0.893)	(0.086)	(2.464)	(0.657)	(0.069)	(1.740)
Rec	?/?/?	0.0012	0.0041	-0.0029	0.0011	0.0036	-0.0025
		(0.257)	(0.861)	(-1.842)	(0.234)	(0.761)	(-1.553)
TBR x DIR x Rec	?/?/0	-0.3322	-0.4583**	0.1261*	-0.3706*	-0.4882**	0.1176*
		(-1.905)	(-2.629)	(2.206)	(-2.153)	(-2.844)	(2.023)
SMR x DIR x Rec	?/?/+	-0.2240	-0.0971	-0.1269**	-0.2374	-0.1230	-0.1144**
		(-1.821)	(-0.790)	(-3.149)	(-1.943)	(-1.009)	(-2.771)
DIR x Rec	?/?/?	-0.0020	-0.0051	0.0031	-0.0016	-0.0041	0.0025
		(-0.269)	(-0.696)	(1.300)	(-0.223)	(-0.575)	(1.038)
Adj. R^2		0.642	0.683	0.225	0.663	0.726	0.226
F-Statistic		33.572**	40.136**	6.284**	26.995**	32.247**	4.860**
Dependent Mean		0.006	0.006	0.000	0.006	0.006	0.000
Root MSE		0.014	0.014	0.004	0.013	0.013	0.004
DW Statistic		1.876	1.946	2.157	1.904	1.963	2.215
Observations		201	201	201	199	199	199

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 19

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Low-Grade and High-Grade Municipal Bond Returns - Calls, Puts, and Calls & Puts Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

Model 1978:01 to 1994:09 Explanatory Variables	13/14/15 Expected Sign	YW (13) Low-Grade Muni	YW (14) High-Grade Muni	YW (15) Return Spread	ML (13) Low-Grade Muni	ML (14) High-Grade Muni	ML (15) Return Spread
Intercept	?/?/0	0.0009	-0.0002	0.0015**	0.0009	-0.0002	0.0015**
		(0.689)	(-0.175)	(3.228)	(0.686)	(-0.182)	(3.256)
TBR	+/+/-	0.3808**	0.4379**	-0.0551**	0.3829**	0.4408**	-0.0549**
		(7.883)	(8.716)	(-3.368)	(7.911)	(8.753)	(-3.364)
SMR	+/+/+	0.0794*	0.0685*	0.0087	0.0774*	0.0660	0.0086
		(2.420)	(2.044)	(0.816)	(2.351)	(1.955)	(0.804)
TBR x DIR	?/?/0	-0.1074	-0.1444	0.0343	-0.1088	-0.1455	0.0343
		(-1.451)	(-1.869)	(1.379)	(-1.476)	(-1.890)	(1.381)
SMR x DIR	?/?/0	-0.0322	0.0014	-0.0315	-0.0299	0.0044	-0.0315
		(-0.610)	(0.027)	(-1.762)	(-0.565)	(0.081)	(-1.761)
DIR	?/?/?	0.0068**	0.0081**	-0.0017*	0.0068**	0.0080**	-0.0017*
		(3.006)	(3.381)	(-2.139)	(3.019)	(3.379)	(-2.156)
TBR x Rec	?/?/0	0.4982**	0.6330**	-0.0972*	0.4909**	0.6275**	-0.0971*
		(3.799)	(4.602)	(-2.165)	(3.754)	(4.582)	(-2.168)
SMR x Rec	?/?/+	0.1105	0.0317	0.0735**	0.1142	0.0347	0.0738**
		(1.374)	(0.379)	(2.626)	(1.421)	(0.415)	(2.634)
Rec	?/?/?	0.0001	0.0049	-0.0031*	-0.0000	0.0050	-0.0031*
		(0.016)	(1.094)	(-2.048)	(-0.004)	(1.124)	(-2.063)
TBR x DIR x Rec	?/?/0	-0.2831	-0.4564**	0.1288*	-0.2779	-0.4561**	0.1290*
		(-1.804)	(-2.712)	(2.358)	(-1.788)	(-2.721)	(2.370)
SMR x DIR x Rec	?/?/+	-0.2347*	-0.1210	-0.1274**	-0.2372*	-0.1239	-0.1275**
		(-2.102)	(-1.040)	(-3.207)	(-2.116)	(-1.068)	(-3.212)
DIR x Rec	?/?/?	0.0013	-0.0043	0.0031	0.0016	-0.0042	0.0031
		(0.205)	(-0.625)	(1.337)	(0.245)	(-0.620)	(1.333)
AR Parameters:							
Lag 2		0.2228**	0.1799*		0.2455**	0.2040**	
		(3.177)	(2.507)		(3.462)	(2.786)	
Lag 7				0.1714*			0.1863*
				(2.385)			(2.557)
Lag 12		-0.1922**			-0.2080**		
		(-2.742)			(-2.902)		
Total R^2		0.693	0.711	0.292	0.694	0.711	0.292
Regression R^2		0.697	0.707	0.282	0.700	0.708	0.284
Root MSE		0.013	0.013	0.004	0.013	0.013	0.004
DW Statistic					1.856	1.968	2.157
Observations		201	201	201	201	201	201

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Except for the Dimson regression, the return spread regression results support the hypothesis that it is the combination of interest rate call and put periods which principally cause more risky municipal bonds to become significantly less sensitive to equity market movements than more credit worthy municipal bonds (i.e., regression model 15, estimated coefficient β_{10}). Therefore, these final regressions would also strongly favor risky debt valuation models which incorporate both interest rate risk and a significantly negative $\rho_{r,V}$.

5 Municipal Bonds, the January Effect, and the Tax Reform Act of 1986

Although not the focus of this thesis, part of the motivation behind the examination of low-grade and high-grade municipal bond returns is the established controversy surrounding the comparison of low-grade and high-grade corporate bond returns. Some studies have supported the proposition that over long periods of time, low-grade corporate bonds have returned more than high-grade corporate bonds (e.g., Hickman [1958], and Fitzpatrick and Severiens [1978]). Other studies have suggested that there is no significant difference between the two corporate bond asset classes (e.g., Fraine and Mills [1961], Blume and Keim [1987], Weinstein [1987], Cornell and Green [1991], and Blume et al. [1991]). Given that this thesis finds that low-grade municipal bonds outperform high-grade municipal bonds, some further analysis is in order. Specifically, the January effect and the Tax Reform Act of 1986 will be evaluated as possible sources of this seeming anomaly.

In order to simplify the analysis which follows, all regression results reported in this section will be simple OLS. The following table provides a comparison of the two sets of risky bond asset classes.

Table 20

A Comparison of Two Factor Regressions of Low-Grade and High-Grade Corporate Bond Returns versus Low-Grade and High-Grade Municipal Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

Models 1, 2, & 3	α_0	β_1	β_2	Adj. R^2	DW	SEE
1978:01 to 1994:09						
Corporate Bonds:						
(1) Coefficient	0.004**	0.321**	0.171**	0.492	1.553	0.016
t-statistic	(3.64)	(9.34)	(6.11)			
(2) Coefficient	0.004**	0.440**	0.006	0.872	1.807	0.006
t-statistic	(8.25)	(34.00)	(0.56)			
(3) Coefficient	0.001	-0.119**	0.165**	0.199	1.451	0.014
t-statistic	(0.63)	(-4.14)	(7.01)			
Municipal Bonds:						
(1) Coefficient	0.002	0.425**	0.081**	0.560	1.820	0.015
t-statistic	(1.95)	(13.37)	(3.11)			
(2) Coefficient	0.001	0.477**	0.082**	0.612	1.841	0.015
t-statistic	(1.30)	(15.03)	(3.16)			
(3) Coefficient	0.001*	-0.052**	-0.001	0.132	2.290	0.005
t-statistic	(2.06)	(-5.22)	(-0.14)			

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Over the sample period, and after controlling for government bond and equity market movements, low-grade corporate bonds have returned slightly more than high-grade corporate bonds but not significantly more, while low-grade municipal bonds have returned significantly more than high-grade municipal bonds. As has been found in other studies (e.g., Cornell and Green [1991]), low-grade corporate bonds are significantly less sensitive to government bond market movements than high-grade corporate bonds, while low-grade corporate bonds are significantly more sensitive to equity market movements than high-grade corporate bonds. As noted previously, the same cannot be said of low-grade and high-grade municipal bonds. Although low-grade municipal bonds are significantly less sensitive to government bond market movements than high-grade municipal bonds, low-grade municipal bonds are approximately as sensitive to equity market movements as high-grade municipal bonds. Again, the whole issue of seemingly positive abnormal returns accruing to low-grade municipal bondholders over the study period may be the result of the inability to specify municipality equity risk appropriately. Other explanations may revolve around the nature of the municipal market itself.

In addition to the significant difference in the sensitivity of low-grade and high-grade corporate bonds to Treasury bond and equity market risk, it has also been found (see Blume et al. [1991] and Cooper and Shulman [1994]) that low-grade corporate bonds have a significant January effect that high-grade corporate bonds do not possess. Does this result extend to municipal bonds? Specifically, after controlling for Treasury bond and equity market movements, do any of the five different municipal bond asset classes show a January effect?

The following regression model was run for the two corporate bond asset classes and the five municipal bond asset classes:
(16) $AClsR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{12} \times JanDV_t + e_t$, where AClsR = asset class return, and JanDV = a dummy variable equal to one if the month is January and zero otherwise.

Table 21

January Effect Regressions of Bond Asset Class Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated A or higher. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings. Insured municipal bond funds invest at least 65% of assets in insured municipal bond issues. Intermediate municipal bond funds invest in municipal bond issues with weighted average maturities of between 5 and 10 years. Short municipal bond funds invest in municipal bond issues with weighted maturities of less than 5 years.

Asset Class		α_0	β_1	β_2	β_{12}	Adj. R^2	DW	SEE
1978:01 to 1994:09								
Corporate Bonds:								
(16) Low-Grade -	Coefficient	0.004**	0.326**	0.166**	0.009*	0.500	1.528	0.016
	t-statistic	(2.93)	(9.55)	(5.96)	(2.10)			
(16) High-Grade -	Coefficient	0.004**	0.440**	0.006	0.000	0.873	1.804	0.006
	t-statistic	(7.84)	(33.84)	(0.54)	(0.20)			
Municipal Bonds:								
(16) Low-Grade -	Coefficient	0.001	0.432**	0.074**	0.012**	0.578	1.828	0.015
	t-statistic	(1.04)	(13.84)	(2.89)	(3.09)			
(16) High-Grade -	Coefficient	0.000	0.485**	0.074**	0.013**	0.633	1.859	0.015
	t-statistic	(0.29)	(15.68)	(2.93)	(3.53)			
(16) Insured -	Coefficient	0.001	0.393**	0.068**	0.013**	0.523	1.876	0.015
	t-statistic	(0.75)	(12.30)	(2.62)	(3.32)			
(16) Intermediate -	Coefficient	0.001	0.326**	0.041*	0.013**	0.589	1.777	0.011
	t-statistic	(0.89)	(14.29)	(2.21)	(4.58)			
(16) Short Maturity -	Coefficient	0.004**	0.092**	0.014*	0.005**	0.532	1.975	0.004
	t-statistic	(13.68)	(12.18)	(2.30)	(5.47)			

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

As noted by Blume et al. [1991], low-grade corporate bonds have a January effect while high-grade corporate bonds do not. The results for municipal bonds are striking. There is a strong January effect for all five municipal bond asset classes. Also, the estimated intercept for the low-grade municipal regression is no longer significant when the January dummy is introduced. This suggests that the positive abnormal returns associated with low-grade municipal bonds are principally determined during the month of January. What is surprising to this researcher is that even intermediate and short maturity municipal bonds show very strong January effects. Although beyond the scope of this thesis, a more detailed analysis of municipal bonds and the January effect would be a worthwhile analysis.

In addition to a municipal bond January effect, are there any other effects which might have a significant influence on the returns of municipal bonds? Much of the more recent municipal bond literature discusses the Tax Reform Act of 1986[7] (e.g., see Poterba [1989], Fortune [1991], and Lovely and Wasylenko [1992]). The Tax Reform Act of 1986 reduced the demand for municipal bonds by dramatically reducing bank demand, and reduced supply by dramatically reducing the ability of issuing authorities to earn arbitrage profits on their borrowings. Did the Tax Reform Act of 1986 significantly influence the returns of low-grade and high-grade municipal bonds? The following table provides regression results which examine low-grade and high-grade municipal bond returns before and after 1986.

Table 22

Tax Reform Act of 1986 Regressions of Low-Grade and High-Grade Municipal Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

Models 1, 2, & 3	α_0	β_1	β_2	Adj. R^2	DW	SEE
1978:01 to 1985:12						
(1) Coefficient	0.001	0.516**	0.094	0.609	1.766	0.018
t-statistic	(0.32)	(10.24)	(1.92)			
(2) Coefficient	-0.000	0.546**	0.094*	0.651	1.787	0.018
t-statistic	(-0.06)	(11.26)	(1.98)			
(3) Coefficient	0.001	-0.029	0.001	0.018	2.327	0.006
t-statistic	(1.16)	(-1.79)	(0.04)			
1986:01 to 1994:09						
(1) Coefficient	0.004**	0.272**	0.079**	0.535	1.690	0.010
t-statistic	(4.06)	(8.43)	(3.66)			
(2) Coefficient	0.003**	0.362**	0.080**	0.564	1.801	0.011
t-statistic	(2.73)	(9.45)	(3.10)			
(3) Coefficient	0.001**	-0.090**	-0.000	0.487	1.992	0.003
t-statistic	(2.76)	(-9.38)	(-0.06)			

* denotes significance at the 1% level, and ** denotes significance at the 5% level.

There is clearly a significant difference between the results before 1986 and after 1985. Before 1986, there is no significant estimated intercept term for any of the three regressions, after 1985 all three regressions have significant estimated intercept terms. This suggests that, after controlling for Treasury bond and equity market risk, positive abnormal returns accrued to both asset classes and more so to low-grade municipal bonds than high-grade municipal bonds (i.e., post 1985). In addition, after 1985 both asset classes became less sensitive to Treasury bond market movements, but low-

[7] It became effective October 22, 1986.

grade municipal bonds became even less sensitive to Treasury bond market movements than high-grade municipal bonds. In short, after 1985 municipal bonds in general acted less like Treasury bonds. Do the abnormal returns still hold after 1985 if the January effect is controlled for? The following table provides regression results with the January dummy variable included.

Table 23

Tax Reform Act of 1986 and January Effect Regressions of Low-Grade and High-Grade Municipal Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Low-grade municipal bond funds invest at least 50% of assets in lower rated municipal bond issues (i.e., issues below the top four credit ratings). High-grade municipal bond funds invest at least 65% of assets in municipal bond issues in the top four credit ratings.

Models 1, 2, & 3		α_0	β_1	β_2	β_{12}	Adj. R^2	DW	SEE
1978:01 to 1985:12								
(16) Low-Grade Muni -	Coefficient	-0.001	0.531**	0.089	0.019**	0.637	1.834	0.018
	t-statistic	-0.52	(10.87)	(1.87)	(2.85)			
(16) High-Grade Muni -	Coefficient	-0.002	0.562**	0.088	0.020**	0.683	1.878	0.017
	t-statistic	-1.01	(12.10)	(1.95)	(3.24)			
(16) LGM-HGM -	Coefficient	0.001	-0.030	0.001	-0.001	0.013	2.333	0.006
	t-statistic	1.30	(-1.84)	(0.06)	(-0.67)			
1986:01 to 1994:09								
(16) Low-Grade Muni -	Coefficient	0.003**	0.273**	0.074**	0.007*	0.549	1.760	0.009
	t-statistic	(3.42)	(8.61)	(3.44)	(2.06)			
(16) High-Grade Muni -	Coefficient	0.002*	0.364**	0.074**	0.008*	0.578	1.860	0.011
	t-statistic	(2.12)	(9.65)	(2.88)	(2.05)			
(16) LGM-HGM -	Coefficient	0.001**	-0.090**	0.001	-0.001	0.490	1.987	0.003
	t-statistic	(2.99)	(-9.43)	(0.09)	(-1.23)			

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Post 1985, the positive abnormal returns still persist after controlling for the January effect. In addition, the January effect persists before 1986 and after 1985. Clearly, there seems to be some structural shift which takes place in the markets for low-grade and high-grade municipal bonds at or around 1986. It is possible that prior to the effect of the Tax Reform Act of 1986 there were fewer structural differences between the corporate and municipal bond markets. For example, especially with respect to Treasury bond market movements, low-grade municipal bonds became significantly less sensitive to Treasury bond market movements after 1985. After 1985, their sensitivity to Treasury bond market movements was almost halved (i.e., estimated coefficient β_1). It is possible that municipal bonds have become more their own market as supply has been constrained and effective tax rates have increased for particular institutional buyers. Especially for institutional investors (e.g., banks), as effective tax rates increase, corporate and Treasury bonds (i.e., taxable bonds) become more imperfect substitutes for tax-exempt bonds.

Overall, much of the low-grade municipal bond positive abnormal returns are principally due to the January effect and/or the effect of the Tax Reform Act of 1986. Further refinement and analysis of these issues are beyond the scope of this thesis, but represent possible future research in the area.

6 Summary and Conclusions

Regarding the overall performance of low-grade municipal bonds, the results presented here suggest there is a significant difference in the financial performance of low-grade municipal bonds relative to high-grade municipal bonds. After controlling for government bond and equity market movements, low-grade municipal bonds do outperform high-grade municipal bonds. Regarding the hypothesis that low-grade municipal bonds have significantly weaker interest rate call protection and/or relatively more interest rate calls, the tests performed in the chapter do not support such an assertion.

All five municipal bond asset classes under study show a significant January effect. Furthermore, the abnormal returns associated with low-grade municipal bonds seem to be largely due to the January effect. Although, the apparent outperformance of low-grade municipal bonds relative to high-grade municipal bonds is more likely the result of the Tax Reform Act of 1986. Sorting the effect of these two influences on low-grade municipal bond financial performance is a possible subject for future research.

During periods of declining interest rates, recession, or combination declining interest rate and recession low-grade municipal bonds do not demonstrate significantly different volatility compared to that of high-grade municipal bonds. Although, periods of declining interest rates significantly affect the relative sensitivity of low-grade and high-grade municipal bonds to movements in the government bond and equity markets. Also, periods of recession do not significantly affect the relative sensitivity of low-grade and high-grade municipal bonds to movements in the government bond and equity markets. Finally, periods of declining interest rates combined with recession significantly affect the relative sensitivity of low-grade and high-grade municipal bonds to movements in both the government bond and equity markets.

The following table provides a summary of the tests conducted.

Table 24

A Comparison of Expectations and Outcomes for Low-Grade versus High-Grade Municipal Bonds

Simple CCA & Credit Spread Effect Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds (est β_3, β_6, β_9)	Expectation for Sensitivity to Stocks (est β_4, β_7, β_{10})
Interest Rate Call Periods (i.e., declining interest rates)	0/0 or +	0/0 or -
Put Periods (i.e., recession)	- or 0/0 or +	+/0 or -
Combination Periods (Call & Put Periods)	- or 0/+	+/-

Realization for Low-Grade vs. High-Grade Bonds (cut-off at the 5% level of significance) 1978:01 through 1994:09	Sensitivity to Treasury Bonds	Sensitivity to Stocks
Interest Rate Call Periods (i.e., declining interest rates)	+	-
Put Periods (i.e., recession)	0	0
Combination Periods (Call & Put Periods)	+	-

During periods of declining interest rates, low-grade municipal bonds become more government bond-like and less equity-like compared to high-grade municipal bonds. During business cycle contractions, low-grade municipal bonds do not become more government bond-like or equity-like compared to high-grade municipal bonds. During combination periods, low-grade municipal bonds become more government bond-like and less equity-like compared to high-grade municipal bonds. These results support risky debt valuation models which incorporate interest rate risk and a significantly negative correlation between changes in interest rates and changes in the value of the firm. If interest rate risk and a significantly negative value for $\rho_{r,V}$ were not of importance in valuing risky municipal bonds, the overall results should have been about the opposite of those found. Clearly, low-grade municipal bonds are complex securities and a relatively accurate valuation model must take account of this fact.

CHAPTER 8

THE EFFECT OF EMBEDDED OPTIONS ON THE FINANCIAL PERFORMANCE OF CONVERTIBLE BONDS

1 Introduction

The primary objectives of this chapter are the following: (1) generally extend the empirical literature on convertible corporate bond (convertible bond) financial performance, and (2) provide evidence to support more complex CCA models of risky bond pricing. The analytic approach used in this chapter is to examine the performance of convertible bond returns relative to straight low-grade corporate bond (low-grade bond) returns within the context of the principal options embedded in them. In the case of convertible bonds, analysis will focus on interest rate call, put, and equity call periods. As outlined in Chapter 5, the primary objectives of this chapter are a by-product of the approach and method employed.

One of the first and most interesting applications of option pricing theory has been the analysis of convertible bonds (e.g., Ingersoll [1977a] and Brennan and Schwartz [1977, 1980]). Although there have been numerous theoretical studies modelling the valuation of convertible bonds, there has been relatively little empirical research based on CCA. Of the empirical work that has been performed on convertible bonds, most has been directed at analyzing and rationalizing the seemingly abnormal call behavior of firms which call the convertible bonds they have issued (e.g., Ingersoll [1977b], Dann and Mikkelson [1984], Harris and Raviv [1985], Acharya and Handa [1988], Jaffee and Shleifer [1990], Singh et al. [1991], Asquith and Mullins [1991], Campbell et al. [1991], Stein [1992], and Mehta and Khan [1995]). This chapter is the first to use CCA as the framework with which to analyze the long run financial performance and relative financial performance of convertible bonds as an asset class.[1]

Given that the principal difference between a convertible bond and straight low-grade bond is an embedded equity call option, unlike Chapters 6 and 7, many of the option periods (i.e., at least 3 of 7) are expected to generate insignificantly different test statistics. Actually, as specified in Chapter 5, only equity call periods and combination periods with equity calls are expected to generate any significant differences between the two asset classes examined (i.e., if periods where no options are exercised or move deeper into-the-money are included, a possible 4 periods of 8). Therefore, three sets of test results of the total seven sets of results represent control tests which test whether the two asset classes behave similarly during periods when theory would expect similar behavior.

This chapter examines the return experience of convertible bonds and straight low-grade bond funds over a long period (i.e., 1/62 through 9/94) in order to begin compiling evidence on the financial performance of convertible bonds. Although not statistically significant, convertible bonds have generated a higher return at a higher standard deviation of return over the period examined.

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[1] Although, Altman [1988] analyzed the size (1980 through 1987), total return (1983 through 1987), and default (1980 through 1987) experience of convertible bonds. Soldofsky [1971, p. 79] analyzed the "yield-risk" performance of convertible securities over the period 1957 through 1969, and found that they "generally have experienced a combination of low yields and poor performance" over the study period. Atkinson [1967] found that convertible bonds defaulted more prior to WWII than after the war (1900-1944), but the quality of convertible bonds declined after the war (1945-1965). Alexander and Stover [1977] analyzed 142 convertible IPOs over the period 1967 through 1970, and found new issues and "low prestige" underwriter issues generated positive excess returns up to 3 1/2 months after issuance. Also, Sparaggis [1995, p. 68] examined an index of convertible bonds over the period 1982 through 1993, and found that "the convertible market has offered excess return over a well-allocated bond/equity portfolio."

Table 1

Mean Monthly Return and Standard Deviation for the Convertible Bond and Low-Grade Corporate Bond Asset Classes (1/62 through 9/94)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate
Observations = 393		
Mean	0.9401%	0.6815%
Standard Deviation	3.3747%	2.4589%

One of the primary questions addressed in this chapter is the extent to which convertible bonds as an asset class have underperformed or outperformed low-grade bonds. That is, over a long period are risk adjusted convertible bond returns greater than risk adjusted low-grade bond returns? This chapter makes the following contributions: (1) generally extends research on convertible bonds; (2) applies CCA to the analysis of the financial performance of convertible bonds, and (3) evaluates the relative financial performance of the convertible and low-grade bond asset classes.

In addition to the possible outperformance of convertible bonds relative to straight low-grade bonds, as mentioned in Chapter 5, there are several other seemingly anomalous low-grade bond findings, applied to convertible bonds, which are addressed by this chapter. Specifically, the following issues are addressed: (1) do convertible bonds as an asset class show evidence of possessing a higher proportion of calls and/or weaker call protection than low-grade bonds; and (2) do convertible bonds as an asset class demonstrate a return generation process which would suggest that changes in risk-free interest rates and/or the economy account for a significant amount of the relative return variation in the convertible bond market overall?

The remainder of this chapter is divided into five sections. Section 2 presents background on the data and provides summary statistics. Section 3 reviews the expectations/hypotheses developed in Chapter 5 which are of relevance to convertible bonds. Section 4 presents the convertible bond and low-grade bond regression results. Section 5 presents the convertible bond January effect regression results. The conclusions are summarized in the last section.

2 Data and Summary Statistics

The convertible bond and low-grade bond data set is derived from open-end mutual funds tracked by Morningstar during the period from January 1962 through September 1994. These returns are net of all but front-end and back-end charges. The Treasury bond series is a spliced series based on the Cornell and Green [1991] Treasury bond series (01/62 through 12/88) and Salomon Brothers' long bond series (01/89 through 09/94). The stock series is derived from the Standard and Poor's 500 return index ("S&P 500"). Therefore, unlike the return series derived from mutual fund returns, the stock and Treasury bond series are gross returns.

Like the Cornell and Green [1991] study on low-grade bonds, this thesis uses monthly open-end mutual fund data to derive asset class return series. Lipper Analytical Services asset class definitions are used for all asset class return series reported. Shares of open-end mutual funds are traded on the basis of NAV. Monthly returns are based on the following calculation:
$\mathrm{Re}\,turn_t = [(NAV_t - NAV_{t-1}) + IncDist_t + CapGainDist_t] / NAV_{t-1}$. In addition, these returns take account of 12b-1 fees and management fees but not front-end loads, back-end loads, or redemption charges.

Each mutual fund based asset class return series was constructed following the method used by Cornell and Green [1991]. For each asset class, the equally weighted average of all mutual funds each month was calculated. The following were the number of funds as of month-end September 1994 for each asset class series derived from Morningstar data: 34 convertible bond funds and 101 low-grade bond funds. Table 2 provides background on the asset class return series used in this chapter.

Table 2

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities

The data are monthly returns. Except for Treasury bonds and the S&P 500 equity series, all mutual fund values are derived from Morningstar. Each mutual fund derived return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 393					
Moments of the Distribution:					
1st - Mean	0.9401%	0.6815%	0.5663%	0.5866%	0.2686%
2nd - Standard Deviation	3.3747%	2.4589%	2.9705%	4.3007%	2.1760%
3rd - Skewness	-0.2632	0.1195	0.6788	-0.3333	0.1260
4th - Kurtosis	2.1869	1.9264	2.6706	3.0062	3.7676
Minimum	-15.0790%	-7.0880%	-8.4600%	-23.9440%	-10.7830%
Maximum	11.9800%	10.9500%	15.2400%	16.3050%	9.7990%
Tests of Normality#:					
T-Statistic: Mean = 0	5.5222	5.5145	3.7792	2.7038	2.3557
Prob>T	0.0001	0.0001	0.0002	0.0072	0.0190
W: Normal	0.9777	0.9666	0.9669	0.9855	0.9650
Prob<W	0.0429	0.0001	0.0001	0.6071	0.0001

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Over the study period (i.e., 01/62 through 09/94), convertible bonds have had higher returns at a higher level of risk, as measured by standard deviation, than low-grade bonds or Treasury bonds. In addition, of the three bond asset classes, only convertible bonds are slightly negatively skewed (as are equities). Whereas, of the three bond asset classes, Treasury bonds have been distributed relatively platykurtically over the period under study.

The tests for normality suggest that, at standard levels of statistical significance, only the equity return series and possibly the convertible bond return series are drawn from a random sample from a normal distribution (i.e., the Shapiro-Wilk test). All four asset class return series reject the null hypothesis that mean of each respective distribution is equal to zero. At normal levels of statistical significance, all four asset class return series have means which are significantly positive. Again, three of four return series reject the null hypothesis that the values are drawn from a random sample from a normal distribution.

Table 3 provides correlation and autocorrelations for the asset class return series used in this chapter.

Table 3

Tests for Autocorrelation and Correlation Coefficients for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities

The data are monthly returns. Except for Treasury bonds and the S&P 500 equity series, all mutual fund values are derived from Morningstar. Each mutual fund derived return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500
Autocorrelation at Lag 1	0.167**	0.253**	0.054*	0.014
Test for White Noise#:				
12 lags	30.16**	45.42**	22.26*	11.46
Correlation with				
Low-Grade Corporate	0.765**			
Treasury Bonds	0.366**	0.505**		
S&P 500	0.862**	0.699**	0.332**	

This is an autocorrelation check for white noise. The null hypothesis is that the autocorrelations sum to zero. The test statistic is at the 12th lag (i.e., one year). Therefore, the null hypothesis for the 12th lag is: $T \times \sum_{k=1}^{12} \hat{r}_k^2 = 0$, where $\hat{r}_k^2$ is the product moment correlation between $\hat{e}_t$ and $\hat{e}_{t-k}$ (k = 1, 2, ..., 12). If the null hypothesis is true, the statistic is distributed as a chi-square with 12 degrees of freedom. If the statistic is not statistically significant, the null hypothesis can be accepted.
* denotes significance at the 5% level of significance, and ** denotes significance at the 1% level of significance.

Both the convertible bond and low-grade bond return series show evidence of autocorrelation. This autocorrelation can be interpreted as evidence of nontrading. Therefore, as in Chapters 6 and 7, several sets of regression results will be presented in order to correct for possible nontrading and/or serial correlation of the error term. As will become clear in sections 4 and 5, the results do not substantially differ regardless of the correction method employed.

Regarding correlations, convertible bonds returns are significantly more positively correlated with equity returns than Treasury bond returns. Clearly, convertible bonds have been more exposed to the risks associated with equities than Treasury bonds. Low-grade bonds returns are more positively correlated with equity returns than Treasury bond returns, but not as much as convertible bond returns are. Compared to low-grade bonds, convertible bonds have been more exposed to the risks associated with equities than Treasury bonds.

3 Risky Convertible Bond and Low-Grade Bond Expectations and Tests

Bond options are often referred to as "embedded options" because they are explicit and implicit options which cannot be detached from the security. This chapter is particularly interested in the effects that the embedded options have on the pricing of convertible bonds and low-grade bonds as asset classes. Therefore, periods when the effects of puts and calls are expected to significantly increase will be examined. The analysis portion of this chapter will be to focus on periods when calls and puts would be expected to be exercised and/or the probability of exercise increases significantly for convertible bonds and low-grade bonds. This will isolate the impact embedded options have on the returns of convertible bonds and low-grade bonds.

Convertible bonds are a type of corporate bond which the owner typically has the option to exchange the bond (at par) for common stock (at the exercise price) of the issuing entity. The following are the three principal embedded options of a convertible bond: (1) interest rate call option, (2) default or put option, and (3) equity call option. A straight corporate bond doesn't have an equity call option. CCA views default as the case where equity holders put the company to bondholders. That is, bond default is equivalent to the exercise of a put option held by equity holders. Like most corporate bonds, most convertible bondholders have explicitly written call options and all have implicitly written put options. Although, unlike most corporate bonds, convertible bondholders hold a call option on some amount of the equity of the issuing firm.[2] Also, like most corporate bonds and municipal bonds, the interest rate call option is

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[2] The equity call option given to most convertible bondholders is an explicit call option on the equity of the firm (see Jennings [1974]). Even though the optimal equity call policy is clear (see Brennan and Schwartz [1977] and Ingersoll [1977a & 1977b]), actual firm conversion policies often delay conversion and are thus non optimal (see Harris and Raviv [1983 & 1985]). Therefore, it should be noted that given significant non optimal conversions, the impact of the equity call option on the financial performance of convertible bonds may not follow from CCA.
Harris and Raviv [1983 & 1985] rationalize these apparent sub optimal delayed calls and the fact that common stock returns are significantly negative around the announcement of the call of a convertible debt issue (also see Mikkelson [1983], Dann and Mikkelson [1984], Jaffee and Shleifer [1988], and Constantinides and Grundy [1989]). In addition, Acharya and Handa [1988] wrote a follow-up study which focused on explaining sub optimal early calls. Harris and Raviv [1983 & 1985] suggest that managers will delay a call of convertibles based on information indicating poor future prospects for the firm, while Acharya and Handa [1988] suggest managers will make an early call of convertibles based on positive information. Therefore, long delays signal an increase in future performance, while early calls signal a decrease in future performance. More recent evidence questions the existence of sub optimal early calls altogether (e.g., Asquith [1995]).

exercised when interest rates decrease enough from the time of issuance to make it profitable for the issuing entity to exercise. Therefore, convertible bonds are distinguished from low-grade bonds by their equity call option, and it is this feature which will be the focus of much of the analysis which follows.

Also, it has been shown that the lower the quality of the bond (i.e., the riskier the bond), the more relevant CCA may be for valuing corporate bonds (see Jones et al. [1984]). Therefore, low-grade bond asset classes are more appropriate than high-grade corporate bonds to apply CCA. Given that convertible bonds and low-grade bonds are mostly composed of lower grade bonds, they make useful asset classes to analyze the effects of options on bond pricing.[3]

Based on the discussion in Chapter 5, there can be different expectations for the changing sensitivities of convertible bonds relative to low-grade bonds during periods when their principal embedded options would be expected to move deeper into-the-money. For example, risky debt valuation models which do not incorporate interest rate risk find that the behavior of low-grade bond returns during recessionary periods seems anomalous; whereas risky debt valuation models which incorporate interest rate risk may be able to explain the behavior of low-grade bond returns during recessionary periods (i.e., assuming $\rho_{r,V}$ is significantly negative). Arguing along the same lines, the behavior of convertible bond and low-grade bond returns during equity call periods may be explained at least in part by risky debt valuation models which incorporate interest rate risk.

As in Chapters 6 and 7, the following table summarizes the difference in expectations for what is termed CCA "assuming no credit spread effect" and CCA "assuming a strong credit spread effect". The first set of expectations are traditional CCA expectations which do not incorporate interest rate risk, whereas the latter case incorporates interest rate risk and assumes that $\rho_{r,V}$ is significantly negative. Of course, if $\rho_{r,V}$ is zero or close to zero, the two should not differ substantially.

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[3] As of 1987, a sample of convertible bonds analyzed by Altman [1988, p. 6] showed that approximately 62% were defined as low-grade bonds.

Table 4
Expectations for Periods under Study

Simple CCA Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds	Expectation for Sensitivity to Stocks
Assuming no Credit Spread Effect:		
Interest Rate Call Periods	0	0
Put Periods	0	0
Equity Call Periods	0	0
Combination Periods (Call & Put Periods)		
Interest Rate Call & Put Periods	0	0
Interest Rate Call & Equity Call Periods	0	0
Put & Equity Call Periods	0	0
Both Calls & Put Periods	0	0
Assuming a Strong Credit Spread Effect:		
Interest Rate Call Periods	0	0
Put Periods	0	0
Equity Call Periods	0 or +	0 or -
Combination Periods (Call & Put Periods)		
Interest Rate Call & Put Periods	0	0
Interest Rate Call & Equity Call Periods	0 or +	0 or -
Put & Equity Call Periods	0 or +	0 or -
Both Calls & Put Periods	0 or +	0 or -

The null hypotheses which follow are based on CCA risky debt models which do not incorporate interest rate risk. Given that both asset classes are predominantly composed of low-grade bonds, the only differences between the two sets of alternative expectations occur during equity call periods and equity call periods combined with the other two types of periods. Hence,

H_0: during periods when interest rates are declining, convertible bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.

H_0: during periods when general credit quality is declining, convertible bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.

H_0: during periods when interest rates are declining and general credit quality is declining, convertible bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.

H_0: during periods when firm values are increasing (i.e., equity call periods), convertible bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.
H_0: during periods when interest rates are declining and firm values are increasing, convertible bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.
H_0: during periods when general credit quality is declining and firm values are increasing, convertible bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.
H_0: during periods when interest rates are declining and general credit quality is declining and firm values are increasing, convertible bonds should not become relatively more or less sensitive to Treasury bond market movements and equity market movements.
Essentially, equity call periods are the only periods expected to have a significant impact on the relative sensitivities of convertible bond returns to Treasury bond market and equity market returns. Note that the overall credit quality of the two asset classes is assumed to be relatively equal, unlike the two chapters examining low-grade vs. high-grade bonds. Therefore, there are no alternative hypotheses which are diametric opposites as was the case for combination periods in the previous two chapters.

Critical to this thesis is the identification of periods when bond calls and puts would be expected to be exercised and/or their probability of exercise significantly increases relative to all other periods. For interest rate call periods, this thesis uses periods of declining interest rates. Bonds would be expected to be called, and/or their probability of exercise increases, when interest rates decline. For put/default periods, this thesis uses periods of recession. Defaults increase during recessionary periods. For equity call periods, this thesis uses periods when equities outperform risky bonds. The equity call option would be expected to be exercised and/or the probability of exercise increases when equity values increase more rapidly than bond values. Table 4 summarizes the expectations for the relative sensitivity of convertible bond versus low-grade bond returns over interest rate call, put/default, equity call, and combination call & put/call periods.

4 Regressions Testing the Impact of Call and Put Periods

Ignoring Kihn [1996], this chapter represents the first study to examine the relative volatility and sensitivity (i.e., to the Treasury bond and equity markets) of convertible bonds (i.e., relative to low-grade bonds) during periods when their principal embedded options would be expected to move deeper into-the-money. It is a central argument of this thesis that one of the primary causes of the seemingly abnormal behavior of low-grade bonds relative to high-grade bonds is that relatively less credit worthy bonds are significantly more affected by the correlation between changes in the risk-free rate of interest and changes in the value of the firm (i.e., $\rho_{r,V}$ is significantly negative) than more credit worthy bonds (i.e., for both corporate and municipal bonds). Given that the principal difference between a convertible bond and a low-grade bond is an equity call option, the comparison of these two risky bond asset classes serves as a control for the analysis of the preceding two chapters (i.e., at least for interest rate call, put, and combination interest rate call and put periods). As in the preceding two chapters, the critical method with which to examine the return behavior of convertible bonds and low-grade bonds is to isolate periods when calls and puts would be expected to be exercised and/or the probability of exercise significantly increases. Specifically, there should be no significant differences between convertible bonds and low-grade bonds during the equivalent periods examined for low-grade and high-grade bonds.

As a baseline to the regression analysis which follows, the following regression models were run to evaluate the sensitivity of convertible bonds and low-grade bonds to Treasury bond and equity market movements:

(1) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

(2) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

(3) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + e_t$

where CVT = convertible bond return, LGR = low-grade bond return, TBR = Treasury bond return, SMR = stock market return (i.e., the return of the S&P 500 index), and e is the error term. This equation was designed to take account of Treasury bond and equity market risk via TBR and SMR.

As in Chapters 6 and 7, in addition to the standard OLS regressions three additional regressions were run to check the robustness of the OLS results. Also as in Chapters 6 and 7, the various results will show that there is little or no difference between the regression methods employed.

Table 5

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

Model 1962:01 to 1994:09 Explanatory Variables	1/2/3 Expected Sign#	(1) Convert. Corp.	(2) Low-Grade Corp.	(3) Return Spread	Dimson (1) Convert. Corp.	Dimson (2) Low-Grade Corp.	Dimson (3) Return Spread
Intercept	?/?/0	0.0050**	0.0034**	0.0016	0.0041**	0.0022**	0.0019*
		(5.741)	(4.062)	(1.772)	(4.731)	(2.617)	(2.069)
TBR (Lag 1)					0.0609*	0.1029**	-0.0420
					(2.050)	(3.632)	(-1.310)
TBR	+/+/-	0.1016**	0.2542**	-0.1526**	0.1093**	0.2585**	-0.1492**
		(3.338)	(8.746)	(-4.775)	(3.667)	(9.090)	(-4.634)
TBR (Lead 1)					-0.0314	0.0026	-0.0341
					(-1.062)	(0.093)	(-1.065)
SMR (Lag 1)					0.0568**	0.0611**	-0.0043
					(2.771)	(3.123)	(-0.194)
SMR	+/+/+	0.6535**	0.3412**	0.3123**	0.6469**	0.3307**	0.3162**
		(31.097)	(16.998)	(14.145)	(31.473)	(16.862)	(14.244)
SMR (Lead 1)					0.0270	0.0350	-0.0080
					(1.324)	(1.797)	(-1.310)
Adj. R^2		0.750	0.570	0.336	0.769	0.606	0.347
F-Statistic		588.155**	260.658**	100.050**	217.883**	101.019**	35.556**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.016	0.018	0.016	0.015	0.018
DW Statistic		1.540	1.710	1.732	1.536	1.681	1.740
Observations		393	393	393	391	391	391

expected signs are based on risky bond expectations (i.e., for the intercept, TBR coefficient, and SMR coefficient) and simple CCA expectations (i.e., for all other coefficient expectations).

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 6

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

		YW	YW	YW	ML	ML	ML
Model		(1)	(2)	(3)	(1)	(2)	(3)
1962:01 to 1994:09	1/2/3		Low-			Low-	
Explanatory Variables	Expected Sign#	Convert. Corp.	Grade Corp.	Return Spread	Convert. Corp.	Grade Corp.	Return Spread
Intercept	?/?/0	0.0051**	0.0035**	0.0016	0.0051**	0.0036**	0.0016
		(3.417)	(3.712)	(1.340)	(3.317)	(3.651)	(1.307)
TBR	+/+/-	0.1004**	0.2404**	-0.1377**	0.1001**	0.2386**	-0.1367**
		(3.537)	(8.382)	(-4.378)	(3.522)	(8.332)	(-4.349)
SMR	+/+/+	0.6427**	0.3275**	0.3176**	0.6418**	0.3257**	0.3181**
		(32.790)	(16.624)	(14.754)	(32.412)	(16.506)	(14.770)
AR Parameters:							
Lag 1		-0.1790**	-0.1436**	-0.1143*	-0.1916**	-0.1639**	-0.1215*
		(-3.634)	(-2.862)	(-2.284)	(-3.889)	(-3.259)	(-2.428)
Lag 5		-0.1264*			-0.1310**		
		(-2.576)			(-2.682)		
Lag 9				-0.1213*			-0.1326**
				(-2.423)			(-2.642)
Lag 12		-0.1524**			-0.1528**		
		(-3.118)			(-3.113)		
Total R^2		0.773	0.582	0.360	0.773	0.582	0.360
Regression R^2		0.767	0.559	0.360	0.768	0.557	0.362
Root MSE		0.016	0.016	0.018	0.016	0.016	0.017
DW Statistic					1.957	1.993	1.965
Observations		393	393	393	393	393	393

expected signs are based on risky bond expectations (i.e., for the intercept, TBR coefficient, and SMR coefficient) and simple CCA expectations (i.e., for all other coefficient expectations).
T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The return spread results are of critical importance, and at a general level there is nothing surprising. First, the estimated intercept for the return spread regressions is slightly positive, but not significantly so (i.e., except for the Dimson regression). This suggests that, after controlling for Treasury bond and equity market risk, convertible bonds have not significantly outperformed low-grade bonds over the sample period. Second, convertible bonds are more equity-like than low-grade bonds. Finally, convertible bonds are less risk-free bond-like (i.e., Treasury bond-like) than low-grade bonds. Again, these last two results only confirm the view of risky debt as a hybrid of equity and pure debt, and that convertible bonds are more equity-like than low-grade bonds. Essentially, these results largely confirm the CCA view of convertible bonds. That is, as expected, the presence of the equity call option should tend to increase the sensitivity of convertible bonds to equity market movements, especially relative to government bond market movements.

4.1 Interest Rate Call Periods

If convertible bonds have had significantly less interest rate call protection and/or a higher call rate than low-grade bonds, there should be a significant decline in the sensitivity of convertible bond returns to risk-free bond returns during periods when interest rate call options should be exercised (i.e., during periods of declining interest rates). This assertion can be tested by examining the behavior of convertible bond returns relative to low-grade bond returns during periods of declining interest rates. Specifically, if there is a significant difference, the sensitivity of convertible bond returns to risk-free bond return movements would significantly decline during periods of declining interest rates. The following table presents the return and standard deviations (among other descriptive statistics) associated with periods where the government 10 year constant maturity Treasury bond experienced a decline in yield.

Table 7

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined (Interest Rate Call Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.
A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 180					
Moments of the Distribution:					
1st - Mean	2.1119%	1.8333%	2.2409%	1.9714%	0.2786%
2nd - Standard Deviation	3.0047%	2.2352%	2.7688%	3.9878%	1.9998%
3rd - Skewness	0.6343	0.5457	1.3342	0.3454	0.3696
4th - Kurtosis	1.1237	2.9823	4.0054	1.2107	1.4540
Minimum	-6.5700%	-6.1500%	-3.9100%	-11.3860%	-5.8270%
Maximum	11.9800%	10.9500%	15.2400%	16.3050%	7.1800%
Tests of Normality#:					
T-Statistic: Mean = 0	9.4301	11.0041	10.8580	6.6323	1.8692
Prob>T	0.0001	0.0001	0.0001	0.0001	0.0632
W: Normal	0.9668	0.9552	0.9282	0.9846	0.9785
Prob<W	0.0100	0.0001	0.0001	0.6702	0.2661

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Although convertible bonds were more volatile than low-grade bonds during periods of declining interest rates, convertible bonds were not significantly more volatile. For months when interest rates were declining, the ratio of convertible bond to low-grade bond standard deviation is approximately 1.34 versus 1.37 for all months. It seems it would not be correct to state that the greater relative number of calls and/or weaker call protection afforded convertible bonds relative to low-grade bonds is the cause of their higher volatility. Over the study period, convertible bonds have been only slightly less sensitive to declining interest rates than low-grade bonds.

In order to further test this contention, the following regression models were run to test for the significance of interest rate call periods on the returns of convertible and low-grade bonds.

(4) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

(5) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

(6) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_3 \times TBR_t \times DIR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t$

where DIR = a dummy variable equal to one if interest rates decline and zero otherwise. The call dummy variable is intended to isolate the effect of periods when calls are more frequent and/or more probable.

Table 8

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.
These regression results compare the effect of periods of declining interest rates. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

Model 1962:01 to 1994:09 Explanatory Variables	4/5/6 Expected Sign	(4) Convert. Corp.	(5) Low-Grade Corp.	(6) Return Spread	Dimson (4) Convert. Corp.	Dimson (5) Low-Grade Corp.	Dimson (6) Return Spread
Intercept	?/?/0	0.0040**	0.0011	0.0028*	0.0039**	0.0014	0.0026
		(3.218)	(0.963)	(2.201)	(3.210)	(1.160)	(1.958)
TBR (Lag 1)					0.0572	0.0847**	-0.0275
					(1.748)	(2.720)	(-0.782)
TBR	+/+/-	0.0560	0.2385**	-0.1825**	0.0841	0.2822**	-0.1981**
		(1.123)	(5.058)	(-3.491)	(1.701)	(5.999)	(-3.728)
TBR (Lead 1)					-0.0304	0.0049	-0.0353
					(-1.023)	(0.174)	(-1.105)
SMR (Lag 1)					0.0537**	0.0621**	-0.0084
					(2.605)	(3.167)	(-0.381)
SMR	+/+/+	0.6838**	0.3456**	0.3382**	0.6757**	0.3328**	0.3428**
		(24.765)	(13.235)	(11.685)	(24.984)	(12.932)	(11.789)
SMR (Lead 1)					0.0223	0.0336	-0.0112
					(1.083)	(1.711)	(-0.507)
TBR x DIR	?/?/0	0.0653	-0.0616	0.1268	0.0539	-0.0914	0.1453*
		(0.944)	(-0.941)	(1.748)	(0.804)	(-1.431)	(2.014)
SMR x DIR	?/?/0	-0.0864*	-0.0323	-0.0540	-0.0732	-0.0084	-0.0649
		(-1.996)	(-0.790)	(-1.191)	(-1.731)	(-0.208)	(-1.425)
DIR	?/?/?	0.0027	0.0071**	-0.0044*	0.0007	0.0039**	-0.0032
		(1.295)	(3.640)	(-2.048)	(0.323)	(1.871)	(-1.355)
Adj. R^2		0.752	0.581	0.343	0.770	0.608	0.353
F-Statistic		238.093**	109.902**	41.952**	145.700**	68.303**	24.672**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.016	0.018	0.016	0.015	0.017
DW Statistic		1.526	1.673	1.726	1.526	1.670	1.748
Observations		393	393	393	391	391	391

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 9

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effect of periods of declining interest rates. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero.

Model 1962:01 to 1994:09 Explanatory Variables	4/5/6 Expected Sign	YW (4) Convert. Corp.	YW (5) Low-Grade Corp.	YW (6) Return Spread	ML (4) Convert. Corp.	ML (5) Low-Grade Corp.	ML (6) Return Spread
Intercept	?/?/0	0.0039*	0.0011	0.0029*	0.0039*	0.0011	0.0029*
		(2.276)	(0.877)	(1.993)	(2.217)	(0.868)	(1.962)
TBR	+/+/-	0.0505	0.2205**	-0.1564**	0.0503	0.2188**	-0.1545**
		(1.100)	(4.850)	(-3.088)	(1.097)	(4.833)	(-3.051)
SMR	+/+/+	0.6720**	0.3337**	0.3428**	0.6713**	0.3324**	0.3433**
		(25.524)	(12.927)	(11.990)	(25.464)	(12.841)	(12.007)
TBR x DIR	?/?/0	0.0759	-0.0484	0.0998	0.0763	-0.0472	0.0977
		(1.167)	(-0.752)	(1.383)	(1.175)	(-0.734)	(1.352)
SMR x DIR	?/?/0	-0.0816*	-0.0412	-0.0496	-0.0813*	-0.0419	-0.0493
		(-2.040)	(-1.046)	(-1.129)	(-2.035)	(-1.067)	(-1.126)
DIR	?/?/?	0.0028	0.0074**	-0.0043*	0.0028	0.0074**	-0.0043*
		(1.468)	(3.910)	(-2.048)	(1.466)	(3.935)	(-2.037)
AR Parameters:							
Lag 1		-0.1826**	-0.1614**	-0.1193*	-0.1927**	-0.1796**	-0.1273*
		(-3.695)	(-3.213)	(-2.371)	(-3.893)	(-3.566)	(-2.531)
Lag 5		-0.1195*			-0.1259*		
		(-2.429)			(-2.567)		
Lag 9				-0.1063*			-0.1190*
				(-2.114)			(-2.348)
Lag 12		-0.1588**			-0.1623**		
		(-3.236)			(-3.293)		
Total R^2		0.777	0.599	0.370	0.777	0.599	0.370
Regression R^2		0.772	0.575	0.369	0.772	0.574	0.371
Root MSE		0.016	0.016	0.017	0.016	0.016	0.017
DW Statistic					1.957	1.983	1.960
Observations		393	393	393	393	393	393

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Again, the estimated intercept can be interpreted as the amount of abnormal return attributed to the dependent return series after adjusting for the various movements of the independent variables. In this case, the results indicate that after controlling for periods of declining interest rates, at the 5% level there is a significant difference in the return performance of the two asset classes (i.e., except for the Dimson regression). It is interesting to note that the estimated coefficient for the dummy for periods of declining interest rates was negative and statistically significant in the asset classes comparison regression (model 6, except for the Dimson regression). Therefore, periods of declining interest rates tend to more negatively impact convertible bond financial performance relative to low-grade bond financial performance. Therefore, this implies that convertible bonds tend to outperform low-grade bonds during periods of increasing interest rates.

Based on the estimated coefficient for the sensitivity of the spread between convertible bond and low-grade bond returns to Treasury bond market returns during interest rate call periods, there is reason to reject the hypothesis that convertible bonds have significantly weaker and/or less interest rate call protection than low-grade bonds. If low-grade bonds were significantly more sensitive to interest rate movements due to greater call protection relative to low-grade bonds, then it would be expected that the estimated coefficient β_3 would be significantly greater than the same coefficient for the convertible bond regression. The fact that this is not the case casts doubt on the contention of a significant difference between the number of calls and/or the call protection associated with the two asset classes.

Overall, interest rate call periods do not seem to have much of an impact on the relative performance of convertible bonds versus low-grade bonds. Given that the primary difference between convertible bonds and low-grade bonds is the equity call feature, this is a sensible result.

4.2 Put Periods

Regarding convertible bond puts or defaults, if there was a significant effect of the exercise and/or increase in the probability of exercise of convertible bond puts relative to low-grade bond puts it will become significant during periods when the economy is performing poorly. If convertible bonds are significantly more exposed to business cycle risk, convertible bond returns should be more sensitive to equity market movements during periods when more defaults would be expected to occur.

Table 10

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Recession Months Only (Put Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.
A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 57					
Moments of the Distribution:					
1st - Mean	0.6762%	0.6346%	1.3510%	0.1374%	0.0416%
2nd - Standard Deviation	4.7197%	4.1170%	4.3508%	6.0246%	2.6392%
3rd - Skewness	-0.0215	0.4636	0.8660	0.2656	0.0433
4th - Kurtosis	0.1753	-0.3734	1.6177	-0.0717	3.0556
Minimum	-11.3230%	-6.8520%	-7.1400%	-11.9330%	-8.6090%
Maximum	11.9800%	10.9500%	15.2400%	16.3050%	8.2480%
Tests of Normality#:					
T-Statistic: Mean = 0	1.0816	1.1637	2.3444	0.1722	0.1190
Prob>T	0.2841	0.2495	0.0226	0.8639	0.9057
W: Normal	0.9866	0.9598	0.9539	0.9800	0.9529
Prob<W	0.9153	0.1151	0.0598	0.6924	0.0529

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Although convertible bonds were more volatile than low-grade bonds during recessionary periods, convertible bonds were not significantly more volatile. For recession months, the ratio of convertible bond to low-grade bond standard deviation is approximately 1.15 versus 1.37 for all months. Over the period analyzed, convertible bonds have been only slightly more sensitive to recessionary periods than low-grade bonds.

In order to test the recession put hypothesis, the following regression models were run to test for the impact of put periods on the returns of convertible and low-grade bonds.

(7) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

(8) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

(9) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_6 \times TBR_t \times \mathrm{Re}c_t + \beta_7 \times SMR_t \times \mathrm{Re}c_t + \beta_8 \times \mathrm{Re}c_t + e_t$

where Rec = a dummy variable equal to one if the economy is in a recession and zero otherwise. The put dummy variable is intended to isolate the effect of recessionary periods when puts are more frequent and/or more probable for convertible and low-grade bonds.

Table 11

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effect of recessionary periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

Model 1962:01 to 1994:09 Explanatory Variables	7/8/9 Expected Sign	(7) Convert. Corp.	(8) Low-Grade Corp.	(9) Return Spread	Dimson (7) Convert. Corp.	Dimson (8) Low-Grade Corp.	Dimson (9) Return Spread
Intercept	?/?/0	0.0053**	0.0040**	0.0013	0.0043**	0.0029**	0.0014
		(5.663)	(4.600)	(1.294)	(4.615)	(3.270)	(1.421)
TBR (Lag 1)					0.0620*	0.0945**	-0.0325
					(2.064)	(3.348)	(-0.998)
TBR	+/+/-	0.0478	0.1777**	-0.1299**	0.0570	0.1879**	-0.1309**
		(1.330)	(5.287)	(-3.430)	(1.644)	(5.762)	(-3.476)
TBR (Lead 1)					-0.0357	0.0040	-0.0397
					(-1.204)	(0.144)	(-1.234)
SMR (Lag 1)					0.0595**	0.0622**	-0.0026
					(2.908)	(3.231)	(-0.119)
SMR	+/+/+	0.6563**	0.3179**	0.3384**	0.6599**	0.3183**	0.3416**
		(27.113)	(14.050)	(13.271)	(28.259)	(14.502)	(13.484)
SMR (Lead 1)					0.0206	0.0228	-0.0022
					(1.007)	(1.186)	(-0.099)
TBR x Rec	?/?/0	0.1936**	0.2492**	-0.0556	0.2023**	0.2484**	-0.0460
		(2.811)	(3.871)	(-0.767)	(3.028)	(3.954)	(-0.635)
SMR x Rec	?/?/0	-0.0334	0.0585	-0.0919	-0.0746	0.0177	-0.0923
		(-0.684)	(1.281)	(-1.785)	(-1.566)	(0.396)	(-1.786)
Rec	?/?/?	-0.0026	-0.0040	0.0013	-0.0020	-0.0040	0.0020
		(-1.047)	(-1.674)	(0.492)	(-0.792)	(-1.725)	(0.764)
Adj. R^2		0.753	0.594	0.341	0.773	0.624	0.352
F-Statistic		240.113**	115.521**	41.559**	148.657**	72.892**	24.527**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.016	0.018	0.016	0.015	0.017
DW Statistic		1.535	1.672	1.712	1.535	1.658	1.727
Observations		393	393	393	391	391	391

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 12

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.
These regression results compare the effect of recessionary periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

Model 1962:01 to 1994:09 Explanatory Variables	7/8/9 Expected Sign	YW (7) Convert. Corp.	YW (8) Low-Grade Corp.	YW (9) Return Spread	ML (7) Convert. Corp.	ML (8) Low-Grade Corp.	ML (9) Return Spread
Intercept	?/?/0	0.0055**	0.0041**	0.0013	0.0055**	0.0041**	0.0013
		(3.595)	(4.052)	(1.045)	(3.477)	(3.967)	(1.024)
TBR	+/+/-	0.0557	0.1587**	-0.1092**	0.0556	0.1565**	-0.1076**
		(1.666)	(4.850)	(-2.942)	(1.666)	(4.799)	(-2.903)
SMR	+/+/+	0.6461**	0.3071**	0.3445**	0.6455**	0.3058**	0.3451**
		(28.493)	(13.991)	(13.928)	(28.519)	(13.974)	(13.975)
TBR x Rec	?/?/0	0.1685**	0.2681**	-0.0688	0.1680*	0.2701**	-0.0695
		(2.608)	(4.298)	(-0.974)	(2.583)	(4.347)	(-0.986)
SMR x Rec	?/?/0	-0.0335	0.0473	-0.0980*	-0.0341	0.0459	-0.0986*
		(-0.742)	(1.064)	(-1.976)	(-0.755)	(1.035)	(-1.987)
Rec	?/?/?	-0.0030	-0.0037	0.0007	-0.0031	-0.0036	0.0007
		(-1.048)	(-1.387)	(0.251)	(-1.037)	(-1.340)	(0.224)
AR Parameters:							
Lag 1		-0.1842**	-0.1631**	-0.1218*	-0.1962**	-0.1837**	-0.1299*
		(-3.722)	(-3.248)	(-2.425)	(-3.940)	(-3.652)	(-2.581)
Lag 5		-0.1201*			-0.1267*		
		(-2.434)			(-2.561)		
Lag 9				-0.1244*			-0.1387**
				(-2.477)			(-2.743)
Lag 12		-0.1435**			-0.1452**		
		(-2.920)			(-2.938)		
Total R^2		0.777	0.611	0.372	0.777	0.611	0.372
Regression R^2		0.771	0.588	0.373	0.771	0.586	0.375
Root MSE		0.016	0.015	0.003	0.016	0.015	0.017
DW Statistic					1.962	2.002	1.967
Observations		393	393	393	393	393	393

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The estimated intercept for the return spread regressions does not suggest that, after controlling for the various movements of the independent variables, convertible bonds have returned significantly more than low-grade bonds. In this case, the results indicate that after controlling for recessionary periods, there is no significant difference in the return performance of the two asset classes. Also, note that all four regressions generally assign the same sign and level of significance to each comparable estimated coefficient.

Based on the estimated coefficient for the sensitivity of the spread between convertible bond and low-grade bond returns to Treasury bond market returns during put periods, there is no reason to reject the hypothesis that convertible and low-grade bonds behave similarly during put periods. If convertible bonds were significantly more (less) sensitive to Treasury bond market movements during recessions, then it would be expected that the estimated coefficient β_6 would be significantly greater (smaller) than the same coefficient for the low-grade bond regression.

Based on the estimated coefficient for the sensitivity of the spread between convertible bond and low-grade bond returns to equity market returns during put periods, there is no reason to reject the hypothesis that convertible and low-grade bonds behave similarly during put periods. If convertible bonds were significantly more (less) sensitive to equity market movements during recessions, then it would be expected that the estimated coefficient β_7 would be significantly greater (smaller) than the same coefficient for the low-grade bond regression.

Over the period, convertible bonds and low-grade bonds did not lose a significant amount of their sensitivity to equity market movements during business cycle contractions (i.e., estimated coefficient β_7). One possible explanation for the lack of a recession effect for convertible and low-grade bonds may be that there is no large increase in perceived credit risk during recessionary periods. As some low-grade bonds and convertible bonds default, thus removing them from their respective asset classes and lowering the duration of each asset class, a relatively equal amount of straight high-grade bonds and high-grade convertible bonds are downgraded. During economic booms, high-grade bonds can be upgraded, but upgrades may be a relatively direct function of the length and magnitude of the expansion, and downgrades are a direct function of the length and magnitude of the contraction. Either way, the results suggest that defaults do not significantly affect the two return series examined.

The embedded puts in convertible bonds have the effect of insignificantly decreasing the sensitivity of convertible bonds with respect to equity price movements (i.e., estimated coefficient β_7 is negative and insignificantly so) and significantly lengthening their duration with respect to government bond price movements (i.e., estimated coefficient β_6 is positive and significant at the 1% level of significance, and at the 5% level of significance for the maximum likelihood regression). This suggests that the duration of convertible bonds actually increases during recessions. This may in part be explained by downgradings of high-grade convertible bonds into the convertible bond asset class which overwhelms the effect puts have on the asset class. Even though puts occur during recessions with higher frequency, high-grade downgradings may more than offset this effect.

In addition, the results indicate that convertible bonds do not act significantly less like government bonds during recessions than low-grade bonds. That is, the covariability of convertible bond returns with government bond returns does not significantly decrease during recessions relative to low-grade bond returns (i.e., model 9, estimated coefficient β_6). This could also be in part explained by downgradings of high-grade bonds during recessions, some of which remain in each asset class while others are still called away during the recession.

Overall, the results suggest that during periods when convertible and low-grade bonds would be expected to show relatively equal sensitivity to equity market movements, they do. During recessions, the two asset classes appear to mirror each other. Convertible bonds become insignificantly less equity-like and significantly more bond-like, and low-grade bonds become insignificantly more equity-like and significantly more bond-like. Given that the essential difference between convertible bonds and low-grades bonds is the equity call feature, the recession regression results support the CCA implication that recessionary periods would not be expected to have a significant impact on the relative performance of the two asset classes, because the primary effect of an economic downturn would be on the embedded put option not on the equity call option which only convertible bonds possess.

4.3 Combination Interest Rate Call and Put Periods

Regarding the increased probability of convertible and low-grade bond interest rate calls and puts, if there was a significant affect of the exercise and/or increase in the probability of exercise of the options of convertible bonds relative to low-grade bonds it should show up during periods when the economy is performing poorly and interest rates are declining. Although, at least relative to low-grade bonds, this thesis hypothesizes that during recessionary periods with decreasing interest rates, convertible bond returns will be insignificantly affected by movements in the Treasury bond and equity markets.

Table 13

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined & Recession (Interest Rate Call & Put Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.
A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 30					
Moments of the Distribution:					
1st - Mean	2.7995%	2.5916%	3.9486%	2.5343%	0.2079%
2nd - Standard Deviation	3.8756%	3.6372%	3.9140%	5.2010%	2.4569%
3rd - Skewness	0.4818	0.2542	1.3317	0.5358	0.1878
4th - Kurtosis	-0.0422	-0.0933	2.0877	0.4424	1.8121
Minimum	-3.7000%	-4.2660%	-1.0900%	-6.0550%	-5.8270%
Maximum	11.9800%	10.9500%	15.2400%	16.3050%	7.1800%
Tests of Normality#:					
T-Statistic: Mean = 0	3.9564	3.9027	5.5256	2.6689	0.4634
Prob>T	0.0005	0.0005	0.0001	0.0123	0.6465
W: Normal	0.9675	0.9729	0.8897	0.9651	0.9698
Prob<W	0.5193	0.6888	0.0046	0.4625	0.5793

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Convertible bonds were more volatile than low-grade bonds during periods of recession and declining interest rates, but not significantly so. During combination recession and declining interest rate months, the ratio of convertible bond to low-grade bond standard deviation is approximately 1.07 versus 1.37 for all months. During months when it is expected that puts and interest rate calls on convertible bonds will be exercised as frequently as those for low-grade bonds, there is some decline in the volatility of convertible bonds relative to low-grade bonds, but that difference is not significant.

In order to test the combination recession put and declining interest rate call hypothesis, the following regression models were run to test for the significance of combination put and interest rate call periods on the returns of convertible and low-grade bonds:

(10) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(11) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

(12) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_9 \times TBR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{10} \times SMR_t \times \mathrm{Rec}_t \times DIR_t + \beta_{11} \times \mathrm{Rec}_t \times DIR_t + e_t$

These regressions are intended to capture the effect of the combination of puts and interest rate calls on the returns of convertible and low-grade bonds. The coefficient β_9 will isolate the effect that changes in Treasury bond prices have on changes in convertible and low-grade bond prices during periods of recession and declining interest rates. The coefficient β_{10} will isolate the effect changes in equity prices have on changes in convertible and low-grade bond prices during periods of recession and declining interest rates.

Table 14

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call & Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effects of recessionary and declining interest rate periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero, and a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

					Dimson	Dimson	Dimson
Model		(10)	(11)	(12)	(10)	(11)	(12)
1962:01 to 1994:09	10/11/12		Low-			Low-	
Explanatory	Expected	Convert.	Grade	Return	Convert.	Grade	Return
Variables	Sign	Corp.	Corp.	Spread	Corp.	Corp.	Spread
Intercept	?/?/0	0.0048**	0.0032**	0.0016	0.0041**	0.0022**	0.0019*
		(5.420)	(3.773)	(1.756)	(4.624)	(2.638)	(1.969)
TBR (Lag 1)					0.0606*	0.0985**	-0.0379
					(1.996)	(3.432)	(-1.155)
TBR	+/+/-	0.0731*	0.2071**	-0.1340**	0.0826*	0.2184**	-0.1358**
		(2.123)	(6.346)	(-3.699)	(2.475)	(6.918)	(-3.759)
TBR (Lead 1)					-0.0326	-0.0013	-0.0313
					(-1.097)	(-0.047)	(-0.974)
SMR (Lag 1)					0.0580**	0.0674**	-0.0094
					(2.808)	(3.450)	(-0.420)
SMR	+/+/+	0.6615**	0.3411**	0.3205**	0.6541**	0.3296**	0.3245**
		(29.749)	(16.189)	(13.708)	(30.141)	(16.065)	(13.822)
SMR (Lead 1)					0.0249	0.0344	-0.0095
					(1.216)	(1.778)	(-0.430)
TBR x DIR x Rec	?/?/0	0.1457	0.2331**	-0.0874	0.1691	0.2569**	-0.0878
		(1.589)	(2.684)	(-0.907)	(1.915)	(3.077)	(-0.920)
SMR x DIR x Rec	?/?/0	-0.0768	-0.0017	-0.0751	-0.0689	0.0071	-0.0761
		(-1.134)	(-0.027)	(-1.055)	(-1.051)	(0.115)	(-1.072)
DIR x Rec	?/?/?	-0.0003	-0.0033	0.0030	-0.0029	-0.0074	0.0046
		(-0.067)	(-0.759)	(0.620)	(-0.652)	(-1.782)	(0.955)
Adj. R^2		0.750	0.578	0.336	0.770	0.614	0.347
F-Statistic		236.420**	108.210**	40.658**	146.099**	69.995**	24.029**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.016	0.018	0.016	0.015	0.018
DW Statistic	.	1.522	1.677	1.716	1.524	1.667	1.728
Observations		393	393	393	391	391	391

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 15

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call & Put Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effects of recessionary and declining interest rate periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; and a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

Model 1962:01 to 1994:09 Explanatory Variables	10/11/12 Expected Sign	YW (10) Convert. Corp.	YW (11) Low-Grade Corp.	YW (12) Return Spread	ML (10) Convert. Corp.	ML (11) Low-Grade Corp.	ML (12) Return Spread
Intercept	?/?/0	0.0050**	0.0033**	0.0017	0.0050**	0.0033**	0.0017
		(3.297)	(3.309)	(1.420)	(3.190)	(3.211)	(1.384)
TBR	+/+/-	0.0710*	0.1871**	-0.1136**	0.0705*	0.1837**	-0.1119**
		(2.204)	(5.851)	(-3.185)	(2.192)	(5.768)	(-3.141)
SMR	+/+/+	0.6518**	0.3255**	0.3277**	0.6509**	0.3229**	0.3284**
		(31.075)	(15.765)	(14.348)	(31.036)	(15.648)	(14.379)
TBR x DIR x Rec	?/?/0	0.1638	0.2506**	-0.0978	0.1653	0.2541**	-0.0986
		(1.899)	(2.920)	(-1.020)	(1.895)	(2.966)	(-1.024)
SMR x DIR x Rec	?/?/0	-0.0855	-0.0074	-0.0833	-0.0862	-0.0081	-0.0840
		(-1.419)	(-0.122)	(-1.241)	(-1.432)	(-0.136)	(-1.252)
DIR x Rec	?/?/?	-0.0014	-0.0018	0.0016	-0.0014	-0.0016	0.0015
		(-0.320)	(-0.420)	(0.342)	(-0.329)	(-0.358)	(0.312)
AR Parameters:							
Lag 1		-0.1898**	-0.1603**	-0.1203*	-0.2034**	-0.1891**	-0.1309*
		(-3.847)	(-3.191)	(-2.396)	(-4.073)	(-3.751)	(-2.585)
Lag 5		-0.1183*			-0.1234*		
		(-2.405)			(-2.514)		
Lag 9				-0.1242*			-0.1382**
				(-2.474)			(-2.742)
Lag 12		-0.1537**			-0.1546**		
		(-3.137)			(-3.135)		
Total R^2		0.776	0.595	0.367	0.776	0.596	0.368
Regression R^2		0.770	0.572	0.368	0.771	0.570	0.370
Root MSE		0.016	0.016	0.017	0.016	0.016	0.017
DW Statistic					1.954	2.002	1.974
Observations		393	393	393	393	393	393

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

As expected, during combination recessionary and declining interest rate periods convertible bonds do not act significantly more or less like equities or more or less like Treasury bonds. The sign and significance of the estimated coefficients β_9 and

β_{10} for the model 12 regressions suggests that periods of declining interest rates combined with recession insignificantly affect the return relationship between convertible and low-grade bonds.

The estimated intercept for the return spread regressions does not suggest that, after adjusting for the various movements of the independent variables, convertible bonds have returned significantly more than low-grade bonds. In this case, the results indicate that after controlling for recessionary and declining interest rate periods, there is no significant difference in the return performance of the two asset classes (i.e., except for the Dimson regression). Also, note that all four regressions generally assign the same sign and level of significance to each comparable estimated coefficient.

As with interest rate call and put periods, during combination recession and declining interest rate periods convertible and low-grade bonds display similar return generation processes. The sign and significance of the estimated coefficients β_9 and β_{10} for the model 12 regressions suggests that periods of declining interest rates combined with recession do not significantly affect the return relationship between convertible bonds and low-grade bonds. This is in contrast to the comparisons of low-grade and high-grade bonds made in Chapters 6 and 7 where the reverse was true.

Based on the estimated coefficient for the sensitivity of the spread between convertible and low-grade bond returns to Treasury bond market returns during combination interest rate call and put periods, there is no reason to reject the hypothesis that the two asset classes have similar return generation processes during combination interest rate call and put periods. If convertible bonds were significantly more (less) sensitive to government bond market movements during declining interest rate and recessionary periods, then it would be expected that the estimated coefficient β_9 would be significantly greater (smaller) than the same coefficient for the low-grade bond regression.

Based on the estimated coefficient for the sensitivity of the spread between convertible and low-grade bond returns to equity market returns during combination interest rate call and put periods, there is no reason to reject the hypothesis that the two asset classes have similar return generation processes during interest rate call and put periods. If convertible bonds were significantly more (less) sensitive to equity market movements during declining interest rate and recessionary periods, then it would be expected that the estimated coefficient β_{10} would be significantly greater (smaller) than the same coefficient for the low-grade bond regression.

4.4 Equity Call Periods

Convertible bonds and low-grade bonds were not expected to significantly differ in their sensitivity to Treasury bond and equity market movements during the previous three periods analyzed, and they did not differ significantly in these sensitivities. The next four periods analyzed involve equity call periods. Therefore, for convertible bonds there is the possibility that there may be some degree of interaction between the risk-free rate of interest, the value of the firm, and the equity call option which may cause the return generation process for convertible bonds to differ significantly from low-grade bonds.

Regarding convertible bond equity calls, if there was a significant affect of the exercise and/or increase in the probability of exercise of equity calls on convertible bonds relative to low-grade bonds it will become significant during periods when equities outperform straight corporate bonds. If convertible bonds are significantly more exposed to equity risk during periods when equities outperform corporate bonds, convertible bond returns should be more sensitive to equity market movements during periods when the relative positive performance of equities increases. Conversely, if there is a significant interaction between the risk-free rate, the value of the firm, and the equity call option, this relationship may not hold. Under more complex CCA risky debt valuation models the opposite result could occur, where convertible bond returns become less sensitive to equity market movements and more sensitive to government bond market movements.

Table 16

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months when Equities Outperform Bonds (Equity Call Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.
A month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 200					
Moments of the Distribution:					
1st - Mean	2.3363%	1.0540%	0.7713%	3.1935%	1.2823%
2nd - Standard Deviation	2.8511%	2.3357%	2.9405%	3.2716%	1.8609%
3rd - Skewness	0.3217	0.1600	0.3337	0.7399	1.2773
4th - Kurtosis	1.7360	1.7150	1.0295	1.6852	3.3341
Minimum	-8.6200%	-7.0880%	-7.4200%	-5.5580%	-3.1570%
Maximum	11.9800%	9.0670%	11.4500%	16.3050%	9.7990%
Tests of Normality#:					
T-Statistic: Mean = 0	11.5885	6.3816	3.7097	13.8043	9.7450
Prob>T	0.0001	0.0001	0.0003	0.0001	0.0001
W: Normal	0.9787	0.9738	0.9799	0.9635	0.9298
Prob<W	0.2470	0.0681	0.3182	0.0014	0.0001

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Convertible bonds were slightly more volatile than low-grade bonds during equity call periods. For equity call months the ratio of convertible bond to low-grade bond standard deviation is approximately 1.22 versus 1.37 for all months. Therefore, during months when equity calls are more probable, there is little change in the relative volatility of convertible bond returns versus those of low-grade bonds.

In order to test the equity call hypothesis, the following regression models were run to test for the impact of equity call periods on the returns of convertible and low-grade bonds.

(13) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{12} \times TBR_t \times EC_t + \beta_{13} \times SMR_t \times EC_t + \beta_{14} \times EC_t + e_t$

(14) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{12} \times TBR_t \times EC_t + \beta_{13} \times SMR_t \times EC_t + \beta_{14} \times EC_t + e_t$

(15) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{12} \times TBR_t \times EC_t + \beta_{13} \times SMR_t \times EC_t + \beta_{14} \times EC_t + e_t$

where EC = a dummy variable equal to one if equities outperform low-grade bonds and zero otherwise. The equity call dummy variable is intended to isolate the effect of periods when equity calls are more frequent and/or more probable for convertible bonds. The regression results are presented in the following two tables.

Table 17

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.
These regression results compare the effect of equity call periods. A month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

					Dimson	Dimson	Dimson
Model		(13)	(14)	(15)	(13)	(14)	(15)
1962:01 to 1994:09	13/14/15		Low-			Low-	
Explanatory Variables	Expected Sign	Convert. Corp.	Grade Corp.	Return Spread	Convert. Corp.	Grade Corp.	Return Spread
Intercept	?/?/0	0.0105**	0.0123**	-0.0018	0.0091**	0.0104**	-0.0014
		(7.443)	(9.928)	(-1.153)	(6.229)	(8.135)	(-0.867)
TBR (Lag 1)					0.0399	0.0640*	-0.0240
					(1.369)	(2.483)	(-0.749)
TBR	+/+/-	0.1386**	0.2689**	-0.1304**	0.1442**	0.2733**	-0.1291**
		(3.380)	(7.497)	(-2.950)	(3.579)	(7.683)	(-2.915)
TBR (Lead 1)					-0.0339	-0.0070	-0.0268
					(-1.175)	(-0.276)	(-0.847)
SMR (Lag 1)					0.0459*	0.0495**	-0.0035
					(2.269)	(2.769)	(-0.159)
SMR	+/+/+	0.7605**	0.4861**	0.2744**	0.7366**	0.4544**	0.2822**
		(21.688)	(15.844)	(7.260)	(21.056)	(14.711)	(7.337)
SMR (Lead 1)					0.0214	0.0264	-0.0050
					(1.079)	(1.507)	(-0.229)
TBR x EC	?/?/0	-0.1306*	-0.1338*	0.0032	-0.1217*	-0.1257*	0.0040
		(-2.185)	(2.557)	(0.049)	(-2.091)	(2.446)	(0.062)
SMR x EC	?/?/0	-0.0350	0.0217	-0.0567	-0.0179	0.0425	-0.0604
		(-0.667)	(0.471)	(-1.001)	(-0.347)	(0.932)	(-1.065)
EC	?/?/?	-0.0104**	-0.0190**	0.0086**	-0.0091**	-0.0174**	0.0083**
		(-4.834)	(-10.102)	(3.715)	(-4.284)	(-9.244)	(3.527)
Adj. R^2		0.769	0.667	0.354	0.783	0.683	0.363
F-Statistic		261.746**	157.819**	43.963**	157.407**	94.218**	25.735**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.016	0.014	0.017	0.016	0.014	0.017
DW Statistic		1.622	1.882	1.711	1.618	1.826	1.714
Observations		393	393	393	391	391	391

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 18

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effect of equity call periods. A month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

Model 1962:01 to 1994:09 Explanatory Variables	13/14/15 Expected Sign	YW (13) Convert. Corp.	OLS (14) Low-Grade Corp.	YW (15) Return Spread	ML (13) Convert. Corp.	OLS (14) Low-Grade Corp.	ML (15) Return Spread
Intercept	?/?/0	0.0100**	0.0123**	-0.0020	0.0099**	0.0123**	-0.0020
		(6.359)	(9.928)	(-1.175)	(6.164)	(9.928)	(-1.175)
TBR	+/+/-	0.1239**	0.2689**	-0.1205**	0.1219**	0.2689**	-0.1198**
		(3.128)	(7.497)	(-2.817)	(3.093)	(7.497)	(-2.808)
SMR	+/+/+	0.7462**	0.4861**	0.2774**	0.7444**	0.4861**	0.2773**
		(21.469)	(15.844)	(7.405)	(21.425)	(15.844)	(7.389)
TBR x EC	?/?/0	-0.0858	-0.1338*	0.0083	-0.0803	-0.1338*	0.0085
		(-1.479)	(2.557)	(0.132)	(-1.386)	(-2.557)	(0.135)
SMR x EC	?/?/0	-0.0505	0.0217	-0.0555	-0.0521	0.0217	-0.0547
		(-0.999)	(0.471)	(-1.011)	(-1.037)	(0.471)	(-0.997)
EC	?/?/?	-0.0088**	-0.0190**	0.0090**	-0.0086**	-0.0190**	0.0090**
		(-4.182)	(-10.102)	(3.945)	(-4.089)	(-10.102)	(3.955)
AR Parameters:							
Lag 1		-0.1594**		-0.1240*	-0.1801**		-0.1298*
		(-3.182)		(-2.474)	(-3.582)		(-2.583)
Lag 9				-0.1301*			-0.1443**
				(-2.595)			(-2.860)
Lag 12		-0.1047*			-0.1187*		
		(-2.091)			(-2.354)		
Total R^2		0.782	0.671	0.385	0.782	0.671	0.386
Regression R^2		0.778	0.671	0.387	0.779	0.671	0.389
Root MSE		0.016	0.014	0.017	0.016	0.014	0.017
DW Statistic			1.882		1.962	1.882	1.965
Observations		393	393	393	393	393	393

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The results indicate that during equity call periods there is no significant difference in the relative return performance of the two asset classes. That is, the estimated intercept in all four regressions is not significantly different from zero. Over the study period, convertible and low-grade bonds did not become significantly more sensitive to equity market movements during equity call periods (i.e., estimated coefficient β_{13}). The estimated equity call period dummy coefficient is significantly positive (i.e., model 15, estimated coefficient β_{14}) and seems to absorb most of the benefit of holding equity calls during equity call periods.

The embedded equity calls in convertible bonds do not have the effect of significantly increasing convertible bonds' sensitivity with respect to equity price movements (i.e., estimated coefficient β_{13} is negative and insignificantly so), but they do significantly decrease their duration with respect to Treasury bond price movements in the OLS regressions (i.e., estimated coefficient β_{12} is negative and significant at the 5% level of significance). This suggests that the duration of convertible bonds actually decreases during equity call periods. Apparently, convertible bonds may not become more equity-like during equity call periods, but they do become less Treasury bond-like. Given that low-grade bonds have similar equity call period effects, the equity call feature embedded in convertible bonds has not produced a significant performance advantage for convertible bonds relative to low-grade bonds.

Overall, the results do not support the contention that during periods when convertible and low-grade bonds would be expected to show significantly different sensitivity to equity prices, they do not. During equity call periods the two asset classes appear to mirror each other. Convertible bonds become insignificantly less equity-like and less government bond-like, and low-grade bonds become insignificantly more equity-like and significantly less Treasury bond-like. Given that the essential difference between convertible bonds and low-grade bonds is the equity call feature, the equity call regression results do not strongly support the notion that equity call periods would be expected to have a significant impact on the relative performance of the two asset classes (i.e., especially with regard to the relative sensitivity of convertible bond values with respect to equity market movements).

4.5 Combination Interest Rate Call and Equity Call Periods

The following three sections analyze equity call periods combined with interest rate call and/or put periods. This section analyzes the effect of combination equity call and interest rate call periods. It is not clear whether combination periods will provide evidence which supports complex interactions between the risk-free rate of interest, firm value, and the value of the equity call option. But to the extent that CCA risky debt valuation models which incorporate interest rate risk apply, combination periods of declining interest rates and equity calls would be expected to generate the most significant effect on the relative sensitivity of convertible bonds to movements in the government bond and equity markets. Therefore, of the following three sections, the results of this section are of particular importance to the issue of the applicability of more complex CCA models to convertible bond valuation.

Table 19

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined & Equities Outperformed Bonds (Interest Rate Call & Equity Call Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.
A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero. A month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 93					
Moments of the Distribution:					
1st - Mean	3.2748%	2.1023%	2.5997%	4.4749%	1.1725%
2nd - Standard Deviation	2.8356%	2.1826%	2.5754%	3.2788%	1.7310%
3rd - Skewness	0.7526	0.1728	0.7647	0.9322	0.7028
4th - Kurtosis	1.2550	1.5594	0.9012	1.6923	1.4003
Minimum	-2.9370%	-4.2660%	-3.1000%	-2.5180%	-3.1570%
Maximum	11.9800%	8.9440%	11.4500%	16.3050%	7.1800%
Tests of Normality#:					
T-Statistic: Mean = 0	11.1373	9.2890	9.7345	13.1617	6.5324
Prob>T	0.0001	0.0001	0.0001	0.0001	0.0001
W: Normal	0.9485	0.9672	0.9642	0.9425	0.9693
Prob<W	0.0030	0.1021	0.0619	0.0008	0.1424

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Convertible bonds were slightly more volatile than low-grade bonds during combination periods of declining interest rates and equity/bond outperformance. The ratio of convertible bond to low-grade bond standard deviation is approximately 1.30 versus 1.37 for all months. During months when it is expected that interest rate and equity calls on convertible bonds and interest rate calls on low-grade bonds will be exercised, there is relatively no change in the volatility of convertible bond returns versus that of low-grade bonds. The combination of interest rate and equity calls alone cannot explain the volatility differential between convertible bonds and low-grade bonds.

In order to test the combination declining interest rate and equity/bond outperformance call hypothesis, the following regression models were run to test for the significance of combination equity and interest rate call periods on the returns of convertible and low-grade bonds:

(16) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{15} \times TBR_t \times EC_t \times DIR_t + \beta_{16} \times SMR_t \times EC_t \times DIR_t + \beta_{17} \times EC_t \times DIR_t + e_t$

(17) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{15} \times TBR_t \times EC_t \times DIR_t + \beta_{16} \times SMR_t \times EC_t \times DIR_t + \beta_{17} \times EC_t \times DIR_t + e_t$

(18) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{15} \times TBR_t \times EC_t \times DIR_t + \beta_{16} \times SMR_t \times EC_t \times DIR_t + \beta_{17} \times EC_t \times DIR_t + e_t$

These regressions are intended to capture the effect of the combined events of interest rate and equity calls for convertible and low-grade bonds. The coefficient β_{15} will isolate the effect that changes in Treasury bond prices have on changes in convertible and low-grade bond prices during periods of declining interest rates and equity/bond outperformance. The coefficient β_{16} will isolate the effect changes in equity prices have on changes in convertible and low-grade bond prices during periods of declining interest rates and equity/bond outperformance. The regression results are presented in the following two tables.

Table 20

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call & Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effects of declining interest rate and equity call periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; and a month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

Model 1962:01 to 1994:09 Explanatory Variables	16/17/18 Expected Sign	(16) Convert. Corp.	(17) Low-Grade Corp.	(18) Return Spread	Dimson (16) Convert. Corp.	Dimson (17) Low-Grade Corp.	Dimson (18) Return Spread
Intercept	?/?/0	0.0065**	0.0049**	0.0017	0.0057**	0.0037**	0.0020
		(6.679)	(5.370)	(1.630)	(5.897)	(4.193)	(1.884)
TBR (Lag 1)					0.0748*	0.1061**	-0.0313
					(2.518)	(3.869)	(-0.980)
TBR	+/+/-	0.1358**	0.3457**	-0.2099**	0.1396**	0.3479**	-0.2083**
		(3.901)	(10.713)	(-5.773)	(4.117)	(11.118)	(-5.716)
TBR (Lead 1)					-0.0317	0.0082	-0.0398
					(-1.075)	(0.301)	(-1.258)
SMR (Lag 1)					0.0517**	0.0611**	-0.0094
					(2.524)	(3.230)	(-0.426)
SMR	+/+/+	0.6912**	0.3606**	0.3306**	0.6824**	0.3499**	0.3325**
		(27.253)	(15.341)	(12.483)	(27.628)	(15.347)	(12.521)
SMR (Lead 1)					0.0234	0.0307	-0.0073
					(1.150)	(1.638)	(-0.336)
TBR x DIR x EC	?/?/0	-0.0307	-0.3493**	0.3186**	-0.0073	0.3280**	0.3207**
		(-0.384)	(-4.708)	(3.812)	(-0.095)	(4.606)	(3.866)
SMR x DIR x EC	?/?/0	-0.0238	0.1269*	-0.1507*	-0.0098	0.1424*	-0.1521*
		(-0.384)	(2.207)	(-2.327)	(-0.162)	(2.556)	(-2.344)
DIR x EC	?/?/?	-0.0064*	-0.0056	-0.0008	-0.0078*	-0.0072	-0.0006
		(-1.957)	(-1.843)	(-0.239)	(-2.476)	(-2.484)	(-0.170)
Adj. R^2		0.755	0.603	0.357	0.775	0.641	0.369
F-Statistic		242.401**	120.236**	44.557**	150.452**	78.255**	26.378**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.015	0.017	0.016	0.015	0.017
DW Statistic		1.545	1.781	1.740	1.551	1.755	1.753
Observations		393	393	393	391	391	391

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 21

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call & Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effects of declining interest rate and equity call periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; and a month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

		YW	YW	YW	ML	ML	ML
Model		(16)	(17)	(18)	(16)	(17)	(18)
1962:01 to 1994:09 Explanatory Variables	16/17/18 Expected Sign	Convert. Corp.	Low-Grade Corp.	Return Spread	Convert. Corp.	Low-Grade Corp.	Return Spread
Intercept	?/?/0	0.0064**	0.0049**	0.0016	0.0064**	0.0049**	0.0016
		(4.287)	(4.965)	(1.273)	(4.084)	(4.875)	(1.232)
TBR	+/+/-	0.1201**	0.3298**	-0.1919**	0.1192**	0.3268**	-0.1904**
		(3.693)	(10.329)	(-5.430)	(3.670)	(10.253)	(-5.385)
SMR	+/+/+	0.6782**	0.3489**	0.3367**	0.6772**	0.3467**	0.3373**
		(27.758)	(14.810)	(12.792)	(27.729)	(14.625)	(12.805)
TBR x DIR x EC	?/?/0	-0.0035	-0.3356**	0.3084**	-0.0028	-0.3329**	0.3080**
		(-0.047)	(-4.565)	(3.707)	(-0.037)	(-4.535)	(3.693)
SMR x DIR x EC	?/?/0	-0.0508	0.1210*	-0.1513*	-0.0523	0.1200*	-0.1511*
		(-0.880)	(2.122)	(-2.388)	(-0.911)	(2.107)	(-2.388)
DIR x EC	?/?/?	-0.0043	-0.0050	-0.0005	-0.0042	-0.0049	-0.0004
		(-1.402)	(-1.680)	(-0.136)	(-1.365)	(-1.644)	(-0.127)
AR Parameters:							
Lag 1		-0.1909**	-0.1078*	-0.1093*	-0.2080**	-0.1288*	-0.1175*
		(-3.861)	(-2.130)	(-2.172)	(-4.206)	(-2.517)	(-2.327)
Lag 4		-0.1093*			-0.1158*		
		(-2.222)			(-2.372)		
Lag 9				-0.1176*			-0.1333**
				(-2.338)			(-2.630)
Lag 12		-0.1294**			-0.1362**		
		(-2.618)			(-2.739)		
Total R^2		0.777	0.614	0.384	0.777	0.614	0.385
Regression R^2		0.773	0.596	0.384	0.774	0.594	0.386
Root MSE		0.016	0.015	0.017	0.016	0.015	0.017
DW Statistic					1.974	1.993	1.963
Observations		393	393	393	393	393	393

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The estimated intercept for the return spread regressions does not suggest that, after adjusting for the various movements of the independent variables, convertible bonds have returned significantly more than low-grade bonds. In this case, the results indicate that after controlling for combination declining interest rate and equity/bond outperformance periods, there is no significant difference in the return performance of the two asset classes. Also, note that all four regressions generally assign the same sign and level of significance to each comparable estimated coefficient.

Based on the estimated coefficient for the sensitivity of the spread between convertible and low-grade bond returns to Treasury bond market returns during combination equity and interest rate call periods, there is reason to reject the hypothesis that convertible bonds behave similarly to low-grade bonds during combination equity and interest rate call periods. If convertible bonds were significantly more (less) sensitive to government bond market movements during combination equity and interest rate call periods, then it would be expected that the estimated coefficient β_{15} would be significantly greater (smaller) than the same coefficient for the low-grade bond regression. The model 18 regressions show that the estimated coefficient β_{15} for the convertible bond regression is significantly larger than the estimated coefficient β_{15} for the low-grade bond regression (i.e., at the 1% level of significance). Therefore, this alone is strong evidence of the relative appropriateness of applying CCA risky debt valuation models which incorporate interest rate risk to convertible bond valuation. This result is in some sense the convertible bond equivalent of the same results for the low-grade/high-grade bond combination interest rate call and put period results in Chapters 6 and 7.

Based on the estimated coefficient for the sensitivity of the spread between convertible and low-grade bond returns to equity market returns during combination equity and interest rate call periods, there is additional reason to reject the hypothesis that convertible bonds behave similarly to low-grade bonds during combination equity and interest rate call periods. If convertible bonds were significantly more (less) sensitive to equity market movements during combination equity and interest rate call periods, then it would be expected that the estimated coefficient β_{16} would be significantly greater (smaller) than the same coefficient for the low-grade bond regression. The model 18 regressions show that the estimated coefficient β_{16} for the convertible bond regression is significantly smaller than the estimated coefficient β_{16} for the low-grade bond regression (i.e., at the 5% level of significance). Therefore, this alone is evidence of the relative appropriateness of applying CCA risky debt valuation models which incorporate interest rate risk to convertible bond valuation. Again, this result is in some sense the convertible bond equivalent of the same results for the low-grade/high-grade bond combination interest rate call and put period results in Chapters 6 and 7.

Overall, the results suggest that during periods when convertible bonds and low-grade bonds would be expected to show relatively equal sensitivity to government bond and equity prices, they do not (i.e., based on more simple CCA risky debt valuation models). Convertible bonds become insignificantly less Treasury bond-like and insignificantly more equity-like, and low-grade bonds become significantly less Treasury bond-like and significantly more equity-like. Given that the essential difference between convertible and low-grade bonds is the equity call feature, these regression results support more complex CCA risky debt valuation models which incorporate interest rate risk.

During combination declining interest rate and equity/bond outperformance periods convertible bonds do not significantly differ in their sensitivity to equity or government bond price movements. On the other hand, during combination declining interest rate and equity/bond outperformance periods low-grade bonds become more equity-like (at the 5% level of significance) and less bond-like (at the 1% level of significance). Relative to low-grade bonds during combination declining interest rate and equity/bond outperformance periods, convertible bonds act less equity-like and more bond-like (i.e., model 18 estimated coefficients β_{16} and β_{15}, respectively). Therefore, the sign and significance of the estimated coefficients β_{15} and β_{16} for the model 18 regressions suggests that periods of declining interest rates combined with equity/bond outperformance significantly affect the return relationship between convertible and low-grade bonds. This effect did not occur during interest rate call periods or during equity/bond outperformance periods. Therefore, standard CCA risky debt valuation models which do not account for the interaction between the risk-free rate of interest, firm value, and the equity call option would not be capable of explaining this result.

4.6 Combination Put and Equity Call Periods

This section analyzes the effect of combination equity call and put periods. The last section was the first section to provide evidence which supports complex interactions between the risk-free rate of interest, firm value, and the value of the equity call option. Given that this section does not explicitly analyze changes in interest rates, the same level of evidence in favor of CCA risky debt valuation models which incorporate interest rate risk is not expected.

Table 22

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months of Recession & when Equities Outperformed Bonds (Put & Equity Call Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.
A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition. A month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 26					
Moments of the Distribution:					
1st - Mean	3.0163%	1.3412%	1.6630%	4.0951%	1.6751%
2nd - Standard Deviation	3.9954%	3.8083%	4.0133%	4.9043%	2.2369%
3rd - Skewness	0.3457	0.1114	-0.2549	0.5986	1.4411
4th - Kurtosis	-0.0391	-0.5967	-0.2746	0.3497	2.8648
Minimum	-4.2250%	-5.0500%	-7.1400%	-3.9050%	-1.6540%
Maximum	11.9800%	9.0670%	8.3200%	16.3050%	8.2480%
Tests of Normality#:					
T-Statistic: Mean = 0	3.8495	1.7958	2.1129	4.2577	3.8184
Prob>T	0.0007	0.0846	0.0448	0.0003	0.0008
W: Normal	0.9714	0.9612	0.9767	0.9597	0.8778
Prob<W	0.6717	0.4344	0.7999	0.4047	0.0047

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Convertible bonds were slightly more volatile than low-grade bonds during periods of equity/bond outperformance and recession. The ratio of convertible bond to low-grade bond standard deviation is approximately 1.05 versus 1.37 for all months. During months when it is expected that equity calls and puts on convertible bonds and puts on low-grade bonds will be exercised, there is relatively little change in the volatility of convertible bond returns versus that of low-grade bonds. The combination of equity calls and puts alone cannot explain the volatility differential between convertible and low-grade bonds.

In order to test the combination equity/bond outperformance call and recession put hypothesis, the following regression models were run to test for the significance of combination equity call and put periods on the returns of convertible and low-grade bonds:

(19) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{18} \times TBR_t \times EC_t \times \mathrm{Rec}_t + \beta_{19} \times SMR_t \times EC_t \times \mathrm{Rec}_t + \beta_{20} \times EC_t \times \mathrm{Rec}_t + e_t$

(20) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{18} \times TBR_t \times EC_t \times \mathrm{Rec}_t + \beta_{19} \times SMR_t \times EC_t \times \mathrm{Rec}_t + \beta_{20} \times EC_t \times \mathrm{Rec}_t + e_t$

(21) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{18} \times TBR_t \times EC_t \times \mathrm{Rec}_t + \beta_{19} \times SMR_t \times EC_t \times \mathrm{Rec}_t + \beta_{20} \times EC_t \times \mathrm{Rec}_t + e_t$

These regressions are intended to capture the effect of the combination of equity calls and puts for convertible bonds and puts for low-grade bonds. The coefficient β_{18} will isolate the effect that changes in Treasury bond prices have on changes in convertible and low-grade bond prices during periods of equity/bond outperformance and recession. The coefficient β_{19} will isolate the effect changes in equity prices have on changes in convertible and low-grade bond prices during periods of equity/bond outperformance and recession. The regression results are presented in the following two tables.

Table 23

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - Put & Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effects of recessionary and equity call periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough; and a month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

					Dimson	Dimson	Dimson
Model		(19)	(20)	(21)	(19)	(20)	(21)
1962:01 to 1994:09	19/20/21		Low-			Low-	
Explanatory	Expected	Convert.	Grade	Return	Convert.	Grade	Return
Variables	Sign	Corp.	Corp.	Spread	Corp.	Corp.	Spread
Intercept	?/?/0	0.0052**	0.0040**	0.0012	0.0044**	0.0029**	0.0015
		(5.823)	(4.798)	(1.290)	(4.933)	(3.527)	(1.559)
TBR (Lag 1)					0.0670*	0.1164**	-0.0494
					(2.223)	(4.172)	(-1.532)
TBR	+/+/-	0.1023**	0.2460**	-0.1437**	0.1041**	0.2453**	-0.1412**
		(3.182)	(8.191)	(-4.291)	(3.332)	(8.484)	(-4.224)
TBR (Lead 1)					-0.0331	-0.0030	-0.0301
					(-1.105)	(-0.109)	(-0.938)
SMR (Lag 1)					0.0565**	0.0616**	-0.0052
					(2.730)	(3.219)	(-0.233)
SMR	+/+/+	0.6543**	0.3344**	0.3198**	0.6477**	0.3242**	0.3235**
		(29.380)	(16.082)	(13.794)	(29.827)	(16.127)	(13.917)
SMR (Lead 1)					0.0266	0.0342	-0.0075
					(1.305)	(1.807)	(-0.343)
TBR x Rec x EC	?/?/0	-0.0210	-0.0048	-0.0162	0.0410	0.0563	-0.0152
		(-0.195)	(-0.047)	(-0.145)	(0.392)	(0.580)	(-0.136)
SMR x Rec x EC	?/?/0	0.0526	0.2340**	-0.1814*	0.0392	0.2184**	-0.1792*
		(0.607)	(2.890)	(-2.009)	(0.471)	(2.832)	(-2.010)
Rec x EC	?/?/?	-0.0054	-0.0179**	0.0125**	-0.0064	-0.0199**	0.0013**
		(-1.202)	(-4.301)	(2.703)	(-1.494)	(-5.000)	(2.929)
Adj. R^2		0.749	0.587	0.345	0.769	0.629	0.358
F-Statistic		234.653**	112.575**	42.279**	145.316**	74.364**	25.144**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.016	0.018	0.016	0.015	0.017
DW Statistic		1.551	1.712	1.701	1.549	1.681	1.706
Observations		393	393	393	391	391	391

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 24

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - Put & Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.
These regression results compare the effects of recessionary and equity call periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough; and a month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

		YW	YW	YW	ML	ML	ML
Model		(19)	(20)	(21)	(19)	(20)	(21)
1962:01 to 1994:09	19/20/21		Low-			Low-	
Explanatory	Expected	Convert.	Grade	Return	Convert.	Grade	Return
Variables	Sign	Corp.	Corp.	Spread	Corp.	Corp.	Spread
Intercept	?/?/0	0.0053**	0.0042**	0.0011	0.0053**	0.0042**	0.0011
		(3.520)	(3.978)	(0.927)	(3.403)	(3.845)	(0.894)
TBR	+/+/-	0.1013**	0.2335**	-0.1301**	0.1008**	0.2313**	-0.1291**
		(3.399)	(7.907)	(-4.001)	(3.386)	(7.855)	(-3.977)
SMR	+/+/+	0.6458**	0.3175**	0.3277**	0.6449**	0.3150**	0.3286**
		(30.423)	(15.599)	(14.419)	(30.385)	(15.387)	(14.444)
TBR x Rec x EC	?/?/0	-0.0229	0.0275	0.0214	-0.0215	0.0313	0.0259
		(-0.227)	(0.283)	(0.197)	(-0.212)	(0.321)	(0.238)
SMR x Rec x EC	?/?/0	0.0245	0.2265**	-0.2155*	0.0223	0.2250**	-0.2187*
		(0.306)	(2.891)	(-2.504)	(0.279)	(2.880)	(-2.554)
Rec x EC	?/?/?	-0.0037	-0.0186**	0.0138**	-0.0036	-0.0187**	0.0139**
		(-0.873)	(-4.501)	(3.022)	(-0.845)	(-4.493)	(3.052)
AR Parameters:							
Lag 1		-0.1728**	-0.1351**	-0.1295*	-0.1875**	-0.1591**	-0.1389**
		(-3.492)	(-2.685)	(-2.585)	(-3.772)	(-3.122)	(-2.757)
Lag 5		-0.1315**			-0.1346**		
		(-2.667)			(-2.735)		
Lag 9				-0.1283			-0.1450**
				(-2.561)			(-2.872)
Lag 11			-0.1045*			-0.1133*	
			(-2.076)			(-2.230)	
Lag 12		-0.1488**			-0.1510**		
		(-3.027)			(-3.047)		
Total R^2		0.773	0.607	0.378	0.773	0.607	0.378
Regression R^2		0.767	0.582	0.379	0.768	0.580	0.382
Root MSE		0.016	0.016	0.017	0.016	0.016	0.017
DW Statistic					1.959	2.000	1.963
Observations		393	393	393	393	393	393

T-statistics are in parentheses.
* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The estimated intercept for the return spread regressions does not suggest that, after controlling for the various movements of the independent variables, convertible bonds have returned significantly more than low-grade bonds. In this case, the results indicate that after controlling for combination recession and equity/bond outperformance periods, there is no significant difference in the return performance of the two asset classes. Also, note that all four regressions generally assign the same sign and level of significance to each comparable estimated coefficient.

Based on the estimated coefficient for the sensitivity of the spread between convertible and low-grade bond returns to Treasury bond market returns during combination put and equity call periods, there is no reason to reject the hypothesis that convertible bonds behave similarly to low-grade bonds during combination put and equity call periods. If convertible bonds were significantly more (less) sensitive to government bond market movements during combination put and equity call periods, then it would be expected that the estimated coefficient β_{18} would be significantly greater (smaller) than the same coefficient for the low-grade bond regression. The model 21 regressions show that the estimated coefficient β_{18} for the convertible bond regression is insignificantly smaller than the estimated coefficient β_{18} for the low-grade bond regression.

Based on the estimated coefficient for the sensitivity of the spread between convertible bond and low-grade bond returns to equity market returns during combination put and equity call periods, there is evidence to reject the hypothesis that convertible bonds behave similarly to low-grade bonds during combination put and equity call periods. If convertible bonds were significantly more (less) sensitive to equity market movements during combination put and equity call periods, then it would be expected that the estimated coefficient β_{19} would be significantly greater (smaller) than the same coefficient for the low-grade bond regression. The model 21 regressions show that the estimated coefficient β_{19} for the convertible bond regression is significantly smaller than the estimated coefficient β_{19} for the low-grade bond regression (i.e., at the 5% level of significance).

Overall, the results suggest that during periods when convertible and low-grade bonds would be expected to show relatively equal sensitivity to Treasury bond and equity markets, they do not. During combination equity call and put periods convertible bonds become insignificantly less government bond-like and insignificantly more equity-like, while low-grade bonds become insignificantly more government bond-like and significantly more equity-like. Given that the essential difference between convertible and low-grade bonds is the equity call feature, the combination recession and equity/bond outperformance regression results support more complex CCA risky debt valuations models which incorporate interactions between the various embedded options.

During combination recession and equity/bond outperformance periods convertible bonds do not significantly differ in their sensitivity to equity or Treasury bond market movements. On the other hand, during combination recession and equity/bond outperformance periods low-grade bonds become more equity-like (at the 1% level of significance) and insignificantly more bond-like. Relative to low-grade bonds during combination recession and equity/bond outperformance periods, convertible bonds act less equity-like (i.e., model 21 estimated coefficient β_{19}). Therefore, the sign and significance of the estimated coefficient β_{19} for the model 21 regressions suggests that periods of recession combined with equity/bond outperformance significantly affect the return relationship between convertible and low-grade bonds. This effect did not occur during recession periods or during equity/bond outperformance periods. Therefore, standard CCA risky debt valuation models which do not incorporate interaction effects among the embedded options would not be capable of explaining this result.

4.7 Combination Interest Rate Call, Put, and Equity Call Periods

This section analyzes the effect of combination equity call, put, and interest rate call periods. The last two sections were the first sections to provide evidence which supports complex interactions between the risk-free rate of interest, firm value, and the value of the equity call option. Given that this section does explicitly analyze changes in interest rates, evidence in favor of CCA risky debt valuation models which incorporate interest rate risk is expected.

Table 25

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: Only for Months when Interest Rates Declined & Recession & when Equities Outperformed Bonds (Interest Rate Call & Put & Equity Call Months)

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.

A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition. A month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 16					
Moments of the Distribution:					
1st - Mean	3.6766%	2.0884%	3.6793%	4.9104%	1.5883%
2nd - Standard Deviation	4.0931%	3.4906%	2.9227%	4.9872%	1.9850%
3rd - Skewness	0.5239	-0.3067	0.2446	0.6946	1.3268
4th - Kurtosis	0.0075	-0.5329	-1.1702	0.4444	3.5942
Minimum	-2.9370%	-4.2660%	-6.8000%	-2.0150%	-1.6540%
Maximum	11.9800%	7.9920%	8.3200%	16.3050%	7.1800%
Tests of Normality#:					
T-Statistic: Mean = 0	3.5930	2.3931	5.0355	3.9385	3.2005
Prob>T	0.0027	0.0302	0.0001	0.0013	0.0060
W: Normal	0.9412	0.9387	0.9460	0.9459	0.8953
Prob<W	0.3593	0.3304	0.4202	0.4193	0.0686

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Convertible bonds were more volatile than low-grade bonds during periods of declining interest rates, equity/bond outperformance, and recession. The ratio of convertible bond to low-grade bond standard deviation is approximately 1.17 versus 1.37 for all months. During months when it is expected that equity calls, puts, and interest rate calls on convertible bonds and puts and interest rate calls on low-grade bonds will be exercised, there is relatively little change in the volatility of convertible bond returns versus that of low-grade bonds. The combination of equity calls, puts, and interest rate calls alone cannot explain the volatility differential between convertible bonds and low-grade bonds.

In order to test the combination equity/bond outperformance call, recession put, and declining interest rate call hypothesis, the following regression models were run to test for the significance of combination equity call, put, and interest rate call periods on the returns of convertible and low-grade bonds:

(22) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{21} \times TBR_t \times EC_t \times \mathrm{Rec}_t \times DIR_t + \beta_{22} \times SMR_t \times EC_t \times \mathrm{Rec}_t \times DIR_t + \beta_{23} \times EC_t \times \mathrm{Rec}_t \times DIR_t + e_t$

(23) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{21} \times TBR_t \times EC_t \times \mathrm{Rec}_t \times DIR_t + \beta_{22} \times SMR_t \times EC_t \times \mathrm{Rec}_t \times DIR_t + \beta_{23} \times EC_t \times \mathrm{Rec}_t \times DIR_t + e_t$

(24) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{21} \times TBR_t \times EC_t \times \mathrm{Rec}_t \times DIR_t + \beta_{22} \times SMR_t \times EC_t \times \mathrm{Rec}_t \times DIR_t + \beta_{23} \times EC_t \times \mathrm{Rec}_t \times DIR_t + e_t$

These regressions are intended to capture the relative effect of the combined events of equity calls, puts, and interest rate calls for convertible bonds and puts and interest rate calls for low-grade bonds. The coefficient β_{21} will isolate the effect that changes in Treasury bond prices have on changes in convertible and low-grade bond prices during periods of equity/bond outperformance, recession, and declining interest rates. The coefficient β_{22} will isolate the effect changes in equity prices have on changes in convertible and low-grade bond prices during periods of equity/bond outperformance, recession, and declining interest rates. The regression results are presented in the following two tables.

Table 26

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call & Put & Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effects of declining interest rate, recessionary, and equity call periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough; and a month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

Model 1962:01 to 1994:09 Explanatory Variables	22/23/24 Expected Sign	(22) Convert. Corp.	(23) Low-Grade Corp.	(24) Return Spread	Dimson (22) Convert. Corp.	Dimson (23) Low-Grade Corp.	Dimson (24) Return Spread
Intercept	?/?/0	0.0052**	0.0037**	0.0014	0.0043**	0.0025**	0.0018
		(5.840)	(4.453)	(1.564)	(4.887)	(3.061)	(1.866)
TBR (Lag 1)					0.0679*	0.1112**	-0.0434
					(2.256)	(3.935)	(-1.341)
TBR	+/+/-	0.1024**	0.2644**	-0.1619**	0.1075**	0.2666**	-0.1591**
		(3.266)	(8.927)	(-4.938)	(3.532)	(9.316)	(-4.855)
TBR (Lead 1)					-0.0346	0.0045	-0.0371
					(-1.156)	(0.088)	(-1.151)
SMR (Lag 1)					0.0583**	0.0613**	-0.0030
					(2.818)	(3.150)	(-0.133)
SMR	+/+/+	0.6557**	0.3377**	0.3181**	0.6476**	0.3270**	0.3206**
		(30.092)	(16.410)	(13.961)	(30.445)	(16.351)	(14.002)
SMR (Lead 1)					0.0262	0.0376	-0.0114
					(1.280)	(1.955)	(-0.518)
TBR x DIRxRecxEC	?/?/0	0.1249	-0.0944	0.2193	0.2413	0.0108	0.2305
		(0.674)	(-0.540)	(1.132)	(1.334)	(0.063)	(1.184)
SMR x DIRxRecxEC	?/?/0	-0.0079	0.2254*	-0.2333*	-0.0194	0.2147*	-0.2342*
		(-0.073)	(2.186)	(-2.044)	(-0.185)	(2.170)	(-2.067)
DIR x Rec x EC	?/?/?	-0.0086	-0.0167*	0.0082	-0.0125	-0.0217**	0.0092
		(-1.201)	(-2.485)	(1.096)	(-1.816)	(-3.346)	(1.235)
Adj. R^2		0.749	0.578	0.340	0.770	0.618	0.353
F-Statistic		234.755**	108.449**	41.335**	145.872**	71.147**	24.595**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.016	0.018	0.016	0.015	0.017
DW Statistic		1.547	1.746	1.723	1.546	1.726	1.732
Observations		393	393	393	391	391	391

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 27

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - Interest Rate Call & Put & Equity Call Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

These regression results compare the effects of declining interest rate, recessionary, and equity call periods. A month is defined as a period of declining interest rates if during the month the change in yield on the ten year constant maturity Treasury bond is less than zero; a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough; and a month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds. The recession period is definition directly based on the U.S. Bureau of Economic Analysis definition.

Model 1962:01 to 1994:09 Explanatory Variables	22/23/24 Expected Sign	YW (22) Convert. Corp.	YW (23) Low-Grade Corp.	YW (24) Return Spread	ML (22) Convert. Corp.	ML (23) Low-Grade Corp.	ML (24) Return Spread
Intercept	?/?/0	0.0053**	0.0038**	0.0014	0.0053**	0.0038**	0.0014
		(3.481)	(4.074)	(1.165)	(3.366)	(3.994)	(1.127)
TBR	+/+/-	0.0910**	0.2511**	-0.1469**	0.0976**	0.2487**	-0.1457**
		(3.371)	(8.607)	(-4.607)	(3.358)	(8.553)	(-4.576)
SMR	+/+/+	0.6468**	0.3251**	0.3256**	0.6459**	0.3229**	0.3264**
		(31.129)	(15.930)	(14.587)	(31.080)	(15.774)	(14.611)
TBR x DIRxRecxEC	?/?/0	0.1658	-0.1143	0.2817	0.1669	-0.1177	0.2884
		(0.979)	(-0.672)	(1.499)	(0.988)	(-0.694)	(1.533)
SMR x DIRxRecxEC	?/?/0	-0.0468	0.2189*	-0.2725*	-0.0495	0.2178*	-0.2761*
		(-0.463)	(2.143)	(-2.433)	(-0.488)	(2.128)	(-2.471)
DIR x DIR x EC	?/?/?	-0.0076	-0.0146*	0.0076	-0.0075	-0.0142*	0.0076
		(-1.148)	(-2.196)	(1.056)	(-1.130)	(-2.140)	(1.050)
AR Parameters:							
Lag 1		-0.1750**	-0.1254*	-0.1185*	-0.1902**	-0.1485**	-0.1284*
		(-3.541)	(-2.484)	(-2.362)	(-3.829)	(-2.904)	(-2.545)
Lag 5		-0.1320**			-0.1356**		
		(-2.679)			(-2.763)		
Lag 9				-0.1308**			-0.1456**
				(-2.606)			(-2.880)
Lag 12		-0.1526**			-0.1536**		
		(-3.109)			(-3.108)		
Total R^2		0.774	0.591	0.371	0.774	0.591	0.372
Regression R^2		0.768	0.571	0.373	0.769	0.568	0.375
Root MSE		0.016	0.016	0.017	0.016	0.016	0.017
DW Statistic					1.953	1.992	1.961
Observations		393	393	393	391	391	391

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

The estimated intercept for the return spread regressions does not suggest that, after adjusting for the various movements of the independent variables, convertible bonds have returned significantly more than low-grade bonds. In this case, the results indicate that after controlling for combination declining interest rates, recession, and equity/bond outperformance periods, there is no significant difference in the return performance of the two asset classes. Also, note that all four regressions generally assign the same sign and level of significance to each comparable estimated coefficient.

Based on the estimated coefficient for the sensitivity of the spread between convertible and low-grade bond returns to Treasury bond market returns during combination interest rate call, put, and equity call periods, there is no reason to reject the hypothesis that convertible bonds behave similarly to low-grade bonds during combination interest rate call, put, and equity call periods. If convertible bonds were significantly more (less) sensitive to government bond market movements during combination interest rate call, put, and equity call periods, then it would be expected that the estimated coefficient β_{21} would be significantly greater (smaller) than the same coefficient for the low-grade bond regression. The model 24 regressions show that the estimated coefficient β_{21} for the convertible bond regression is insignificantly larger than the estimated coefficient β_{21} for the low-grade bond regression.

Based on the estimated coefficient for the sensitivity of the spread between convertible bond and low-grade bond returns to equity market returns during combination interest rate call, put, and equity call periods, there is evidence to reject the hypothesis that convertible bonds behave similarly to low-grade bonds during combination interest rate call, put, and equity call periods. If convertible bonds were significantly more (less) sensitive to equity market movements during combination interest rate call, put, and equity call periods, then it would be expected that the estimated coefficient β_{22} would be significantly greater (smaller) than the same coefficient for the low-grade bond regression. The model 24 regressions show that the estimated coefficient β_{22} for the convertible bond regression is significantly smaller than the estimated coefficient β_{22} for the low-grade bond regression (i.e., at the 5% level of significance).

Overall, the results suggest that during periods when convertible and low-grade bonds would be expected to show relatively equal sensitivity to Treasury bond and equity market movements, they do not. Convertible bonds become insignificantly more Treasury bond-like and insignificantly less equity-like, while low-grade bonds become insignificantly less Treasury bond-like and significantly more equity-like. Given that the essential difference between convertible and low-grade bonds is the equity call feature, the combination declining interest rates, recession, and equity/bond outperformance periods regression results support more complex CCA risky debt valuations models which incorporate interest rate risk and/or interactions between the various embedded options.

During combination declining interest rates, recession, and equity/bond outperformance periods convertible bonds do not significantly differ in their sensitivity to equity or government bond market movements. On the other hand, during combination declining interest rates, recession, and equity/bond outperformance periods low-grade bonds become more equity-like (at the 5% level of significance) and insignificantly less bond-like. Relative to low-grade bonds during combination declining interest rates, recession, and equity/bond outperformance periods, convertible bonds act significantly less equity-like (i.e., model 24 estimated coefficient β_{22}). Therefore, the sign and significance of the estimated coefficient β_{22} for the model 24 regressions suggests that periods of declining interest rates and recession combined with equity/bond outperformance significantly affect the return relationship between convertible and low-grade bonds. This effect did not occur during declining interest rate periods or during recession periods or during equity/bond outperformance periods. Therefore, standard CCA risky debt valuation models which do not incorporate interest rate risk and/or interaction effects among the embedded options would not be capable of explaining this result.

5 Convertibles and the January Effect

A slight digression is in order to evaluate whether convertible bonds display a January returns generation process which significantly differs from low-grade bonds. The following table provides summary statistics for the asset classes examined in this chapter for the month of January.

Table 28

Summary Statistics and Tests of Normality for the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, Treasury Bonds, and Equities: January Only

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80% of assets in corporate bond issues rated below BBB.

1962:01 to 1994:09	Convertible Bonds	Low-Grade Corporate	Treasury Bonds	S&P 500	CVT - LGC Spread
Observations = 33					
Moments of the Distribution:					
1st - Mean	2.5152%	2.0361%	0.1869%	1.6989%	0.4791%
2nd - Standard Deviation	3.8185%	2.8743%	2.8686%	5.4205%	2.6291%
3rd - Skewness	0.5842	0.5580	-0.2949	0.2979	1.6852
4th - Kurtosis	-0.2531	0.8442	0.7167	-0.3516	3.8348
Minimum	-3.6190%	-3.8720%	-7.4200%	-7.6470%	-3.0820%
Maximum	11.6100%	9.0670%	6.6700%	13.1770%	9.7990%
Tests of Normality#:					
T-Statistic: Mean = 0	3.7839	4.0694	0.3744	1.8005	1.0469
Prob>T	0.0006	0.0003	0.7106	0.0812	0.3030
W: Normal	0.9559	0.9598	0.9854	0.9675	0.8668
Prob<W	0.2423	0.3095	0.9409	0.4812	0.0006

The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

Convertible bonds were slightly more volatile than low-grade bonds during the month of January, but not significantly so. During January, the ratio of convertible bond to low-grade bond standard deviation is approximately 1.33 versus 1.37 for all months. Equities were clearly the most volatile during the month of January. In addition, of the four asset classes, only Treasury bonds are slightly negatively skewed. Whereas, of the three bond asset classes, low-grade bonds have been distributed relatively platykurtically over the period under study.

The tests for normality suggest that, at standard levels of statistical significance, all four asset class return are drawn from a random sample from a normal distribution (i.e., the Shapiro-Wilk test). Only the two corporate bond asset class return series reject the null hypothesis that mean of each respective distribution is equal to zero. At normal levels of statistical significance, only the two corporate bond asset class return series have means which are significantly positive. Across all values presented, the two corporate bond asset classes appear to mirror each other during the month of January.

Given that low-grade bonds display a January effect (e.g., see Blume et al. [1991]), does this result extend to convertible bonds? Specifically, after controlling for Treasury bond and equity market movements, do convertible bonds display a January effect? The following regression models were run for the convertible and low-grade bond asset classes:

(24) $CVT_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{24} \times JanDV_t + e_t$

(25) $LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{24} \times JanDV_t + e_t$

(26) $CVT_t - LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times SMR_t + \beta_{24} \times JanDV_t + e_t$,

where JanDV = a dummy variable equal to one if the month is January and zero otherwise. The following two tables provide the results for the January effect regressions.

Table 29

Coefficients from Two Factor Ordinary Least Squares Regressions of Convertible and Low-Grade Corporate Bond Returns - January Effect Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

					Dimson	Dimson	Dimson
Model		(25)	(26)	(27)	(25)	(26)	(27)
1962:01 to 1994:09	25/26/27		Low-			Low-	
Explanatory Variables	Expected Sign#	Convert. Corp.	Grade Corp.	Return Spread	Convert. Corp.	Grade Corp.	Return Spread
Intercept	?/?/0	0.0042**	0.0024**	0.0018	0.0041**	0.0027**	0.0014*
		(4.651)	(2.802)	(1.876)	(4.555)	(3.219)	(1.409)
TBR (Lag 1)					0.0608*	0.1061**	-0.0453
					(2.043)	(3.769)	(-1.418)
TBR	+/+/-	0.1082**	0.2622**	-0.1540**	0.1093**	0.2577**	-0.1484**
		(3.590)	(9.181)	(-4.803)	(3.663)	(9.132)	(-4.638)
TBR (Lead 1)					-0.0313	-0.0018	-0.0295
					(-1.055)	(-0.064)	(-0.928)
SMR (Lag 1)					0.0568**	0.0621**	-0.0053
					(2.766)	(3.197)	(-0.241)
SMR	+/+/+	0.6471**	0.3334**	0.3136**	0.6468**	0.3332**	0.3136**
		(31.007)	(16.860)	(14.129)	(31.391)	(17.099)	(14.193)
SMR (Lead 1)					0.0269	0.0402	-0.0133
					(1.310)	(2.069)	(-0.603)
January Dummy	?/+/?	0.0098**	0.0118**	-0.0020	0.0002	-0.0075	0.0076
		(3.207)	(4.090)	(-0.628)	(0.050)	(-2.621)	(2.358)
Adj. R^2		0.756	0.590	0.335	0.769	0.612	0.355
F-Statistic		404.870**	186.354**	66.728**	186.272**	88.893**	31.633**
Dependent Mean		0.009	0.007	0.003	0.009	0.007	0.002
Root MSE		0.017	0.016	0.018	0.016	0.015	0.017
DW Statistic		1.554	1.693	1.727	1.536	2.301	1.722
Observations		393	393	393	391	391	391

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 30

Coefficients from Two Factor Regressions using the Yule-Walker and Maximum Likelihood Methods of Estimating the Autoregressive Parameters of Convertible and Low-Grade Corporate Bond Returns - January Effect Regressions

The data are monthly returns. All values are derived from Morningstar. Each return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions were based on Lipper definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds invest at least 80% of assets in corporate bond issues rated below BBB.

Model 1962:01 to 1994:09 Explanatory Variables	25/26/27 Expected Sign#	YW (25) Convert. Corp.	YW (26) Low-Grade Corp.	YW (27) Return Spread	ML (25) Convert. Corp.	ML (26) Low-Grade Corp.	ML (27) Return Spread
Intercept	?/?/0	0.0044**	0.0026**	0.0017	0.0044**	0.0026**	0.0017
		(2.946)	(2.634)	(1.442)	(2.888)	(2.597)	(1.407)
TBR	+/+/-	0.1047**	0.2470**	-0.1390**	0.1043**	0.2448**	-0.1380**
		(3.707)	(8.785)	(-4.406)	(3.690)	(8.730)	(-4.377)
SMR	+/+/+	0.6376**	0.3194**	0.3187**	0.6366**	0.3175**	0.3191**
		(32.358)	(16.515)	(14.735)	(32.240)	(16.379)	(14.749)
January Dummy	?/+/?	0.0091**	0.0118**	-0.0019	0.0090**	0.0118**	-0.0019
		(2.849)	(4.222)	(-0.617)	(2.851)	(4.227)	(-0.609)
AR Parameters:							
Lag 1		-0.1789**	-0.1523**	-0.1161*	-0.1910**	-0.1745**	-0.1234*
		(-3.623)	(-3.036)	(-2.316)	(-3.863)	(-3.456)	(-2.451)
Lag 5		-0.1311**			-0.1350**		
		(-2.662)			(-2.752)		
Lag 9				-0.1190*			-0.1306**
				(-2.374)			(-2.597)
Lag 12		-0.1359**			-0.1336**		
		(-2.771)			(-2.710)		
Total R^2		0.777	0.601	0.360	0.778	0.601	0.361
Regression R^2		0.771	0.578	0.360	0.771	0.576	0.362
Root MSE		0.016	0.016	0.018	0.016	0.016	0.018
DW Statistic					1.967	1.989	1.963
Observations		393	393	393	393	393	393

T-statistics are in parentheses.

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

Convertible bonds do display a strong January effect. As is the case in the return spread regression which does not include the January dummy variable (i.e., model 3), the estimated intercept for the return spread regression is positive but not significant. The estimated January dummy coefficients for convertible bonds have roughly the same level of January effect as those for low-grade bonds. Therefore, regarding the January effect, convertible bonds and low-grade bonds are roughly equivalent. Although beyond the scope of this paper, a more detailed analysis of the convertible bond January effect would be a worthwhile analysis.

6 Summary and Conclusions

This chapter is the first to analyze the pricing of convertible bonds by examining the financial performance of open-end convertible bond funds over the period 01/62 through 09/94. The following are several findings of this chapter: (1) in general, after adjusting for government bond and equity market movements, convertible bonds have not outperformed low-grade bonds over the study period, (2) convertible bonds are significantly more equity-like and significantly less bond-like than low-grade bonds, and (3) convertible bonds display a strong January effect. Furthermore, the results suggest that the equity call option embedded in convertible bonds has been appropriately price over the period 01/62 through 09/94.

During periods of declining interest rates, recession, or combination periods of declining interest rate and recession, convertible bonds do not demonstrate significantly different volatility compared to that of low-grade bonds (i.e., during the three periods which correspond to those examined in Chapters 6 and 7). In addition, during the following combination periods convertible bonds do not demonstrate significantly different volatility compared to that of low-grade bonds: (1) equity/bond outperformance, (2) declining interest rates and equity/bond outperformance, (3) recession and equity/bond outperformance, and (4) declining interest rates, recession, and equity/bond outperformance. This would imply that much of the volatility differential between convertible and low-grade bonds is generated over many different periods, not just one.

Regarding the hypothesis that convertible bonds have significantly weaker interest rate call protection and/or relatively more interest rate calls than low-grade bonds, the tests performed in this chapter do not support such an assertion. Regarding the hypothesis that convertible bonds have significantly weaker put protection and/or relatively more puts than low-grade bonds, the tests performed in this chapter do not support such an assertion. Regarding the hypothesis that convertible bonds have significantly weaker interest rate call and put protection and/or relatively more interest rate calls and puts than low-grade bonds, the tests performed in this chapter do not support such an assertion. Therefore, convertible bonds display similar return generation processes during the three periods which correspond to those examined in Chapters 6 and 7 (i.e., interest rate call periods, put periods, and combination interest rate call and put periods).

Regarding the relative sensitivity of convertible and low-grade bonds to movements in the government bond and equity markets, the overall results of the tests conducted support more complex CCA risky debt valuation models which incorporate interest rate risk and the interaction of the principal embedded options. The following table provides a summary of the tests conducted.

Table 31

A Comparison of Expectations and Outcomes for Convertible versus Low-Grade Bonds

Simple CCA & Credit Spread Effect Expectations		
Period under Study	Expectation for Sensitivity to Treasury Bonds (est. β_3, β_6, β_9, β_{12}, β_{15}, β_{18}, β_{21})	Expectation for Sensitivity to Stocks (est. β_4, β_7, β_{10}, β_{13}, β_{16}, β_{19}, β_{22})
Interest Rate Call Periods (i.e., declining interest rates)	0/0	0/0
Put Periods (i.e., recessions)	0/0	0/0
Equity Call Periods (i.e., equities outperform bonds)	0/0 or +	0/0 or -
Combination Periods (Call & Put Periods):		
Interest Rate Call & Put Periods	0/0	0/0
Interest Rate Call & Equity Call Periods	0/0 or +	0/0 or -
Put & Equity Call Periods	0/0 or +	0/0 or -
Both Calls & Put Periods	0/0 or +	0/0 or -

Realization for Convertible vs. Low-Grade Bonds (cut-off at the 5% level of significance) 1962:01 through 1994:09	Sensitivity to Treasury Bonds	Sensitivity to Stocks
Interest Rate Call Periods (i.e., declining interest rates)	0	0
Put Periods (i.e., recessions)	0	0
Equity Call Periods (i.e., equities outperform bonds)	0	0
Combination Periods (Call & Put Periods):		
Interest Rate Call & Put Periods	0	0
Interest Rate Call & Equity Call Periods	+	-
Put & Equity Call Periods	0	-
Both Calls & Put Periods	0	-

Of the four periods where some possible differences in expectations exist, the following three provide evidence which would support more complex CCA risky debt valuation models: (1) combination interest rate call and equity call periods, (2) combination put and equity call periods, and (3) combination interest rate call, put, and equity call periods. Of these three, the strongest supportive evidence comes from the combination of declining interest rates (i.e., interest rate call periods) and equity/bond outperformance (i.e., equity call periods). Clearly, convertible bonds are complex securities whose value is affected by interest rate changes not just through its effect on the underlying pure bond component of the security. Also, it is clearly important to capture interactions between the various embedded options in a convertible bond (i.e., particularly the equity call option versus all other embedded options).

CHAPTER 9

SUMMARY & CONCLUSIONS

This thesis had the following nine primary objectives: (1) review important laws and regulations affecting distressed firms, (2) review the empirical literature on the costs of bankruptcy to provide the background to the empirical chapter on the losses incurred during successful bankruptcy, (3) further address the question of the size and magnitude of the costs of distress and examine several factors which might affect the total costs of successful bankruptcies, (4) review the relevant literature on risky debt pricing and empirical studies on risky debt returns, (5) establish the theoretical expectations regarding the three related risky bond empirical chapters, (6) generally extend the empirical literature on low-grade corporate bond financial performance, (7) begin empirical literature on low-grade municipal bond financial performance, (8) generally extend the empirical literature on convertible bond financial performance, and (9) provide evidence to support more complex CCA models of risky bond pricing.

1 Summary of Preceding Chapters

This section provides a summary of the main results derived from Chapters 2 through 8. The objective of Chapter 2 was to satisfy objective #1. There was no comprehensive source of information on U.S. laws and regulations in regards to distressed firms and their securities. This thesis gathered together a unique set of publications in order to provide a reasonably comprehensive overview of important laws and regulations. Also, some statistics were presented to provide background on specific issues of importance to this thesis (e.g., the rate of Chapter 7 and Chapter 11 since the inception of the Code). The following is a list of some principal areas addressed in Chapter 2: (1) the Code, (2) Chapter 7 and 11, (3) the Doctrine of

Absolute Priority, (4) the Doctrine of Fraudulent Conveyance, (5) DIP financing, (6) prepackaged Chapter 11s versus restructurings, (7) low-grade bond covenants, (8) U.S. tax consequences of restructuring debt, (9) OID, (10) NOL limitations, (11) COD, (12) accounting for debt restructurings, and (13) low-grade firm financial statements. In reviewing these and other areas, it was clear that a substantial amount of future research can be made regarding the laws and regulations affecting distressed firms.

The objective of Chapter 3 was to satisfy objective #2. Chapter 3 began with a general discussion of the motivation behind empirical work on the costs of bankruptcy. The bankruptcy cost issue is often motivated by models which trade-off the tax shield generated by issuing debt against the costs of bankruptcy. A review of the various costs of bankruptcy (i.e., both direct costs and indirect costs) was made. Finally, a review of the empirical studies on the costs of bankruptcy were reviewed and results regarding a scale effect for the direct costs of bankruptcy were reviewed. The following limitations of the studies reviewed were noted: (1) regarding the administrative costs of bankruptcy, a reliance on generally small samples which tended to be industry and/or geographic specific; (2) little or no evidence on the total costs of, or losses associated with, bankruptcy; and (3) very little evidence on the scale effect of the administrative costs of bankruptcy and none regarding whether there is a scale effect for the total costs of bankruptcy.

The objective of Chapter 4 was to satisfy objective #3. A measure incorporating many indirect costs of Chapter 11s which emerged from bankruptcy court protection was proposed (i.e., a measure of the total losses incurred during Chapter 11). The losses of "successful" Chapter 11 were found to be large, representing about 24% of asset value. Except for the very largest firms, losses were found to be an increasing function of firm size. This may be principally due to the fact that the indirect costs of bankruptcy are larger than the direct costs of bankruptcy. Regression analyses were performed which suggested that the total losses incurred during successful bankruptcy were at least in part a function of firm size, time spent under court protection, and the relative level of debt. In addition, it was found that time spent under Bankruptcy Court protection varied significantly between some court districts and for the very smallest firms examined. This suggests that at least regarding one indirect measure of the efficiency of the Chapter 11 process (i.e., time to plan of reorganization confirmation), venue and size can matter.

The objective of Chapter 5 was to satisfy objectives #4 and #5. Chapter 5 began by reviewing several motivations for research on the low-grade corporate bond asset class. Several seemingly anomalous observations and/or statements were noted. For example, the observation by Cornell and Green [1991] that low-grade corporate bonds were more sensitive to interest rates during recessions. In order to place some of the unresolved issues mentioned in context, a review of previous research on low-grade corporate bond returns was made. In order to reconcile some past empirical observations with more recent theory in the field of risky bonds, a review of some relevant CCA literature on risky bond valuation was made. The importance of embedded options in explaining the observed return generation process for risky bonds was made in order to generate the theoretical expectations regarding the three related empirical chapters (i.e., Chapters 6 through 8). After establishing the CCA based expectations, the hypotheses and the research method were detailed. Finally, a summary of the three risky bond asset class studies was made.

The objective of Chapter 6 was to satisfy objectives #6 and #9. Chapter 6 is an empirical study on the performance of low-grade corporate bond funds. The following are the principal low-grade corporate bond contributions: (1) extends risky bond pricing literature by examining the effects embedded options have on the financial performance of low-grade corporate bonds relative to high-grade corporate bonds; (2) provides some evidence to support more complex CCA models of risky bond pricing which incorporate both a stochastic firm value and risk-free interest rate; (3) provides some evidence which does not support the contention that low-grade corporate bonds are called more early and/or have significantly weaker call protection than high-grade corporate bonds over the period 1/60 through 9/94; and (4) generally extends the empirical literature on low-grade corporate bond financial performance.

The objective of Chapter 7 was to satisfy objectives #7 and #9. Chapter 7 is an empirical study on the performance of low-grade municipal bond funds. The following are the principal low-grade municipal bond contributions: (1) first to analyze the risk and return of low-grade municipal bonds by examining the financial performance of low-grade open-end municipal bond funds over the period 1/78 through 9/94; (2) generally extends the low-grade/high-grade corporate result to the municipal market; and (3) finds some evidence to support the contention that, after controlling for risk with a particular two factor model, low-grade municipal bonds have outperformed high-grade municipal bonds over the study period.

The objective of Chapter 8 was to satisfy objectives #8 and #9. Chapter 8 is an empirical study on the performance of convertible bond funds. The following are the convertible bond contributions: (1) in general convertible bonds have not outperformed straight low-grade corporate bonds over the study period 1/62 through 9/94; (2) convertible bonds are significantly more equity-like and significantly less bond-like than straight low-grade corporate bonds; (3) convertible bonds display a strong January effect; and (4) the results suggest that the equity call option embedded in convertible bonds has been appropriately priced over the study period.

2 Limitations of the Studies

Chapters 1 through 3 and 5 were intended as background chapters, and this chapter contains the summary and conclusions. Therefore, comments regarding limitations of the studies apply primarily to Chapters 4 and 6 through 8. Given that the studies were primarily empirical studies, many of the limitations discussed are related to sample limitations.

The principal limitation of the study performed in Chapter 4 was that the sample was composed exclusively of successful Chapter 11s. Although, this restriction was made in order to make the analysis more applicable to this form of bankruptcy. It may be that the absolute size of the cost of bankruptcy and relationships between the losses incurred during bankruptcy and the variables studied do not hold for Chapter 7s or unsuccessful Chapter 11s.[1] Also, another limitation was that the measure of the losses incurred during bankruptcy was designed to measure the losses incurred during Chapter 11. Therefore, the measure used may not be universally applicable to all bankrupt firms.

Chapters 6 through 8 all suffered from data series length limitations. The principal limitation of the study performed in Chapter 6 is the length of the time series under study (i.e., 34 3/4 years of monthly data). Although, this restriction was made based on data availability and it was the longest data set available (i.e., more than twice that of one study highlighted). The principal limitation of the study performed in Chapter 7 is the length of the time series under study (i.e., 16 3/4 years of monthly data).

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[1] Actually, this was the argument made to support the contention that this measure of the cost of bankruptcy was a lower bound measure for the total cost of bankruptcy. Of course, this assumes that the relative cost of Chapter 7 is greater than that of Chapter 11.

Although, this restriction was made based on data availability and it was the longest data set available. The principal limitation of the study performed in Chapter 8 is the length of the time series under study (i.e., 32 3/4 years of monthly data). Although, this restriction was made based on data availability and it was the longest data set available.

Chapters 6 through 8 all suffer from the problem of possible nontrading. Of course, this is a problem endemic to all risky assets and it is not clear if it is only partially caused by nontrading, or even caused by nontrading at all. As mentioned by Lo and MacKinlay [1990], it is difficult to know whether nonsynchronicity of asset prices is caused by economic forces or mismeasurement or some combination thereof. Of course, this is a limitation but it might also be a useful future research topic to attempt to sort through the possible institutional and more economic based causes of nonsynchronous risky asset prices.

3 Suggestions for Future Research

This thesis was motivated by the premise that those areas of finance related to distress and low-grade securities have been under researched. Therefore, it should not be surprising that this thesis generates many suggestions for future research. The following suggestions are in no way intended to be a complete list of possible research related to that in the thesis. In addition, it should be noted that the literature in the area has expended greatly since I began writing the thesis.

Even though Chapter 2 was intended as a background chapter, the following is a list of possible future research suggestions motivated by the chapter: (1) a study on the relationship between legal low-grade bond seniority and recovery rates (i.e., measure and analyze the extent to which legal seniority does not guarantee recovery seniority), (2) a study on the economic value of DIP financing (e.g., Does DIP financing indicate economic viability or does it primarily indicate and/or induce agency problems?), (3) a study on the impact of large bankruptcy case rulings on the pricing of low-grade debt (i.e., the impact of specific legal events on the perceived probabilities of negotiated settlements and security valuation), (4) a study on the extent to which limitations on dividends covenants limit or enhance stockholder-bondholder conflict (of course other critical convents could be studied), and (5) a study on the extent to which tax laws affect restructuring negotiation outcomes (e.g., Do OIDs and COD discourage or encourage out-of-court settlements and prepacks?). Obviously, more than one dissertation could be written focusing on the above issues alone.

There are two central suggestions for future research derived from Chapter 4. The first is concerned with other possible factors influencing the total cost of bankruptcy. For example, creditors, customers, suppliers, managers, employees, product, and other court specific factors (i.e., other than court district) could be analyzed. Although, it might be very challenging to operationalize many of these factors for empirical analysis. Evidence of their significance might lend additional support to the theory that indirect costs, not the administrative costs, drive the total costs of bankruptcy. The same analysis could also be applied to Chapter 7 firms. The second area for future research derived from Chapter 4 was regarding district 10. Given that most empirical studies have used data gathered from this district, yet it is a largely unrepresentative district (i.e., at least regarding successful Chapter 11s) it would seem useful to break out what it is about the Southern District of New York which makes it unique. For example, is it the judges, trustees, or types of firms filing which create the systematic cost differentials and success rates in that district?

A few comments should be made regarding the field of distress research. First, there are significant data problems. For example, often it is difficult, if not impossible, to find anything other than book values or court derived values for bankrupt firms. Therefore, there is a natural tendency to focus on large publicly traded firms which file for bankruptcy and have publicly traded equity. Although, the vast majority of firms which file for bankruptcy are small start-up firms. Clearly, this may be one effect impacting the results found in Chapter 4. Relatively new small firms probably have a high level of asset specificity and, therefore, they may be required to propose high levels of proposed payments in order to have their reorganization plans confirmed. Second, the nature of much of the research in the area tends to lend itself to small sample studies. For example, there aren't many large Chapter 11 cases and even fewer large Chapter 7 cases, and there are many idiosyncratic factors affecting distressed firms. Clearly, one bankruptcy court judge may be significantly more positively inclined to rule in favor of creditors over managers, while another judge may be of the polar opposite inclination. In short, in studying distress it is often difficult to make generalisations. Research result generalisations may be much more common in more liquid financial markets with more easily obtainable data than more illiquid financial markets with hard to obtain data.

There are two rather general suggestions for future research derived from Chapter 6 through 8. The first is regarding asset class duration. For example, what effect do the upgradings of low-grade debt and downgradings of high-grade debt have on their respective asset classes (i.e., corporate and municipal)? Of course, there are many other duration effects on various asset classes which could be studied. The second suggestion is regarding the call rate on low-grade versus high-grade debt. That is, historically, what exactly has the respective call rate for the respective asset classes been (i.e., corporate and municipal)?

Regarding low-grade debt at a macroeconomic level, a more general area of future research could be pursued by examining the following causation puzzle: do credit spread changes cause recessions or do recessions (i.e., the possibility of recession) cause credit spreads to change? In Chapters 6 through 8 much analysis was performed by isolating the impact of recessionary periods on the return generation process of low-grade bonds, but there remains the question as to whether credit spreads respond to the changes in the business cycle or whether the business cycle responds to changes in credit spreads (i.e., or some combination). Credit spreads have been used in macro economic forecasting models (e.g., Chen [1991]) and equity and debt market return forecasting models (e.g., Chen et al. [1986]), but they all implicitly presuppose that causation runs from credit spread to the economy not vice versa. This type of analysis would extend the work done by Jaffee [1975] on the cyclical variations in the risk structure of interest rates (i.e., default premiums and the macro economy). One problem with this area of research is that, unlike the work on term structure, there isn't a directly observable measure (i.e., term to maturity).

Ignoring this thesis, given that there has been no academic research on low-grade municipal bonds to date, there are a large number of possible research projects available in the area of low-grade municipal bonds. Specifically, as mentioned in Chapter 7, further research could be done in the area of sorting through the impact of the January effect and the Tax Reform Act of 1986 on the return generation process for low-grade municipal bonds (or any other municipal asset class for that matter). In addition, no academic default study has been performed on municipal bonds (i.e., the Altman [1989] and Asquith et al. [1989] studies on low-grade corporate bond mortality could be used as potential guides).[2] Finally, there is the issue of a CCA

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[2] There has been some work on predicting defaulted GOs, but the data the analysis is based on goes back to the 1930s (see Hempel [1973]). In short, a thorough study on default rates for revenue bonds is lacking.

risky municipal debt valuation model which might incorporate specific municipal market risks (see Yawitz [1978] on municipal default risk) and/or modify the corporate risky debt risks to more closely suit the municipal market (e.g., municipality default risk which may differ significantly from corporate default risk).

Clearly, the potential for research in areas directly and indirectly related to those areas studied in this thesis are immense. That is one of the principal reasons for my research in the area in the first place. The key will be to first select those future research topics which will have the greatest impact on the field per unit of cost, and that is a task in and of itself.

APPENDIX 1

ADJUSTING FOR NONTRADING

This appendix is intended as background to the assertion that adjusting for the potential effects of nontrading doesn't significantly affect the autocorrelation of the municipal bond regressions run. Cornell and Green [1991] included a lead and a lag term for each of the market return factors in the regressions for low-grade and high-grade corporate bond returns in order to "take account of the potential impact of nontrading." This Dimson [1979] adjustment was intended to reduce the impact of lagged movements in bond prices. That is, the stale trading adjustment was intended to reduce the effect of autocorrelation in the market model equation.[3] Firstly, did this adjustment reduce autocorrelation in the regressions for low-grade and high-grade bond returns? More specifically, did the adjusted equation show significantly fewer time series problems with its error term than a more simple model? Therefore, the null hypothesis is: H_0: the adjustment for nontrading significantly reduced time series problems associated with the error term of a model using the adjustment relative to a model without the adjustment.

Taken directly from Cornell and Green [1991], the following equation measures the sensitivity of low-grade bond returns to changes in the long-term risk-free rate of interest, changes in high-cap equity prices, and includes the Dimson adjustment for nontrading (i.e., a lead and a lag of the RHS variables):

(1) $LGR_t = \alpha_0 + \beta_1 \times TBR_{t+1} + \beta_2 \times TBR_t + \beta_3 \times TBR_{t-1} + \beta_4 \times SP500R_{t+1} + \beta_5 \times SP500R_t + \beta_6 \times SP500R_{t-1} + e_t$

where LGR = low-grade bond return, TBR = Treasury bond return, SP500R = Standard & Poor's 500 return, and e is the error term. The following equation measures the sensitivity of low-grade bond returns to changes in the long-term risk-free rate of interest and changes in high-cap equity prices:

[3] Although, Fowler and Rorke [1983, p. 279] concluded "that the Dimson procedure is incorrect and cannot generally be expected to yield consistent beta estimates."

(2) $LGR_t = \alpha_0 + \beta_2 \times TBR_t + \beta_5 \times SP500R_t + e_t$.

These same models were applied to low-grade and high-grade municipal bond returns. Tables 1 and 2 provide the regression results for low-grade and high-grade municipal bonds, respectively.

Table 1

Regressions of Low-Grade Municipal Bond Returns with and without the Adjustment for Nontrading

Models 1 & 2	α_0	β_1	β_2	β_3	β_4	β_5	β_6	Adj. R^2	DW	SEE
78:01 to 94:09										
(1) Coefficient	0.002	-0.036	0.405	0.089	0.070	0.080	-0.071	0.596	1.832	0.014
t-statistic	1.57	-1.14	12.94**	2.81**	2.73**	3.12**	-2.76**			
(2) Coefficient	0.002		0.425			0.081		0.560	1.820	0.015
t-statistic	1.95		13.37**			3.11**				

** denotes significance at the 1% level.

Table 2

Regressions of High-Grade Municipal Bond Returns with and without the Adjustment for Nontrading

Models 1 & 2	α_0	β_1	β_2	β_3	β_4	β_5	β_6	Adj. R^2	DW	SEE
78:01 to 94:09										
(1) Coefficient	0.001	-0.016	0.453	0.091	0.058	0.083	-0.084	0.645	1.849	0.014
t-statistic	1.00	-0.50	14.53**	2.91**	2.29*	3.28**	-3.29*			
(2) Coefficient	0.001		0.477			0.082		0.612	1.841	0.015
t-statistic	1.30		15.03**			3.16**				

* denotes significance at the 5% level, and ** denotes significance at the 1% level.

If the adjustment for stale trading was justified, a regression run without the adjustment should show a statistically significant greater amount of autocorrelation than a regression run with the adjustment. Based on models 1 and 2, several tests were run to check for the effect of the stale trading adjustment on the error term. These tests checked for the presence of autoregressive (AR) and moving average (MA) processes of the error term of the regressions run. The principal test used was the Breusch-Godfrey test.

The first four rows of Table 3 present the results of eight tests run to check for the presence of an AR(p) or MA(q) process of the error term for the regressions run to evaluate the return performance of low-grade and high-grade bonds. The AR and MA processes were both tested at one and twelve lags (i.e., p=1 and q=1, and p=12 and q=12, respectively). The AR(p) process evaluated was

$e_t = p_1 \times e_{t-1} + p_2 \times e_{t-2} + ... + p_{12} \times e_{t-12} + v_t$ and the MA(q) process evaluated was $e_t = v_t + a_1 \times v_{t-1} + a_2 \times v_{t-2} + ... + a_{12} \times v_{t-12}$, where e_t is the random disturbance term at time t.

To test for the presence of autocorrelation, the Breusch-Godfrey test uses the OLS residuals to test the joint significance of the first p autocorrelations of the estimated coefficients. Given that the data used in this study was monthly, 12 lags were used to run the test. Given that the test applies to both the AR and MA hypotheses, the test was run for each. Therefore, four tests were run for each regression (i.e., a total of sixteen tests were run). An AR(1) and AR(12) test for the two-factor model and Dimson adjusted model, and an MA(1) and MA(12) test for the two-factor model and Dimson adjusted model were run for each regression.

In order to calculate the Breusch-Godfrey test for the null hypothesis that there was no significant amount of autocorrelation up to twelve lags of the error term, the following procedures were run: (1st) apply OLS to the equation being estimated, (2nd) regress the estimated residual $\hat{e}_t$ on the relevant dependent variables (depending if the model is the two-factor model or two-factor model with Dimson adjustment), $\hat{e}_{t-1}$, $\hat{e}_{t-2}$,........., $\hat{e}_{t-12}$ and calculate the R^2 , (3rd) calculate T x R^2 (where T is the sample size and the statistic is distributed chi-square with p degrees of freedom). Explicitly, to test for the presence of autocorrelation in the unadjusted two-factor model regressions, the following null hypothesis was tested for each regression: H_0: the estimated R^2 of the estimated equation $\hat{e}_t = \hat{\alpha} + \hat{p}_1 \times \hat{e}_{t-1} + \hat{p}_2 \times \hat{e}_{t-1} + ... + \hat{p}_{12} \times \hat{e}_{t-12} + \hat{\beta}_1 \times X1_t + \hat{\beta}_2 \times X2_t + v_t$ is 0, where X1 and X2 are the two independent variables (i.e., RHS variables). The same procedures can be run to test for the presence of an MA(12) process. Explicitly, to test for the presence of a moving average process in the unadjusted two-factor model regression, the following null hypothesis was tested for each regression: H_0: the estimated R^2 of the estimated equation $\hat{e}_t = \hat{\alpha} + \hat{q}_1 \times \hat{v}_{t-1} + \hat{q}_2 \times \hat{v}_{t-1} + ... + \hat{q}_{12} \times \hat{v}_{t-12} + \hat{\beta}_1 \times X1_t + \hat{\beta}_2 \times X2_t + v_t$ is 0.

Additionally, Q-statistics are reported. The Q-statistics reported were run to test whether the autocorrelation and partial autocorrelation functions of the residuals of the factor models regressions and Dimson adjusted regressions were distributed as white noise. That is, that the residuals were distributed randomly. The null hypothesis is that the residuals were not correlated. Regarding autocorrelations, all twelve lags of autocorrelations will sum to approximately zero if no autocorrelation is present over twelve lags. To test for autocorrelation up to lag twelve, the Q-test is $Q = T\sum \hat{r}^2_{12}$, where $\hat{r}^2_{12}$ is the product moment correlation between $\hat{e}_t$ and $\hat{e}_{t-p}$ (p=1,2,.........12). If the null hypothesis is true, Q is distributed as chi-square with twelve degrees of freedom. Explicitly, the null hypothesis is $H_0\!:\sum \hat{r}^2_{12} = 0$. Regarding partial autocorrelations (i.e., moving average), all twelve lags of partial autocorrelations will approximately sum to zero if no moving average is present. Explicitly, the null hypothesis is $H_0\!:\sum \hat{r}^2_{12} = 0$, where $\hat{r}^2_{12}$ is the product moment correlation between $\hat{e}_t$ and $\hat{v}_{t-q}$ (q=1,2,.........12). A high Q-statistic implies that the residuals are not random. The Q-tests provide an additional check on the Breusch-Godfrey results.

Table 3
Breusch-Godfrey and Q-Statistic Test Results

These tests evaluate the extent to which the adjustment for nontrading effects the error term of the full period regressions.

	Chi-Square Statistic	
Breusch-Godfrey Test	High-Grade	Low-Grade
Model 2 (1 Lag of Residuals)	1.27	1.65
Model 2 (1 Lag of Error Residuals)	0.18	0.22
Dimson Model 1 (1 Lag of Residuals)	1.15	1.39
Dimson Model 1 (1 Lag of Error Residuals)	0.06	0.06
Model 2 (12 Lags of Residuals)	25.53*	33.81**
Model 2 (12 Lags of Error Residuals)	15.74	24.94*
Dimson Model 1 (12 Lags of Residuals)	19.40	30.55*
Dimson Model 1 (12 Lags of Error Residuals)	12.72	25.25
Q Statistic - Test for White Noise		
Model 2 (12 Lags of Residuals)	22.23*	32.41**
Model 2 (12 Lags of Error Residuals)	12.20	22.85*
Dimson Model 1 (12 Lags of Residuals)	17.76	26.79**
Dimson Model 1 (12 Lags of Error Residuals)	10.86	24.15*

* denotes significance at the 5% level, ** denotes significance at the 1% level of significance.

Except for the model 2 regression using 12 lags of residuals, the high-grade bond regressions showed no statistically significant evidence of an AR or MA process. Therefore, for the high-grade bond return regressions there is virtually no statistical justification for an adjustment for stale trading.

For low-grade bonds, both the Breusch-Godfrey and white noise tests for an AR(12) process showed a statistically significant level of autocorrelation. Therefore, an adjustment for stale trading for the low-grade bond return regressions would be called for if it significantly reduces the level of autocorrelation. In both cases, the Dimson adjustment slightly decreased autocorrelation. Regarding both the Breusch-Godfrey and white noise tests for the presence of a MA(12) process, the Dimson adjustment slightly increased the effect (e.g., the Breusch-Godfrey test statistic increased from 24.94 to 25.25). Regarding the Breusch-Godfrey tests for the presence of an AR(1) and MA(1) process, the tests only displayed a moderate decrease in statistical significance after the adjustment for nontrading.

Given that the purpose of the Dimson adjustment was to eliminate a nontrading bias, thus eliminating autocorrelation, the tests run indicate that the adjustment made did not unambiguously reduce evidence of nontrading for the monthly return series of the low-grade and high-grade municipal bond asset class return series under study. In addition, first order effects were not statistically significant in any regression.

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The Effect of Embedded Options on the Financial Performance of Convertible Bond Funds

John Kihn

This study is the first to analyze the pricing of convertible bonds by examining the financial performance of open-end convertible bond funds. The findings indicate that (1) in general, convertible bonds did not outperform straight low-grade corporate bonds during the study period, January 1962 through September 1994; (2) convertible bonds are significantly more equitylike and significantly less bondlike than low-grade bonds; and (3) convertible bonds display a strong January effect. The results suggest that the equity call option embedded in convertible bonds was appropriately priced during the study period.

One of the first and most interesting applications of option pricing theory or contingent claims analysis (CCA) has been the analysis of convertible bonds.[1] Although many theoretical studies have modeled the valuation of convertible bonds, relatively little empirical research has been based on CCA. Of the empirical work that has been performed on convertible bonds, most has been directed at analyzing and rationalizing the seemingly abnormal call behavior of firms that call the convertible bonds they have issued.[2] This study is the first to use CCA as the framework for analyzing the long-run financial performance and relative financial performance of convertible bonds as an asset class.[3]

One of the primary questions this study answers is the extent to which convertible corporate bonds as an asset class have underperformed or outperformed straight low-grade corporate bonds. That is, over a long period are risk-adjusted convertible bond returns greater than low-grade bond returns? The study makes the following contributions: (1) It generally extends financial research on convertible bond returns, (2) it applies CCA to the analysis of the financial performance of convertible bonds, and (3) it evaluates the relative financial performance of the convertible bond and low-grade bond asset classes.[4] Table 1 presents the means, standard deviations, and correlations of the asset class return series.

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Convertible bonds have returned more than low-grade bonds but at a higher level of risk (if risk is measured as standard deviation). Convertible bond returns are significantly more positively correlated with equity returns than with Treasury bond returns. Clearly, convertible bonds have been more exposed to risks associated with equities than those associated with Treasury bonds.

BONDS WITH EMBEDDED OPTIONS

Bond options are often referred to as "embedded options" because they are explicit and implicit options that cannot be detached from the security. This study is focused on the effects the embedded options have on the pricing of convertible and low-grade bonds as asset classes. Therefore, we particularly examined periods when the effects of puts and calls might be expected to increase significantly.[5] The analysis portion of the study is focused on periods when calls and puts would be expected to be exercised and/or the probability of exercise increases significantly for convertible bonds. This approach isolates the impact embedded options have on the returns of convertible and low-grade corporate bonds.

Convertible bonds are a type of corporate bond for which the owner typically has the option to exchange the bond (at par) for common stock (at the exercise price) of the issuing entity. Ignoring illiquidity, the three embedded options of a con-

Table 1. Means, Standard Deviations, and Correlations of the Returns of Convertible Bond Funds, Low-Grade Corporate Bond Funds, High-Grade Corporate Bond Funds, Treasury Bonds, and Equities, January 1962 to September 1994

Statistic	Convertible Bonds	Corporate Bonds: Low-Grade Corporates	Corporate Bonds: High-Grade Corporates	Treasury Bonds	S&P 500
Observations = 393					
Moments of the distribution (%)					
1st: Mean	0.9401	0.6815	0.5541	0.5663	0.5866
2nd: Standard deviation	3.3747	2.4589	1.8320	2.9705	4.3007
Correlations					
Low-grade corporates	0.765**				
High-grade corporates	0.445**	0.624**			
Treasury bonds	0.366**	0.505**	0.833**		
S&P 500	0.862**	0.699**	0.400**	0.332**	

Note: The data are monthly returns. Except for Treasury bonds and the S&P 500 equity series, all mutual fund values are derived from Morningstar. Each mutual-fund-derived return series represents the average net returns on all open-end bond funds for that asset class. Asset class definitions are based on Lipper/Morningstar definitions. Convertible bond funds invest primarily in bonds and preferred stocks that can be converted into common stocks. Low-grade corporate bond funds generally invest at least 80 percent of assets in corporate bond issues rated below BBB. High-grade corporate bond funds generally invest at least 80 percent of assets in corporate bond issues rated A or higher.

** denotes significance at the 1 percent level.

vertible bond are an interest rate call option, a default or put option, and an equity call option. A straight corporate bond does not have an equity call option. CCA views default as the case in which equity holders put the company to bondholders. That is, bond default is equivalent to the exercise of a put option held by equity holders. Like most corporate bonds, most convertible bondholders have explicitly written call options and all have implicitly written put options. Unlike most corporate bonds, however, convertible bondholders hold a call option on some amount of the equity of the issuing firm.[6] Also, like most corporate bonds and municipal bonds, the interest rate call option is exercised when interest rates decline enough from the time of issuance to make it profitable for the issuing entity to exercise.

Ignoring illiquidity, the following is a simplified contingent claims view of the general equations of the five types of securities analyzed in this study:

- $TBND_i = B_i$, where $TBND_i$ is the value of Treasury bond i and B_i is the value of risk-free bond i;
- $HGC_i = B_i - C_iIR$, where HGC_i is the value of high-grade corporate bond i and C_i^{IR} is the value of interest rate call option i;
- $LGC_i = B_i - C_iIR - P_iDflt$, where LGC_i is the value of low-grade corporate bond i and P_iDflt is the value of default or put option i;
- $CNVRTi = Bi - Ci^{IR} - Pi^{Dflt} + Ci^{Eqty}$, where $CNVRT_i$ is the value of convertible corporate bond i and C_iEqty is the value of equity call option i; and
- $EQTY_i = P_iDflt + C_iEqty$, where $EQTY_i$ is the value of equity security i.

Clearly, from a CCA viewpoint, convertible bonds appear to be the most complex security listed. They are composed of all four of the building blocks that form all five security types. Treasury bonds are the simplest security type listed and, by definition, are an element of all of the bond security types.

As one works down the security hierarchy, certain options distinguish one bond or asset type from another. What distinguishes an *HGC* from a *TBND* is C^{IR}, what distinguishes an *HGC* from an *LGC* is P^{Dflt}, and what distinguishes a *CNVRT* from a straight *LGC* is C^{Eqty}. In addition, as the value of the equity call option increases (goes farther into the money), the value of a convertible bond approaches $CNVRT_i = B_i - C_iIR - P_iDflt + EQTY$, which reduces to $CNVRT_i = B_i - C_iIR + C_iEqty$. Therefore, as equity call options increase in value and the convertible bond becomes more equitylike, it is not clear that the convertible bond will respond to its embedded put option. This example illustrates the complexities involved with evaluating the financial performance of complex risky bonds, which is what this study is designed to do. We evaluated the financial performance of convertible bonds during periods when their three embedded options would be expected to increase in value. Therefore, the key to empirical CCA is identifying when these embedded options are exercised and/or the probability of exercise increases. For direct comparisons of financial performance, convertible bonds are evaluated against low-grade bonds.

The volatility of bonds with embedded options is complicated by the various covariance terms. Assuming the portfolio weights sum to 1, the following is the relationship for the variance of return on a straight low-grade, or risky, bond:

$$\sigma_{RB}^2 = w_B^2\sigma_B^2 + w_P^2\sigma_P^2 + w_C^2\sigma_C^2 - 2(w_Bw_P\sigma_{B,P} + w_Bw_C\sigma_{B,C} + w_Pw_C\sigma_{P,C}),$$

where $\sigma_{B,P}$ is the covariance between the risk-free bond and the put, $\sigma_{B,C}$ is the covariance between the risk-free bond and the interest rate call, and $\sigma_{P,C}$ is the covariance between the put and the interest rate call. Therefore, if the options embedded in risky bonds sufficiently negatively covary with each other and/or the risk-free bond, the variance associated with a risky bond may be less than that of a risk-free bond.

CCA, for example, does not always specify the relationship between certain key option valuation factors. An increase (decrease) in the risk-free rate of interest will decrease (increase) the value of a risk-free bond and tend to increase the value of the interest rate call option primarily by increasing the value of the underlying bond (although the call option will decrease in value as rates drop), but it may or may not affect the value of the put option. In the case of an increase in the risk-free rate of interest, the direction of the change in value of the put option will depend on whether the decrease in put value caused by the increase in the discount rate dominates the possibility that the value of the firm declines because of an increase in the risk-free rate of interest. Based on CCA, changes in the value of the firm and changes in the risk-free rate of interest are negatively correlated. Thus, if the correlation coefficient between changes in the value of the firm and changes in the risk-free rate of interest is sufficient to dominate the discount effect, then as the risk-free rate of interest increases, the value of the firm may increase and the value of the put option decrease. The reverse will hold if the correlation coefficient between changes in the value of the firm and changes in the risk-free rate of interest is positive or zero (or only slightly negative).

This study particularly addresses the possibility that the correlation between changes in the value of the firm and changes in the risk-free rate of interest is significant enough to have an impact on the returns of the convertible bond asset class over time. Of course, the most interesting case would be that the correlation between the value of the firm and the risk-free rate of interest is such that a decrease in the value of the risk-free bond is at least partially offset by a decrease in the value of the put option, which seems to be the case with straight low-grade bonds.[8]

The foregoing analysis generally applies to a portfolio of risky bonds or a risky-bond asset class. Of course, in addition to the interaction between the changes in value of a risk-free bond, an embedded put, and an embedded interest rate call for each risky bond, an interaction may also exist between each component of the individual risky bonds forming the portfolio or the asset class under study, which can affect the volatility of the portfolio or asset class. The duration of a portfolio is defined as

$$D_{Portfolio} = \sum_{i=1}^{N} D_i,$$

where D_i is the duration of the risk-free bond or embedded option, i.[9] Therefore, *ceteris paribus* and assuming all embedded positions are long positions, the greater the number of embedded options whose price changes negatively covary with the underlying bond's price changes, the farther out of the money are the embedded options that covary positively with their underlying bond price movements; the farther in the money are the embedded options that covary negatively with their underlying bond price movements, the lower the expected duration of the portfolio or asset class. The intriguing aspect of empirical finance is that actual data over a relatively long period are available to analyze some of the effects of portfolios of embedded options.

Critical to this study is the identification of periods when bond calls and puts would be expected to be exercised and/or their probability of exercise increases significantly relative to all other periods. For interest rate call periods, we used periods of declining interest rates. Bonds would be expected to be called and/or their probability of exercise increases when interest rates decline. For put/default periods, we used periods of recession, when defaults increase. For equity call periods, we used periods when equities outperformed straight risky bonds. The equity call option would be expected to be exercised and/or the probability of exercise increases when equity values increase more rapidly than bond values. Table 2 summarizes the expectation for the relative sensitivity of convertible versus low-grade bond returns over interest rate call, put/default, equity call, and combination call and put/call periods.

Based on the foregoing analysis, convertible bonds are not expected to differ from low-grade bonds in their interest rate call propensities or put propensities. Therefore, relative to low-grade bonds, convertible bonds would not be expected to be relatively more or less sensitive to Treasury bond market movements or more or less sensitive to stock market movements during interest rate call or put periods. Given that straight low-grade bonds do not possess an equity call option, however, convertible bonds would be expected to be more sensitive to stock market movements during

Table 2. Expectations for Periods under Study: Simple CCA Expectations

Period under Study	Expectation for Sensitivity to Treasury Bonds	Expectation for Sensitivity to Stocks
Interest rate call periods	0	0
Put periods	0	0
Equity call periods	0	+
Combination periods		
Interest rate call/put periods	0	0
Interest rate call/equity call periods	0	+
Equity call/put periods	0	+

equity call periods. These same expectations apply to combination periods. The interaction between the various embedded options may dominate during combination periods so as to render some expectations invalid, but knowing a priori what expectations may not hold is difficult.

Because of the complex nature of the embedded options in various types of bonds and their portfolio and asset class effects, the expected risk–return relationship for each asset class analyzed can be nontrivial. For example, defaults have been shown to have an asymmetric effect on the financial performance of the two corporate bond asset classes.[10] That is, defaults and the probability of default have a greater effect on low-grade bonds than on high-grade bonds. Therefore, the relative lack of defaults for high-grade bonds tends to make them more volatile relative to low-grade bonds.

In addition, CCA has shown that, in theory, the interaction between the put option and the interest rate call option can be significant.[11] Because the effect and interaction of the various embedded options on convertible bonds as an asset class is an issue in this study, we empirically tested this theoretical observation. Also, it has been shown that the lower the quality of the bond (i.e., the riskier the bond), the more relevant CCA may be for valuing corporate bonds.[12] Therefore, CCA is more applicable to low-grade bond asset classes than to high-grade bonds.[13] Given that the convertible bond and straight low-grade bond return series used in this study are mostly composed of lower grade bonds,[14] they make useful asset classes for analyzing the effects of options on bond pricing.

EMPIRICAL ANALYSIS

Critical to this study is a clear comparison between the convertible and low-grade bond asset classes. Therefore, to put the analysis in context, the following regressions were run for convertible and low-grade bond returns:

$$CNVRT_t = \alpha_0 + \beta_1(TBR_t) + \beta_3(SMR_t) + e_t \quad (1)$$

$$LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_3(SMR_t) + e_t \quad (2)$$

$$CNVRT_t - LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_3(SMR_t) + e_t \quad (3)$$

where $CNVRT$ is the convertible bond return, LGR is the low-grade bond return, TBR is the Treasury bond return, SMR is the stock market return, and e is the error term. The intercept term can be interpreted as the level of abnormal returns associated with the return series after controlling for bond market and stock market risk.

Table 3 provides results for the convertible and low-grade bond returns. Over the sample period and after controlling for bond and stock market movements, convertible bonds returned slightly more than low-grade bonds, but not significantly more. As expected, convertible bonds were signifi-

Table 3. Two-Factor Regressions of Convertible Bond and Low-Grade Corporate Bond Returns, January 1962–September 1994
(*t*-statistics in parentheses)

Model	Coefficients α_0	β_1	β_3	Adj. R^2	Durbin-Watson	Standard Error
Equation 1	0.005 (5.74)**	0.102 (3.34)**	0.654 (31.10)**	0.750	1.540	0.017
Equation 2	0.003 (4.06)**	0.254 (8.75)**	0.341 (16.00)**	0.570	1.710	0.016
Equation 3	0.002 (1.77)	–0.153 (–4.78)**	0.312 (14.15)**	0.336	1.732	0.018

** denotes significance at the 1 percent level.

cantly less sensitive to bond market movements than low-grade bonds, and convertible bonds were significantly more sensitive to stock market movements than low-grade bonds. Essentially, these results largely confirm the CCA view of convertible bonds; that is, as expected, the presence of the equity call option tends to increase the sensitivity of convertible bonds to stock market movements, especially relative to bond market movements.

Given that low-grade bonds display a January effect,[15] does this result extend to convertible bonds? Specifically, after controlling for Treasury bond market movements and large capital stock market movements, do convertible bonds display a January effect? The following regression model was run for the convertible bond and low-grade bond asset classes:

$$ACIsR_t = \alpha_0 + \beta_1(TBR_t) + \beta_3(SMR_t) + \beta_6(JanDV_t) + \epsilon_t \quad (4)$$

where *ACIsR* is the asset class return and *JanDV* is a dummy variable equal to 1 if the month is January and zero otherwise. Table 4 provides the regression results for the January effect. Convertible bonds display a strong January effect. In addition, the estimated intercept for the convertible bond regression remains significant when the January dummy is introduced. This result suggests that the positive abnormal returns associated with convertible bonds are not principally determined during the month of January.[16]

To the extent that certain risks in a portfolio or asset class offset each other (e.g., owning a put and the underlying security) or increase diversification (thereby reducing the overall risk of the portfolio or asset class), being exposed to a larger number of risks does not necessarily increase overall portfolio or asset class risk. For example, given that stocks and bonds are not perfectly correlated, the fact that low-grade bond prices covary with stock and bond prices offers some diversification effect, but stock and bond prices are not perfectly correlated over time. In addition to the stock/bond diversification effect, there may also be an effect with respect to the put and call options written on most low-grade bonds. In effect, calls and puts may be valued and exercised over all the bonds in the asset class in such a way as to contribute to a lower asset class duration for convertible bonds than for low-grade bonds.

Call Periods

High-grade bonds are significantly more sensitive to interest rate changes than are low-grade bonds.[17] This relative lack of interest rate sensitivity has been attributed by some to the higher relative call rate for low-grade bonds. If this were the case, the sensitivity of low-grade bond returns to risk-free bond returns should decline significantly during periods when the call option should be exercised (i.e., during periods of declining interest rates). This assertion was tested by examining the behavior of low-grade bond returns relative to high-grade bond returns during periods of declining interest rates.[18] The return spread between low-grade and high-grade bonds showed no significant difference during periods of declining interest rates. Relative to high-grade bonds, the sensitivity of low-grade bond returns to risk-free bond return movements did not significantly decline during periods of declining interest rates. Does this result hold for convertible and straight low-grade bonds? That is, does the equity call feature significantly affect convertible bonds when interest rates decline? Table 5 presents the means and standard deviations of the asset class return series associated with periods in which the government ten-year constant-maturity Treasury bond experienced a decline in yield.

Although convertible bond returns were more volatile than low-grade bonds during periods of declining interest rates, they were not significantly more volatile. For months when interest rates were declining, the ratio of convertible to low-grade bond standard deviations was approximately 1.34 versus 1.37 for all months. Based on this analysis, the cause of low-grade bonds' lower volatility cannot be the greater relative number of calls and/or weaker call protection afforded convertible bonds relative to low-grade bonds; that is, the price of a

Table 4. January Effect Regressions of Bond Asset Class Returns, January 1962–September 1994
(*t*-statistics in parentheses)

	Coefficients						
Asset Class	α_0	β_1	β_3	β_6	Adj. R^2	Durbin–Watson	Standard Error
Convertible	0.004 (4.65)**	0.108 (3.59)**	0.647 (31.01)**	0.010 (3.21)**	0.756	1.554	0.017
Low grade	0.002 (2.80)**	0.262 (9.18)**	0.333 (16.86)	0.012 (4.09)**	0.587	1.693	0.016

** denotes significance at the 1 percent level.

Table 5. Means and Standard Deviations of the Returns of Various Asset Classes: Months when Interest Rates Declined (Interest Rate Call Months)

Statistic	Convertible Bonds	Corporate Bonds: Low-Grade	Corporate Bonds: High-Grade	Treasury Bonds	S&P 500
Observations = 180					
Mean (%)	2.1119	1.8333	1.5810	2.2409	1.9714
Standard deviation	3.0047	2.2352	1.7289	2.7688	3.9878

Note: A month is defined as a period of declining interest rates if, during the month, the change in yield on the ten-year constant-maturity Treasury bond is less than zero.

bond that is short an interest rate call is expected to be less sensitive to decreasing interest rates than a bond without an interest rate call (or more protected from a call).

The following regression models were run to test for the significance of interest rate call periods on the returns of convertible bonds and low-grade bonds:

$$CNVRT_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times DIR_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times DIR_t) + \beta_5(DIR_t) + e_t \quad (5)$$

$$LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times DIR_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times DIR_t) + \beta_5(DIR_t) + e_t \quad (6)$$

$$CNVRT_t - LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times DIR_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times DIR_t) + \beta_5(DIR_t) + e_t \quad (7)$$

where *DIR* is a dummy variable equal to 1 if interest rates decline and zero otherwise. This equation was designed to take account of bond and stock market risk via *TBR* and *SMR*. The call dummy variable is intended to isolate the effect of periods when calls are more frequent and/or more probable. The regression results are presented in Table 6.

The estimated α can be interpreted as the amount of abnormal return attributed to the dependent return series after adjusting for the various movements of the independent variables. In this case, the results indicate that during periods of declining interest rates, the return performances of the convertible and low-grade bond classes are significantly different (at the 5 percent level). During declining interest rate periods, convertible bonds seem to have positive abnormal returns relative to low-grade bonds after controlling for Treasury bond and stock market risk.

Convertible bonds are more sensitive to interest rate movements than low-grade bonds during periods of declining interest rates (Equation 7, estimated coefficient β_2), although not significantly so. Convertible bonds do not display a significant difference in Treasury bond market sensitivity during periods of declining interest rates when compared with low-grade bonds. This evidence suggests that at least convertible and low-grade bonds exhibit no significant differential regarding interest rate call options.

Compared with straight low-grade bonds, convertible bonds are not significantly less sensitive to stock market movements than low-grade bonds during periods of declining interest rates (Equation 7, estimated coefficient β_4). Although convertible bonds become significantly (at the 5 percent level) less sensitive to stock market movements during periods of declining interest rates, they do not become more sensitive to bond market movements.

The coefficient for the dummy for periods of declining interest rates was negative and statisti-

Table 6. Interest Rate Call Regressions of Convertible and Low-Grade Corporate Bond Returns, January 1962–September 1994
(*t*-statistics in parentheses)

Model	α_0	β_1	β_2	β_3	β_4	β_5	Adj. R^2	Durbin–Watson	Standard Error
Equation 5	0.004	0.056	0.065	0.684	−0.086	0.003	0.752	1.526	0.017
	(3.22)**	(1.12)	(0.94)	(24.77)*	(−2.00)*	(1.30)			
Equation 6	0.001	0.238	−0.062	0.346	−0.032	0.007	0.581	1.673	0.016
	(0.96)	(5.06)**	(−0.94)	(13.24)**	(−0.79)	(3.64)**			
Equation 7	0.003	−0.182	0.127	0.338	−0.054	−0.004	0.343	1.726	0.018
	(2.20)**	(−3.49)**	(1.75)	(11.69)**	(−1.19)	(−2.050)*			

Note: These regression results compare the effect of periods of declining interest rates.

* denotes significance at the 5 percent level.
** denotes significance at the 1 percent level.

cally significant in the asset classes comparison regression (Equation 7). Therefore, periods of declining interest rates tend to affect convertible bond financial performance more negatively than that of low-grade bonds. Given that low-grade bonds are more bondlike than convertible bonds, this result should not be too surprising.

Overall, interest rate call periods do not seem to have much effect on the relative performance of convertible bonds versus low-grade bonds. This result is sensible. Given that the primary difference between convertible bonds and low-grade bonds is the equity call feature, periods of declining interest rates would not be expected to have much of an effect on the equity call option embedded in convertible bonds. Therefore—excluding the CCA premise that the value of the firm is a negative function of the rate of interest (which may explain convertible bonds' decrease in sensitivity to stock market movements), changes in interest rates should not significantly affect the equity call option.

Put Periods

Regarding convertible puts or defaults, if the exercise and/or increase in the probability of exercise of puts had a significant effect on convertible bonds relative to low-grade bonds, this effect should become significant during recessions. If convertible bonds are significantly more exposed to business cycle risk during recessions, convertible bond returns should be more sensitive to equity movements during periods when defaults would be expected to increase. Therefore, during recessionary periods, convertible bond returns should be even less affected by interest rates and more affected by movements in the stock market than at other times. Thus, if the embedded put options in convertible bonds are an effective means of diversifying risk during default or put periods (i.e., recessions), that characteristic will show up in the sensitivity of convertible bond returns to bond and stock returns during recessionary periods.

Table 7 presents the means and standard deviations of each asset return series associated with recessionary periods. Convertible bonds were slightly more volatile than low-grade bonds during periods of recession. For recession months, the ratio of convertible bond to low-grade bond standard deviations is approximately 1.07 versus 1.37 for all months. Like interest rate calls, puts alone cannot explain the volatility differential between convertible and low-grade bonds, unless they have the effect of increasing convertible bonds' sensitivity to stock market movements during periods when their exercise and/or the probability of their exercise should increase.

The following regression models were run to test for the impact of put periods on the returns of convertible bonds and low-grade bonds:

$$CNVRT_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times Rec_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times Rec_t) + \beta_5(Rec_t) + e_t \quad (8)$$

$$LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times Rec_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times Rec_t) + \beta_5(Rec_t) + e_t \quad (9)$$

$$CNVRT_t - LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times Rec_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times Rec_t) + \beta_5(Rec_t) + e_t, \quad (10)$$

where *Rec* is a dummy variable equal to 1 if the economy is in a recession and zero otherwise. The put dummy variable is intended to isolate the effect of recessionary periods, when puts are more frequent and/or more probable for convertible and low-grade bonds.[19]

The regression results are presented in Table 8. The results indicate that, during recessions, the return performance of the two asset classes do not differ significantly. This result would support the contention that convertible bonds are a good hedge against extreme movements in stock markets or government bond markets. Thus, convertible bonds are no worse a hedge against business cycle risk than low-grade bonds.

During the study period, convertible and low-grade bonds did not lose a significant amount of their sensitivity to stock market movements during business cycle contractions (estimated coefficient β_4). One possible explanation for the absence of a recession effect for convertible and low-grade bonds may be the lack of any large increase in

Table 7. Means and Standard Deviations of the Returns of Various Asset Classes: Recession Months (Put Months), January 1962–September 1994

Statistic	Convertible Bonds	Corporate Bonds: Low-Grade	Corporate Bonds: High-Grade	Treasury Bonds	S&P 500
Observations = 57					
Mean return (%)	0.6762	0.6346	1.0876	1.3510	1.3740
Standard deviation	4.7197	4.1170	3.0479	4.3508	6.0246

Note: A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

Table 8. Put Regressions of Convertible and Low-Grade Corporate Bond Returns, January 1962–September 1994
(*t*-statistics in parentheses)

Model	α	Coefficients β_1	β_2	β_3	β_4	β_5	Adj. R^2	Durbin–Watson	Standard Error
Equation 8	0.005	0.048	0.194	0.656	–0.033	–0.003	0.753	1.535	0.017
	(5.66)**	(1.33)	(2.81)**	(27.11)**	(–0.68)	(–1.05)			
Equation 9	0.004	0.178	0.249	0.318	0.058	–0.004	0.594	1.672	0.016
	(4.60)**	(5.29)**	(3.87)**	14.05)**	(1.28)	(–1.67)			
Equation 10	0.001	–0.130	–0.056	0.338	–0.092	0.001	0.341	1.712	0.018
	(1.29)	(–3.43)**	(–0.77)	(13.27)**	(–1.79)	(0.49)			

Note: These regression results compare the effect of recessionary periods.

** denotes significance at the 1 percent level.

perceived credit risk during recessionary periods. As some low-grade bonds and convertible bonds default, thus removing them from their respective asset classes and lowering the duration of each asset class, a relatively equal amount of straight high-grade bonds and high-grade convertible bonds are downgraded. During economic booms, high-grade bonds may be upgraded, but upgrades may be a relatively direct function of the length and magnitude of the expansion, just as downgrades may be a direct function of the length and magnitude of the contraction. Either way, the results suggest that defaults do not significantly affect the two return series under study. For convertible bonds, at least relative to low-grade bonds, embedded puts have not been a good method of diversifying equity market risk during recessions.

The embedded puts in convertible bonds have the effect of insignificantly decreasing their sensitivity with respect to stock price movements (estimated coefficient β_2 is insignificantly negative) and significantly lengthening their duration with respect to bond price movements (estimated coefficient β_2 is positive and significant at the 1 percent level). This result suggests that the bond duration of convertible bonds actually increases during recessions. This increase may be partly explained by downgradings of high-grade bonds into the convertible bond asset class, which overwhelms the effect puts have on the asset class. Even though puts occur more frequently during recessions, high-grade downgradings more than offset this effect.

The results also indicate that convertible bonds do not act significantly less like government bonds during recessions than do low-grade bonds. That is, the covariability of convertible bond returns with government bond returns does not significantly decrease during recessions relative to low-grade bond returns (Equation 10, estimated coefficient β_2). This result could also be explained in part by downgradings of high-grade bonds during recessions, some of which remain in each asset class, although others are still called away during the recession.

Overall, the results weakly suggest that during periods when convertible and low-grade bonds would be expected to show relatively equal sensitivity to equity prices, they do. During recessions, the two asset classes relatively mirror each other. Convertible bonds become insignificantly less equitylike and significantly more bondlike, and low-grade bonds become insignificantly more equitylike and significantly more bondlike. Given that the essential difference between convertible bonds and low-grade bonds is the equity call feature, the recession regression results support the simple CCA implication that recessionary periods would not be expected to have a significant impact on the relative performance of the two asset classes because the primary effect of a business downturn would be on the embedded put option not on the equity call option, which only convertible bonds possess.

Equity Call Periods

By definition, convertible bonds have embedded equity calls and straight low-grade bonds do not. Of the three basic types of periods under study, which are intended to correspond to the three convertible bond embedded options, equity call periods would be expected to produce a direct differential effect on convertible bonds versus low-grade bonds. If the exercise and/or increase in the probability of exercise of equity calls on convertible bonds relative to low-grade bonds has a significant effect, it will be significant during periods when equities outperform straight corporate bonds. If convertible bonds are significantly more exposed to equity risk during periods when equities outperform corporate bonds, convertible bond returns should be more sensitive to stock movements during periods when the relative positive performance of equities increases. Therefore, during equity call periods, convertible bond returns should be significantly less affected by interest rates and more affected by movements in the stock market than at other times. That is, if the embedded equity call options in convertible bonds are an effective means of making the bonds more equitylike, that effect will show up in the sensitivity of convertible bond returns to primarily stock returns during periods when those options would be expected to be more in the money.

Of course, this effect is contingent upon the value of the equity call option not being significantly affected by companies attempting to force conversion by calling the bonds (i.e., based on the interest rate call option). In effect, companies can cap the value of the equity call option at the value of the interest rate call exercise price. Therefore, in a more complex world, the equity call option might be expected to reduce the sensitivity of convertible bond returns to equity returns during periods when equity call options are going farther into the money. Furthermore, this effect could explain why convertible bonds might become more sensitive to bond market movements and less sensitive to equity market movements during periods when interest rates are declining and equities are outperforming straight low-grade bonds.

Table 9 presents the means and standard deviations of each asset return series associated with equity call periods. Convertible bonds were slightly more volatile than low-grade bonds during equity call periods. For equity call months, the ratio of convertible to low-grade bond standard deviations is approximately 1.22 versus 1.37 for all months. Like interest rate calls and defaults, equity calls alone cannot explain the volatility differential between convertible and low-grade bonds.

The following regression models were run to test for the impact of equity call periods on the returns of convertible and low-grade bonds:

$$CNVRT_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times EC_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times EC_t) + \beta_5(EC_t) + e_t \quad (11)$$

$$LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times EC_t) + \beta_3(SMR_t) + \beta_4(SMR_t \times EC_t) + \beta_5(EC_t) + e_t \quad (12)$$

$$CNVRT_t - LGR_t = \alpha_0 + \beta_1(TBR_t) + \beta_2(TBR_t \times EC_t) - \beta_3(SMR_t) + \beta_4(SMR_t \times EC_t) + \beta_5(EC_t) + e_t, \quad (13)$$

where EC is a dummy variable equal to 1 if the stocks outperform straight low-grade bonds and zero otherwise. The equity call dummy variable is intended to isolate the effect of periods when equity calls are more frequent and/or more probable for convertible bonds.

The regression results are presented in Table 10. After controlling for the five factors, the results indicate that convertible bonds do not display abnormal returns relative to low-grade bonds. During the study period, convertible and low-grade bonds did not become significantly more sensitive to stock market movements during equity call periods (estimated coefficient β_4). Especially for convertible bonds, this result seems to be somewhat anomalous. The estimated equity call period dummy coefficient, however, is significantly positive (Equation 13, estimated coefficient β_5). This result suggests that convertible bonds are significantly more positively affected than low-grade bonds by equity call periods.

The embedded equity calls in convertible bonds do not have the effect of significantly increasing their sensitivity with respect to equity price movements (estimated coefficient β_4 is negative and insignificantly so), but they do significantly decrease their duration with respect to bond price movements (estimated coefficient β_2 is negative and significant at the 5 percent level). This finding suggests that the bond duration of convertible bonds actually decreases during equity call periods. Apparently, convertible bonds may not become more equitylike during equity call periods, but they do become less bondlike. Given that straight low-grade bonds have similar equity call period effects, the equity call feature embedded in convertible bonds has not produced a significant performance advantage for convertible bonds relative to low-grade bonds (at least regarding their relative duration).

Overall, the results do not support the contention that during periods when convertible and

Table 9. Means and Standard Deviations of the Returns of Various Asset Classes for Months when Equities Outperform Straight Risky Bonds (Equity Call Months), January 1962–September 1994

Statistic	Convertible Bonds	Corporate Bonds: Low-Grade	Corporate Bonds: High-Grade	Treasury Bonds	S&P 500
Observations = 200					
Mean (%)	2.3363	1.0540	0.6618	0.7714	3.1935
Standard deviation	2.8511	2.3357	1.9042	2.9405	3.2716

Note: A month is defined as a period of equity call if, during the month, the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

Table 10. Equity Call Regressions of Convertible and Low-Grade Corporate Bond Returns
(*t*-statistics in parentheses)

Model	Coefficients α_0	β_1	β_2	β_3	β_4	β_5	Adj. R^2	Durbin–Watson	Standard Error
Equation 11	0.011	0.139	–0.131	0.760	–0.035	–0.010	0.769	1.622	0.016
	(7.44)**	(3.38)**	(–2.19)*	(21.69)**	(–0.67)	(–4.83)**			
Equation 12	0.012	0.269	–0.134	0.486	0.022	–0.019	0.667	1.882	0.014
	(9.93)**	(7.50)**	(–2.56)**	(15.84)**	(0.47)	(–10.10)**			
Equation 13	–0.002	–0.130	0.003	0.274	–0.057	0.009	0.354	1.711	0.017
	(1.15)	(–2.95)**	(0.05)	(7.26)**	(–1.00)	(3.72)**			

Note: These regression results compare the effect of periods when equities outperform risky bonds. A month is defined as a period of equity call if during the month the return on the S&P 500 total return index is greater than the return on low-grade corporate bonds.

* denotes significance at the 5 percent level.

** denotes significance at the 1 percent level.

low-grade bonds would be expected to show significantly different sensitivity to equity prices, they do not. During equity call periods, the two asset classes tend to mirror each other. Convertible bonds become insignificantly less equitylike and significantly less bondlike, and low-grade bonds become insignificantly more equitylike and significantly less bondlike. Although the essential difference between convertible bonds and low-grade bonds is the equity call feature, the equity call regression results do not strongly support the notion that equity call periods would be expected to have a significant impact on the relative performance of the two asset classes (especially with regard to the sensitivity of convertible prices with respect to stock prices). Of course, the estimated coefficient β_5 in Equation 13 does indicate some level of asymmetric performance for convertible bonds attributable to equity call periods.

SUMMARY AND CONCLUSIONS

From 1962 through September 1994, convertible bonds returned more than low-grade bonds but at a higher standard deviation of return. After adjusting for bond and stock market movements, convertible bonds outperformed low-grade bonds, but not at commonly accepted statistical levels of significance. Convertible bonds are more sensitive to stock market movements and less sensitive to bond market movements than low-grade bonds. Given the additional equity call option embedded in convertible bonds, they should behave more like stocks and less like bonds. In addition, like low-grade bonds, convertible bonds display a strong January effect.

The analysis shows that during interest rate call periods, convertible bonds display positive abnormal returns relative to low-grade bonds.

Table 11. A Comparison of Expectations and Outcomes for Convertible versus Low-Grade Bonds during Each Period Tested: Simple CCA Expectations

Period under Study	Expectation for Sensitivity to Treasury Bonds (estimated β_2)	Expectation for Sensitivity to Stocks (estimated β_4)
Interest rate call periods	0	0
Put periods	0	0
Equity call periods	0	-
Combination periods		
Interest rate call/put periods	0	0
Interest rate call/equity call periods	0	-
Equity call/put periods	0	-
Realization for convertible versus low-grade bonds (cut-off at the 5% level of significance)		
Interest rate call periods	0	0
Put periods	0	0
Equity call periods	0	0
Combination periods		
Interest rate call/put periods	0	0
Interest rate call/equity call periods	+	-
Equity call/put periods	0	-

During business cycle contractions, equity call periods, or combination option exercise periods (i.e., all other periods analyzed), convertible bonds do not display abnormal returns relative to low-grade bonds.[20] As can be seen in Table 11, the expected and actual effect of the embedded equity call option in convertible bonds is what principally distinguishes them from straight low-grade bonds.

As expected by simple CCA, the only significant embedded option effects occur during equity call periods, although the simple CCA expectations regarding the direction of the effect differs from expectations. Clearly, the effect of the equity call option on the asset class is more complex than initial expectations.

What do these findings mean for investors? First, like straight low-grade bonds, the put option embedded in convertible bonds displays some offsetting effect, especially during combination equity call and put periods. Second, the equity calls embedded in convertible bonds do not necessarily give the upside in rising equity markets relative to straight risky bonds, as might be expected. Last, after controlling for stock and bond market risk, convertible bonds have been at least as good an investment as straight low-grade bonds.[21]

NOTES

1. See, for example, M.J. Brennan and E.S. Schwartz, "Convertible Bonds: Valuation and Optimal Strategies for Call and Conversion," *The Journal of Finance*, vol. 32 no. 5 (December 1977):1699–715; and Jonathan Ingersoll, Jr., "A Contingent-Claims Valuation of Convertible Securities," *Journal of Financial Economics*, vol. 4 no. 3 (May 1977):289–322.
2. For example, Jonathan Ingersoll, "An Examination of Corporate Call Policies on Convertible Securities," *The Journal of Finance*, vol. 32, no. 2 (May 1977):463–78; Milton Harris and Artur Raviv, "A Sequential Signalling Model of Convertible Debt Call Policy," *The Journal of Finance*, vol. 40, no. 5 (December 1985):1263–81; and S. Acharya and P. Handa, "Early Calls of Convertible Debt: New Evidence and Theory," Salomon Brothers Center for the Study of Financial Institutions, New York University Working Paper Series, no. 477 (June 1988).
3. Edward I. Altman, in "Risk and Return Experience in the Corporate Convertible Debt Market," New York University Working Paper Series, no. 500 (1988), analyzed the size (1980 through 1987), total return (1983 through 1987), and default (1980 through 1987) experience of convertible bonds.
4. The convertible bond series data are derived from open-end mutual funds tracked by Northfield Information Systems from January 1962 through September 1994, which are based on Morningstar data on open-end mutual funds. The other corporate bond data series are derived from open-end mutual funds tracked by Morningstar during the same period. These returns are net of all but front-end and back-end charges. The Treasury bond series is a spliced series based on Bradford Cornell and Kevin Green, "The Investment Performance of Low-grade Bond Funds," *The Journal of Finance*, vol. 46, no. 1 (March 1991):29–48; Treasury bond series (January 1, 1962, through December 1988); and Salomon Brothers' long bond series (January 1, 1989, through September 1994). The stock series is derived from Standard & Poor's 500 Index. Therefore, unlike the return series derived from mutual fund returns, the stock and Treasury bond series are gross returns.

   Like the Cornell and Green study on corporate low-grade bonds, this study uses monthly open-end mutual fund data to derive asset class return series. Lipper Analytical Services asset class definitions are used for all asset class return series reported. Shares of open-end mutual funds are traded on the basis of net asset value (*NAV*). Monthly returns are based on the following calculation: $Return_t = [(NAV_t - NAV_{t-1}) + IncDist_t + CapGainDist_t]/NAV_{t-1}$. In addition, these returns take account of 12b-1 fees and management fees but not front-end loads, back-end loads, or redemption charges.

   Each mutual-fund-based asset class return series was constructed following the method used by Cornell and Green. For each asset class, the equally weighted average of all mutual funds each month was calculated. As of month-end September 1994, the Morningstar data covered 101 low-grade bond funds, 149 high-grade bond funds, and 34 convertible-bond funds. Table 1 provides background on the asset class return series used in this study.
5. One problem with this method is that the effects of illiquidity may also have a significant effect during periods when only calls and puts are expected to be significant. Nevertheless, the assumption here is that periods when interest rate calls, puts, and equity calls significantly affect the pricing of risky bonds can be identified.
6. The equity call option given to most convertible bondholders is an explicit call option on the equity of the firm; see Edward H. Jennings, "An Estimate of Convertible Bond Premiums," *Journal of Financial and Quantitative Analysis*, vol. 9, no. 1 (January 1974):33–56. Even though the optimal equity call policy is clear (see Brennan and Schwartz, "Convertible Bonds"; Ingersoll, "A Contingent-Claims Valuation"; and Ingersoll, "An Examination of Corporate Call Policies on Convertible Securities"), actual firm conversion policies often delay conversion and are thus nonoptimal (see Harris and Raviv, "A Sequential Signalling Model of Convertible Debt Call Policy"). Therefore, given significant nonoptimal conversions, the effect of the equity call option on the financial performance of convertible bonds may not follow from CCA.

   Harris and Raviv, in "A Sequential Signalling Model of Convertible Debt Call Policy," rationalize these apparent suboptimal delayed calls and the fact that common stock returns are significantly negative around the announcement of the call of a convertible debt issue. See also Wayne Mikkelson, "Capital Structure Change and Decreases in Stockholder's Wealth: A Cross-Sectional Study of Convertible Security Calls," National Bureau of Economic Research Working Paper, no. 1137 (June 1983); Larry Y. Dann and Wayne Mikkelson, "Convertible Debt Issuance, Capital Structure Change and Financing-related Information," *Journal of Financial Economics*, vol. 13, no. 2 (June 1984):157–86; and D. Jaffee and A. Shleifer, "Costs of Financial Distress, Delayed Calls of Convertible Bonds, and the Role of Investment Banks," National Bureau of Economic Research Working Paper, no. 2558 (April 1988). In addition, Acharya and Handa, in "Early Calls of Convertible Debt," a follow-up study, focused on explaining suboptimal early calls. Harris and Raviv, in "A Sequential Signalling Model," suggest that managers will delay a call of convertibles based on information indicating poor future prospects for the firm, although Acharya and Handa, in "Early Calls of Convertible Debt: New Evidence and Theory," suggest managers will make an early call of convertibles based on positive information. Therefore, long delays signal an improvement in future performance, and early calls signal a deterioration in future performance.

7. Note that high-grade corporate bonds have put options, but they are, by definition, so far out of the money that they are dropped from the equation to simplify the analysis.
8. See John Kihn, "Unravelling the Low-Grade Bond Risk/Reward Puzzle," *Financial Analysts Journal*, vol. 50, no. 4 (July/August 1994):32–42.
9. Embedded options also affect the convexity of a risky bond or a portfolio of risky bonds.
10. See Kihn, "Unravelling the Low-Grade Bond Risk/Reward Puzzle."
11. See J. Kim, K. Ramaswamy, and S. Sundaresan, "Does Default Risk in Coupons Affect the Valuation of Corporate Bonds?: A Contingent Claims Model," *Financial Management*, vol. 22, no. 3 (Autumn 1993):117–31.
12. See E. Philip Jones, Scott P. Mason, and Eric Rosenfeld, "Contingent Claims Analysis of Corporate Capital Structures: An Empirical Investigation," *The Journal of Finance*, vol. 39, no. 3 (July 1984):611–25.
13. In 1987, for a sample of convertible bonds analyzed by Altman in "Risk and Return Experience," approximately 62 percent were defined as low-grade bonds.
14. To be specific, given that Lipper does not strictly define low-grade bond funds to be composed of 100 percent low-grade bonds and not all convertible bonds are low-grade bonds, the low-grade return series used are not purely low grade.
15. See, for example, Marshall E. Blume, Donald B. Keim, and Sandeep A. Patel, "Returns and Volatility of Low-Grade Bonds 1977–1989," *The Journal of Finance*, vol. 46, no. 1 (March 1991):49–74.
16. Although beyond the scope of this paper, a more detailed analysis of the convertible bond January effect would be a worthwhile analysis.
17. See Cornell and Green, "The Investment Performance of Low-grade Bond Funds"; and Blume, Keim, and Patel, "Returns and Volatility of Low-Grade Bonds 1977–1989."
18. See Kihn, "Unravelling the Low-Grade Bond Risk/Reward Puzzle."
19. These regression models are based on the models developed to examine the high returns and low volatility associated with low-grade bonds. See Cornell and Green, "The Investment Performance of Low-grade Bond Funds."
20. A method similar to the individual period method was applied to analyze combination periods, but because of space limitations, the rather lengthy results of the analyses are not included in this article.
21. The author would like to thank Gordon Johnson, Mike Roberge, and Jim Steaggall. In addition, the author would like to thank Dan Dibartolomeo of Northfield Information Services, Inc., for the convertible bond data.

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Contents

Unravelling the Low-Grade Bond Risk/Reward Puzzle

John Kihn

Previous studies have suggested that low-grade bonds are more likely to be called than high-grade bonds, and that this difference explains the higher returns and lower standard deviations of low-grade compared with high-grade corporates. But during periods of declining interest rates, when one might expect corporate call activity to be high, the volatility of low-grade bonds does not differ significantly from that of high-grade bonds. Calls alone appear to have an insignificant impact on the relative volatilities of low-grade and high-grade bond returns.

Low-grade bonds also incorporate embedded put options; in effect, these allow corporate equity holders to put the corporation to bondholders if the corporation's shares become worthless. Exercise of these puts might be expected to be most frequent during business cycle contractions, when defaults tend to be at their highest rates. During such periods, low-grade bonds do not demonstrate significantly different overall volatility from that of high-grade bonds. They do, however, become significantly more sensitive to bond market movements and less sensitive to stock market movements compared with high-grade bonds.

During periods of recession combined with declining interest rates, this effect is accentuated. In effect, during periods when both calls and puts are likely to be exercised, the credit quality of low-grade bonds declines, depressing prices enough to discourage the exercise of call options. At the same time, high-grade bonds tend to be called away because of the decline in interest rates, while the credit quality of the whole asset class is deteriorating because of the business downturn.

The passage of the savings and loan bailout bill in the summer of 1989 sent low-grade bonds into a tailspin that lasted until January 1991.[1] That act, requiring savings and loans to divest themselves of low-grade bond holdings by 1994, was followed, in early 1990, by the bankruptcy of the largest broker and issuer of junk bonds. During this period of upheaval in the low-grade market, several academic studies concluded that low-grade bonds were not an anomalous asset class, as suggested by certain "junk bond" salesmen.

High-yield bonds have recently experienced a resurgence, with new issues and renewed interest coming from investors concerned with the relatively low yields of government bonds. This article examines the return experience of low-grade and high-grade bonds over a long period in order to shed some light on the central controversy that has motivated the interest in low-grade bonds as an asset class—that is, the fact that low-grade bonds appear to have generated a higher return at a lower risk than high-grade bonds (see Table 1).

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ARE LOW-GRADE BONDS ANOMALOUS?

Several researchers have suggested that low-grade bonds are not anomalous:

> The standard deviation of low-grade bond returns is frequently less than the standard deviation of high-grade bond returns. Blume, Keim and Patel attribute this to the fact that low-grade bonds typically have a shorter duration. The effective duration of low-grade bonds is lower than that for high-grade bonds and Treasury bonds because the coupons are higher and because low-grade bonds are often called earlier. Early calls occur more often for low-grade bonds because they generally have weaker call protection than their high-grade counterparts and because the credit quality of low-grade bonds is more likely to rise.[2]

Low-grade bonds do generally have a lower duration than high-grade bonds, but we will show

Table 1. Return and Risk for Several Asset Classes, 1960-88

	Treasury Bonds	High-Grade Bonds	Low-Grade Bonds	S&P 500
Observations = 348				
Cumulative Return	449.08%	532.73%	828.70%	1,336.68%
Average Return	6.05%	6.57%	7.99%	9.62%
Standard Deviation	10.16%	9.42%	8.64%	15.02%
Reward/Risk Ratio	0.60	0.70	0.92	0.64

that their susceptibility to early call cannot fully explain their shorter duration and subsequent lower standard deviation. In fact, defaults have a greater impact on the duration of low-grade bonds than calls.

This article emphasizes the asymmetric impact of defaults on the two corporate bond asset classes: Default and the probability of default have a greater impact on low-grade bonds than on high-grade bonds. It is the relative scarcity of defaults of high-grade bonds that makes them more volatile relative to low-grade bonds.

PRINCIPAL COMPONENTS OF CORPORATE BOND PRICING AND DURATION

Altman notes that the price of risky bonds is principally determined by (1) interest rate risk, (2) default risk and (3) illiquidity risk.[3] Interest rate risk is related to reinvestment risk, which is in turn related to the risk that the bond will be called. If a bond is called during a period of declining interest rates (i.e., rising bond prices), the holder will be forced to reinvest the proceeds at a lower rate of interest, *ceteris paribus*. Investors will demand a premium for the net difference between the cost of reinvestment risk and the call premium.

Default risk essentially reflects the risk that shareholders will put the company to bondholders if the company's shares become worthless. Bond investors will demand a premium for writing this implicit put. The premium's value will depend on the probability of the company defaulting and the distribution of possible recovery values.

Illiquidity risk is the risk that the price of the bond will fall because of a lack of buyers. For bearing this risk, bond investors will demand a premium, the value of which will increase, the more illiquid the bond is expected to be.

All the premiums associated with risky bonds suggest the bonds will sell at a rather substantial discount relative to risk-free bonds. Much of the pricing of risky bonds can therefore be represented by the following equation:

$$RB_i = B_i - (P_i + C_i + L_i),$$

where

RB = risky bond,
B = risk-free bond,
P = put or default option value,
C = call option value and
L = illiquidity or ease-of-sale option value.

The equation tells us that P, C and L directly affect the price of a risky bond. It is the combination of P, C and L that explains the unique behavior of risky bonds relative to risk-free bonds.

This article focuses on the effects that P and C have on the pricing of high-grade and low-grade bonds as asset classes. It therefore examines periods when the effects of P and C could reasonably be expected to be significant.[4] These include periods when calls and puts would be expected to be exercised and/or the probability of exercise could be expected to increase significantly for low-grade bonds. This isolates the impact puts have on corporate bond returns.

This study is the first to focus on the effects of puts and calls on corporate bond returns. Option and contingent-claims analyses view default as equityholders putting the company to bondholders. In this construct, bond default is equivalent to the exercise of a put option held by equityholders.

There is a well established asymmetry between low-grade and high-grade bonds. High-grade bonds experience downgradings before default. Thus default may be expected to have a direct impact on low-grade bonds only.[5] In effect, holders of low-grade bonds have written call and put options on the bonds they have purchased.[6]

To evaluate whether calls are the primary cause of low-grade bonds' lower durations relative to high-grade bonds, this study focuses on the effects of calls and puts on low-grade bonds.

Bond Duration

How do puts and calls affect the returns and risks of low-grade bonds relative to those of high-grade bonds? Analysis of the durations of the two corporate bond asset classes yields an explanation.

Given that duration is a measure of the sensitivity of the price of a bond to a change in interest rates, it is an appropriate starting point for analyzing possible asymmetries between low-grade and high-grade bond volatilities.[7]

In general, duration can be expressed as:

$$D_{B_i} = -[(dB_i/d(1+r)) \times (1/B_i)],$$

where B_i is the price of risk-free bond i and r is the interest rate. Default can lower a bond's duration drastically, even with no change in the discount rate. Historically, defaults have reduced low-grade bond prices by more than 50%.[8] In the case of default caused by bankruptcy, this price decline occurs over a period of several years prior to bankruptcy.[9]

All low-grade bonds include an implicit put, written by the bondholders for the issuing firms' shareholders. Most low-grade bonds also include explicit call options. In the case of both low-grade and high-grade bonds, the issuing company will exercise a call when interest rates have declined enough to make doing so profitable.

Ignoring security-specific factors such as liquidity, the value of a low-grade bond can be represented by the following general equation:

$$LG_i = B_i - P_i - C_i,$$

where LG is the value of low-grade bond i, B is the value of risk-free bond i, P is the value of the put option i and C is the value of the call option i. In this contingent-claims view, the duration of a low-grade bond can be expressed as the weighted average of the previous three components:[10]

$$D_{LG_i} = (B_i\ LG_i) \times D_{B_i} + (P_i\ LG_i) \times D_{P_i} + (C_i\ LG_i) \times D_{C_i},$$

where D_{B_i} is as specified above and:

$$D_{P_i} = -[(dP_i\ d(1+r)) \times (1/P_i)] \text{ and}$$

$$D_{C_i} = -[(dC_i\ d(1+r)) \times (1/C_i)].$$

The following equation represents the long form of the duration of the put option:

$$D_{P_i} = -[[((\partial P_i\ \partial B_i) \times (\partial P_i\ \partial(1+r))) +$$

$$(\partial P_i\ \partial(1+r))] \times (1\ P_i)] = \Lambda \times D_{B_i} - \rho$$

where Λ is the elasticity of the option price with respect to the underlying bond price and ρ is the elasticity of the option price with respect to interest rate changes. If lambda exceeds 1, the option's duration is greater than the duration of the underlying bond. The further the underlying bond price is from the option striking price (i.e., the further the option is "out of the money"), the greater the duration of the option and the lower its value and subsequent weighting in the total bond duration calculation. Because, by definition, the put options of high-grade bonds are well out of the money compared with the puts of low-grade bonds, we can expect significant asymmetry between the effects of the put option on the durations of the two asset classes.

As most low-grade bonds have explicit or implicit put and call options written on them, their low volatility should not surprise us. If interest rates decline sufficiently, the bonds will be called away. If the fortunes of the company decline sufficiently, the company will be put to the bondholders. We hypothesize that it is principally the interaction of these effects that contributes to the low volatility of low-grade bonds as an asset class.

A Caveat

Previous studies explained the lower standard deviation of low-grade bonds relative to high-grade bonds in terms of the duration of low-grade bonds relative to that of high-grade bonds.[11] Although the duration of low-grade bonds is clearly lower than that of high-grade bonds, we show below that call rates and the relative weakness of call protection for low-grade bonds are not the principal or even significant causes of their relatively lower duration.[12]

Past studies did not focus on *asset class* durations. The distinction between the duration of a portfolio of assets and the duration of an asset class is critical. Particularly in the case of low-grade bonds, using closed definitions of duration (taking the weighted average of the durations of the assets forming a portfolio as the portfolio's duration, for example) may cause problems.[13]

In addition to coupons and calls, other factors can influence the relative durations of low-grade and high-grade bonds. These include (1) upgradings of low-grade bonds, (2) downgradings of high-grade bonds, (3) maturities of low-grade bonds, (4) maturities of high-grade bonds, (5) exchanges of low-grade bonds, (6) exchanges of high-grade bonds, (7) repurchases of low-grade bonds, (8) repurchases of high-grade bonds, (9) defaults of low-grade bonds, (10) issuance of new low-grade bonds and (11) issuance of new high-grade bonds. Previous studies have ignored the effects of these factors on the differences in durations between high-grade and low-grade bond asset classes over time.

Past Evidence

Given previous assertions concerning the relative call rates of low-grade and high-grade bonds, we will review the empirical evidence on low-grade bond calls. We will also review the default rate experiences of these asset classes—a factor ignored by previous studies.[14] Securities with long durations are more volatile than those with shorter durations; the frequency of events such as calls and default should directly impact duration.

Prior research has never established the extent to which each asset class is affected by calls. We might start by looking at the relative number of high-grade and low-grade bonds that have call options written on them. (Not all low-grade bonds have a call option written into the indenture.) If the option to call is more common for low-grade than high-grade bonds (and any effects of this difference are not balanced or outweighed by differential impacts of strike interest rates and exercise prices), then we might expect call options to reduce the duration of low-grade bonds more than they reduce the duration of high-grade bonds.

Past evidence indicates that defaults have had a greater impact on low-grade bond duration than calls.[15] Table 2 compares the frequencies of calls and defaults for low-grade bonds.[16] Over the 10 annual cohort groups, the default rate as of December 12, 1988 was 10.66% versus 10.88% for the call rate. Over the sample, then, defaults and calls occurred with approximately the same frequency for original-issue low-grade bonds. Recovery rates for low-grade bonds have been below 50%, however; defaults have thus had a greater impact than calls on the duration of original-issue low-grade bonds.[17]

An example illustrates this. Consider two portfolios, A and B. Portfolio A comprises 10 bonds with a call option written on each bond. Portfolio B comprises 10 bonds with a put option written on each bond. All bonds in both portfolios mature in 10 years and all are zero-coupon bonds. The risk-free discount rate is 10% per annum and the term structure is flat. Original-issue bonds with call options written on them are called at a rate of 10% per year and original-issue bonds with put options written on them default at a rate of 10% per year. Called bonds receive 100 cents on the dollar whereas defaulted bonds recover only 50% of par value. Bonds that are called or default reinvest at the discount rate for the remainder of the 10-year period. Historically, call and default rates are about 2% to 5% per annum for original-issue bonds.[18] Furthermore, defaulted bonds recover about 38 cents on the dollar.[19]

A portfolio comprised of risk-free, zero-coupon bonds without options written on them has a duration of 10 years. Portfolio A (the call portfolio) has a duration of approximately 4.7 years. If we assume investors do not expect any defaults, Portfolio B (the default portfolio) has the same duration as Portfolio A. If we assume investors accurately adjust their discount rate to reflect the expected 10% default rate and 50% recovery rate, the discount rate would be approximately 23% and Portfolio B's duration would be approximately 3.9 years. Based on conservative estimates, then, the duration of a portfolio of bonds that are callable is about 17% greater than the duration of a portfolio of bonds that default. In short, if we assume investors anticipate default rates and call rates,

Table 2. Cumulative Disposition of Original-Issue Low-Grade Bonds by Par Amount Issued (December 31, 1988)

Issue Year	Total Issued (millions)	Defaults (%)	Exchanges (%)	Calls (%)	Maturities (%)	Residual Out. (%)
1977	$ 908	33.92%	0.00	32.60%	9.59%	24.14%
1978	1,442	34.26	9.02	25.87	0.00	30.86
1979	1,263	24.70	1.11	32.78	0.00	41.41
1980	1,223	27.56	4.09	30.09	0.00	38.27
1981	1,240	20.97	19,35	27.82	2.42	29.44
1982	2,490	25.94	0.40	47.15	10.84	15.66
1983	6,003	19.21	7.58	13.16	5.83	54.22
1984	11,552	9.38	3.94	9.17	4.60	72.91
1985	14,463	3.53	3.25	13.99	0.00	79.23
1986	30,949	8.14	1.07	3.03	0.97	86.68
Total	$71,533	10.66%	3.01%	10.88%	2.19%	73.27%

Source: P. Asquith, D. Mullins and E. Wolff, "Original Issue High Yield Bonds: Aging Analyses of Defaults, Exchanges, and Calls," *Journal of Finance*, September 1989.

defaults shorten the duration of low-grade bond portfolios more than calls.[20]

Generally, for low-grade bonds, security distress has had a larger impact on duration than declining interest rates.[21] The opposite may be true for high-grade bonds. Furthermore, default rates have been dramatically higher for low-grade than for high-grade bonds.[22]

THE IMPACT OF CALL AND PUT PERIODS

Blume, Keim and Patel have observed that "low-grade bonds are complex securities having some of the characteristics of higher grade bonds and some of the characteristics of equities."[23] Accordingly, low-grade bond prices covary with both stock and bond prices. How are the put and call options written on most low-grade bonds related to stock and high-grade bond options?

To examine the return behavior of high-grade and low-grade bonds, we isolate periods in which calls and puts are likely to be exercised or in which the probability of exercise significantly increases. We assume that, in regard to embedded put options (i.e., defaults and outright bankruptcies), the salient periods for examination are recessionary periods, whereas the salient periods for examining calls are those of declining interest rates. By examining low-grade and high-grade returns during these periods, we can analyze the impacts that puts and calls have on the relative returns of the two corporate bond asset classes.

Call Periods

High-grade bonds are significantly more sensitive to interest rate changes than low-grade bonds.[24] Why this is so remains open to question. If low-grade bonds' relative lack of interest rate sensitivity could be attributed to their relatively higher call rate, we would expect a significant decline in the sensitivity of low-grade bond returns to risk-free bond returns during periods when call options are likely to be exercised (i.e., periods of declining interest rates).

We can test this by examining the behavior of low-grade bond returns relative to high-grade bond returns during periods of declining interest rates. Specifically, if there is a meaningful difference, the sensitivity of low-grade bond returns to risk-free return movements should decline significantly. Table 3 presents returns and standard deviations for periods when the 10-year, constant-maturity Treasury bond yield declined.

Although low-grade bonds were less volatile than high-grade bonds during periods of declining interest rates, low-grade bonds were not significantly less volatile (at the 10% level of significance). For months when interest rates were declining, the ratio of high-grade to low-grade bond standard deviations is approximately 1.18; it is 1.09 for all months. The greater number of calls of and the weaker call protection afforded low-grade bonds relative to high-grade bonds cannot fully explain their lower volatility.

We ran the following regression models to test for the significance of call periods on the returns of high-grade and low-grade bonds:

$$LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times DIR_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t \quad (1)$$

$$HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times DIR_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t \quad (2)$$

$$LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times DIR_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times DIR_t + \beta_5 \times DIR_t + e_t \quad (3)$$

Here

LGR = low-grade bond return,
HGR = high-grade bond return,
TBR = Treasury bond return,
DIR = a dummy variable equal to 1 if interest rates decline and 0 otherwise,
SMR = stock market return (the return of the S&P 500) and
e = an error term.

The regression equations were designed to take account of bond and stock market risk via TBR and SMR. The call dummy variable is intended to

Table 3. Return and Risk for Several Asset Classes for Months when Interest Rates Declined (call months), 1960–88

	Treasury Bonds	High-Grade Bonds	Low-Grade Bonds	S&P 500
Observations = 149				
Cumulative Return	2,425.50%	2,080.38%	1,522.98%	2,436.41%
Average Return	29.70%	28.17%	25.16%	29.75%
Standard Deviation	9.85%	9.28%	7.86%	14.09%
Reward/Risk Ratio	3.02	3.04	3.20	2.11

Table 4. Call Regressions of Low-Grade and High-Grade Bond Return†

Model	α_0	β_1	β_2	β_3	β_4	β_5	Adj. R^2	DW	SEE
(1) Coefficient	0.000	0.264	−0.030	0.373	−0.032	0.006	0.668	1.85	0.014
t-Statistic	0.12	5.91*	−0.49	15.61*	−0.82	3.14*			
(2) Coefficient	−0.000	0.785	0.005	0.041	0.037	0.002	0.820	2.25	0.012
t-Statistic	−1.12	21.87*	0.09	2.09**	1.18	1.31			
(3) Coefficient	0.000	−0.521	−0.035	0.337	−0.069	0.004	0.587	2.00	0.015
t-Statistic	0.22	−11.51*	−0.55	13.78*	−1.75	2.06**			

* Denotes significance at the 1% level.

** Denotes significance at the 5% level.

† These regression results compare the effect of periods of declining interest rates. A month is defined as a period of declining interest rates if during the month the change in yield on the 10-year constant-maturity Treasury bond is less than zero.

isolate the effect of periods when calls are more frequent and/or more probable.

Table 4 gives the results. The estimated alpha can be interpreted as the amount of abnormal return attributed to the dependent return series after adjusting for the various movements of the independent variables. In this case, the results indicate that, during periods of declining interest rates, there is no significant difference between the return performances of the two asset classes.

As expected, low-grade bonds are significantly less sensitive to interest rate movements (β_1 and β_2) and significantly more sensitive to stock market movements (β_3 and β_4) than high-grade bonds. The fact that they are not significantly more or less sensitive to either interest rate or stock price movements during periods of declining interest rates (β_2 and β_4, respectively) casts doubt on the existence of significant asymmetry in the effect of call options on low-grade versus high-grade bonds. If high-grade bonds were significantly more sensitive to interest rate movements because of greater call protection relative to low-grade bonds, we would expect the coefficient for β_2 to be significantly more positive than the same coefficient for the low-grade bond regression.

Interestingly, the coefficient for the dummy for periods of declining interest rates is statistically significant in the third regression. This suggests that periods of declining interest rates do have some significant impact on the returns of the two asset classes and, further, that the impact is significantly asymmetric (i.e., low-grade bond returns are more positively affected than high-grade bond returns). At a minimum, after controlling for government bond and stock market risk, this supports the contention that low-grade bonds can offer diversification advantages over high-grade bonds during periods of declining interest rates.

Put Periods

If the exercise of a put or the probability of its exercise has a greater impact on low-grade bonds than on high-grade bonds, the difference is more likely to be significant during downturns in the business cycle. If low-grade bonds are significantly more exposed to business cycle risk during recessions, low-grade bond returns should be more sensitive to equity movements during periods when more defaults occur. Therefore, we hypothesize that low-grade bond returns will be significantly more affected by interest rates and less affected by movements in the stock market during recessionary periods than at other times. That is, if the put options embedded in low-grade bonds are an effective means of diversifying risk, this will be most apparent in the sensitivity of low-grade bond returns to bond and stock returns in recessionary periods.

Table 5 shows that low-grade bonds were only slightly less volatile than high-grade bonds during recessions. For recession months, the ratio of high-grade to low-grade bond standard deviations is approximately 1.10, versus 1.09 for all months. It seems that, as was the case with calls, defaults alone do not explain the volatility differential between high-grade and low-grade bonds.

Perhaps defaults dampen the sensitivity of low-grade bond returns to stock market movements during recessionary periods. We ran the following regressions to test for the impact of recessionary periods on the returns of high-grade and low-grade bonds:

$$LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times Rec_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times Rec_t + \beta_5 \times Rec_t + e_t \quad (4)$$

$$HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times Rec_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times Rec_t + \beta_5 \times Rec_t + e_t \quad (5)$$

Table 5. Return and Risk for Several Asset Classes: Recession Months (put months), 1960–88

	Treasury Bonds	High-Grade Bonds	Low-Grade Bonds	S&P 500
Observations = 59				
Cumulative Return	110.26%	108.22%	50.35%	36.58%
Average Return	16.32%	16.09%	8.65%	6.55%
Standard Deviation	14.45%	14.34%	13.04%	19.97%
Reward/Risk Ratio	1.13	1.12	0.66	0.33

$$LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times Rec_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times Rec_t + \beta_5 \times Rec_t + e_t \quad (6)$$

Here Rec is a dummy variable equal to 1 if the economy is in a recession and 0 otherwise. The put dummy variable is intended to isolate the effect of recessionary periods when puts are more frequent and/or more probable for low-grade bonds.[25]

The results in Table 6 indicate that during recessions there is no significant difference between the return performances of the two asset classes. This supports the contention that low-grade bonds provide a good hedge against extreme movements in stock and government bond markets. In this particular analysis, low-grade bonds seem to have provided a good hedge against business cycle risk.

Over the period, low-grade bonds lost some of their sensitivity to stock market movements during business cycle contractions, whereas high-grade bonds became significantly more sensitive to stock market movements (estimated coefficient β_4). These somewhat counterintuitive results imply that high-grade bonds behave more like equities during business cycle contractions than during business cycle expansions.[26]

A large increase in perceived credit risk during recessionary periods could explain this. Whereas some low-grade bonds default, and are thus removed from the asset class, lowering its duration, high-grade bonds are more likely either to remain in their asset class or to be downgraded. During economic booms, high-grade bonds can be upgraded, but upgrades may be a declining function of the length and magnitude of the expansion, whereas downgrades are a direct function of the length and magnitude of the contraction. Either way, the results suggest that defaults may not be the death of an asset class. For low-grade bonds, at least relative to high-grade bonds, defaults have been a good method of diversifying equity market risk during recessions.

The embedded puts in low-grade bonds insignificantly increase the bonds' sensitivity to equity price movements (i.e., estimated coefficient β_4 is positive but insignificantly so) and significantly lengthen their duration with respect to bond price movements (i.e., β_2 is very large and very significant). This suggests that the duration of low-grade bonds actually increases during recessions. This may in part be explained by high-grade bonds being downgraded into the low-grade asset class, overwhelming the effect puts have on the asset class. Even though puts are exercised more frequently during recessions, high-grade downgradings more than offset this effect.

The results also indicate that low-grade bonds

Table 6. Put Regressions of Low-Grade and High-Grade Bond Returns†

Model	α_0	β_1	β_2	β_3	β_4	β_5	Adj. R^2	DW	SEE
(4) Coefficient	0.003	0.202	0.255	0.365	0.004	−0.004	0.679	1.87	0.014
t-Statistic	2.96*	6.09*	4.30*	16.96*	0.09	−1.72			
(5) Coefficient	−0.001	0.782	0.051	0.032	0.095	0.002	0.825	2.27	0.011
t-Statistic	−1.41	29.27*	1.08	1.84**	2.83*	0.31			
(6) Coefficient	0.002	−0.580	0.203	0.333	−0.091	−0.004	0.595	1.98	0.014
t-Statistic	1.79	−17.15*	3.37*	15.20*	−2.15**	−1.79			

* Denotes significance at the 1% level.

** Denotes significance at the 5% level.

† These regression results compare the effect of recessionary periods. A recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. This definition is directly based on the U.S. Bureau of Economic Analysis definition.

Table 7. Return and Risk for Several Asset Classes: Combination Recession and Declining Interest Rate Months (put and call months), 1960–88

	Treasury Bonds	High-Grade Bonds	Low-Grade Bonds	S&P 500
Observations = 31				
Cumulative Return	212.56%	190.02%	117.16%	122.72%
Average Return	55.45%	51.01%	35.01%	36.34%
Standard Deviation	13.30%	13.71%	10.94%	17.32%
Reward/Risk Ratio	4.17	3.72	3.20	2.10

act significantly more like government bonds during recessions, whereas high-grade bonds act less like government bonds. The covariability of low-grade bond returns with government bond returns increases significantly during recessions relative to that of high-grade bond returns (i.e., estimated coefficient β_2). This could also be explained in part by downgradings of high-grade bonds during recessions; most of these bonds remain in the asset class and are not called away during the recession.

Overall, the results strongly suggest that during periods when low-grade bonds would be expected to show a great deal more sensitivity to equity prices relative to high-grade bonds, they do not. During recessions, the two asset classes seem partially to reverse their roles. Low-grade bonds become less like equity and more like bonds, whereas high-grade bonds become more like equity and less like bonds. This effect will tend to increase the volatility of high-grade bonds relative to that of low-grade bonds.

Combining Call and Put Periods

If the exercise or the probability of exercise of an option has more or less of an effect on low-grade bonds than on high-grade bonds, the difference should show up during periods when the business cycle is on a downturn and interest rates are declining. We hypothesize that, during recessionary periods with decreasing interest rates, low-grade bond returns will be significantly more affected than high-grade returns by interest rates and less affected by movements in the stock market than at other times.

Table 7 shows that low-grade bonds were less volatile than high-grade bonds during periods of recession and declining interest rates. In months of recession and declining interest rates, the ratio of high-grade to low-grade bond standard deviations was approximately 1.25. During months when we might expect puts and calls on low-grade bonds to be exercised, the volatility of low-grade bonds declined somewhat versus that of high-grade bonds, but the difference is not significant. Defaults and calls alone cannot explain the difference in volatility between high-grade and low-grade bonds.

We ran the following regression models to test for the significance of simultaneous put and call periods on the returns of high-grade and low-grade bonds:

$$LGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times Rec_t \times DIR_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times Rec_t \times DIR_t + \beta_5 \times Rec_t \times DIR_t + e_t \quad (6a)$$

Table 8. Put and Call Regressions of Low-Grade and High-Grade Bond Returns†

Model	α_0	β_1	β_2	β_3	β_4	β_5	Adj. R^2	DW	SEE
(7) Coefficient	0.002	0.233	0.260	0.383	−0.100	−0.003	0.670	1.84	0.014
t-Statistic	2.16**	7.35*	3.33*	19.45*	−1.72	−0.67			
(8) Coefficient	0.001	0.789	0.032	0.038	0.179	−0.002	0.828	2.28	0.011
t-Statistic	1.27	31.54*	0.52	2.44*	3.90*	−0.81			
(9) Coefficient	0.001	−0.556	0.228	0.345	−0.279	−0.000	0.608	1.96	0.014
t-Statistic	1.18	−17.68*	2.94*	17.71*	−4.83*	−0.04			

* Denotes significance at the 1% level.

** Denotes significance at the 5% level.

† These regression results compare the effects of recessionary and declining interest rate periods. A month is defined as a period of declining interest rates if during the month the change in yield on the 10-year, constant-maturity Treasury bond is less than zero, and a recession is defined as the period immediately following the business cycle peak up to the month of the subsequent trough. The recession period definition is directly based on the U.S. Bureau of Economic Analysis definition.

$$HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times Rec_t \times DIR_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times Rec_t \times DIR_t + \beta_5 \times Rec_t \times DIR_t + e_t \quad (7)$$

$$LGR_t - HGR_t = \alpha_0 + \beta_1 \times TBR_t + \beta_2 \times TBR_t \times Rec_t \times DIR_t + \beta_3 \times SMR_t + \beta_4 \times SMR_t \times Rec_t \times DIR_t + \beta_5 \times Rec_t \times DIR_t + e_t \quad (8)$$

These regressions are intended to capture the relative effects of the dual events of puts and calls for low-grade bonds and calls for high-grade bonds.[27] The β_2 coefficient isolates the effect changes in government bond prices have on changes in low-grade and high-grade bond prices during periods of recession and declining interest rates. The β_4 coefficient isolates the effect changes in equity prices have on changes in low-grade and high-grade bond prices during periods of recession and declining interest rates.

The recession effect is accentuated during periods of declining interest rates (see Table 8). That is, during business cycle contractions with declining interest rates, high-grade bonds behave more like equities and less like government bonds than during business cycle contractions without declining interest rates (compare Model 5 and 8 results, particularly for estimated coefficient β_4). The sign and significance of the estimated β_2 and β_4 coefficients for the Model 9 regressions suggest that periods of declining interest rates combined with recession significantly affect the relationship between low-grade and high-grade bond returns.

Recessionary periods combined with periods of declining interest rates do not seem to have had a great impact on the pricing of low-grade bonds. We hypothesize that this is in large part due to the fact that the net effect of writing both put and call options on low-grade bonds is to increase their diversification properties. In short, periods of declining interest rates and recessions diversify the risk inherent in the options written on low-grade bonds, especially relative to the risk of bonds with only call options (i.e., high-grade bonds).

The results indicate a somewhat counterintuitive conclusion. During periods when both calls and puts should be exercised (i.e., the worst of both worlds), their net effect is reduced because, as credit quality declines (i.e., bankruptcies and defaults rise) prices are depressed sufficiently to discourage the exercise of the call option (i.e., moving the price down and away from the strike price). This partially offsets the potential call effect and allows some price appreciation for the more creditworthy bonds.

In short, combining the put option with a call option, especially during periods when calls and defaults are most likely, diversifies default risk. Higher-quality bonds will tend not to be called during a recession, even when interest rates decrease, and new, relatively high-quality downgrades enter the lower-quality asset class. This price appreciation is obviously offset by the exercise of put options. For high-grade bonds, however, there is relatively little offsetting effect. As interest rates decline, high-grade bonds tend to be called away; during recessions, credit quality generally declines for the whole asset class.

CONCLUSIONS

Much of the lower volatility of low-grade bond returns relative to other risky asset classes can be attributed to their relatively low durations. Past studies have found that the higher coupon rates and call features associated with low-grade bonds explain their relatively low durations. But past analyses have largely ignored the fact that high-grade bonds also have call features.[28] Our analysis shows that it is not clear that differences in call features can explain the shorter durations of low-grade bonds. On the basis of past default rates, call rates and default recovery values, defaults have had a greater impact than calls on shortening the durations of low-grade bonds.

Calls may not have had a significant impact on the sensitivity of low-grade bonds relative to high-grade bonds, but the combination of calls and embedded puts acts to diversify the exposure of low-grade bonds to the risks of both recession and declines in interest rates. Over the 1960–88 period, at least, low-grade bonds have demonstrated significantly less sensitivity to both bond and stock market risks than high-grade bonds as an asset class.

What does it all mean? Very long-term investors in low-grade bonds should not fear recessionary periods.[29] In the long run, recessionary periods will reduces the volatility of low-grade bonds relative to high-grade bonds. Also, in the very long run, investors in low-grade bonds do not have much to fear from periods of declining interest rates. To the extent corporate bonds are a sound investment, low-grade bonds are at least in part a good investment because of the call and put options written on them.[30]

FOOTNOTES

1. This was the Financial Institutions Reform and Recovery Enforcement Act ("FIRREA"), which was passed by Congress on August 4, 1989.
2. B. Cornell and K. Green, "The Investment Performance of Low-Grade Bond Funds," *Journal of Finance*, March 1991. See also M. Blume, D. Keim and S. Patel, "Returns and Volatility of Low-Grade Bonds 1977–1989," *Journal of Finance*, March 1991.
3. E. Altman, "Setting the Record Straight on Junk Bonds: A Review of the Research on Default Rates and Returns," *Journal of Applied Corporate Finance* (Continental Bank), Summer 1990.
4. One problem with this method is that the effects of L may also have a significant effect during periods when only C and P are expected to be significant. Nevertheless, it is assumed that call and put periods significantly affecting the pricing of risky bonds can be identified.
5. Strictly speaking this is not true. All corporate bonds have put options written on them, but the put options written on high-grade bonds are relatively far out of the money compared with those written on low-grade bonds. Therefore, put options would be expected to have a significantly larger impact on low-grade bonds than high-grade bonds.
6. J. Fons, "The Default Premium and Corporate Bond Experience," *Journal of Finance*, March 1987, found that in his sample of 702 "low-rated" issues, 670 had call provisions (i.e., 95.44%). By comparison, S. Katz, "The Price Adjustment Process of Bonds to Rating Reclassifications: A Test of Bond Market Efficiency," *Journal of Finance*, May 1974, found that in his sample of 115 high-grade electric utility bonds, 100% had call provisions. As Katz stated: "It is reasonable to assume that almost all corporate bonds currently issued have some form of call feature."
7. It is defined as the elasticity of price with respect to the interest rate.
8. For example, see E. Altman, "Measuring Corporate Bond Mortality and Performance," *Journal of Finance*, September 1989.
9. For example, in the case of bankrupt equities, see J. Aharony, C. Jones and I. Swary, "An Analysis of Risk and Return Characteristics of Corporate Bankruptcy Using Capital Market Data," *Journal of Finance*, September 1980.
10. See R. Bookstaber, *Option Pricing and Investment Strategies*, third edition (New York: Probus Publishing Company, 1991).
11. Blume, Keim and Patel, "Returns and Volatility of Low-Grade Bonds," *op. cit.* and Cornell and Green, "The Investment Performance of Low-Grade Bond Funds," *op. cit.*
12. As an extreme example, assuming a flat term structure and instantaneous reinvestment, calls do not change the duration of a portfolio of bonds based on such a strategy, although there is limited economic justification for calling a bond if interest rates do not change.
13. Formally, the duration of a portfolio with N bonds is defined as:

$$D_p = \sum_{i=1}^{N} X_i \times D_i,$$

where X_i = the weight of bond i in the portfolio, and D_i = the duration of bond i.
14. The return series used were the same as those used in Cornell and Green ("The Investment Performance of Low-Grade Bond Funds," op. cit.), with the exception of 1989, for which data were unavailable. The low-grade returns were based on low-grade mutual fund data from Lipper Analytical Services. The returns are net of transaction costs, management fees and operating expenses. To be considered low-grade, a fund must have had at least two-thirds of its portfolio invested in corporate bonds rated Baa or lower by Moody's or BBB or lower by Standard & Poor's throughout the month. This data set avoids the selection bias problems inherent in creating indexes based on thinly traded securities. Unfortunately, not all the securities held by the mutual funds were low-grade bonds. The return series used was the unweighted average of the returns available from each fund for each month. The Treasury bond and high-grade corporate bond data are derived from Ibbotson and Sinquefield data provided by Dimensional Fund Advisors. The S&P 500 returns are based on that index. The dummy variable values used for rising or falling interest rates were derived from the 10-year, constant-maturity Treasury bond yields published by the *Wall Street Journal*. The dummy variable values for recession were derived from values provided by the U.S. Bureau of Economic Analysis ("Business Cycle Expansions and Contractions").
15. Several studies have provided historical call and default rates for low-grade bonds. See, for example, E. Altman, "Measuring Corporate Bond Mortality and Performance," *Journal of Finance*, September 1989 and P. Asquith, D. Mullins and E. Wolff, "Original Issue High Yield Bonds: Aging Analyses of Defaults, Exchanges and Calls," *Journal of Finance*, September 1989. Given that the results in the latter include calls and exchanges, and there is no significant difference between the default rates produced by the two studies (see E. Altman, "Setting the Record Straight on Junk Bonds: A Review of the Research on Default Rates and Returns," *Journal of Applied Corporate Finance* (Continental Bank), Summer 1990), we used the Asquith, Mullins and Wolff results. The problem with comparing the two studies is that the methodologies differ. Altman used a mortality approach and included fallen angels, while Asquith et al. used a cohort methodology. Given that we are concerned with the relative frequencies of calls and defaults, the Asquith et al. study provides both sets of values using a consistent methodology.
16. These values do not account for sinking fund and partial repurchases. Defaults were defined by at least one of the following events—(1) a declaration of default by the bond's trustee, (2) filing of bankruptcy by the firm or (3) assignment of a D rating by Standard & Poor's for a missed coupon payment. In addition to the frequency of calls and defaults for low-grade bonds, the price change from issuance to call or put is important. If the frequency of calls and defaults is relatively equal, but the price change for defaulted low-grade bonds is more than from calls, then default is a more significant determinant of duration and the subsequent low volatility of low-grade bonds.

17. When a bond is called, an investor typically receives at least the face value of the bond. If default occurs, much of the original principal is lost. Therefore, the loss of principal associated with default guarantees lower duration for a well diversified, long-lived portfolio.
18. See E. Altman, "Defaults and Returns on High Yield Bonds: An Update Through the First Half of 1991" (New York University Working Paper Series, 1991), p. 9.
19. See Altman, *ibid.*, p. 15. This recovery value was an average based on a sample of 392 low-grade issues over the period 1971 through the first half of 1991. The price is based on the price immediately after default. The value for the period 1971 through 1987 was 40.63, and for the period 1988 through the first half of 1991 was 34.46.
20. Also, given that most exchanges are effectively default events, not call events, puts have occurred with greater frequency than calls for low-grade bonds. Exchanges are effectively out-of-court bankruptcies, therefore are considered to be very negative events. Typically, there is a reduction in the present value of the security exchanged for. As of December 31, 1988, Asquith et al. calculated that 58.07% of the exchanges made were outstanding, 32.81% resulted in default, and 9.11% resulted in calls or maturity. Conservative forecasts from these rates would add approximately 2.36% to the 10.66% default rate (i.e., 13.02%) and approximately 0.65% to the 10.88% call rate (i.e., 11.53%).
21. It should be noted that these results do not necessarily apply to convertible low-grade bonds. A follow-up to the Asquith et al. study was made by Rosengren, who studied low-grade convertible bonds over the same period (see E. Rosengren, "Defaults of Original Issue High-Yield Convertible Bonds," *Journal of Finance*, March 1993). Rosengren found significantly lower default rates for convertible low-grade bonds than nonconvertible low-grade bonds. Rosengren stated that "lower coupon rates, and the ability to retire these securities if the firm does well, are the most likely explanations for these lower default rates." Evidently, convertible low-grade bonds are low-grade and relatively low-yield, not low-grade and relatively high-yield.
22. With the possible exception of the Texaco bankruptcy (where there was no exchange of bonds or stoppage of interest), no high-grade bond has ever defaulted. Trivially, if it can be shown that two or more high-grade bonds have been called, calls have had a more significant influence on high-grade bond duration than defaults.
23. See Blume, Keim and Patel, "Returns and Volatility of Low-Grade Bonds 1977-1989," *op. cit.*, p. 69.
24. See Cornell and Green, "The Investment Performance of Low-Grade Bond Funds," *op. cit.* and Blume, Keim and Patel, "Returns and Volatility of Low-Grade Bonds," *op. cit.*
25. See Cornell and Green, *ibid.* Note, the time period examined in this study is 1960 through 1988, not 1960 through 1989 as in the Cornell and Green study.
26. *Ibid.* Cornell and Green found these observations "difficult to understand." They expected that low-grade bonds would become more sensitive to interest rates and the stock market during recessions. One point of this study is the emphasis on defaults or puts for low-grade bonds during recessions, which would tend to decrease their sensitivity to the stock market during these periods.
27. Again, downgradings for high-grade bonds may have significant impacts during recessions and may be affecting the results as well.
28. In an article on the efficiency of ratings changes, Katz ("The Price Adjustment Process of Bonds to Rating Reclassifications," *op. cit.*, p. 552) noted that his sample of 115 bonds from 66 high-grade electric utility companies was composed only of bonds with call options. Given Katz's sample, it is unlikely that low-grade bonds have a higher percentage of bonds with call provisions.
29. Obviously, a caveat applies to short-term investors.
30. The author would like to thank Kevin Green and Alan Williams for making the data available, Joel Sternberg and W. V. Harlow for their helpful comments, and Dave Hart, Lili Kihn and Roberta Kihn for their insights. I would especially like to thank Roberta Kihn for all her help and support over the years.

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Table of Contents

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Dynamic Asset Allocation in the Finnish Financial Markets*

ABSTRACT

This paper examines the applicability of applying dynamic asset allocation (»DAA») in the Finnish financial markets. Several equity signals are examined and evaluated within the context of asset allocation and mean-variance optimization. The findings suggest that DAA can be successfully applied in the Finnish financial markets.

1. INTRODUCTION

The purpose of the study is to examine the feasibility of applying DAA (often referred to as integrated or tactical asset allocation), to the Finnish financial markets. Typically, in DAA a portfolio is formed of certain asset classes (e.g., stocks, bonds, and cash) and the weightings of the asset classes are changed over time in response to fundamental changes in the financial markets and/or economy. For over a decade asset allocation[1] has been applied successfully in the United States (U.S.) financial markets.

The fundamental assumption behind DAA is that the financial markets can be »timed». Normally, given the volatility of stocks relative to other asset classes, the stock market is the critical market to time. For example, mistiming the stock market is relatively more costly than mistiming the cash market. Given the importance of the stock signal, much of this study will examine the results of four different stock signals used within a DAA framework.

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[1] Most references to asset allocation are references to static asset allocation. This study is principally concerned with DAA not static asset allocation. Often the final DAA model results are compared to the average or static mix. See Ross et al. [1989] for a practical example of static asset allocation. As the name suggests, in static asset allocation the asset class weightings do not change from period to period.

There are several aspects of this study which are unique. First, to date there have been no other published studies reviewing asset allocation literature. Second, to date there have been no published studies which develop a specific DAA model from start to finish. That is, no other published studies lay out the theoretical and practical methods of designing a DAA model. Finally, there have been no published DAA or static asset allocation studies based on the Finnish financial markets.

In order, this study is composed of the following sections: introduction, review of literature, data, method employed in the analysis, results and analysis, and conclusion. This is the general layout of this study, but the data section is expanded to include a longer than normal overview of the risk/return experience of the Finnish financial markets. Also, of course, the method employed in the study will be an asset allocation framework (see Figure 1).

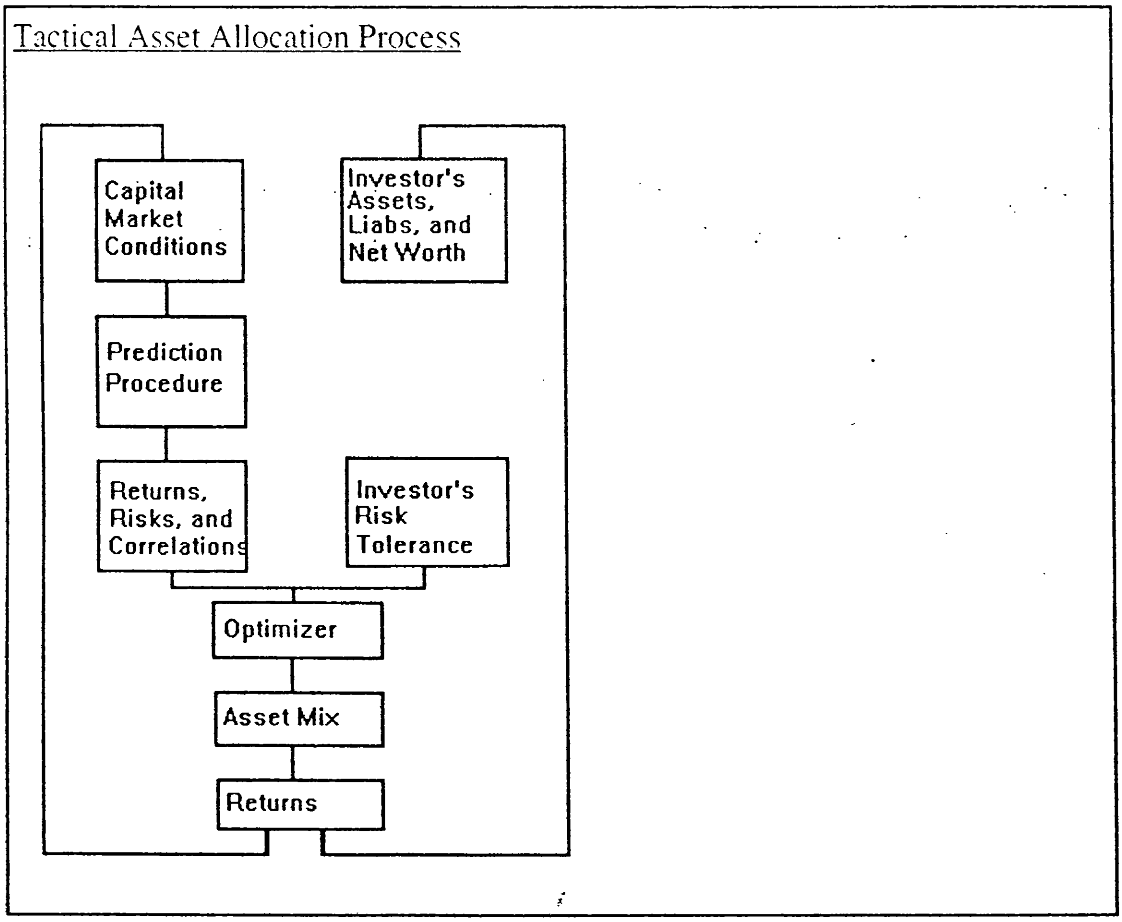

Figure 1. Tactical Asset Allocation Process.
Source: Sharpe, W., »Integrated Asset Allocation.» Financial Analysts Journal, September–October 1987, p. 29.

2. REVIEW OF THE LITERATURE

The literature is roughly composed of the following two general areas: (1) Finnish financial markets literature, and (2) asset allocation literature. The emphasis of the Finnish financial markets literature will be on certain unique characteristics of the financial markets in Finland, particularly the bond and stock markets. The emphasis of the asset allocation literature will be on its significance as it relates to asset allocation in general and DAA in particular.

2.1. Finnish Financial Markets Literature (Finland Peculiarities)

> One obvious reason for the dearth of foreign portfolio investment in Finland, besides the now-dismantled but long-lived exchange control system, can be found in the small size of Finnish financial markets; in terms of market capitalization, Finland's securities markets are among the smallest in Europe. Koskinen [1991, p. 7]

Although, they appear to be expanding rapidly. This observation has been explained as a historic result of bank dominance in the financial markets (e.g., Koskinen [1991] and Koskinen and Pylkkonen [1992]). Also, especially for the equity market, past restrictions on foreign investments have likely had a negative impact on financial market size. The history of bank dominance and the size of the equity markets limits the time period this study is capable of examining.

2.1.1. Debt Instruments

Historically, tax-exempt bonds and deposits have encouraged banks to dominate the bond market (see Koskinen and Pylkkonen [1992] and Malkamaki [1993]). Until recently, budget surpluses may have also contributed to this bank domination (i.e., the government hasn't been required to issue a significant amount of bonds). Tax-exempt government bonds were not traded much since they were purchased mostly by individuals and held to maturity.[2]

Corporate bonds have also been dominated by large banks. Corporate bonds have been a problem since no publicly operated credit rating system has been operating in Finland. That is, the costs of monitoring a bond position is higher without a bond rating agency. Therefore, the holder must do all the monitoring. Given that it is relatively expensive to monitor a corporate bond position in Finland, a larger financial institution with ties to that business has been the logical provider of credit. The result has been that large banks in Finland have dominated the corporate lending markets. Also, given the relatively small size of Finnish firms, banks have tended to raise foreign money for domestic firms.

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[2] Koskinen [1991, p. 8] stated that »the segmentation of the debt-instrument market by type of investor reduces the efficiency of the secondary market.»

Given the size of Finnish debt markets, liquidity has been a problem (i.e., it has been low).[3] Koskinen and Pylkkonen [1992, p. 9–11] have noted that there has been a relatively recent increase in liquidity caused by the following factors: (1) growth in the markets (i.e., new issues[4]), (2) public sector deficits. (3) introduction of the withholding tax[5], (4) tightening of the banks' capital adequacy requirements, and (5) introduction of a trading system for the secondary market. Also, restrictions on the entry of foreign investors were lifted on January 1, 1991 (January 1, 1993 for the equity market) for the bond markets. Again, the recent increase in new issues has been due in large part to the banks inability to provide most corporate financing. Banks have been unable to provide capital due to bad debts and the change in capital adequacy requirements. The introduction of the withholding tax for bond income has decreased the incentive of individual investors to hold bonds until maturity (i.e., taxable bonds). Generally, recessionary forces have encouraged private and public institutions to find new sources of capital. Finally, a secondary debt market trading system should encourage trading in the bonds being traded.[6]

Recently, the debt markets in Finland have seen great growth compared to that of equity market. Koskinen and Pylkkonen [1992, p. 8] have attributed this to the following: (1) the dramatic increase in the government deficit, and (2) fundamental bank problems (i.e., excessive bad debts as a result of the economic downturn). Both in relative and absolute terms, the bond markets have grown. Koskinen and Pylkkonen [1992] found that in 1980 the bond market had less than 25 million FIM of bonds outstanding, which was less than 10% of GDP; and by year end 1991 over 125 million FIM of bonds were outstanding, which was over 30% of GDP. In short, from 1980 through 1991 the Markka denominated bond markets have experienced over a 500% absolute increase and, as measured as a percentage of GDP, over a 300% relative increase.

2.1.2. Equity Instruments

Due to the relatively high levels of Finnish corporate debt, the market for equity securities has been limited. At least until recently, the equity markets in Finland

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[3] Also, in addition to liquidity, Koskinen and Pylkkonen [1992, p 8] have noted that only recently, due to bankruptcies, have investors demanded risk premiums.

[4] It is important to note that many, if not most, new issues have been convertible bonds. This can be attributed to the difficulty of raising equity capital during a recession. The problem with this is that convertible bonds are not pure debt securities. Therefore, the time series for debt may not represent a true debt series, and offered yields are not pure debt yields.

[5] Also, see Malkamaki [1993, p. 15] on this point.

[6] The system is intended to require anyone acting as a primary dealer in the government benchmark bond issues to act as market makers for those bonds. Through these market makers, the Bank of Finland intends to make more information on volumes and prices publicly available. Also, another possible avenue for increasing financial market liquidity, the government may allow unit trusts in the future. Although, it is possible that trusts may increase liquidity in the bond markets; Malkamaki [1993, p. 15] reports that trusts (i.e., mutual funds) have increased liquidity in the equity markets.

have not shown to be »weak form» efficient.[7] That is, past prices have had significant forecasting ability (e.g., Yli-Olli and Virtanen [1987] and Martikainen et al. [1991b][8])[9] [10]. Significant and persistent autocorrelation in the time series for equity returns could indicate some degree of »stale trading». That is, a general lack of trading can cause equity prices to display a high degree of autocorrelation. Although, Berglund and Liljeblom [1988] found that, on a daily basis, over the period 1977 through 1982 stale trading was not a significant cause of autocorrelation found in markets returns.[11] Based on these observations, many studies have successfully modelled the time series behavior of Finnish stock returns (e.g., see Booth et al. [1994]).

Stock price indices have had an interesting history in Finland (see Hernesniemi [1991]). Until the introduction on June 1, 1990 of the Helsinki Stock Exchange's (the »HSE») own index (i.e., the »HEX»), the Unitas Ltd. (the »Unitas» index) and the Kansallis-Osake-Pankki (the »KOP» index) were the principal stock indices. Although highly correlated, the KOP and Unitas indices had given substantially different impressions as to price movements. For example, Hernesniemi [1991,

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[7] The »E/P anomaly» has been found in the Finnish equity markets. Regarding the E/P anomaly in Finland, Martikainen [1992] found that after estimating systematic risk by four accounting instrumental variables (i.e., accounting beta, financial leverage, operating leverage, and growth) the effect of the E/P anomaly became insignificant. Although, these results do not prove that the Finnish equity markets are no longer »weak form» inefficient as originally defined by Fama [1970].

Also, there have been a number of other anomalies found in the Finnish equity market. These include the size effect, the day-of-the-week effect (i.e., in Finland it seems to occur on Tuesdays not Mondays), the turn-of-the-month effect, and the turn-of-the-year effect. See Berglund [1986], Martikainen and Puttonen [1993], Martikainen et al. [1993a], and Berglund [1986], respectively for the relevant empirical evidence and analysis.

[8] The Martikainen et al. [1991b] article is a review of empirical research literature on the Finnish stock market. Regarding weak-form inefficiencies, Martikainen et al. [1991b, p. 259] conclude by indicating that although weak-form efficiency doesn't seem to exist on the Finnish stock market, they do not believe »past return series could be used to earn supernormal returns.»

[9] Yli-Olli and Virtanen [1987] studied the predictability of stock returns on the Helsinki Stock Exchange from 1975 through 1986. Based on monthly and quarterly returns of the Unitas index, they found substantial and significant coefficients for their IMA (1,1) models (i.e., Integrated Moving Average models). They tested the explanatory power of the following variables: (1) one period lag of the endogenous variable, (2) changes in factory orders, (3) change in the yield on bonds or bank deposits, (4) change in money supply, (5) inflation, and (6) contemporaneous stock returns on the Stockholm Stock Exchange. All but the change in the yield on bonds or bank deposits were reported as having statistically significant coefficients.

Indirectly, Drummen and Zimmermann [1992, p. 22] found that »international factors (world, Europe) are particularly unimportant for Italian, Spanish and Scandinavian stocks». In short, contrary to much of Europe, the Scandinavian equity markets are quit idiosyncratic. Therefore, when constructing Scandinavian stock market return models it might be useful to focus on country specific and Scandinavia specific factors.

[10] Although, the basic empirical form of the CAPM (Capital Asset Pricing Model) based on Finnish data seems to correspond well to the results derived in other financial markets (see Ostermark [1987]). That is, given its limitations, the traditional CAPM seems to model the return generation process on the Helsinki stock exchange reasonably well.

[11] Berglund and Liljeblom [1988] attributed some of the cause to Finnish Stock Exchange trading practices during the period studied.

p. 7] noted that during 1988 the KOP general index showed a 49.2% increase while the Unitas general index showed a 31.7% increase during the same year. Hernesniemi [1991, p. 7–8] gave the following reasons for the KOP and Unitas index divergences: (1) prices used, (2) share issue adjustments, (3) dividend smoothing, (4) weighting scheme used, and (5) formulas used. In particular, the formulas and weights used were determined to be the primary causes of the systematic discrepancies between the two indices (Hernesniemi [1991, p. 8]). In the final analysis, the formula itself may be most important. [12]

One relatively recent development has been the growth in the nonrestricted share market (see Koskinen [1991]). The 1939 Restriction Act limits foreign ownership of shares of Finnish companies to a 20% maximum (i.e., restricted shares). A foreign shareholder, with government consent, could raise this upper bound to 40%. Overseas trading of unrestricted shares is concentrated in the Stock Exchange Automated Quotation System (»SEAQ») in London. As of June 1991 the unrestricted shares of ten companies were traded on the SEAQ. Koskinen [1991, p. 10] found that the average premium paid for the shares of those ten companies on the SEAQ was 24%. In addition, Koskinen [1991, p. 11] found that the average turnover of the shares of those ten companies on the SEAQ was over 200% that of Helsinki. Some reasons given for this were: (1) ability to avoid a 1% stamp duty if the counterparty to the trade is a foreigner, and (2) anonymity of the buyer and seller. [13]

In addition, Hietala [1989] found that ownership restrictions caused a significant price differential between restricted and unrestricted shares. As of January 1, 1993 there were no limitations for foreign ownership in the HSE. A more recent study by Booth et al. [1993] found that restricted HSE share prices seemed to drive the pricing of unrestricted shares (i.e., the unrestricted shares were being priced with a lag, based on restricted prices). Therefore, the price behavior of unrestricted shares before 1993 seemed to indicate that fundamental pricing information was being used to price restricted shares before unrestricted shares. Also, unrestricted shares showed a higher level of volatility than restricted shares over the share restriction period.

2.2. Asset Allocation Literature in General

Literature on the concept of asset allocation is a relatively recent phenomenon, and that on DAA even more recent. In all likelihood, most literature on asset allocation has been unpublished practitioner work. This study will review a substantial

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[12] Note that most of the research on the Finnish stock market has used the WI-index, which was academically justified by Berglund et al. [1983].

[13] It is most likely this is in large part due to liquidity differentials between the SEAQ and the Helsinki Stock Exchange (see Amihud and Mendelson [1986a and 1986b] regarding the price impact of liquidity).

amount of the published material. The literature in the area falls into the following three general areas: (1) asset allocation literature (2) international asset allocation (»IAA«) literature, and (3) asset allocation through the use of options. Although, and fortunately for this study, there is substantially more written on the more general area of asset allocation.

2.2.1. Asset Allocation Literature

Much of the general asset allocation literature covers aspects of portfolio optimization (e.g., Sharpe [1987], Speidel et al. [1989], Michaud [1989], Leibowitz and Henriksson [1989], Jorion [1992], Smith-Britto and Crowell [1992], and Kritzman [1992]). Another group of the general asset allocation literature addresses asset allocation decision itself and special considerations (e.g., Fielitz and Muller [1983], Arnott and von Germeten [1983], Arnott [1985], Bostock et al. [1989], Farrell [1989], Wainscott [1990], Booth and Fama [1992], and Riley and Chow [1992]).

The Sharpe [1987] article may be the most significant background article on asset allocation written. Within the article the framework for a DAA model is presented (see Figure 1), and various other forms of asset allocation are discussed. The method used in this study is directly based on this framework.

The Speidel et al. [1989] article provides information on what portfolio optimization in essence is. For example, Speidel et al. [1989, p. 22] state: »optimization makes sure that, at each level of reward, the portfolio has the lowest possible risk.« Speidel et al. [1989, p. 22–28] review the following topics: (1) diversification; (2) the efficient frontier; (3) optimizers and allocators; (4) optimizing relative to a benchmark; and (5) investor risk tolerance. The article is a good overview of issues of interest to most investors.

The Michaud [1989] article discusses whether »Markowitz optimization« is truly optimal. The article is critical of Markowitz style optimization. The article principally addresses optimization with respect to individual assets or securities, not asset classes. Michaud [1989, p. 31] states that »its practical value may be enhanced by the sophisticated adjustment of inputs and the imposition of constraints based on fundamental investment considerations and the importance of priors.« Michaud [1989, p. 32–33] lists the following as the principal benefits of mean-variance optimizers (»MVOs«): (1) satisfaction of client objectives; (2) control of portfolio risk exposure; (3) implementation of style objectives and market outlook; (4) efficient use of portfolio information; and (5) timely portfolio changes. Michaud [1989, p. 33] indicates that standard optimization is not used for the following reasons: (1) politics (i.e., senior management's decision making authority may be reduced); (2) a more quantitative investment process may increase the level of accountability, communication, and risk sharing; and (3) marketability (i.e., it is often difficult to market optimized portfolios both internally and externally to those without the required background). Michaud [1989, p. 33–36] claims the following as limitations of MVOs: (1) they maximize errors; (2) most MVOs use historic means which »is generally not optimal»; (3) there tend to be missing factors (e.g., liquidity); (4) mismatched levels of information for the inputs (e.g., the return on equities may be significantly uncertain relative to cash); (5) unstable optimal solutions; (6) non-uniqueness of the »optimal portfolio»; and (6) some MVOs are not exact. Finally, Michaud [1989, p. 37–38] suggest the following Bayesian motivated adjustments to standard MVOs: (1) use of a benchmark such as a market index; (2) Bayes-Stein shrinkage estimators (i.e., adjust estimated expected returns toward some global mean); (3) scale estimates to an economically meaningful scale; (4) explicit use of priors when selecting from among several optimal portfolios; (5) linear as opposed to quadratic programming; and (6) test for mean-variance efficiency.

The Leibowitz and Henriksson [1989] article develops portfolio optimization with »shortfall constraints». Leibowitz and Henriksson [1989, p. 35] define a shortfall constraint as »a minimum return that will be exceeded with some specified probability». Portfolio optimization is the application of combining assets in order to achieve an optimal set of portfolios. This optimal set is known as the »efficient frontier». These portfolios should represent the best tradeoffs between risk and return. The relevant measures of risk and return have traditionally been the variance or standard deviation of returns and return itself. Leibowitz and Henriksson [1989, p. 36] suggest that »the concept of a confidence limit is similar to that of a floor in dynamic hedging. The floor – the minimum allowable return – is intended to limit potential loss.» In essence, this approach requires modifying the standard efficient frontier in order to take account of specific investor determined constraints. Leibowitz and Henriksson [1989] discuss this principally within the context of the allocation portfolio and an index benchmark.

The Jorion [1992] article emphasises one point of the Michaud [1989] article concerning measurement error. Jorion calls this additional MVO risk »estimation risk». By construction, optimal portfolios tend to weight those assets with high expected returns more than those with lower returns. The problem is that those assets or securities with high positive expected returns tend to possess positive estimation error. Jorion [1992, p. 68] states: »a major drawback with the classical implementation of mean-variance analysis is that it completely ignores the effect of measurement error on optimal portfolio allocations.» Jorion [1992], with simulation results, goes on to show the effect of this by comparing the performance of a passive world index with that of a U.S. index over the period 1978 through 1988. Jorion [1992, p. 68] finds that »an ex-post mean-variance analysis systematically overstates the possible gains from going international.»

The Smith-Britto and Crowell [1992] article discusses the asset class real estate within a MVO context. As stated by Smith-Britto and Crowell [1992, p. 40]: many standard portfolio optimization models favor real estate because of its low standard deviation and low correlation with other asset classes.» The main point of the article seems to be that the transaction costs of exiting real estate are sufficiently higher than most other asset classes to warrant an extra transaction cost and/or liquidity cost constraint on real estate. Of course, if the cost of trading an asset class increases, its return decreases, which in turn decreases its weighting in an asset allocation context.[14]

The Kritzman [1992] article reviews optimization itself. It describes the objective function, and what is meant by optimization with constraints.[15] Also, Kritzman [1992, p. 12–13] reviews the Sharpe [1987] algorithm for portfolio optimization. Lastly, Kritzman [1992, p. 13] discusses what »cynics refer to as 'error maximization'.« Kritzman [1992] did not indicate that he thought the biases associated with estimation errors were intractable.

The Fielitz and Muller [1983] article reviews a static asset allocation model called SIMR. This is an early article on asset allocation and was principally interested in providing simulation results to demonstrate the usefulness of such models for the asset allocation decision. As Fielitz and Muller [1983, p. 44] state: »SIMR allows the investor a cost-effective way to test different assumptions before taking on real portfolios.«

The Arnott and von Germeten [1983, p. 31] article can be well summarized by the following quote from the authors:

> Asset allocation is a difficult process if only because the most effective way to add value to a balanced portfolio may be to focus on the least comfortable asset class. But simple calculations of market returns – the current yield for cash equivalents, the yield to maturity for bonds and the dividend discount model rate of return for equities – can provide valuable guidance for asset allocation by revealing the relative market outlook for various asset classes. The use of a disciplined approach for including other information, such as recent inflation and economic experience, can give still more insight into the return prospects for each asset class.

One of the simplest yet most powerful methods to forecast bond and cash returns is to use the yields on those asset classes in a MVO framework. That is, the expected return for cash is the cash yield, and the expected return for bonds is the bond yield. While, one of the simplest and yet most powerful methods to forecast equity returns is to use a dividend discount model calculated yield in a MVO framework. It seem that these methods have produced strong indicators of current investor sentiment and expected future returns, particularly in turbulent financial periods. The authors are strong proponents of the systematic use of market signals in the asset allocation decision.

The Arnott [1985] article is based on a questionnaire sent to large pension plan sponsers[16]. There were 50 respondents representing over $100 billion in invested assets. The questionnaire asked a wide range of questions (see Arnott [1985, p.17–18]). The key result was (Arnott [1985, p. 17]) that »sponsers do not pay the most

[14] This would be true of any asset or asset class, not just real estate.

[15] Kritzman [1992, p. 11–12] uses as an example a Lagrange multiplier problem to show this, and then uses an example of matrix inversion to solve for the resulting system of linear equations.

[16] These are people or organizations which often serve as intermediary between a corporation with a pool of pension plan assets and the portfolio manager.

for those aspects they perceive as offering the greatest opportunity for adding value.» Long term asset allocation and strategic (i.e., tactical) asset allocation were universally considered more important than specialty asset allocation, alternative investments, equity management, bond management, or balanced management. Both were perceived to add the most value yet were ranked 2nd and 3rd from the bottom for payment rank (i.e., 5th and 6th of 7 categories). Strategic asset allocation was ranked first in perceived ability to add value. Also, both were perceived to have the greatest impact over a market cycle. The study explained the huge gap between payment and value as possibly a function of cost. Arnott [1985, p. 22] stated that »a multibillion dollar sponser cannot spend more than a few basis points on the long-term asset allocation decision, even if it makes a real effort to spend money on that decision.» In short, asset allocation is a relatively costless way of generating large gains in value, while active bond and equity management (i.e., bond and stock picking) is expensive by its nature yet adds little incremental value.

The Bostock et al. [1989] article addresses an issue of particular importance for pension plan's worried about the duration of its liabilities. This is more an article concerned with the duration of assets and pension fund liabilities than asset allocation per say. Logically, Bostock et al. [1989, p. 53] suggest that matching the duration of a pension pan's assets to the duration of its liabilities can minimize funding uncertainty associated in unexpected changes in discount rates.»

The Farrell [1989] article discusses the problem of using forecasts within a standard MVO framework. Farrell [1989, p. 32] states that »differences in inputs, particularly estimated correlation coefficients, can have a significant impact on the weighting of asset classes in an asset allocation scheme and on the risk and return characteristics of that combination.» Most of the article shows the pattern and relationship between stocks, bonds, and cash returns in the U.S. from 1929 through 1986. The author notes how important correct expectations can be in determining the best asset allocations over long time periods, but gives little or no guidance in how traditional historic based forecast inputs can be improved.

Although not stated, the Wainscott [1990] article is a followup to the Farrell [1989] article. It specifically addresses the issue of forecast correlation coefficients used in the standard MVO framework. Wainscott [1990, p. 55] states that »of these three estimates (i.e., returns, risks, and correlations), correlations have appeared to be the most stable and have therefore received the least attention.» The article focuses on the correlation between stocks and bonds in the U.S. over the period 1926 through 1986. Wainscott [1990, p. 58] states that »clearly, historical correlations have been an unsatisfactory predictor of future correlations.» Wainscott [1990, p. 59] showed that »the income return difference between bonds and stocks is a significant and powerful factor in the future stock-bond correlation.» Therefore, the article suggests that it is possible to improve on traditional historical based stock-bond correlation forecasts by using the income return differential between stocks and bonds.

The Booth and Fama [1992] article provides empirical background on and a review of the Markowitz portfolio diversification principal regarding combining asset classes in the U.S. Booth and Fama [1992, p. 31] state that »diversification returns are assured only for those portfolios that maintain relatively fixed asset weights.» In short, Booth and Fama claim that active management strategies are less likely to provide traditional diversification gains than static asset allocation. Although, Booth and Fama do not directly address DAA, they seem to be skeptical of market timing.

The Riley and Chow [1992] article provides evidence of individual risk aversion in the U.S. for over 17,000 households and develops a model of relative risk aversion[17]. Riley and Chow [1992, p. 32] find that »a comparison of risk-aversion indexes for various demographic and socioeconomic categories reveals distinct differences for three groups – individuals over 65, those with incomes below the poverty level, and the very wealthy.» Gender, race, and marital status seem to be of little importance in relative risk aversion, while education, income, and age seem to be important determinants of risk aversion. Generally, more education and income seem to contribute to higher risk tolerance, while age, especially for those over 65, tends to have the opposite effect. This research is useful in establishing actual levels of risk aversion, the expectations of which are inputs into many optimizers.

2.2.2. International Asset Allocation Literature and Asset Allocation Using Options

IAA is asset allocation with at least one asset taken from at least two different countries. Given that the principal concern of this study to examine DAA for Finland, a short summary of a few articles will follow. What little there has been of IAA literature supports the following contentions: (1) significant gains from dynamic IAA are difficult to achieve (e.g., Arnott and Henriksson [1989] and Black and Litterman [1992]; (2) significant diversification gains from static IAA are relatively easy to achieve (e.g., Odier and Solnick [1993]); and (3) the currency hedging decision should be made independent of the asset allocation decision (e.g., Arnott and Henriksson [1989]). The Arnott and Henriksson [1989] and Black and Litterman [1992] articles do provide some basis to be hopeful that value added dynamic IAA may be possible. Otherwise, static IAA seems to be a relatively easy way to add value, but dynamic IAA seems to be difficult to achieve.

An even smaller literature than that concerning IAA has been that on options within the context of asset allocation. Given that this study is not concerned with the use of options within DAA, a short summary of a few articles in the area will follow. Generally, the research on the use of options in an asset allocation framework is based on the following strategy: buy and/or replicate call options on the

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[17] Riley and Chow [1992, p. 33–34] define relative risk aversion as the following: RRA=(1-Risky Assets/Wealth), where risky assets are defined as equity securities; and wealth is the sum of personal property, real estate, bonds & checking, and risky assets. This measure is based on the Arrow-Pratt measure of relative risk aversion (i.e., the ratio of risky assets to wealth). Formally, the Arrow-Pratt measure is $W[U''(W)/U'(W)]$, where W=wealth, and U(W) is the utility function of wealth.

risky asset classes by borrowing the riskless asset class (see Tilley and Latainer [1985] and Fong and Vasicek [1989]). The Tilley and Latainer [1985] article is based on traditional stock, bond, and cash asset allocation, while the Fong and Vasicek [1989] article is based on IAA across equity markets. The research is interesting and promising.

3. DATA AND SUMMARY STATISTICS

Typically asset allocation strategies have used the following three asset classes (1) stocks, (2) bonds, and (3) cash. The basic inputs into the model are the following: (1) stock returns, (2) bond returns, (3) cash returns, (4) a stock signal, (5) a bond signal, and (6) a cash signal. As much as possible, this study will follow convention. Generally, the signals are the principal determinants of recommended asset mixes, while the returns are used to evaluate the effectiveness of the model(s) used to forecast the asset class returns.

This study is based on monthly data. Most of the data is available from the Bank of Finland Bulletin. It is important to base DAA models on readily available data. If the data a DAA model is based on are not readily available the recommended strategy may not be achievable (this is especially true of the stock, bond, and cash signals).

The stock return series is a spliced series based on the Unitas overall index and the HEX all share index. Given that the emphasis of DAA is market timing, a spliced series which is highly positively correlated with the true asset class return series will not significantly change the results of the study. The Unitas based return series covers the period 12/86 through 01/90 (i.e., from the month it was first reported in the Bank of Finland Bulletin until the inception of the HEX). The HEX based return series covers the period 02/90 through 06/93 (i.e., inception through the first half of 1993). The stock signal will be discussed in more detail later.

The bond return series is a derived and spliced series. Given that there were no available bond indices with which to generate bond returns, bond returns were derived by the following equation: $BR_t = BRA_t + BRU_t$, where BR_t = bond return at time t, BRA_t = anticipated portion of bond return at time t, and BRU_t = unanticipated portion of bond return at time t. BRA is based on the yield to maturity of the issue. The following was the equation used to calculate anticipated return: $BRA_t = y_{t-1} \times (1/12)$, where y_{t-1} = the yield to maturity lagged one period. Therefore, it is assumed that the yield one month previously is the anticipated portion of the bond return this period (i.e., adjusted for monthly values). BRU is based on the change in yield and bond duration (i.e., the sensitivity of the bond to changes in interest rates). The following was the equation used to calculate unanticipated return: $BRU_t = -(D_t \times \Delta_i)$, where D_t = duration at time t, and Δi = unanticipated change in interest rates. Duration was based on the following calculation: $D_t = \Sigma_{t=1}^{T}\ [(t \times C_t)/(1 + i_t)]/P_t$. The unanticipated change in interest rates was based on the following equation:

$\Delta i = (i_t - i_{t-1})/(1 + i_{t-1})$, where C_t (cash flow at time t) was set equal to y_t, T (i.e., maturity) was set equal to 5 years, P_t (i.e., price at time t) was set equal to unity, and i_t (i.e., the interest rate at time t) was set equal to y_t. Therefore, in order to generate bond returns, it was assumed that the yield curve was flat over the period under study. In reality, a certain portion of the changes in interest rates are anticipated by market participants, but certain simplifying assumptions were made in order to systematically generate past bond returns. The maturity period of five years was used based on the last time series used (i.e., five year bonds) of the two spliced bond time series.

The bond return series is a spliced series based on the secondary market taxable government bond rate and the secondary market 5 year long-term rate (see the Bank of Finland Bulletin Table 3.5 for relevant rates). The taxable government bond rate covers the period 12/86 through 12/87 (i.e., from the first month stock returns were reported in the Bank of Finland Bulletin until the first reporting of the 5 year bond series). The 5 year bond rate covers the period 01/88 through 06/93 (i.e., inception through the first half of 1993). The bond signal used was this spliced series. As discussed in the asset allocation literature review, bond yields have been found to be useful predictors of future bond returns. Bond yields seem to be sufficient bond market signals in Finland as well. Therefore, one lag of the bond yield was used as the expected return for bonds.

Cash yields were also used to derive cash market returns and used as cash market signals. The one month HELIBOR (Helsinki Interbank Offered Rate) was used as the cash signal and to derive cash returns. Regarding the derivation of cash returns the calculation used was the same as that for deriving the anticipated portion of bond returns (i.e., $CR_t = y_{t-1} \times (1/12)$). Given that the values used are monthly, this results in as precise a calculation of return as is possible (i.e., the holding period is exactly one month for a theoretical one month HELIBOR security). Therefore, there are no unanticipated movements for a one month rate measured over one month. The first available values for the HELIBOR rates were as of 01/87. Therefore, the return series began as of February 1987.[18]

Table 1 provides background on the performance of stocks, bonds, and cash in Finland over the period February 1987 through June 1993. Given the three asset classes and the period under study, stocks have been the poorest performing asset class. In hindsight, cash and/or government bonds were the best places to invest over the period. Stocks were particularly poor investments over the period 1989 through 1991. These values will be used to determine the performance of recommended asset class mixes. The relevant question for Finnish investors is: could these performances have been predicted?

Table 2 provides some basic characteristics of the monthly return series used in this study. All three asset class return series are slightly positively skewed, bond

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[18] Obviously, it was this series which constrained the period under study. Therefore, the earliest starting month for the study was February 1987.

Table 1. Finnish Financial Markets from Feb. 1987 through June 1993.

Finnish Financial Markets (02/87–06/93)			
Year	Stocks	Bonds	Cash
1987 (Feb. – Dec.)	25.11%	17.42%	9.53%
1988	31.18	5.68	10.02
1989	–15.44	7.75	12.61
1990	–34.25	14.20	14.70
1991	–22.23	15.43	14.70
1992	7.37	17.91	14.54
1993 (Jan. – June)	33.96	16.46	4.80
Cumulative Return[1] (1987–1993)	2.07%	142.02%	114.31%
Average Annual Return	0.32%	14.77%	12.61%
Annual Standard Deviation	22.99%	5.82%	0.68%
Reward/Risk Ratio	0.01	2.54	18.57

[1] Reported cumulative returns are based on the following calculation: $CUM = [\prod_{t=02/87}^{06/93}(1 + R_t)] - 1$. Reported average annual returns are the annualized geometric average of the reported cumulative return.

Table 2. Basic Statistics and Tests of Normality for the Return Series.

Basic Statistics and Tests of Normality for the Return Series			
Statistic (Observations = 77)	Stocks	Bonds	Cash
Moments of the Distribution:			
1st - Mean	0.0024	0.0117	0.0100
2nd - Standard Deviation	0.0668	0.0169	0.0020
3rd - Skewness	0.5652	1.1982	0.5016
4th - Kurtosis	1.0030	5.3715	–0.7863
Median	0.0014	0.0101	0.0097
Minimum	–0.1150	–0.0367	0.0070
Maximum	0.2427	0.0864	0.0148
Tests of Normality[1]:			
T-Statistic: Mean = 0	0.3183	6.0606	44.2347
Prob>T	0.7511	0.0001	0.0001
W:Normal	0.9662	0.9180	0.9281
Prob<W	0.1327	0.0001	0.0002

[1] The first test of normality is Student's t value for testing the null hypothesis that the population mean is zero. The second test of normality is the Shapiro-Wilk statistic for testing the null hypothesis that the values are a random sample from a normal distribution.

returns being skewed the most over the period under study. The kurtosis values indicate that stocks returns have been distributed relatively platykurtically over the period under study. The most striking result of the table is that the stock return series does not appear to be normally distributed. Both the mean test and the normal distribution test indicate that the stock return series is not normally distributed.

The following table provides a check for first order autocorrelation, tests for white noise at the 12th and 24th lag[19], and correlation coefficients regarding the three asset class return series.

Table 3. Tests for Autocorrelation and Correlation Coefficients.

Tests for Autocorrelation and Correlation Coefficients	Stocks	Bonds	Cash
Autocorrelation at Lag 1	0.45*	0.22*	0.84*
Test for White Noise (12 lags)	34.02*	12.05	186.25*
Test for White Noise (24 lags)	56.67*	22.96	197.57*
Correlation with			
Stocks	0.52*	-0.19	
Bonds	0.09		

* denotes significance at the 1% level of significance.

All three asset class return series have significant first order autocorrelation, but bonds have about half that of stocks. Both autocorrelation tests suggest that the stock return series is not generated by a white noise process. The only significant correlation coefficient is between the stock and bond return series. Over the period stock returns have been negatively correlated with cash returns, but not significantly so.

4. METHOD EMPLOYED (DYNAMIC ASSET ALLOCATION)

The method used is DAA. DAA is a method were a portfolio is formed over time based on a defined set of asset classes. The portfolio is usually formed of three asset classes. Based on the following expectations: (1) the risk of each asset class, (2) the return of each asset class, (3) the correlation between asset classes, (4) the utility function of the investor (i.e., the risk/return tradeoff for the investor), and (5) the investment horizon of the investor a portfolio is formed each period. Typically the portfolio is constrained to be 100% invested in the asset classes (i.e., no short sales or leveraging). Each period the expectations are updated and the portfolio mix (e.g., 10% stocks, 30% bonds, and 60% cash) is recalculated. Therefore, this is a dynamic strategy requiring the updating of expectations and portfolio rebalancing.

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19 These are autocorrelation checks for white noise. The null hypothesis is that the autocorrelations sum to zero. These test statistics are at the 12th and 24th lags (i.e., one and two years). Therefore, the null hypothesis for the 12th lag is: $T \times \Sigma_{k=1}^{12} \hat{r}_k^2 = 0$, where $\hat{r}_k^2$ is the product moment correlation between $\hat{e}_t$ and $\hat{e}_{t-k}$ (k = 1, 2, ... , 12). If the null hypothesis is true, the statistic is distributed as a chi-square with 12 degrees of freedom. If the statistic is not statistically significant, the null hypothesis can be accepted.

In the U.S., the asset classes used in DAA are typically stocks, bonds, and cash. Usually, in the U.S. the S&P 500 proxies for the equity asset class, some long-term government bond proxies for the bond asset class (e.g., the 20 year »constant maturity» Treasury bond), and a short term government bill (e.g., the three month Treasury bill) proxies for the cash instrument. For Finnish Asset Allocation (»FAA») an attempt will be made to keep some degree of consistency with past practice. That is, a stocks, bonds, and cash dynamic allocation will be examined. Although, given the relatively recent nature of secondary market trading for stocks and bonds in Finland three way asset allocation will be examined over a relatively short period.

Institutions should be interested in DAA. Although academic in design, the purpose of DAA is very practical. Its purpose is to achieve a return series for the asset allocation portfolio which is superior to the best performing risky asset class. For most countries the best performing asset class has been equities. Therefore, assuming that an investor prefers more return to less, and holding risk constant, DAA attempts to create a portfolio which achieves a higher return than the best performing asset class at an equal or lower risk.[20] Any investor which values lower risk and higher return should be interested in DAA.

4.1. Optimization and Calculating Optimal Portfolio Weights (A DAA Algorithm)

> Optimization is a process by which we determine the most favorable tradeoff between competing interests, given the constraints we face. Within the context of portfolio management, the competing interests are risk reduction and return enhancement. Asset allocation is one form of optimization. Kritzman [1992, p. 10]

As stated by Kritzman [1992], portfolio optimization is a process by which an objective is maximized (minimized) subject to one or more constraints. Modern portfolio theory has established the objective as quadratic in nature (e.g., see Elton and Gruber [1991]). The objective is to maximize return and minimize risk, subject to an investor's wealth, risk preferences, etc. The exact form of the objective function can vary from investor to investor. The algorithm to follow is based on Sharpe's [1987] objective function and algorithm for portfolio optimization. The general form of the objective function to be maximized is:

$$E(U) = E(R_P) - \lambda \times \sigma_P^2$$

where

$E(U)$ = the expected utility for the DAA investor;

[20] As an example of a practitioner model, on an annualized basis, a model developed for the United Kingdom returned more than 2% over the best performing asset class (i.e., which were stocks) with less than 3% the risk (i.e., as measured by the standard deviation of the return series). Of course, those values were net of transactions costs.

$E(R_P)$ = the expected return for the portfolio;
λ = the risk aversion parameter for the DAA investor; and
σ_P^2 = the expected variance of the portfolio.

Again, the above objective function is but one form of the objective function possible, but it is both logical and simple. As expected return increases, expected utility increases. As expected risk increases, expected utility decreases. The greater is risk aversion, the lower is expected utility. Risk aversion and expected risk are directly related.

The method by which the objective function is maximized is linear programming. Based on the five sets of inputs mentioned, various weights are substituted into the calculation until the maximum is reached (i.e., the asset class weights are the unknowns). The following is the general method used to calculate total utility and solve for the asset class weights.

First, the expected return and expected risk of the portfolio must be calculated. The expected return of a portfolio is the weighted average of the expected returns of the assets in that portfolio. Given the three asset class case, the following is the expected return for the portfolio:

$$(1) \quad E(R_P) = (W_S \times E(R_S)) + (W_B \times E(R_B)) + (W_C \times E(R_C))$$

where
$E(R_S)$ = the expected return for stocks;
$E(R_B)$ = the expected return for bonds;
$E(R_C)$ = the expected return for cash;
W_S = the percentage allocated to stocks;
W = the percentage allocated to bonds; and
W_C = the percentage allocated to cash.

Traditionally, the risk of a portfolio is measured by its standard deviation or variance. Given the three asset class case, the following is the expected variance for the portfolio:

$$(2) \quad \sigma_P^2 = (W_S \times \sigma_S)^2 + (W_B \times \sigma_B)^2 + (W_C \times \sigma_C)^2 + \{2 \times [(W_S \times W_B \times \rho_{SB}) + (W_B \times W_C \times \rho_{BC}) + (W_S \times W_C \times \rho_{SC})]\}$$

where
σ_S = the expected standard deviation of stocks;
σ_B = the expected standard deviation of bonds;
σ_C = the expected standard deviation of cash;
ρ_{SB} = the expected correlation between stocks and bonds;
ρ_{BC} = the expected correlation between bonds and cash; and
ρ_{SC} = the expected correlation between stocks and cash.

From the above equation, assuming some expectation of correlation between asset classes, expected portfolio variance is a function of the expected individual asset standard deviations and the expected co-variability of asset class returns.[21]

Second, the expected volatility and drift of the portfolio must be calculated, based on the expected risk of the portfolio, the expected return of the portfolio, and the investment horizon[22] of the DAA investor. The following is the calculation for the natural logarithm relative expected volatility of the portfolio[23]:

$$(3) \qquad V_P = LN\,(1 + E(R_P)) - [LN(1 + (\sigma_P^2\,/E(R_P)^2))/2].$$

Next the investment horizon adjusted volatility (i.e., the drift) of the portfolio is calculated:

$$(4) \qquad D_P = \sqrt{V_P/H}$$

where

H = the investment horizon of the DAA investor. The longer the investment horizon, the less important volatility is in determining expected utility. That is, a long term investor tends to increase his or her holdings of the expected riskier asset classes.[24] As Fielitz and Muller [1983, p. 45] state: »the time dimension is extremely important. As the analysis horizon is extended, risk increases, but at a slower rate than expected return.» That is, risk varies with the square root of time, while return is assumed independent and log normally distributed over time.

Third, integrate the utility function (i.e., calculate total expected utility based on the current asset mix). Utility is: $E(U) = \lambda \times (V_P + D_P)$. Fourth, continue recalculating expected utility with different asset weights until utility is maximized (i.e., given the constraints). Lastly, output utility maximizing asset weights.

In linear programming terms, the objective function (i.e., total utility) is maximized subject to the following constraints: (1) the asset class weights must sum to unity (i.e., $W_S + W_B + W_C = 1$); (2) the asset class weights are equal to or greater than zero (i.e., $W_S \geq 0$, $W_B \geq 0$, and $W_C \geq 0$); (3) the asset class weights are less than or equal to unity (i.e., $W_S \leq 1$, $W_B \leq 1$, and $W_C \leq 1$); (4) the investor's risk aversion parameter is positive (i.e., $\lambda > 0$)[25]; (5) the investor's risk aversion parameter is less than infinity (i.e., $\lambda < \infty$); (6) the investor's investment horizon is greater than zero

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21 More specifically, expected portfolio risk is measured by the variance or standard deviation around the portfolios expected return.

22 See Levhari and Levy [1977] for a mathematical treatment of investment horizon, mean-variance analysis, and the CAPM.

23 See Booth and Fama [1992] for the appropriate calculation for the variance of a portfolio.

24 Generally, DAA is considered to be a long term strategy. Therefore, investors with short investment horizons should not be encouraged to invest in such strategies.

25 As the slope of the objective function changes, so does the optimal solution. Obviously, the risk aversion parameter has a large impact on total utility.

(i.e., H > 0); (7) the expected return of the portfolio is greater than zero (i.e., $E(R_P) > 0$); and (8) the expected volatility (i.e., risk) of the portfolio is greater than zero (i.e., $\sigma_p^2 > 0$). Constraints (1) through (3) are not required, but they are typical assumptions made for DAA. Most institutional investors interested in an asset allocation strategy do not intend to engage in short sales of asset classes or the leveraging of their portfolio.[26] Constraint (2) enforces no short sales of the asset classes. Constraints (2) and (3) enforce that the asset weights are constrained to be zero or positive and between 0% and 100% for each asset class. Constraint (1) ensures that the portfolio is always 100% invested in the asset classes under study. Constraints (4) through (8) are required to make the appropriate computations (i.e., to enable the estimation of total utility), but are also logical. Constraint (4) makes the assumption that the investor is risk averse (i.e., holding all other variables constant, the investor requires more expected return for each unit increase in expected risk). Constraint (5) makes the assumption that the investor is not so risk averse that he or she will not invest in risky asset classes (i.e., if the investor is infinitely risk averse he or she would never receive enough return to warrant taking on any risk). Constraint (6) makes the assumption that a DAA investor will not withdraw funds the instant those funds are invested. Constraint (7) makes the assumption that, given the optimal mix, there is some level of positive expected return (i.e., DAA investments are always made with the expectation of positive returns). Constraint (8) makes the assumption that, given the optimal mix, there is always some level of positive expected volatility (i.e., expected returns are not constant for the DAA portfolio).

4.2. Estimation of Expected Equity Returns

Probably the most critical input into a DAA model is the stock market return expectation. With the possible exception of innovations in money supply, most macroeconomic variables have been found to be of limited use in explaining Finnish stock market movements (see Yli-Olli and Virtanen [1987] and Viskari [1992]). Also, Martikainen et al. [1991a] show that, based on monthly values, the relation between stock returns and several macroeconomic variables was unstable over the period 1977 through 1986. In Finland, at least for paper companies, past dividends have been found to have a great amount of explanatory power in forecasting future dividends (see Yli-Olli [1982])[27]. Also, aggregate Swedish stock price movements are highly correlated with aggregate Finnish stock price movements (see Yli-Olli and Virtanen [1987, p. 235–237]).

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[26] Note that short sales are prohibited on Finnish financial markets (see Puttonen and Martikainen [1991]).

[27] Yli-Olli [1982] examined the dividend series of 7 Finnish paper and product firms. He found that one lag of past dividends had a great deal of predictive power regarding the current level of dividends. Although, this has apparently changed dramatically in recent years when the dividends of Finnish firms have been more volatile than before (see Martikainen et al. [1993b]).

As stated by Sharpe [1987, p. 29]: »in practice tactical asset allocation systems are 'contrarian' in nature.» DAA is based on the observation that although markets price securities based primarily on fundamental factors, the markets seem to »overreact to information». Also, it may be the case that although there is a great deal of efficiency within an asset class, fundamental adjustments between asset classes are rather slow and inefficient. Therefore, if financial markets overreact in a systematic way, market timing may be achieved. In DAA, the critical market to time is the market with the greatest level of risk (i.e., the equity market). Therefore, it is imperative that the stock signal be a good forecaster of future stock price movements relative to the other asset classes.

Again, primarily based on the Yli-Olli and Virtanen [1987] article, the following factors were considered important determinants of Finnish stock market returns: (1) Swedish Stock Exchange returns; (2) changes in money supply; (3) inflation; (4) past returns; (5) changes in industrial production (or changes in factory orders); and (6) dividends. It was decided to avoid Swedish values in order to build a fundamentally Finnish model for forecasting Finnish stock returns. Industrial production values were not analyzed because those reported by the Bank of Finland were neither timely or accurate (i.e., they were significantly adjusted long after they were initially reported). As stated before, the values used for DAA must be readily available and not subject to significant revisions.

A logical starting point for estimating the price of a share of stock is what is popularly known as the »constant growth» dividend discount model (»DDM». see Elton and Gruber [1991, p. 449–464] on this and other dividend discount models). The following is the appropriate equation: P=D/(k-g), where P = the price of a share of stock, D = the dividend for the share, k = the discount rate for the share, and g = the constant growth rate for the share. This model assumes that dividends will grow at a constant rate. The greater the rate of growth, the greater the price paid for the share. Other DDM models assume varying growth rates throughout the foreseeable life of a company (e.g., the »two period» DDM). This study will focus on the simple constant growth DDM.

Given that this study is concerned with the asset class stocks, estimating individual stock growth rates is not of principal importance as it is for security analysts. Therefore, to the extent to which all Finnish equity claims capture the growth in the Finnish economy, this model can be extended to the Finnish economy in general.

Given that this study is interested in forecasting the return on Finnish stocks, the DDM equation requires to be solved for the discount rate. Therefore, rearranging the DDM equation yields the following equation: k=g+(D/P). More specifically, the following was the relationship being solved for in order to generate expected stock returns: $E(RS)_t = E(g)_t + E(D/P)_t + RS_{t-1}$, where E(RS) = the expected return for stocks, D/P = the dividend yield for stocks, and RS = the actual return of stocks. Particularly for longer periods, dividend yield has been found to be a strong predictor of stock market movements (e.g., see Fama and French [1987]). A lagged returns component was added in order to capture some of the nature of the

Finnish stock market (i.e., past stock market returns are correlated with current returns).

The following was the general form of the growth relationship: g = f(MS,I), where MS = growth in the money supply and I = inflation. In short, it was assumed that growth for the stock market is a function of the growth in money supply and inflation. As stated before, both these factors had been found to be important components of stock returns in Finland. More precisely, the forecast for g was based on the following: $E(g)_t = [\Sigma_{t=-1}^{-18} (MS_t - I_t)/18] \times 12$, $MS_t = (M_t - M_{t-1})/M_{t-1}$, and $I_t = (PI_{t-1})/PI_{t-1}$, where M = money supply, and PI = price index. The forecast was based on an 18 month rolling average of the net growth in money supply (annualized).[28] The money supply values are from the Bank of Finland's series for M2. The price index values are also from the Bank of Finland. Two sets of values were generated based on the CPI (consumer price index) and the WPI (wholesale price index). The CPI values were less volatile than the WPI values and were expected to yield a more stable signal.

The following was the general form of the dividend relationship: D/P = f(D/P,i). Future dividend yields were assumed to be a function of the previous dividend yield and interest rate. Furthermore, it was assumed that the discount rate given to businesses was the relevant interest rate for predicting the level of future dividends relative to price. An OLS regression was run based on the values over the period 02/85 through 11/86 (i.e., 22 values) in order to forecast out of sample over the period 12/86 through 06/93. The results were the following forecast equation for dividend yield: $E(D/P)_t = -0.0056 + 0.8645 \times (D/P)_{t-1} + 0.1346 \times BDR_{t-1}$, where BDR = base discount rate. The dividend yield series was based on values gathered from Kauppalehti. The BDR series was from the Bank of Finland Bulletin.

Finally, a coefficient for the autoregressivity of stock returns was selected. The coefficient selected was 0.8. Given past reports on the autoregressivity of Finnish stock market returns a high positive coefficient seemed justified. Unfortunately, it would have been more satisfactory to base this measure on an out of sample series, but this would have shortened an already relatively short study period.

5. EMPIRICAL RESULTS AND ANALYSIS

The results are based on four different expected stock return series (i.e., all other parameters were the same). The first two models were based principally on dividend yield. This was done in order to provide a base with which to judge the more theoretically acceptable DDM based Finnish expected equity return model,

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[28] An 18 month period was selected, but periods of between one to two years did not significantly change the results. A long period was preferred in order to stablilize the equity return signal and increase the probability that errors and changes in the estimated money supply would not overwhelm the stock signal.

and to show the impact of adding an autoregressive parameter. Again, the only difference between the two DDM based expected return models is that one uses the CPI and the other the WPI to generate the growth parameter.

The following were the MVO parameters used: (1) $\lambda=3$; (2) H=10 years; (3) minimum portfolio change = 10%; (4) $\sigma_S = 30\%$; (5) $\sigma_B = 10\%$; (6) $\sigma_C = 2\%$; (7) $\rho_{SB} = 0.5$; (8) $\rho_{BC} = 0$; and (9) $\rho_{SC} = 0$. A risk aversion parameter of 3 indicates that for each unit of expected volatility, the investor requires 3 more units of expected return.[29] A long investment horizon is not uncommon for institutional investors. Other investment horizons were not tested. The selection of a ten year horizon is based in part on the fact that DAA is a long term strategy. Therefore, a short investment horizon would not be theoretically justified. The minimum portfolio change of 10% is useful for investors desiring to keep rebalancing costs to a minimum. Smaller increments were not tested. A low minimum portfolio change value tends to make trading more common. Therefore, in order to keep the models tested from trading excessively, a relatively large minimum portfolio change was selected. The expected standard deviations and correlations were selected before any actual Finnish security market return calculations were made. These were based on the authors prior beliefs concerning studies of other financial markets. The actual correlation between stocks and bonds over the period studied was approximately 0.5, while the correlation between stocks and cash and bonds and cash was not statistically significant over the period studied. It may be useful to vary these parameters in future studies (e.g., calculate out of sample rolling averages of stock and bond standard deviations and the stock/bond correlation) in order to see if these techniques can significantly enhance performance. Given the relatively short period under study, and past experience with the sensitivity of MVO results with varying parameters (4) through (9), it was useful to use constant parameters (i.e., 4 through 9) based principally on prior beliefs.

In order to show the potential of DAA, and to provide a basis of comparison for other results, a theoretical »perfect» DAA return series was constructed. The following table gives the results of a »perfect» DAA model. These values reflect the results of 100% investments in the best performing asset class each month.[30] Therefore, these values represent the theoretical maximum return achievable on a monthly basis over the period under study.

Regarding transactions costs, it was assumed that the investor incurred institutional levels of transactions costs. Also, transactions costs were assumed to only be incurred by the initial investment, not on the exit (i.e., only on the buy side). Therefore, all transactions costs are »front loaded». That is, transactions costs were based

[29] This is a typical value used in the U.S. Other risk aversion parameters were not used. Most of the above parameters were based on typical values used in the U.S. An obvious extension to this study is to vary certain parameters to check the sensitivity of the results.

[30] Of course, the shorter return intervals, the better the results. That is, assuming prices change over time, perfect weekly timing would outperform perfect monthly timing, and perfect daily timing would outperform perfect weekly timing, etc.

Table 4. »Perfect» DAA from Feb. 1987 through June 1993.

Perfect DAA (02/87–06/93)

Average Mix: 43/25/32 (S/B/C)
Turnover = 514.29%

Year	DAA	DAA with transactions costs	Average Mix
1987 (Feb. – Dec.)	49.14%	45.90%	18.40%
1988	50.75	44.76	17.77
1989	21.75	18.84	–1.21
1990	23.48	19.64	–9.17
1991	44.61	41.01	–1.98
1992	90.68	79.65	13.64
1993 (Jan. – June)	47.44	44.17	19.89
Cumulative Return (1987–1993)	1,274.11%	996.70%	67.09%
Average Annual Return	50.44%	45.24%	8.33%
Annual Standard Deviation	13.22%	12.83%	10.64%
Reward/Risk Ratio	3.82	3.53	0.78

on two times the estimated cost of a one way transaction. Transactions costs were as follows: (1) stocks were 200 basis points (i.e., 100 X 2) per buy trade; (2) bonds were 20 basis points per buy trade (i.e., 10 X 2); and (3) cash was 10 basis points per buy trade (i.e., 5 X 2).

This table, and the four that follow, is principally composed of three columns of results. The first column of results gives the results of the DAA strategy without transactions costs. The second column of results gives the results of the DAA strategy with transactions costs included. The last column of results gives the results of a static asset allocation strategy derived from the DAA strategy. That is, the static strategy is based on the average mix derived from the dynamic strategy. Therefore, in the column entitled »average mix» the returns from a strategy of investing in constant asset class weightings is reported. Given that the average mix results are only achievable ex-post, the average mix column is intended to provide some basis of comparison for the specific strategy under consideration, not necessarily as a comparison between strategies.

At a minimum, the results of Table 4 (especially when compared to Table 1) indicate that monthly market timing is important in Finland over the period 02/87 through 06/93. The first results indicate that this theoretical maximum was achievable over the period with an average allocation mix of 43% stocks, 25% bonds, and 32% cash. Although, the average annual turnover of the DAA portfolio was over 500%. That is, on average the portfolio was reinvested over 5 times each year. Given this rate of turnover, a high level of transactions costs were incurred with this strategy (i.e., compare column 2 to column 3). On average annual basis, approximately 500 basis points were spent each year on transactions costs.

The following is a list of the three models used to calculate the expected stock returns:

Model 1: $E(RS)_t = 4 \times (D/P)_{t-1}$;
Model 2: $E(RS)_t = (4 \times (D/P)_{t-1}) + (0.8 \times RS_{t-1})$; and
Model 3: $E(RS)_t = E(D/P)t + E(g)_t + (0.8 \times RS_{t-1})$.

Models 1 and 2 are based on the general soundness of using past dividends to forecast future stock prices. A scaling factor of four was used in order to move the stock expectation to a level where stocks would be selected in favor of the other asset classes. Comparing model 1 versus model 2 will provide background as to the usefulness of adding an autoregressive factor to equity return prediction in Finland. Again, two expected return series will be estimated using model 3. One expected return series will base expected growth in the economy on the WPI and the other on the CPI.

The following table provides the results of DAA using the expected stock return series derived from model 1.

Table 5. DAA based on Expected Stock Returns Model 1.

DAA based on Expected Stock Returns Model 1 (02/87–06/93)			
Average Mix: 4/23/73 (S/B/C) Turnover = 137.14%			
Year	DAA	DAA with transactions costs	Average Mix
1987 (Feb. – Dec.)	13.67%	13.29%	11.94%
1988	9.02	8.79	9.77
1989	12.67	12.54	10.32
1990	7.40	6.31	12.32
1991	12.80	12.05	13.35
1992	18.15	17.34	15.38
1993 (Jan. – June)	8.04	8.03	8.48
Cumulative Return (1987-1993)	115.91%	109.43%	116.03%
Average Annual Return	12.74%	12.21%	12.75%
Annual Standard Deviation	2.99%	3.03%	2.00%
Reward/Risk Ratio	4.26	4.03	6.37

The results do not suggest timing ability. Although, this model produced a very conservative mix of asset classes over the period. Just slightly more than 1/4th of the recommended investments were in the risky asset classes (i.e., stocks and bonds). The average mix performed better than the DAA strategy. The reward to risk ratio was 6.37 for the average mix and 4.03 for the DAA with transactions costs. This suggests that movements out of asset classes did not add much value. In fact, the model produced a return series with substantially more risk and about the same return than an all cash investment (i.e., 12.74% return versus 12.61% for cash, and 2.99% risk versus 0.68% for cash). Past dividends alone do not seem to provide much promise for forecasting stock returns in Finland.

The following table provides the results of DAA using the expected stock return series derived from model 2.

Table 6. DAA based on Expected Stock Returns Model 2

DAA based on Expected Stock Returns Model 2 (02/87–06/93)

Average Mix: 14/19/67 (S/B/C)
Turnover = 294.55%

Year	DAA	DAA with transactions costs	Average Mix
1987 (Feb. – Dec.)	21.41%	17.80%	13.27%
1988	16.34	14.18	12.11
1989	12.38	12.17	7.42
1990	12.97	11.99	6.26
1991	24.18	21.23	9.12
1992	48.40	43.03	14.96
1993 (Jan. – June)	13.37	12.06	10.84
Cumulative Return (1987-1993)	274.61%	228.32%	101.53%
Average Annual Return	22.85%	20.35%	11.54%
Annual Standard Deviation	10.35%	9.38%	3.89%
Reward/Risk Ratio	2.21	2.17	2.97

The results strongly suggest timing ability.[31] Over 30% of the recommended investments were in the risky asset classes. With exception of the reward to risk ratio, the average mix performed worse than the DAA strategy. In no year, did the suggested mix result in a negative return. Comparing the results to the best performing risky asset class over the period (i.e., bonds), it seems clear that at least on a return basis the DAA strategy based on the expected stock return series based on model 2 was substantially better than a strategy of investing in bonds only. The DAA strategy with transactions costs yielded over 5% more per annum than bonds alone. Al-

[31] Henriksson/Merton timing tests were run for the four models. This model was the only model to show a statistically significant timing coefficient (i.e., significant at below the 0.1% level of significance). Timing tests are generally dependent upon the model moving in and out of the stock market at critical times. Unfortunately, during the period under study it would have been difficult to time the stock market (i.e., it was generally in decline). Therefore, it was expected that a model having recommended a significant amount of stock might show timing ability. Of the four models examined, this model had the second highest level of average stock (i.e., 14% versus 15% for the next model reviewed). Therefore, in order to better judge timing ability of the models reviewed it would be beneficial to extend the period under study to include periods when stocks were performing better than that experienced in the period under study.

though, this extra return came at the expense of increased risk (bonds had a standard deviation of 5.82% versus 9.38% for the DAA strategy). Adding a factor for lagged stock returns significantly improves timing ability.

The following table provides the results of DAA using the expected stock return series derived from model 3 with the forecast for g based on the WPI.

Table 7. DAA based on Expected Stock Returns Model 3 using the WPI.

DAA based on Expected Stock Returns Model 3 using the WPI (02/87–06/93)

Average Mix: 15/14/71 (S/B/C)
Turnover = 243.12%

Year	DAA	DAA with transactions costs	Average Mix
1987 (Feb. – Dec.)	35.25%	30.37%	13.09%
1988	18.65	15.08	12.57
1989	13.04	11.55	7.29
1990	13.64	12.70	5.61
1991	15.90	15.09	8.62
1992	17.13	14.42	14.78
1993 (Jan. – June)	7.39	7.23	10.62
Cumulative Return (1987–1993)	200.55%	166.33%	98.91%
Average Annual Return	18.71%	16.49%	11.31%
Annual Standard Deviation	4.01%	3.64%	3.96%
Reward/Risk Ratio	4.66	4.53	2.86

At a minimum, these results indicate that DAA can successfully be applied in Finland. Net of transactions costs, the DAA strategy dominates the best performing risky asset class (16.49% annualized return versus 14.77 and 3.64% risk versus 5.82%). Over the period, the suggested mixes resulted in exceptionally high returns at exceptionally low risk. The reward to risk ratio is exceptionally high.

Table 8 provides the results of DAA using the expected stock return series derived from model 3 with the forecast for g based on the CPI. Especially with respect to risk, these results are more impressive than the last set. The most striking aspect of these results is the low level of risk. Without transactions costs, the DAA strategy clearly dominates the best performing risky asset class (15.40% annualized return versus 14.77 and 2.01% risk versus 5.82%). Clearly, on a risk basis, this is the best model presented. Over the period, the suggested mixes resulted in high returns at extraordinarily low risk. The reward to risk ratio is significantly higher than the previous results.

Table 8. DAA based on Expected Stock Returns Model 3 using the CPI.

DAA based on Expected Stock Returns Model 3 using the CPI (02/87–06/93)

Average Mix: 7/18/75 (S/B/C)
Turnover = 208.83%

Year	DAA	DAA with transactions costs	Average Mix
1987 (Feb.– Dec.)	14.79%	12.79%	13.09%
1988	15.40	13.07	12.57
1989	13.67	12.60	7.29
1990	14.81	14.35	5.61
1991	14.95	14.56	8.62
1992	17.13	14.42	14.78
1993 (Jan. – June)	7.71	7.52	10.62
Cumulative Return (1987–1993)	150.72%	131.44%	111.19%
Average Annual Return	15.40%	13.97%	12.36%
Annual Standard Deviation	2.01%	1.50%	2.25%
Reward/Risk Ratio	7.68	9.34	5.49

6. SUMMARY AND CONCLUSIONS

As discussed in the method section, DAA can provide investors with increased return at lower risk than a strategy of investing in the best performing risky asset class. It is a useful tool, particularly for large institutional investors exposed to equity market and bond market risk. This is particularly applicable for large financial institutions which are exposed to large amounts of single asset class risk. Even if an institution decides not to implement a DAA model, it can use the output to enhance the allocation decision process. For example, if a DAA model suggests 0% in bonds and stocks and 100% in cash and the institution is heavily invested in bonds, it might be prudent to stop rolling over maturing bonds and place the money into shorter term instruments. Generally, it may be better to base financial decisions on quantifiable financial market valuation than intuition. More to the point, of the 1,000s of portfolio managers in the U.S. only a handful have outperformed DAA.

Also, most portfolio value is gained or lost based on the asset class chosen, not by »picking» stocks and/or bonds (the only value I've read on this issue, based on a large sample of mutual funds, was in excess of 90% for asset class and less than 10% for the securities chosen). Again, the purpose of this study was to research whether the Finnish financial markets can be timed. One implication of this study is, based on a relatively short period of time, the Finnish financial markets can be timed. The question remains, if Finnish financial markets can be »timed», why aren't they?

A few final words of warning may be in order. Although the results are very encouraging there are some issues which may make past and future timing ability suspect. DAA may not be profitable after taking account of all transactions costs. Assuming that the transactions costs used are relatively representative of the costs of trading for the respective asset classes, DAA has been economically profitable in Finland. If transactions costs are substantially greater than those used in this study, the results would not be as strong. Although, it is likely that transactions costs will be reduced in the future as the Finnish financial markets expand and become more exposed to international pressures. It may also be that it is not possible to buy the equity index in Finland. Regardless of whether the complete index can be bought or sold is not at issue. A liquid subset of the index which is highly correlated with the stock market would be sufficient to enable an investor to time the stock market. The most important caveat to these results may be the common caveat made to all time series studies: the past may not repeat itself. That is, past economic and financial market relationships may significantly change in the future in such a way as to stop investors from being able to time the market as they did in the past. Given the four models presented, the results are largely dependent on the continuation of autocorrelation in the stock return series going into the future.[32] It is possible that the large recent structural changes in the markets and Finnish economy may make forecasting market movements, particularly stock market returns, virtually impossible. Again, this final caveat applies to any empirically based economic relationship, not just DAA models.

Overall, the results are encouraging. The results of this study could be improved by taking into account some of the suggestions made by previous research in the area (e.g., dynamic asset class correlation coefficient forecasts) and/or by improving the models presented. In conclusion, this study strongly suggests that DAA could have been successfully applied in the Finnish financial markets. Although, the question remains as to whether DAA can be successfully applied in the Finnish financial markets in the future?

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To Load or Not to Load?
A Study of the Marketing and Distribution Charges of Mutual Funds

John Kihn

A mutual fund firm's ability to charge for marketing funds is a function of more than past financial performance. Front-end loads and annual fund marketing charges are at least in part determined by customer services, whether deferred marketing charges can be imposed, and financial performance. The results imply that, at least in the short run, mutual fund firms should focus relatively more on fund marketing and service-related characteristics of their funds than on financial performance. Mutual fund investors seem to demand high levels of services in exchange for high marketing charges.

The 1990s have witnessed unprecedented growth in mutual fund assets under management and the number of mutual funds. Figure 1 illustrates this growth. Mutual fund growth, at least in part, can be attributed to legislation permitting tax-deferred savings accounts and the general aging of the U.S. population compared with historic demographic patterns. Specifically, legislation concerning 401(k) plans and Individual Retirement Accounts (IRAs) has had a dramatic impact on the recent growth in the mutual fund industry.[1] Against this backdrop of surging amounts of individual investor funds flowing into an ever-increasing number of mutual funds has been an acceleration of the marketing efforts of mutual fund firms.

Given that mutual funds are set up in large part to cater to the needs of what are often referred to as "uninformed investors," on the surface these marketing efforts seem to be a rational response to consumer needs. Commonly accepted economic

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theory suggests that marketing, in particular advertising, efforts are in large part an attempt to provide information to consumers. Of particular concern to economists has been the notion that marketing efforts are an intentional attempt to reduce consumers' search costs. For example, one theory is that for many consumer products, maintaining a trademark is an economically efficient means for a company to sell a product. In the case of more costly products, however, or investments, consumers could gain from performing more thorough searches. Whatever the current economic argument, at a minimum, the logical conclusion is that firms and consumers do not pay for costly marketing services unless such services provide profits to the firms making these efforts and at least a perceived benefit to the consumers being targeted.

Even though mutual fund marketing efforts make sense from the standpoint of profit-minded mutual fund firms, it is not clear that most mutual fund consumers benefit from these efforts on their behalf. Generally, in finance, an expense is considered justified if the marginal benefit is at least equal to its cost.[2] Finance professionals often refer to "value-added" services in this context. The issue is whether the costs of marketing mutual funds are justified from a value-added perspective. Actually, it has been shown that a significant negative difference exists between mutual funds charging loads (i.e., front-end marketing charges) and those not charging loads.[3] No-load funds have been shown to outperform load funds.[4]

Also, in finance, it has become accepted doctrine to assume that investors should be concerned primarily with the return and risk of their investments. The assumption that a mutual fund investor is concerned only with return and risk whereas a consumer durables consumer is concerned with more than two performance criteria would imply that mutual fund consumers should have an easier time evaluating a $2,000 mutual fund purchase than, say, a $2,000 used car purchase. On the surface, the fact that the average used car buyer seems to get a better bargain than the average mutual fund buyer is perplexing.

This study addresses an area of finance that has been generally based on beliefs and anecdotes. That is, it provides an empirical backdrop to the issues surrounding the charging of mutual fund marketing costs. The following issues are covered:

- Given the past observed relationship between mutual fund sales and performance, what variables would be expected to determine the charging of marketing costs?
- Based on relatively recent data, are mutual fund marketing charges justified?
- What factors determine mutual fund marketing costs?

THE COMPONENTS OF MUTUAL FUND MARKETING COSTS—A MUTUAL FUND MARKETING THEORY

It used to be that when a fund had good performance, the money would naturally flow into it, ... Now even funds with *unspectacular numbers are seeing substantial asset increases, which is clear testimony to the power of marketing.* **Front [1987][5] [Please provide better reference.]**

It has become generally accepted that from an investor's perspective, the two most important characteristics of a financial investment are the return and risk of that investment. Risk-averse investors are believed to increase their utility if return is increased while risk is held constant or, conversely, if risk is decreased while return is held constant. Clearly, the intent of this study is not to suggest that in the mutual fund game, return and risk do not matter, but that the marketing value of return and risk may be relatively insignificant when compared with other, more marketing-related variables.[6]

Therefore, to provide a clear outline for the direction of the research that follows, a general model of the optimal charging of marketing costs is proposed. The following observation drives a critical assumption of this section: What if, as several researchers have found, the return and risk performance of a mutual fund does not appear to significantly affect the ability of the seller of a mutual fund to sell the product. If so, then one might expect that an increase in marketing costs, especially brokerage commissions, may ultimately lead to increased money under management and increased management fees. In economist jargon, the marginal cost of many types of marketing expenses in the 1980s and 1990s may have been substantially lower than the marginal returns they seem to have generated.[7] Even though investors would be expected to pay higher relative management fees for higher expected performance, this study would suggest that the same dynamic might hold for current or short-run marketing charges.

Why do mutual fund investors seem to violate a basic tenant of modern finance? Why do they not demand more return for the extra costs they incur by purchasing a mutual fund from a mutual fund company that directly and/or indirectly charges higher marketing costs than other funds but does not return more than the added cost(s) the investors are charged? The answer may be that smaller, less informed investors value services that provide a certain level of comfort with an investment they cannot see on a daily basis.

At a minimum, particularly with mutual funds, there appears to be some need for an extension to the standard relationship between costs, risk, and return. As long as most mutual fund investors are relatively uninformed, the case may be that trademarks and other mass-marketing-related goodwill are significantly more important than specific fund performance. Holding asset class or portfolio strategy characteristics constant, what are the determinants of mutual fund marketing charges? More specifically, given that up-front marketing charges (i.e., loads) are not well explained by past or future performance, what other factors determine the ability to charge up-front marketing charges? That is, what factors increase sales revenue more than their marginal cost? Generally, the level of informedness of the investor and the size of investment determine the increase in sales revenue. A well-informed investor would be expected to stress traditional performance criteria, whereas a less informed investor might value nonperformance-related investor services and image more highly than other criteria. Also, as suggested by search theory, the larger the mutual fund investment, *ceteris paribus*, the more resources will be expended searching for a mutual fund.

Given the previous arguments and past observations, the following general model of mutual fund current marketing charges is proposed:

$$CMC_i = f(PC_i, CS_i, DC_i),$$

where

CMC = current marketing charges (up-front load or 12b-1 charges)

PC = performance characteristics (return, risk, and asset class)

CS = customer services (e.g., telephone switching, low minimum initial purchase, etc.)

DC = deferred marketing charges (deferred charges or penalties for leaving the fund)

This model is intended to be used as the basis for exploratory analysis on the determinants of the cost of marketing mutual funds.

The investor's problem is to maximize the following utility function:

$$U = U(\overset{+}{PC}, \overset{+}{CS}, \overset{-}{DC}) ,$$

subject to $PC(P^{PC}) + CS(P^{CS}) - DC(P^{PC}) + CS(P^{CS}) - DC(P^{DC})$

$\leq I$ and $PC,\ CS,\ DC \geq 0$,

where P is the price of the specified general set of factors and I is the value of the investor's investment. The mutual fund firm, to maximize profits, must provide the investor with those services or attributes from which he or she derives more utility than the costs of those services.

STATISTICS AND REGRESSIONS TESTING THE DETERMINANTS OF CURRENT MARKETING CHARGES[8]

In some sense, mutual fund marketing charges are hidden costs. That is, marketing charges are not included directly in the costs of managing a mutual fund and therefore do not directly affect the fund's observed financial performance. The three current types of marketing charges are loads, 12b-1 fees, and deferred charges or penalties. Loads are immediately deducted from the investment and are considered to be primarily sales commissions. 12b-1 fees are legally defined to be for marketing, distribution, and advertising expenses. They are annual fees intended to pay for a wide array of marketing services over the year (management fees are similarly designated). Deferred charges are referred to as "back-end loads" and are normally applied only to the original investment. Deferred charges are charged upon the sale of fund shares and are typically constructed to encourage staying invested in the fund (many decline over time).[9]

In 1980, the mutual fund industry successfully lobbied for SEC approval of 12b-1 fees by arguing that their use would increase fund sizes and thereby provide economies of scale.[10] All evidence to date suggests this result has not occurred.[11] In fact, 12b-1 fees seem to have contributed to increasing management expenses.[12] In addition, management expenses themselves have been shown to have a significant negative relationship with net returns (12b-1 fees show some of the same effect).[13] Finally, the actual distributions of front-end loads and 12b-1 fees illustrate diverse pricing strategies.

As can be seen from Figures 2 and 3, about half of minimum front-end loads **[please define minimum loads]** and 12b-1 fees are zero. Minimum loads show some clustering around 3.3 percent, and 12b-1 fees around 0.2 percent. A fund charging no load will tend to charge a higher-than-normal 12b-1 fee and vice versa. Even though legally distinct, to some extent front-end loads and 12b-1 fees are substitutes.

All the correlation coefficients presented in Table 1 are significant at well below the 1 percent level of significance. Also, the large positive correlation coefficients for year-end minimum loads for 1992 and 1993 suggest that front-end loads for this sample changed little from 1992 to 1993. The same result applies to 12b-1 fees from 1992 to 1993.[14] The negative correlation between front-end loads and 12b-1 fees suggests that

12b-1 fees are being used as substitutes for legally defined loads (*i.e.*, front-end loads). This finding suggests that the trade-off between loads and 12b-1 fees is in large part a marketing decision on the part of mutual fund firms. Given this apparent trade-off between loads and 12b-1 fees, the regression analysis that follows will report regressions using minimum load and 12b-1 fee as the two dependent variables.

The regression models that were tested were the following:

$$CMC_i = \alpha_0 + \beta_1(R3_i) + \beta_2(Risk3_t) + \beta_3(FutR_i) + e_i \quad (1)$$

$$CMC_i = \alpha_0 + \beta_1(R3_i) + \beta_2(Risk3_t) + \beta_3(FutR_i) + \beta_4(DDC_i) + \beta_5(D12b_i) + \beta_6(D800_i) + \beta_7(DTS_i) + \beta_8(DIP500) + \beta_9(Age_i) + \beta_{10}(Size_i) + \beta_{11}(ManExp) + \beta_{12}(DMuni_i) + e_i , \quad (2)$$

where

CMC = current marketing charge(s) (minimum load or 12b-1 fees are used)

$R3$ = the monthly mean return over the previous three years[15]

$Risk3$ = the monthly standard deviation of return over the previous three years

$FutR$ = the fund's one-year-hence, or one-year-future, return

DDC = the deferred charge dummy variable (equal to 1 if a deferred charge was reported, 0 otherwise)

$D12b$ = the 12b-1 dummy variable (equal to 1 if 12b-1 charges are allowed, 0 otherwise)

*D*800 = the 800 number dummy variable (equal to 1 if an 800 number is provided, 0 otherwise)

DTS = the telephone switching dummy variable (equal to 1 if telephone switching is available, 0 otherwise)

*DIP*500 = the $500 initial purchase dummy variable (equal to 1 if the initial purchase amount is less than or equal to $500, 0 otherwise)

Age = the number of years the fund has been in business

Size = the asset size of the fund in millions of dollars (the common logarithm is taken)[16]

ManExp = annual management expenses

DMuni = the municipal bond fund dummy variable (equal to 1 if the fund objective is municipal bonds, 0 otherwise)

e = error term

Equations 1 and 2 are designed to take account of financial performance via *R*3, *Risk*3, and *FutR*. Equation 1 is based on strictly financial performance criteria and is therefore intended for comparative purposes. The mean three-year return was selected because the results using the mean three-year return or mean five-year return variables did not differ substantially. The three-year standard deviation was selected in favor of beta as the risk measure because a large number of the funds are not well correlated with the stock market (e.g., bond and money market funds). Also, the three-year standard deviation of return was selected because the results using the three-year standard deviation of return or the five-year standard deviation of return did not differ substantially. The future one-year return was selected based on the notion that when investors pay marketing charges in the short run, they may at least agree to pay them in part on anticipated future performance as much as on past performance. The expected signs of the financial performance variables are as follows:

- a positive sign for past return (mutual fund investors will be willing to pay higher marketing and other charges for funds they expect to generate more return, holding risk constant)
- a negative sign for past risk (mutual fund investors will be willing pay lower marketing and other charges for funds they expect to be riskier, holding return constant)
- a positive sign for future return (based on the same reasoning applied to past return and the argument that mutual fund companies will be more likely to ask for more marketing charges for a fund if they also expect that fund to perform well in the future)

DDC and *D12b* in Equation 2 are intended to isolate the effect that other, less immediate marketing charges may have on the setting of more-current marketing charges. For example, if a mutual fund company is charging a deferred charge, one would expect that the current load or 12b-1 charge would be lower (i.e., a substitutability argument). That is, is the relationship between the charging of deferred marketing charges and current marketing charges negative or are they complimentary? Also, if a mutual fund is allowed to charge future 12b-1 fees on an annual basis, one could argue that front-end load charges could be lower. Therefore, is the relationship between the ability to charge 12b-1 fees later and front-end loads negative, are they complimentary, or neither?

*D*800, *DTS*, and *DIP*500 are intended to isolate the effect that small client services have on a mutual fund firm's ability to impose current marketing charges. These three service variables are not intended to represent an exhaustive list of important service variables, but such variables as perceived investment prowess on the part of a mutual fund firm are beyond the scope of this study. Given that all these services can be viewed as beneficial to relatively small mutual fund investors, the expected coefficients should be positive.

Age, *Size*, *ManExp*, and *DMuni* are added to examine orthodox financial or economic relationships. The older a mutual fund is (as measured by years incorporated), *ceteris paribus*, the higher the marketing charge. The larger the mutual fund (as measured by total assets under management), *ceteris paribus*, the greater the economies of scale with respect to marketing charges (i.e., the larger the size the lower the relative marketing charge). Management expenses are included to test for the degree to which marketing charges are dependent upon or independent of management expenses and to test the extent to which marketing charges are compliments or substitutes for the two marketing charges examined. The inclusion of a dummy variable for municipal bond mutual funds was intended to pick up any tax-exempt bond clientele effect. Tax-exempt bond mutual funds might be well positioned to ask for an extra premium from less informed investors desiring to invest in tax-exempt bonds (although investor demand for specific asset classes could be viewed as a client services or financial performance variable).

The financial model regressions, the results of which are given in Table 2, show a dramatic difference between using front-end loads (as measured by minimum front-end load) versus 12b-1 fees as the dependent variable. First, the R^2 for both regressions is below 1 percent. This result indicates that financial performance, both past and future, of a mutual fund does not explain much of the variance between the two CMC measures for the cross-sectional sample of mutual funds under study. Second, as expected, the estimated coefficient for past returns (*R*3) is positive and statistically significant for minimum load. Unexpectedly, the sign of the estimated β_1 is negative and very statistically significant for the 12b-1 regression, which suggests that mutual fund investors are not willing to pay higher annual marketing fees if the past (and future) returns are high, *ceteris paribus*. Second, regarding the estimated β_2, the results for the 12b-1 regression directly conflict with the **other regression [the MinLoad regression?]** The statistically significant positive estimated coefficient for *Risk*3 suggests that mutual fund investors are willing to pay higher 12b-1 fees the riskier the mutual fund. Third, the sign of the estimated β_3 for the 12b-1 regression, although not statistically significant, indicates that higher future returns, *ceteris paribus*, have a negative effect on past marketing charges. Finally, even though both front-end loads and 12b-1 fees are considered current marketing charges, financial performance variables affect them in very different ways.[17]

At a minimum, from a traditional financial performance perspective, something is odd about 12b-1 fees. Possibly, 1992 was a very strange year, but excluding the future return variable, the same basic results held for 1993 (results not reported). As mutual fund consumers have become more aware and possibly concerned with loads, 12b-1 fees may have become a more effective means of paying for marketing expenses, which would suggest a substitutability argument with the following twist: Although 12b-1 fees may be an effective substitute for front-end loads, they have the desirable feature that they can be charged to pay for marketing on riskier, low-return funds *ex post*. If so, the ability to charge 12b-1 charges would have substantial option value to a mutual fund firm. That is, even though a mutual fund firm may not currently need to charge substantial 12b-1 fees, the fact that it may be able to do so annually without the consent of mutual fund investors may be of moderate value for poorly performing funds, as suggested by the 12b-1 regression, but possibly of substantial value in general.

Clearly, as Table 3 shows, the dramatic increase in R^2 for both regressions suggests that the additional variables add a significant amount of explanatory power to the original three-variable financial regression model. Particularly encouraging is that the explained variance for 12b-1 fees is now in excess of 60 percent. In fact, the financial performance variables (and size) add very little to the explanatory power of the models.

Regarding the first three estimated beta coefficients, not all of the effects established in the financial-model-based regressions hold. First, the estimated coefficients for *R*3 and *FutR* for the MinLoad regressions remain positive and statistically significant. The estimated coefficient for *R*3 for the 12b-1 regression changes from negative in the first regression to positive and statistically significant in the full-model regression. The estimated coefficient for *FutR* for the 12b-1 regression does not change from the financial-model-based regression but is now slightly statistically significant. Apparently, even after controlling for customer service and other variables, increased past returns do not significantly affect the setting of 12b-1 fees. Second, regarding *Risk*3, the sign of the estimated coefficient for the front-end load regressions reverses, but it is not statistically significant. Third, as before, overall the full-model regressions indicate that mutual fund returns positively affect the setting of front-end loads, not 12b-1 fees. Fourth, overall the full-model regressions indicate that mutual fund risk negatively affects the setting of 12b-1 fees but not front-end loads.

For the three variables identified as possible substitutes or compliments to front-end loads and 12b-1 fees (*DDC*, *D*12b, and *ManExp*), the results are statistically very strong. The estimated coefficient for *DDC* (the deferred marketing charge dummy) strongly suggests that deferred charges are a compliment to 12b-1 fees and a substitute for front-end loads. For example, the fact that the average 1992 minimum front-end load was 1.73 percent and the estimated coefficient for the MinLoad regression is -1.90 percent suggests that a mutual fund that imposes a deferred charge reduces its front-end load by 190 basis points, which is 17 basis points lower than the average 1992 minimum front-end load. Conversely, a mutual fund that imposes a deferred charge increases its 12b-1 fees by 51 basis points, or more than twice the average 1992 12b-1 fee charged (the average 12b-1 fee for 1992 was 20 basis points). Clearly, deferred charges have opposite effects on front-end loads as on 12b-1 fees. The estimated coefficient for *D*12b (the dummy for the legal option to charge 12b-1 fees) is positive and statistically significant at well below the 0.01 percent level of significance. Therefore, the estimated coefficient for *D*12b strongly suggests that the legal ability to charge 12b-1 fees is complimentary to front-end loads. Most publicly listed mutual fund firms either charge front-end loads or 12b-1 fees.[18] A firm that can charge 12b-1 fees but is not currently charging a high 12b-1 fee is likely to have a high front-end load; later, it may be required to increase 12b-1 fees to cover marketing costs.

The estimated coefficient for management expenses is negative and not statistically significant for the MinLoad regression, but it is positive and statistically significant for the 12b-1 regression. Clearly, a mutual fund firm that imposes high annual marketing fees tends to charge high management expenses. Therefore, management expenses are a compliment to 12b-1 charges.

The service variables strongly support the notion that mutual fund investors pay substantial fees to acquire certain services. Except for the estimated coefficient for *DTS* in the 12b-1 regression, which was not statistically significant, the estimated coefficients for the three customer service variables (*D*800, *DTS*, and *DIP*500) are positive in both regressions, although the estimated coefficients for the customer service variables are not as important in the 12b-1 regression as in the MinLoad regression. The results suggest that customer services allow a fund to charge more for front-end loads than for annual marketing fees. This finding is especially true of the estimated coefficient for *DIP*500, which was slightly more than 16 times larger in the MinLoad regression than in the 12b-1 regression. The estimated coefficient for *D*800 was positive and statistically significant in the 12b-1 regression and in the MinLoad regression. In the MinLoad regression, the estimated coefficient for *D*800 and *DTS* were each greater than 27 basis points (37 and 27, respectively) and statistically significant. The results of the customer service variables suggest the following insights:

(1) in general, the link between customer services and front-end loads and 12b-1 fees is positive; (2) regarding front-end loads and 12b-1 fees, telephone services matter; (3) regarding minimum initial purchase amounts, mutual funds can charge a premium permitting relatively small initial investment amounts; and (4) given the size and significance of the estimated coefficients for an incomplete set of three customer service variables, it would be difficult to argue that financial performance is a more important determinant of the marketing charges price-setting behavior of mutual funds than customer services.

The estimated coefficient for *Age* is positive and statistically significant in the MinLoad regression and negative and statistically significant in the 12b-1 regression. This result suggests that the older a mutual fund is the lower the 12b-1 fees it will charge; the opposite holds true of front-end loads. The most plausible explanation would be that older funds may have an easier time charging front-end loads while newer mutual funds tend to rely on 12b-1 fees to pay for marketing and distribution. Why this is the case is not clear, unless mutual fund firms prefer to skew charges toward front-end fees and mutual fund age is one determinant of the ability to charge front-end loads. Also, funds that were in existence before 12b-1 fees were allowed may have found it difficult to substitute front-end fees for 12b-1 fees and/or newer funds more optimally use 12b-1 fees as opposed to front-end loads.

The estimated coefficient for mutual fund size (total assets under management) is not statistically significant in either regression. Also, the positive coefficient in both regressions goes against standard economies of scale logic. In this case, *ceteris paribus*, the larger the mutual fund the higher the current marketing charges. The results for the size variable proxy would seem to stress the point that economies or diseconomies of scale do not appear to apply with respect to mutual fund size and current marketing charges.

The estimated coefficient for municipal bond mutual funds (*DMuni*) is positive and statistically significant for the MinLoad regression but not statistically significant for the 12b-1 regression. This finding suggests that the ability to charge a marketing premium for municipal bond mutual funds is generally applicable to front-end loads only, not annual marketing fees. Possibly, municipal bond mutual fund investors are more willing to pay a single up-front charge rather than annual charges, especially if the average municipal bond mutual fund investor tends to be a relatively long-term investor compared with other mutual fund investor clienteles. Front-end loads are much more popular in municipal bond funds than in overall funds in general.

SUMMARY AND CONCLUSIONS

Given that the data analyzed cover 1992 through 1993 (in particular, 1992), the empirical results of this study may be specific only to 1992 and 1993. Therefore, an obvious extension of this research is to examine whether the relative and absolute levels of marketing charges by mutual fund firms are subject to trends.

What have we learned? First, 12b-1 fees and front-end loads are very different marketing charges. Some of the determinants of front-end loads seem to be

- whether the fund imposes deferred marketing charges
- whether annual marketing charges (*i.e.*, 12b-1 fees) can be charged
- hether the mutual fund caters to a municipal bond clientele (*i.e.*, tax clientele)
- whether low initial purchases are allowed
- next years' fund return
- past fund returns
- whether telephone switching is available
- whether an 800 number is available
- the age of the fund

Some of the determinants of 12b-1 fees seem to be

- whether the fund charges deferred marketing charges
- the level of annual management fees charged
- the age of the mutual fund
- whether an 800 number is available
- whether low initial purchases are allowed
- the past risk of the mutual fund
- next years' fund returns

At a minimum, these rather lengthy lists of statistically significant determinants of current marketing charges suggest that the determination of current marketing charges is a complex process dependent upon more than financial performance.

Overall, the financial performance variables add little to the explanatory power of models designed to identify the determinants of current marketing charges. The overall results support the general theory of mutual fund marketing charges. That is, financial performance is not the most important determinant of current marketing charges. Mutual fund services and other marketing-related charges are critical determinants of current marketing charges.

Mutual fund firms interested in increasing sales can learn several lessons from this study. First, they should pay special attention to the trade-off between front-end loads, 12b-1 fees, and deferred charges. In addition, each asset class may require a significantly different optimal trade-off between front-end loads, 12b-1 fees, and deferred charges. Second, customer services seem to be very important to mutual fund investors. Therefore, a firm would be well advised to increase relatively low-cost customer services and research the cost-benefit feasibility of other services. Third, although the image of a competent finance firm may be important to the average mutual fund investor, the firm should worry relatively more about marketing image and less about actual financial performance. Therefore, a large mutual fund firm would be well advised to focus on the financial performance of one or two "flagship" or high-visibility funds and not worry so much about the financial performance of other funds (especially if the other funds the firm has are a well-diversified group).

Mutual fund investors also can learn several lessons. First, mutual fund investors should trade off all marketing costs (front-end loads, annual fees, and deferred charges) of the mutual funds they are examining. Generally, marketing charges do not add any real value to the financial performance of mutual funds. Second, be better informed. In finance, the general rule is that the risk-averse rational investor faces a trade-off between return and risk. This study suggests that the majority of mutual fund investors are more concerned with customer services than with financial performance.[19]

Notes:

1. See J. Poterba, S. Venti, and D. Wise, "401(k) Plans and Tax-Deferred Saving," National Bureau of Economic Research, Working Paper No. 4181, October 1992. The Economic Recovery Tax Act of 1981 expanded eligibility for IRAs. 401(k) plans were established by the Revenue Act of 1978 but were rarely used until the Treasury Department issued clarifying rules in 1981.

2. See A. Yohannes, "The Derivation of Simple Formulas for Comparing Investment Alternatives with and without Load and Account Fees," *The Journal of Consumer Affairs*, **vol. ?, no. ?** (Winter 1988):333-41 for a general present value formula that makes this relationship explicit for mutual fund marketing charges.

3. See the following studies for evidence on this point: I. Friend, M. Blume, and J. Crockett, *Mutual Funds and Other Institutional Investors: A New Perspective* (New York:McGraw-Hill Book Company, 1970); G. Perritt, "Is the Load too Much to Bear?" *American Association of Individual Investors Journal*, **vol. ?, no. ?**(June 1984):18-21; and *Consumer Reports*, "A Guide to Mutual Funds" (July 1985):390-95.

4. For example, see K. Smyth, "The Coming Investor Revolt," *Fortune*, **vol. ?, no. ?** (October 13, 1994):66-76.

5. See A. Marton, "The no-loads fight back," *Institutional Investor*, **vol. ?, no. ?** (April 1987):253-56.

6. See M. Greene, "A Note on Loading Charges for Variable Annuities," *The Journal of Risk and Insurance*, **vol. ?, no. ?** (September 1973):473-78 for a list of reasons for high front-end loads. The reasons given, which are also applicable to mutual funds, are (1) salesmen's commissions, (2) the cost of allowing switching between funds, and (3) management expenses.

7. It has been found that for every $1 spent on fees (both management fees and marketing fees), investors receive $0.20 in return (see Smyth, "The Coming Investor Revolt.").

8. The data were obtained from Steele Systems, Inc. The sample is based on the calendar year-end 1992 and 1993 sample populations provided. Records were eliminated because of the absence of (1) reported returns for 1992 or 1993, (2) reported 12b-1 charges, (3) reported management expenses, (4) reported loads, (5) reported initial purchase amount, and (6) reported date of fund incorporation. These criteria reduced the 1992 sample from 3,048 mutual funds to 2,586 and the 1993 sample from 4,182 mutual funds to 3,308. The sample was further reduced upon merging the two files, because not all the funds existing at year-end 1992 were still in existence at year-end 1993. The final sample consists of 2,496 mutual funds.

9. Redemption charges are also applied upon the sale of shares, although they typically apply to the whole investment and are not referred to as a form of back-end load. Redemption charges are not strictly legally defined as marketing charges, but given that they are real costs and do not affect the legally defined returns of mutual funds (i.e., financial performance), one could argue on economic grounds that they should be classified as deferred marketing charges.

10. See, for example, S. Ferris and D. Chance, "The Effect of 12b-1 Plans on Mutual Fund Expense Ratios: A Note," *The Journal of Finance*, vol. 42, no. 4 (September 1987):1077-82. The possible exception to this rule is growth-oriented equity funds.

11. See, for example, Ferris and Chance, "The Effect of 12b-1 Plans on Mutual Fund Expense Ratios"; and C. Trzcinka and R. Zweig, "An Economic Analysis of The Cost and Benefits of SEC Rule 12b-1," Monograph Series in Finance and Economics, Leonard N. Stern School of Business, New York University, 1990. Also, R. McLeod and D. Malhotra, in "A Re-examination of the Effect of 12b-1 Plans on Mutual Fund Expense Ratios," *The Journal of Financial Research*, **vol. ?, no. ?** (Summer 1994):231-40, confirm and extend the Ferris and Chance results.

12. For example, see Ferris and Chance, "The Effect of 12b-1

Plans on Mutual Fund Expense Ratios."

13. See Josef Lakonishok, "Performance of Mutual Funds Versus Their Expenses," *Journal of Bank Research*, **vol. ?, no. ?** (Summer 1981):110-13.

14. The average minimum load declined slightly from 1.7289 percent in 1992 to 1.6829 percent in 1993. The average 12b-1 fee increased slightly from 0.1999 percent in 1992 to 0.2014 percent in 1993. This slight shift from front-end loads to 12b-1 fees may indicate a general trend for mutual fund firms toward marketing charges that are more palatable. Investors may be beginning to key in on front-end loads, and mutual fund firms may be responding by dynamically shifting marketing charges toward those that are less consumer sensitive at this time.

15. In some cases, less than three years of data are available as the basis for the historic return measure.

16. Given that the logarithm of assets under management was taken and several observations did not list assets under management, a zero was substituted for those observations.

17. Although, given that 12b-1 fees drag annual financial performance down without a commensurate increase in returns, the seemingly anomalous estimated coefficients are somewhat sensible.

18. Based on the sample under study, for 1992, 69.6 percent (1,738 out of 2,496) reported nonzero minimum front-end loads and/or 12b-1 fees and for 1993, 70.9 percent (1,770 out of 2,496) reported nonzero minimum front-end loads and/or 12b-1 fees.

19. A special thanks to Alan Williams. In addition, the author would like to thank Bruno Sere of Steele Systems, Inc. for helping educate the author on the data provided and on mutual fund expenses in general.

Table 1. Correlation Coefficients for Current Marketing Charges

	Minimum Load		12b-1	
Charge	1992	1993	1992	1993
Minimum load 1992	1.0000	0.9598	-0.1453	-0.125
Minimum load 1993		1.0000	-0.1300	-0.1119
12b-1 fee 1992			1.0000	0.9606
12b-1 fee 1993				1.0000

Source: Based on data provided by Steele Systems, Inc.

Table 2. Current Marketing Charge Regressions: Financial Model

	MinLoad		12b-1	
Variable	Parameter	*t*-Statistic	Parameter	*t*-Statistic
Intercept	1.5146	16.46****	0.2339	14.80****
R3	0.2601	3.43***	-0.0533	-4.09****
Risk3	-0.0669	-3.20***	0.0075	2.09*
FutR	0.0134	4.24****	-0.0009	-1.62
Adjusted R^2	0.0077		0.0059	
F-statistic	7.42****		5.96***	

Source: Based on data provided by Steele Systems, Inc.

* statistically significant at the 5 percent level.
** statistically significant at the 1 percent level.
*** statistically significant at the 0.1 percent level.
**** statistically significant at the 0.01 percent level.

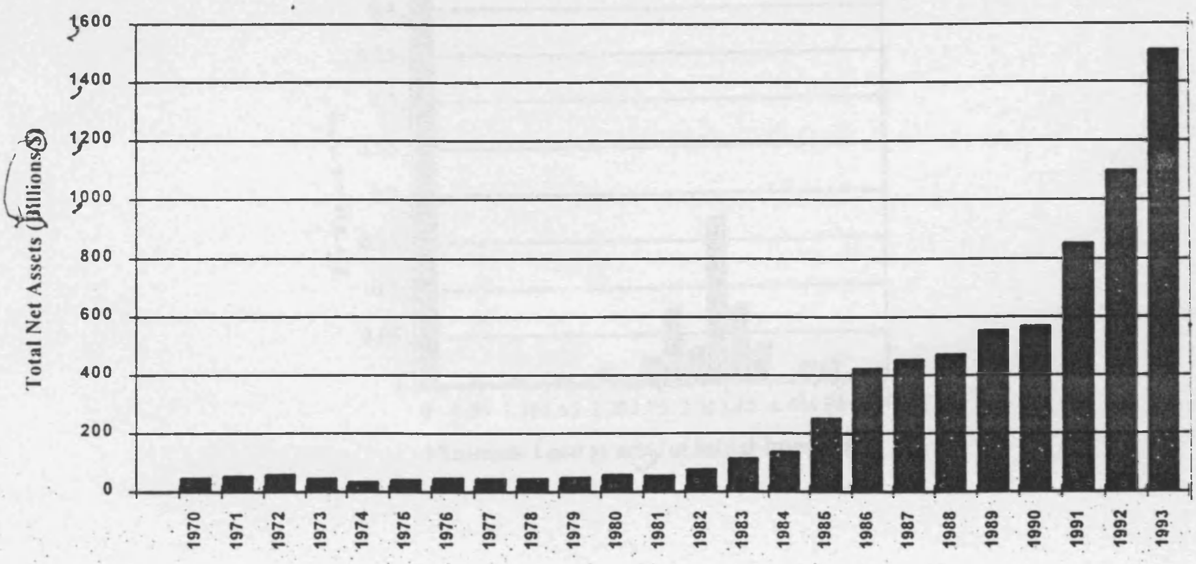
Table 3. Current Marketing Charges Regressions: Full Model

	MinLoad		12b-1	
Variable	Parameter	*t*-statistic	Parameter	*t*-statistic
Intercept	-0.0432	-0.23	-0.1481	-6.48****
*R*3	0.2493	3.70***	0.0085	1.05
*Risk*3	0.0146	0.66	-0.0156	-5.93****
FutR	0.0148	5.34****	-0.0008	-2.47*
DDC	-1.9049	-18.33****	0.5139	42.13****
*D*12b	1.3380	19.68****		
*D*800	0.3672	2.63**	0.0935	5.64****
DTS	0.2735	3.59***	0.0122	1.33
*DIP*500	0.5973	8.30****	0.0353	4.07****
Age	0.0083	2.78**	-0.0010	-2.88**
Log(*Size*)	0.0124	0.27	0.0103	1.88
Management fees	-0.1100	-1.78	0.1777	24.33****
DMuni	0.7280	8.54****	0.0093	0.90
Adjusted R^2	0.2613		0.6350	
F-statistic	74.54****		395.67****	

Source: Based on values provided by Steele Systems, Inc.

* statistically significant at the 5 percent level.
** statistically significant at the 1 percent level.
*** statistically significant at the 0.1 percent level.
**** statistically significant at the 0.01 percent level.

Figure 1. Annual Total Net Mutual Fund Assets for Equity, Bond,and Income Funds, 1970-93



Source: Investment Company Institute, Washington, D.C., *1994 Mutual Fund Fact Book*, p. 100

Figure 2. Minimum Load Frequency Distribution, Year-End 1992

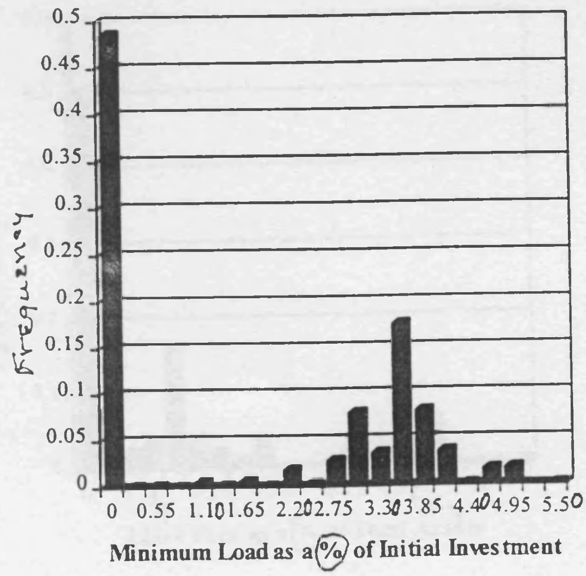
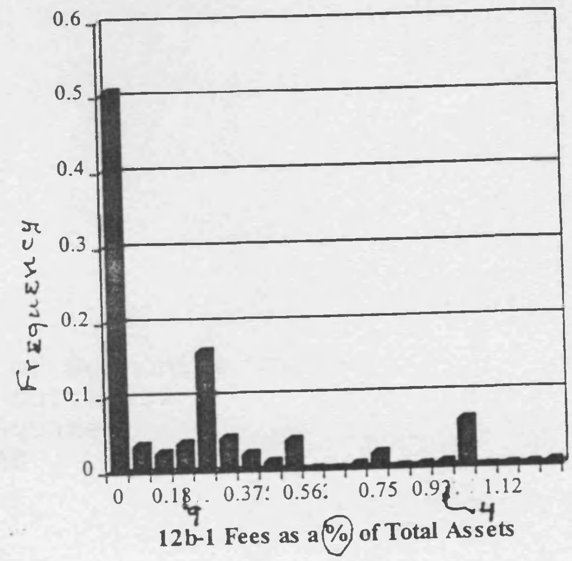


Figure 3. 12b-1 Fee Frequency Distribution, Year-End 1992



Larisa –
Numbers on horizontal axis are on every third bar (I think!)

Financial Analysts Journal
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March 26, 1996

John Kihn
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London House, Suite 222
Mecklenburgh Square
London WC1N 2AB
England

Dear Mr. Kihn:

Here is the edited version of your upcoming *FAJ* article, "To Load or Not to Load? A Study of the Marketing and Distribution Charges of Mutual Funds." It is tentatively scheduled for publication in the May/June 1996 issue.

Please read through the manuscript, paying particular attention to all boldface queries. Be sure to make any changes you want, and return it to me no later than April 2. Meanwhile, if you have questions, you can reach me at (804) 980-3645 or, by e-mail, at cs@aimr.com.

Sincerely,

Charlene/LBB

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Senior Editor

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