Environmental Liabilities and Bond Yields

By

Allan Wayne Graham

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John J. Maher, chairman
Robert M. Brown
John A. Brozovsky
Raman Kumar
G. Rodney Thompson

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(ABSTRACT)

Environmental remediation liabilities are generated primarily as a result of past actions by a firm. The most important of these liabilities for domestic U.S. firms are related to Superfund sites as designated by the Environmental Protection Agency (EPA). These liabilities are important for domestic firms because of their size, which is estimated to be approximately $300 billion (Congressional Budget Office 1994) and because of public concern for the environment.

This study examines the relation among bond ratings, bond yields, and EPA-based estimates of contingent environmental remediation liabilities to test if the relationships hold as theory implies it would. Extant theory suggests that financial variables, such as environmental remediation liabilities, have incremental explanatory power beyond the information included in bond ratings for bond yield. The purpose of this study is to determine the importance of external estimates of a firm’s contingent environmental liabilities for a firm’s cost of debt. In addition, the manner in which a firm’s contingent environmental liabilities are included in the costs of debt is examined in this study.

The results of this study indicate that external estimates for environmental liabilities are associated with the bond ratings and bond yield for a data set of new bond issues collected from the period 1995 to 1997. Despite that firms are increasing their recognition of environmental liabilities, either due to regulatory pressure or other factors, the measures based on EPA data still have significant explanatory power. The results imply that firms are either still lagging in appropriate recognition or that the external measures proxy for amounts imputed by the capital markets for some probable unspecified future costs. The latter explanation is supported by additional evidence in this study that the largest monetary measure of the liability is the most significantly associated with bond ratings and bond yields. Further, the results indicate that the external estimates are incorporated in bond ratings as part of the firm's default risk and have no direct influence over bond yield beyond that included in the bond ratings. This implies that bond ratings are particularly important for any evaluation of investment in debt securities from firms that have contingent environmental liabilities.

Dedication

This work is dedicated to my parents, Robert J. Graham and Genelle T. Graham, and to my wife, Debra Skaradzinski. My mother gave me the confidence to undertake important tasks and my father, through his examples, gave me the courage to try new endeavors. Without my parents and Debra's unconditional love and support this project would not have been possible.

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Chapter 1

Introduction

Environmental remediation liabilities are generated primarily as a result of past actions by a firm. The most important of these liabilities for domestic U.S. firms are related to Superfund sites as designated by the Environmental Protection Agency (EPA). These liabilities are important because of their size, which is estimated to be approximately $300 billion (Congressional Budget Office (CBO) 1994) for domestic firms, and also because of public concern for the environment. The liabilities are considered to be contingent liabilities because of the long time period for resolution of responsibility and the difficulty of estimating the likely final outcome for costs. As such, the estimation and disclosure/recording of environmental remediation liabilities are governed by Statement of Financial Accounting Standards number five (SFAS No. 5) which allows management a great deal of discretion when reporting these liabilities.

This study examines the relation among bond ratings, bond yields, and EPA-based estimates of contingent environmental remediation liabilities, to test if the relationships hold as theory implies they would. Extant theory (Ederington, et al. 1987, Ziebart and Reiter 1992) suggests that financial variables, such as environmental remediation liabilities, have incremental explanatory power beyond the information included in bond ratings for bond yield. The purpose of this study is to determine the importance of external estimates of a firm's contingent environmental liabilities with regard to a firm's cost of debt. In addition, the manner in which a firm's contingent environmental liabilities are included in the cost of debt is examined. That is, do contingent environmental liabilities have a direct influence on bond yields, or are they indirectly related to bond yield through an issue's bond rating?

Contingent environmental liabilities are potentially a large part of U.S. firms' liability structure (Congressional Budget Office 1994). These environmental liabilities are pervasive across many industries (Barth and McNichols 1994) and affect nearly 50% of the firms among many of the popular indexes, such as the S & P 500 (Stanny 1998, Mitchell 1997). There is some evidence that externally generated measures of these liabilities based on EPA data are important in the equity markets (Barth and McNichols 1994, Northcut 1995) as well as for bond ratings (Graham, Maher, and Northcut 2000). Environmental Remediation Liabilities exist in a much richer information environment than other contingent liabilities such as lawsuits or product liability claims in that an independent external information source is publicly available for estimation of the likely costs (Campbell, et al. 1998). External measures using EPA data have been used in part because actual firm-provided disclosures concerning contingent environmental liabilities have historically been relatively poor (Gamble, et al. 1995).

The lack of consistent treatment by firms with environmental liabilities has attracted the attention of certain regulatory bodies. In the early 1990s, the Security and Exchange Commission became increasingly active in its monitoring of disclosure practices by publicly listed firms (Stanny 1998, Levitt 1998) and in 1993, issued a staff accounting bulletin (SAB 92) that encouraged better disclosure and recognition of environmental liabilities. Concomitant with the regulatory changes, researchers reported that firms were recognizing the liabilities at increasing rates during the late 1980s and early 1990s (Barth, et al. 1997, Gamble 1995). Two reasons suggested for the better recognition include an increase in political pressures (Walden and Schwartz 1997) and the presence of publicly available external measures (Li, et al. 1997). The external measures reduce the flexibility of a firm's management to withhold information concerning the contingencies from financial statement users.

If external estimates continue to be associated with a firm's cost of capital, even in the face of increasing recognition by firms, then it is reasonable to ask why? Barth and McNichols (1994) argue that estimates generated from external data should be reasonable proxies for the share of costs that the firm will ultimately bear when the contingency has been resolved. On the other hand, Li and McComony (1999) suggest that the capital markets impute additional liabilities over and above what firms have revealed about their liabilities. Capital markets may find an external measure useful even if a firm has fully accounted for its estimated share of *current* environmental liabilities. Future liabilities may not be reasonably estimated by a firm which is a criterion required for accounting recognition/disclosure, yet may be anticipated by the capital markets.

In addition to the influence that external measures of environmental liabilities appear to have on bond ratings, recent studies suggest that a firm's contingent liabilities may have an independent influence on the firm's bond pricing. Disclosure frequency and severity of a firm's contingent liabilities have been shown to be positively associated with risk premiums for a firm's public debt (Backmon and Vickery 1997). In addition, among those firms that issued junk bonds and subsequently went into default, firms with large contingent liabilities stayed in default longer than firms without such liabilities (Helwege 1999).

Given these findings, it is not surprising to expect a relationship between contingent environmental liabilities and bond yields. Yet, the question of how the liabilities affect bond yields is important for determining the role that bond ratings play in capturing the added default risk implied by Helwege (1999) and Backmon and Vickery (1997), and ultimately the value of bond ratings for bond investors. Studies by Ederington, et al. (1986) and Ziebart and Reiter (1992, 1994) have proposed models for measuring the relation between bond ratings and bond yields. These studies have shown that, when included in a model of bond yields, bond ratings appear to have incremental explanatory power over and above the financial variables used to model the bond rating.

Ederington, et al. (1987) suggest that this may be due to the presence of a private information set available to bond raters, and that bond ratings capture additional information over and above that available in financial variables alone. Consequently, bond ratings could be better predicted by including measures that proxy for private information. It is possible that the external measures of contingent environmental liabilities are primarily determinates of default risk as suggested by Helwege (1999). If so, when these variables are included in a model of bond yield with bond ratings, they will have little, if any, incremental explanatory power because they have been fully impounded in the firm's bond rating. If these variables remain significant in a model of bond yields, then as Ederington, et al. (1986) and Ziebart and Reiter (1992) found for other financial variables, the bond ratings will not have fully captured the information the proxies for environmental liabilities provide the debt market.

The results of this study indicate that external estimates for environmental liabilities are positively associated with the bond ratings and bond yields for a data set of new bond issues collected from the period 1995 to 1997. The positive association with bond yield is clear in that, all other things equal, environmental liabilities will be correlated with higher yields. On the other hand, environmental liabilities would seem to be negatively related to bond ratings in that higher liabilities would be related to lower bond ratings. The fact that the relationship between environmental liabilities and bond ratings is positive in this study is due to the coding scheme used, which is consistent with the way that the Compustat database codes the ratings. This rating scheme assigns a value of one for the best rating, AAA, and assigns progressively higher numbers for lower ratings.

Despite that firms are increasing their recognition of environmental liabilities, either due to regulatory pressure or other factors, the measures based on EPA data still contain significant explanatory power. The results imply that firms are either still lagging in appropriate recognition or that the external measures proxy for amounts imputed by the capital markets for some probable unspecified future costs. The latter explanation is supported by evidence in this study that the largest monetary measure of the liability is more highly associated with bond ratings and bond yields than the smaller measures are. Throughout the analysis described here, two estimates are consistently found to be the most important. The first is simply the number of notice letters that the firm has received over the course of the EPA's Superfund program. The second is largest dollar estimate, which assumes that the firm will bear the entire costs of each site on which it has been named as a potentially responsible party (PRP).

Further, the results indicate that the external estimates are incorporated in bond ratings as part of the firm's default risk and have no direct influence on bond yields beyond that impounded in the bond ratings. When bond ratings are included in the bond yield model with the external estimates of a firm's contingent environmental liabilities, the external estimates provide no incremental explanatory power with respect to bond yields. This implies that bond ratings are particularly important for any evaluation of investment in debt securities issued by firms that have contingent environmental liabilities.

The rest of this paper is organized as follows. Chapter 2 includes a synopsis of the EPA's Superfund program, which is the primary environmental liability generating mechanism for U.S. firms, and a brief overview of the current environmental liability accounting issues facing the firm. Chapter 2 also includes a literature review of relevant studies concerning environmental liabilities, bond ratings, and bond yields. Chapter 3 states and discusses the hypotheses developed within the literature review. Chapter 4 describes the models and variables employed. Chapter 5 presents the empirical results as well as the analysis of the results. Chapter 6 concludes with the contributions and limitations of this research.

Chapter 2

Literature Review and Current Accounting for Environmental Liabilities

The purpose of this chapter is primarily to review prior literature on the research streams important to this study, which includes environmental liabilities and bond ratings/bond yield research. A secondary purpose is to provide a background of the EPA's Superfund program and a review of the current accounting treatment for environmental liabilities. Included with the review of research regarding bond ratings/bond yield is a summary of innovations in the bond markets that occurred prior to and during the sample period.

These innovations necessitate the inclusion of some additional control variables in order to adequately model the bond yields. The innovations include Rule 144A private placements that actually function much like regular public debt. Other innovations include an increased use of put options for bond offerings, and make-whole provisions that are similar to call options for bonds. Each of these is discussed and relevant research on them is reviewed.

The primary research areas associated with this study include the influence of financial variables, including contingent liabilities, on bond ratings and bond yields. Relevant literature in regards to both bond ratings and bond yields is summarized for the purpose of developing the hypotheses that this study examines and for developing the models that are used to test the hypotheses. This chapter concludes with a synthesis of the research streams and the implications for the examination of environmental liabilities and bond yields.

2.1 Overview of Accounting for Environmental Liabilities

2.1.1 The Superfund Program

Concern over the quality of air and water was evident as early as the 1950s and culminated in 1970 with the creation of the Environmental Protection Agency (EPA) and the passage of the Clean Air Act. Over the course of the next three decades, a number of legislative acts and amendments have increased the impact of environmental legislation. These include the Clean Water Act, the Federal Environmental Pesticide Control Act, Toxic Substances Control Act, the Resource Conservation and Recovery Act (RCRA), and the National Environmental Policy Act (NEPA). The NEPA act created the requirement for Environmental Impact Statements. Some of these acts were in response to specific events. For instance, the main impetus for the Comprehensive Environmental Response, Compensation, and Liability Act or CERCLA (1980) came from the scandal over the Love Canal environmental disaster (CBO 1994). While all of these regulations may imply substantial costs for firms, either from the firm's past actions or future intentions, this study is restricted to the Superfund liabilities created by CERCLA.

The focus is placed on Superfund related liabilities because the EPA provides publicly available data which permits estimates to be made of a firm's contingent liability. Superfund was created as a method of remediating toxic waste contamination from various sites around the country. It is but one of a number of environmental regulatory legislative acts that may generate future expenditures for firms and so should not be seen as the only liability-generating governmental regulation. The EPA estimates the annual total of all domestic environmental expenditures to be $60 billion a year (EPA 1991). The cleanup of identified Superfund sites alone has been estimated to be between $224 (CBO 1994) to $704 billion (Russell et. al 1992). The cleanup will affect a broad range of firms with roughly 24,000 potentially responsible parties (PRPs) identified at approximately 1300 sites (CBO 1994).

Superfund liabilities represent a significant portion of total environmental costs and often involve publicly listed firms. Barth and McNichols (1994) found 1,496 PRP's on the Compustat database in a broad range of SIC codes, and Stanny (1998), with a sample restricted to non-financial firms identified as PRP's on at least three Superfund sites, generated a sample of 199 firms out of the S&P 500. In Mitchell's (1997) sample from the Fortune 300 firms, the average liability for firms listed as a PRP ranged from $892 million (maximum possible liability assuming one PRP suffered the entire estimated cost of remediating a site) to $33 million (pro rata liability among all firms listed at a site).

Superfund, originally created as a part of CERCLA and later revised by the Superfund Amendments and Reauthorization Act of 1986 (SARA), is actually the third of four interrelated parts of the act. The first part calls for the identification of waste sites and toxic substances and is characterized by listing of sites on a National Priority List (NPL). The second part authorizes the federal administration to respond to the need for emergency clean-ups as either a removal action (short-term) or a remedial action (long-term). This requires the EPA, through the powers of the office of the President of the United States, to utilize a Hazard Ranking System to add sites to the NPL. The third part creates the actual Superfund that is comprised of direct appropriations and special fees for firms in certain industries. The reserve funds from Superfund, currently in excess of $16 billion, are to be used only as a last resort when no responsible parties can be found that are financially able to cover the estimated costs.

The fourth, and most critical part of the act, calls for the identification of responsible parties who will be held liable for costs of removal and remediation and for damages to natural resources. Provisions of the act specify that the liability is retroactive. This means that any past action, irrespective of whether or not the action was in compliance with then existing laws or regulations, can generate liability. A related act, the Resource Conservation and Recovery Act, uses the term "cradle-to-grave" as the length of time a firm may be responsible for toxic waste. Courts have held that the liability imposed under CERCLA is "strict", meaning that no negligence is required for damages, only involvement at a site as a generator, transporter, owner, or operator. Additionally, courts have held that the liability is "joint and several", meaning that any named responsible party may be liable for the total damages at the site.

After a site is added to the National Priority List and responsible parties have been identified, several steps are taken to accomplish the cleanup. First, either the EPA or one of the PRP's completes a remedial investigation and feasibility study (RI/FS). Using the study, the EPA chooses a remediation method. This choice results in the issuance of a Record of Decision (ROD), which includes an estimate of the capital costs required to clean-up the site and, if necessary, an estimate of any on-going operating and maintenance costs. The Record of Decision is usually the first publicly available estimate of the extent of the liability. The final steps in the process include the remediation design and the actual capital expenditure for cleanup.

After the issuance of the Record of Decision, the EPA and the PRP's may engage in a long process of litigation before any actual cleanup occurs. A study by the Congressional Budget Office reported that as of 1992 only 149 of the 1,275 NPL sites had completed substantially all work related to the cleanup remedies, and just 40 had been declared completed. The Congressional Budget Office also estimates that the average time between being listed as an NPL site and complete cleanup is approximately twelve years. Part of the high costs of handling toxic waste sites is related to transaction costs, which include legal and administrative costs by the EPA, the PRPs and their insurers. Dixon (1994) estimated in a Rand study that the transaction costs average between 23 and 31 percent of total cleanup costs.

To avoid the transaction costs and to speed the process of remediation, the EPA may engage in settlements with PRP's. Small liability settlements are called "de minimis" settlements. Due to strengthened enforcement provisions in SARA passed in 1986, the EPA has a greater ability to demand settlements as a first alternative (EPA 1991). As a result, settlements have been reached at a larger portion of the NPL than the number of completed Record of Decisions (Northcut 1997). Whether a Record of Decision or a partial settlement results from the enforcement activities of the EPA, either event is a compelling benchmark for the recognition of an impending liability. This study utilizes Record of Decision (ROD) data from the EPA to measure for value relevance in new issue bond ratings and yields.

2.1.2 Current Accounting Practice for Environmental Liabilities

Current accounting treatment for environmental liabilities is governed primarily by SFAS No. 5, *Accounting for Contingencies* (FASB 1975). Statement No. 5 requires that a loss be both probable and estimable before accrual is necessary. If only one of the conditions is met, disclosure must still be made in the notes to the financial statements. Managers have argued that there are many difficulties involved in estimating the probability of occurrence and the eventual costs of the impending environmental liability. Consequently, a great deal of managerial discretion is exercised in the recognition of these liabilities. Several rulings subsequent to SFAS No. 5 by the FASB and related regulatory bodies, including the Securities and Exchange Commission and the American Institute of Certified Public Accountants, have partially circumscribed this discretion.

Closely following SFAS No. 5, the FASB issued FASB Interpretation No. 14 (FIN 14), *Reasonable Estimation of the Amount of a Loss* (1976), to recognize that some liabilities may be estimable only as a range of possible losses and not a specific value. FIN 14 provides that if a loss can only be estimated as a range of possibilities, and one amount is a better estimate than any other in the range, then that amount should be accrued. If no amount is any better than any other in the range, then the minimum of the range can be used for disclosure or accrual. This provision has direct applicability to several measures used in this study to assess Superfund site liability in which site specific liability is divided among PRPs.

Since 1989, three Emerging Issues Task Force (EITF) consensus positions, 89-13, 90-8, and 93-5 have addressed issues related to environmental liabilities. Both EITF Issue 90-8, *Capitalization of Costs to Treat Environmental Contamination* and EITF Issue 89-13, *Accounting for the Cost of Asbestos Removal*, limit the practice of capitalizing environmental remediation costs to specific situations which generally do not hold for Superfund site liabilities. EITF Issue 93-5, *Accounting for Environmental Liabilities,* deals with two issues that have caused variation in reported environmental liabilities. First, firms would often net the estimated loss from an environmental liability with expected recoveries from insurers or expected recoveries from other PRP's. Second, firms would sometimes discount the expected outflows to recognize the time value of money. The consensus position was that firms could offset the expected losses with a potential recovery "only when the claim for recovery is probable of realization" (FASB, 1993). The FASB further stated that discounting the future loss is only appropriate when the future liabilities are fixed and verifiable. Consequently, if a loss is estimated from a range of possible losses per FIN No. 14 above, no discounting is appropriate. An SEC official serving as a member of the task force noted that, for public registrants, even if losses are offset with known recoveries, the gross amounts of the loss and recovery must be reported in the notes to the financial statements.

Prior to 1994, firms commonly offset contingent liabilities with anticipated insurance recoveries. Late in 1993, the FASB issued Interpretation No. 39, *Offsetting of Amounts Related to Certain Contracts*, which severely limited the practice of offsetting. The restriction, as recognized by concurrent rulings of the SEC with their issuance of Staff Accounting Bulletin No. 92 (SAB 92), effectively eliminated the practice. Even before the stricter rules for offsetting began to take effect, changes in the availability of future and past insurance coverage for environmental remediation was being curtailed by the insurance industry and thus, offsetting may not be as applicable (Kimble 1991, Reich and Kaplan 1991, Cole 1992).

The two most important additions to GAAP after SFAS No. 5 relating to the accounting treatment of environmental liabilities are Staff Accounting Bulletin No. 92, *Accounting and Disclosures Relating to Loss Contingencies*, issued by the Security and Exchange Commission in 1993, and Statement of Position No. 96-1 , *Environmental Remediation Liabilities*, issued by the American Institute of Certified Public Accountants (AICPA) in 1996. Both of these pronouncements try to provide some guidance in an area characterized by diverse current disclosure practices and "uncertainty regarding the alternative methods of presenting in the balance sheet the amounts recognized as contingent liabilities" (SEC, SAB No. 92). SAB No. 92 is intended to address questions of disclosure practices for public companies and the AICPA's SOP No. 96-1 is intended to summarize current authoritative literature and to provide audit guidance.

SAB No. 92 summarizes accounting treatment available under the FASB's SFAS No. 5, EITF No. 93-5, FINs 14 and 39, and gives interpretative responses to unclear issues in each. In addition, SAB No. 92 specifies the types of information necessary for complete disclosure in the notes and in the Management Discussion and Analysis section of the financial statements. The SEC warns registrants that stating that the contingent liability is not expected to be material will not satisfy the requirements of SFAS No 5. If there is at least a reasonable possibility that a loss exceeding amounts already recognized may have been incurred, and the amount of that additional loss would be material to a decision to buy or sell the registrant's securities, then a disclosure should be made. The SEC's interpretation of materiality may be set at a lower threshold in order to combat the perceived under reporting of environmental liabilities (Kolins and Jones 1994). In addition, the SEC receives information on a regular basis from the EPA concerning notice letters and impending litigation in order to verify the disclosures by those firms registered as public companies.

Unfortunately, many of the recommendations contained in SOP 96-1 and SAB No. 92 are small advances in, or interpretations of, a still vague authority, SFAS No. 5. As noted below, the issuance of SAB No.92 has had an effect on the number of disclosures by firms with environmental liabilities, although the substance of the recognition is yet to be determined with regard to the amount and size of accruals that firms make. Likewise, no studies have been done with regard to the effectiveness of SOP No. 96-1. Some researchers (Gamble, et. al., 1995) have argued that the issue requires a comprehensive statement from the FASB for resolution.

Studies by several groups outside the accounting regulatory process have shed light on the extent of disclosure and accrual for environmental liabilities, and generally on attitudes of firms towards environmental regulations. Price Waterhouse has done repeated surveys of large U.S. corporations to determine their practices in the area of accounting for environmental liabilities. A 1992 Price Waterhouse survey reports that 62% of respondents had known liabilities that were not yet recorded in their financial statements. The event that prompted most respondents to record a liability was the feasibility study (RI/FS) or a settlement offer. A smaller percentage (15%) waited to expense the costs as cleanup progressed. A 1994 Price Waterhouse follow-up survey finds a reduction in the variability of accounting practices and that respondents reported an increase in the amount of discussion of environmental policies in their financial statements. Price Waterhouse states that this is most likely due to the issuance of EITF No. 93-5 and SAB 92 which discourage or prohibit practices such as offsetting liabilities against potential recoveries and discounting estimated future costs, and encourage a more complete reporting of contingent environmental liabilities.

2.2 Literature review

2.2.1 Information and Disclosure

A large volume of accounting and finance literature focuses on information asymmetries (see Myers and Majluf 1984) which creates an expectation that a firm's management has information that is not disclosed. In order for bond ratings to be useful, bond-rating agencies have a large incentive to access private information that management may hold, to better rate the default risk of the firm. Bond-rating prediction models used by Ederington, et al. (1987) and Ziebart and Reiter (1992) confirm that bond ratings supply information not available from financial variables. This implies that some information impounded in bond ratings is not available in the reported accounting numbers, or perhaps even in qualitative disclosures included in the annual report. Ederington, et al. (1987) surmise that while two-thirds of a bond rating can be explained by a few publicly available accounting numbers, the other one-third may represent private information. Indeed, an examination of publications by Standard and Poors indicates that confidential information is used to make a bond rating decision:

> "**Confidentiality:** A substantial portion of the information set forth in company presentations is highly sensitive and is provided by the issuer to Standard & Poor's solely for the purpose of arriving at ratings. Such information is kept strictly confidential by the ratings group. Even if the assigned rating is subsequently made public, any rationales or other information that Standard & Poor's publishes about the company will only refer to publicly available corporate information." (Standard & Poor's *Corporate Ratings Criteria* (1998) p. 12.)

Several recent studies have considered levels of disclosure quality by using either empirical or analytical methods (Botosan 1997, Sengupta 1998, Penno 1997). Other studies have examined disclosures of environmentally related information (Barth, McNichols, and Wilson 1997, Blaconierre and Northcut 1997, Blaconierre and Patten 1994, Freedman and Jaggi 1996, Li, et al. 1997). Additionally, recent studies have investigated how managers voluntarily disclose information, and the relation between those disclosures and information quality (Penno 1997, Jung and Kwon 1988, Verrecchia 1990).

Li, et al. (1997) present an analytical model that predicts that firms with good news (low relative liability) will disclose and firms with bad news (high relative liability) will withhold disclosures about environmental liabilities. They attribute this tendency to the level of inherent uncertainty involved with contingent liabilities, which allows managers to withhold disclosures without penalty. They posit that if external information is available, managers will have a decreased ability to withhold disclosure. Regarding this study, because an external measure exists and is publicly available, disclosure levels should be closer to their true value as determined by management.

Likewise, if firms have poor disclosures concerning an important contingent liability, such as environmental remediation liabilities, then the market will search for and utilize external measures of the liability, if they are available. Barth and McNichols (1994) determine that Environmental Protection Agency (EPA) estimates of the liabilities are value relevant for the equity markets. Graham, Maher, and Northcut (2000) find a similar set of measures to be important for bond raters for a sample from 1990-1992. Indeed, bond raters claim to use many sources of information for making a determination of default risk for the firm including quality of disclosure, publicly available financial data, and confidential information provided by the firm's management. Additional research (Blacconiere and Northcut 1997, Campbell, et al. 1998) indicates that external estimates and firm disclosures are related through an interaction effect. That is, disclosure, measured by the presence or absence of a few key items related to environmental costs, leads to a lower reliance on the external measure. In the case of Superfund legislation, more disclosure leads to a less negative market reaction to the legislation.

Blacconiere and Northcut (1997) look at a specific event (i.e., the passage of the Superfund Amendments and Reauthorization Act (SARA) of 1986) and its effect on equity values. The authors use an event study instead of a balance sheet valuation model approach that many of the previous studies have used. They examine two hypotheses. First, firms with more extensive environmental disclosures are expected to have a less negative market reaction to the legislation (as an extension of Blacconniere and Patten

(1994) below). Secondly, firms with higher future costs, as measured by EPA RODs database estimates, are expected to have a more negative market reaction. Using a sample of 72 chemical firms, the authors find some support for the hypothesis that firms with more extensive disclosures experienced a less negative market reaction. The authors state that this suggests that investors see these more extensive disclosures as a positive sign of the firm's strategy in managing environmental risk related to Superfund exposure.

Barth, et al. (1997) found that firms disclose more when they have environmental liability estimates at less than the industry median and that firms that are higher than the industry median disclose relatively less. Barth, et al. (1997) also found that firms with environmental liabilities tend to disclose more as the size of the liability increases. In addition, firms accessing the capital markets appear to disclose more. Their findings seem somewhat contradictory, especially when compared to Blacconiere and Northcut's (1997) findings that disclosure content is negatively related to external environmental liability estimates.

Kennedy, Mitchell, and Sefcik (1998) suggest that financial statement user's estimates of environmental liabilities are anchored by the estimates that management provides. In particular, their results suggest that management should disclose only the minimum estimate because users tend to understate the possible distribution of potential losses when given the minimum estimate as a disclosure. This indicates that users can be highly influenced by the actual disclosures that management makes, irrespective of independent information estimates.

Outside information from government sources has a non-zero cost (Campbell et.al 1995) and can be difficult to analyze. More detailed financial information from outside sources tends to be only rough estimates that are site specific, not firm specific. In addition, much of the information from investor groups like the Investors Research and Responsibility Center (Lancaster 1998) that is typically considered a source of publicly available information actually comes from the firm's own disclosures, not outside estimates.

A recent paper by Holland (1998) examined the relationship of privately revealed information to the annual report. Holland conducted interviews with thirty large UK firms on their communication of private information with their large institutional investors. In his interviews he asked the respondents to compare the information they share with their large institutional investors to the information contained in their annual reports. He identified several reasons why the two information sets differed, including the limitations of current requirements for public disclosure, and the desire of institutional investors to know important information before it is revealed in public. This is, of course, constrained by the prohibition on releasing price sensitive information in private settings.

Freedman and Jaggi (1996) showed that the use of outside information is especially important for certain industries. Using data from 1979-1987, they found no association between environmental disclosures and environmental performance for firms in the utility industry, and a negative association between environmental disclosure and environmental performance for firms in the pulp and paper industry. Freedman and Jaggi suggest that their evidence supports arguments for mandated disclosure requirements for environmental liabilities.

Neu, et. al. (1998) examined how firms attempt to manage public perceptions with discretionary environmental disclosures. Neu, et al. (1998) did not measure environmental disclosure quality per se, but measured the level of environmental disclosures by counting the number of words in relevant environmental disclosures contained in the annual reports of Canadian firms. They found that firms increased their disclosures during unprofitable years but that the firms did not change their level of disclosure when the firm's debt/equity ratio changed. They conclude that environmental disclosures seem to be more important for the equity markets than for debt markets.

Stanny (1998) illustrates the frequency and level of disclosure of environmental liabilities by S & P 500 firms before and after the issuance of SAB 92 by the SEC in June 1993. She finds that disclosures increased significantly after the issuance of SAB 92, although the total amount of liability disclosed was not a large percentage of total assets of the 199 sample firms. Interestingly, even though she restricted her sample to firms that had been named as PRPs on at least three Superfund sites, 120 of the firms had not disclosed any liability during the sample period 1991-1993. This period encompassed reporting years both before and after the issuance of SAB 92.

Gamble, et. al. (1995) look at environmental disclosures in annual reports and 10Ks and find that overall environmental disclosures are low in quality. Despite this the number of firms disclosing environmental information increased significantly during their sample period of 1986 -1991. While the overall average quality was low, some industries had reasonably high quality disclosures, including petroleum refining, hazardous waste management, and steel works and blast furnaces (3 out of 12 studied). Gamble et. al. (1995) speculate that the reasons for increased disclosures over the sample period were probably due to various accounting regulatory events like the release of EITF consensus no. 89-13 and no. 90-8, increased public concern over major catastrophes like the Exxon *Valdez* oil spill, and the announcement of CERES's (Coalition for Environmental Responsible Economies) *Valdez* principles. The authors summarize their findings by stating that their results show disclosures are generally inadequate to allow stakeholders to make informed decisions regarding the average firm's environmental position. More importantly, the differences found in the quality of disclosures indicate a lack of consistency, which Gamble, et al. conclude can only be achieved by regulatory mandates.

Walden and Schwartz (1997) show that firms in the four industries they examined increased their levels of disclosure over the period 1988-1990. They contend that firms were responding to public policy pressure in the wake of the Exxon *Valdez* oil spill. They measure the disclosures in two ways that included content analysis and a quantity measure of disclosure. They surmise that firms will only disclose financial information if required by regulation or under public policy pressure. This position is consistent with Li, et al. (1997) who show analytically, that firms will have poor disclosure in an information state characterized by asymmetry, and that firms will tend to disclose more when external estimates are available.

The determinants of environmental disclosures for the period 1986 to 1993 are the focus of a study by Cormier and Magnan (1999). They find that disclosure levels are increasing for the period and that the disclosures increase across all industries in their sample. They show that firms that have recently issued equity have higher disclosure, firms with higher return on assets (ROA) and lower leverage disclose more, and that better environmental performance is positively associated with environmental disclosures. In essence, financially healthy firms that access the capital markets and have good news concerning their environmental performance disclose more.

Ely and Stanny (1999) find that firms with high analyst following disclose more information, and more specific information, than do firms with low analyst following. They surmise that firms with low analyst following and a low proportion of institutional ownership have less sophisticated investors. These firms have an incentive to disclose less about their PRP status in their annual reports because Ely and Stanny (1999) show that firms that disclose less have a less negative impact on their firm value vis-à-vis firms that disclose relatively more.

Daley and Schuler (1999) use a 1994 sample of some severe polluters as evidenced by the firm's receipt of an EPA sanction for violations of the Clean Water Act or the Clean Air Act. They find that firms that receive such a sanction rarely disclose the information in subsequent 10-ks. Their findings confirm Freedman and Stagliano (1998) and others that find that disclosure is not necessarily correlated with poor environmental performance.

In summary, studies of disclosures have found that disclosure of contingent environmental liabilities is increasing over the period of the early 80s to the early 90s, due in part to a stiffer regulatory environment. Some studies have found that as a firm's liabilities increase, the firm discloses more (Barth, et al. 1997), while other studies show that firms may not disclose much, if any, information about recent environmental problems (Cormier and Magnan 1999, Daley and Schuler 1999). Other studies have found that firms have incentives to disclose less (or at the low end of compliance) (Ely and Stanny 1999, Barth, et al. 1997, Kennedy, et al. 1998). On the other hand, studies have found that firms have incentives to disclose more when public policy pressures are high (Walden and Schwartz 1997); when the firm is accessing the capital markets (Barth, et al. 1997, Frankel, et al. 1995, Cormier and Magnan 1999); and when the availability of external information makes the costs of withholding information higher (Li, et al. 1997).

2.2.2 Empirical evidence concerning the effect of numerical estimates of environmental contingent liabilities on firm value

Evidence of the importance of environmental liabilities to corporate stakeholders has been limited by the inability to pinpoint an event window for a traditional event study. Barth and McNichols (1994) use an association test to measure the impact of estimates of the liabilities on shareholder wealth. Their results are difficult to interpret due to their finding that the most important measure was simply the number of times that a firm had been named as a potentially responsible party (PRP) at a Superfund site. Nonetheless, the 1,496 PRPs that Barth and McNichols (1994) find among firms listed on the Compustat database indicate that the incidence of being named as a PRP is widespread. In other samples, Mitchell (1997) finds that over half of the Fortune 300 are listed as potentially responsible parties at some site in the U.S., and Stanny (1998) finds a similar proportion among the S&P 500.

Barth and McNichols (1994) attempt to develop estimates of the environmental liabilities for firms named as a PRP by the Environmental Protection Agency (EPA) from information provided by government agencies and consultants. They reason that if site-specific value-relevant estimates can be formed with outside information, then the firm should be able to make reliable estimates with admittedly better (private) information. Their self-generated estimates are only weakly relevant, but the use of different specifications of the EPA site-specific estimates are significantly related to firm value.

Barth and McNichols (1994) also find that proxies for liabilities based on the ROD (record of decision) information are impounded in the share prices by investors even though the firm has not formally accrued the liabilities. The authors regress market value of shares outstanding against total assets and liabilities (including the fair value of pension plan assets and accumulated pension benefit obligations) and a proxy for environmental liabilities. The authors also use a long-run accumulated abnormal return model to show that the market impounds the information about environmental liabilities over time, generally over a three-year period. Interestingly, of the various proxies for environmental liability they test, a simple measure of the number of times a firm is named as a PRP provides as much explanatory power as more specific dollar-based measures from the ROD data. The authors suggest that this means their measures are either crude or noisy, and that either explanation is just as plausible.

Northcut (1997) attempts to provide additional evidence for a determination of which explanation discussed by Barth and McNichols (1994) is most plausible. Because a finding that the measures are noisy would imply that the measures are irrelevant, firms may argue that disclosure is not necessary. On the other hand, a finding that the measures are crude would imply that investors are using the measures as proxies for environmental liabilities, which help determine firm value. To test this idea, Northcut (1997) uses additional data from the EPA's settlement database which is more definite (and therefore less noisy) than ROD data because it is comprised of negotiated settlements between the EPA and PRPs. Because the settlement data is more extensive (72.5 % of sites have settlement data vs. 58.1% for ROD data) there is less need to estimate cleanup costs as Barth and McNichols (1994) did in their study. Northcut (1997) finds that the settlement data did not increase the explanatory power of valuation models in the year that the firms are notified as PRP's. He concludes that this is a sign that Barth and McNichols (1994) measures are crude and not noisy.

Holthausen (1994) comments on the Barth and McNichols (1994) study and calls into question the strength of the findings. The model employed by Barth and McNichols (1994), and others in similar studies, is based on regressing the firm's market value of equity against total assets, total liabilities and other control variables. Variables of interest such as environmental liabilities are then introduced into the model. If the environmental variables are value relevant, they will have significant negative coefficients indicating an unaccrued (undisclosed) cost. Holthausen believes the model is mis-specified. He demonstrates that even if the sample firms recognize all environmental liabilities correctly, the model will still show value relevance based on the tests employed.

Graham, Maher, and Northcut (2000) utilize a bond rating model with new bond issues and find that similar variables provided from EPA estimates are important determinants in the bond rating process for those firms with environmental liabilities. The authors use industry dummies, which are not typically included in bond rating models, because industry membership appears to be important to bond raters (S&P 1998). Their results also include an increase in classification power from 60 % for the base model to over 75% for a bond rating model incorporating environmental estimates and industry dummies.

Cormier and Magnan (1997) find that poor performance on a corporate pollution measure (based on water pollution) devised by the authors is negatively related to the firm's stock market valuation. They construe this as an assignment by the market of an implicit environmental liability for the firm. Cormier and Magnan's (1997) sample included Canadian firms in four industries: pulp and paper, chemicals, metals and mining, and oil refiners, and the pollution measure was based on waste-water discharges. Stock market valuation was determined by using an accounting based measure of market value similar to Barth and McNichol's (1994) model. The results of Cormier and Magnan (1997) suggest that the link between amounts of pollution and market value is that pollution in the current period will result in increased fines and other costs in the future. By polluting today, a firm is reducing future discretionary cash flows and, therefore, the market impounds a penalty for poor environmental management.

Blacconiere and Patten (1994) examine intra-industry reactions to a catastrophic environmental event (the chemical leak in Bhopal, India) and find that there was a significant negative intra-industry market reaction. Further, they find that firms with prior extensive environmental disclosures fared less badly than firms with less extensive or no prior environmental disclosure. Using a sample of 47 chemical firms, the authors perform an event study measuring cumulative-abnormal returns around the event date. The authors then regress the resulting CARs against the ratio of chemical segment revenues to total firm revenues and a variable describing a firm-specific environmental disclosure content rating. The authors suggest that a reasonable explanation for the finding that firms with more extensive environmental disclosures experienced a less negative response is that, if firms tend to disclose only "good news" and suppress "bad news," then investors may see prior disclosures as a positive signal concerning a firm's exposure.

Northcut (1995) examines the explanatory power of firms' EPA based liabilities (RODs) and disclosures rated on a scale of one to seven based on extensiveness. Using a balance sheet valuation model similar to Barth and McNichols (1994), Northcut finds that the EPA based estimates of liability and the level of disclosure are negatively related to firm value. In addition, he examines the determinants of individual firm's environmental accrual provisions when the firm has Superfund liabilities as expressed in EPA data. He finds that several factors influence a firm's provision for environmental liabilities. These include managerial incentives to satisfy implicit claims by stakeholders, debt covenants, the complexity of Superfund site conditions, and the likelihood of obtaining insurance coverage. The last factor is represented by a dummy variable based on the state in which site is located.

As stated before, generally the study of environmental liabilities does not lend itself to event studies because the liabilities accrete slowly. In the case where some dramatic ecological event does occur, studies have been done that attempt to show abnormal returns associated with environmental liabilities. These include attempts to capture the market reaction to an environmental disaster (Blacconiere and Patten 1994), legislative changes (Blacconiere and Northcut 1997), the announcement of a hazardous waste lawsuit (Little, et al. 1995) or being named as a PRP (Harper and Adams 1996).

Harper and Adams (1996) show that for an eleven day event window (the notice day and ten days after) around the issuance of PRP notices, firms suffer a negative abnormal return. Further, they include a proxy for the deep-pockets hypothesis where only publicly traded firms share the costs and find that the market does penalize larger, publicly traded firms more than other PRP's. In their study covering the period from 1980-1990, the effect is only present in the mid-80s. They surmise that one of two explanations is possible for the absence of an effect in other parts of their sample period. One possibility is that the EPA may have become more adept at identifying PRP's at a particular site. This spreads the costs among more parties, and therefore the deep pockets effect is diminished. Alternately, the incremental effect of an additional site is no longer important to the total liability of a firm because a large percentage of the firms that are likely to be named as a PRP have been named multiple times. Nonetheless, their results lend support to examining variables that proxy for a deep-pockets effect.

Garber and Hammitt (1998) look at the effect of Superfund liability on the costs of capital. They concentrate primarily on the costs of equity capital, and restrict their investigation to the chemical industry in the period 1983-1992. They find that the larger firms tend to be much more affected by liability estimates constructed from notification data (SETS) than smaller firms. They measure the effects using a CAPM approach to estimate the affected firm's equity beta, and find that equity betas are affected by exposure of the firm to environmental liability risk. They consider a firm's total costs of capital, which includes changes in a firm's market value of debt. Their study is hampered by the absence of site-specific dollar estimates of the liabilities, subsequently they resort to average estimates of cleanup costs similar to Barth and McNichols (1994). As in Barth and McNichols (1994), Garber and Hammitt (1998) find their average site-specific estimates have little explanatory power, whereas being named as a PRP is significantly associated with an increase in equity beta.

Results from Little, et al. (1995) indicate that the equity markets react in a negative way when hazardous waste lawsuits are filed by the EPA against firms with potential liability at a particular site. The authors examine the firm's financial statement disclosures to see if the firm reported the possible contingent loss to users of the annual report. They find the link to be nonexistent between negative market reactions to environmental hazard lawsuits and subsequent financial statement disclosure about those issues. Further, their findings suggest that the larger the negative abnormal return, the smaller the probability of subsequent disclosure in the annual report. In such an information environment, it is reasonable to assume that external information would be highly valued by the financial markets, and that the associations found in prior research between external estimates and firm value or bond ratings are valid.

The question of how to allocate the external estimates of site remediation is examined in a number of studies including Barth and McNichols (1994). Barth and McNichols use several proxies that have gained acceptance among subsequent studies, and those proxies are used in this study as well. One issue discussed by Barth and McNichols is that irrespective of the statistical significance of the competing allocation schemes, the measures need to be logical, i.e., a firm would reasonably be expected to shoulder the burden implied by the measure. A recent study completed by Li and McConomy (1999) suggests that this may not be necessary in all situations.

Li and McConomy (1999) investigate the adoption of new environmental remediation accounting standards for the Canadian mining and natural resource industries. They find that firms that are raising capital and firms audited by a "Big 6" audit firm are more likely to adopt the new standards early. Their findings also suggest that investors value the disclosures that firms make at more than face value, such that the market considers the disclosures to be indicators of future remediation costs. This could explain why studies such as Graham, Maher, and Northcut (2000) find that the largest estimates are the most statistically significant ones. These large estimates could be proxies for the market's expectation about current and future environmental liabilities combined. With regard to the current study, because all firms in the sample are accessing the capital markets, these firms should have greater than average disclosure about their environmental liability. Because disclosure is relatively higher, the externally generated measures should have lower power according to Li et al. (1997). Hence finding an association between the EPA based measures and bond yields should become more difficult.

2.2.3 Studies examining joint effects between Bond Yields and Bond Ratings

The relation between accounting information and the cost of capital is an important question that has been examined in many ways. Particularly relevant for this study is literature that examines bond yields and bond ratings in combination with accounting variables to answer questions related to the cost of capital. The studies reviewed in the sections to follow either relate to the concept of the interaction of bond ratings and bond yields or help establish the usefulness of the variables and models chosen to form the basis of the tests performed in this study.

Ederington, et. al. (1987) and Ziebart and Reiter (1992) find that bond ratings have incremental explanatory power for bond yields beyond the disclosed accounting information normally used to model the ratings. They believe this indicates that the bond ratings contain some non-observable information about the default risk of the firm. If this is true, then attempting to explain the cost of capital with only disclosed quantitative information may miss an important part of the firm-specific risk that helps determine the ratings, and ultimately influences the price of debt.

A major issue when evaluating accounting information's impact on debt markets is whether or not the accounting numbers have meaning for the pricing of debt over and above that incorporated in the bond rating. Ziebart and Reiter (1991, 1992) have shown that accounting numbers have both direct and indirect effects on bond yields. The financial information has indirect effects on bond yields through the bond ratings and separate direct effects beyond the information's effect on bond ratings. Ederington, et al. (1987) have similar findings and conclude that bond ratings do appear to have information content beyond the accounting numbers and economic information included in models of bond yield. One interesting difference between Ziebart and Reiter (1992) and Ederington, et al. (1987) is that Ziebart and Reiter (1992) found that when Moody's ratings were used, the financial variables did not contribute additional explanatory power. They surmise that Moody's ratings more fully impound the information content of the financial statements.

Two studies with similar findings (Hand, et al. 1992, Lui, et al. 1999) both show that changes in bond ratings by the two large rating agencies have an effect on stock prices and bond prices. Hand, et al. (1992) look at upgrades and downgrades by Moody's and S&P for outstanding bond issues. They find that both stock prices and bond prices are affected when changes in rating occur but that downgrades have a much larger impact. The link these authors establish between bond yields, bond ratings, and equity values suggest that it is important to determine the joint and separate effects of large liabilities, such as environmental remediation costs.

Lui, et al. (1999) focus on the expansion of ratings categories by Moody's in 1982 that resulted in three levels of ratings within each rating category (Baa1, Baa2, Baa3, etc.). They find that bond returns are affected by the assignment of additional rating qualifiers. They surmise that, just as in Holthausen and Leftwich (1986), Hand, et al. (1992), and Ederington, et al. (1987), bond ratings appear to have information content beyond the financial statement information released by the firms themselves. This supports the bond raters claims that their service has value.

Sengupta (1998) uses a proxy for disclosure quality from the Financial Analyst Federation (FAF), which is a branch of the Association for Investment Management (AMIR). The FAF rates between 400-500 firms each year on overall disclosure quality. Sengupta regresses the disclosure rating and control variables against two measures of the cost of debt: yield to maturity (the most typical measure), and a measure of total interest costs that includes both the interest cost to bondholders and underwriters. He finds that overall disclosure quality as defined by the FAF is an important determinant for both bond ratings and bond yields although he does not make a distinction between direct and indirect effects of the disclosures.

2.2.4 Bond yields and Contingent Liabilities

Contingent liabilities have particular importance for the debt markets. Helwege (1999) looks at the length of time junk bonds spend in default. He examines a number of factors including bondholder holdouts, firm value and proxies for information problems. Helwege finds that two of the most important indicators of time spent in default are firm size and the presence of contingent liabilities. For contingent liabilities, Helwege includes pension liabilities and environmental liabilities among others, but treats lawsuits as a separate indicator variable. Because of limited sample size, he makes no distinction between these possible contingencies but nonetheless finds that the presence of contingencies significantly extends the time that the defaulting firms spend in default. The findings suggest that uncertainty over competing creditors claims forces the defaulting firm to negotiate the values of the claims among the creditors and achieve some acceptable valuation for the contingencies. The importance of contingent liabilities for junk bond defaults implies that classes of contingent claims, like environmental remediation liabilities, should be important for all public debt issues.

Backmon and Vickery (1997) examine the relationship of contingent liabilities and bond yields by including the severity and frequency of disclosures by firms for various contingent claims in a model of bond yields. They find that disclosures in annual reports and 10-Ks concerning contingent liabilities increase the bond yield model's explanatory power and are likely used by bond raters and underwriters to value the debt. However, if environmental liabilities are underreported and inconsistently reported, then the use of disclosures may severely understate the importance of these particular contingent liabilities. Likewise, if other types of contingent liabilities (such as lawsuits and product liability claims) suffer from the same problems as environmental liabilities, then the understatement may be quite large. Backmon and Vickery (1997) rate disclosures of contingent liabilities in terms of severity (a measure of whether the contingency is listed both in the annual report and auditors report) and frequency (number of events in during the sample period of 1983-1990). They regress their measures of disclosure and control variables against the absolute yield spread (risk premium) and find that contingent liability disclosures are significant determinants of bond pricing.

2.2.5 Bond Ratings

The ratings process and the determinants of bond ratings have been well studied. A wide variety of statistical methods have been employed to discover the determinants of default risk with logistic regression, ordinary least squares and multiple discriminate analysis (MDA) among the most popular. Studies based on logistic regression and MDA have used the model's classification power as the most important indicator of model effectiveness, whereas the OLS versions use measures of fit, r-squares, to rank model variations.

Pinches and Mingo (1973) use factor analysis to reduce thirty-five financial variables to seven factors. The factors that Pinches and Mingo identify are size, financial leverage, long-term capital intensiveness, return on investment, short-term capital intensiveness, earnings stability, and debt and debt coverage stability. After identifying the factors, the authors choose one variable from each factor and use MDA to provide an analysis of the importance of the factors and to test the classification power of the model. They identify subordination status, firm stability (their proxy for this is years of consecutive dividends), and size as the most important of the variables and achieve a classification rate of approximately sixty-five percent for a holdout sample.

Kaplan and Urwitz (1979) compare several models for bond rating. In particular, they test the logistic model, which uses maximum likelihood estimators, and an OLS model for bond ratings. They posit that the logistic model should be superior because the model can deal with ordinal dependent variables while the OLS specification assumes equally spaced intervals between n-chotomous items. They test these models with both seasoned issues and new issues and find that, both models work equally well with their sample of bond issues. For new issues, Kaplan and Urwitz (1979) find that the most important independent variables are subordination status, asset size, leverage, profitability, and to a lesser extent, beta and interest coverage.

Ederington (1985) compares four statistical models that have been used in studies of bond rating determinants and classification: regression (OLS), ordered probit (logit), unordered probit (logit), and MDA (both linear and quadratic). He finds some differences in the classification power of each with ordered probit (logit) providing the best classification power and linear multiple discriminate providing the least number of correct classifications. In particular, the ordered probit model does the best job in classifying issues rated on the cusp of investment grade/non-investment grade ratings, i.e., Baa and Ba. These ratings are frequently misclassified with MDA models (Pinches and Mingo 1975). This is particularly important because issues rated in these categories tend to be subordinated issues and subordination is a critical explanatory variable.

Maher and Ketz (1993) and Graham, Maher, and Northcut (2000) include additional explanatory variables to a bond rating model similar to Kaplan and Urwitz' (1979) formulation. Both studies find that their additional variables are incrementally important to the ratings model. Maher and Ketz (1993) find significance for their pension variables, but their improved model's classification power remained substantially the same as the base model, whereas Graham, Maher, and Northcut (2000) find a dramatic increase in classification power when certain environmental remediation liability estimates and industry dummies are included.

Pinches and Mingo (1973) conclude that the power of their models to predict bond ratings is diminished by the possibility that either their models are missing some important determinants or that bond raters use non-financial "qualitative" information in the ratings process. Kaplan and Urwitz (1979), Ederington (1985), Ederington, et.al. (1987), and Ziebart and Reiter (1992) contend that the power of their models may be low because of those reasons, and that the raters may have some "private information" that is not observable. Bond raters have claimed this in their publications about the process (Standard and Poor's 1982, 1996). Results from Graham, Maher, and Northcut (2000) suggest that the environmental variables may proxy for some relevant information not reported in the financial statements but known to the bond raters.

Industry specific models were shown to be useful for bond rating analysis by Perry, et al. (1984). They use discriminate analysis to reduce a set of thirty-three financial variables and find a best model for each of six industries. They find that industry-specific models yield higher classification accuracy than do single models for a pooled sample analysis. Perry, et al. (1984) are able to achieve over 80% accuracy when models are specified for each industry separately. On the other hand, simply using industry dummies enable Graham, Maher, and Northcut (2000) to achieve nearly 75% accuracy in a pooled sample model.

Pinches and Mingo (1973) and Perry, et al. (1984) use a large set of financial variables to find optimal reduced sets for their samples. Some of the variables are ratio variables based on income statement and balance sheet data similar to those used in this study, and some are ratios based on funds flow data like cash flows/assets or levels of inventories. Gentry, et al. (1988) test subsets of the different types of variables to see if funds flow ratios are superior to balance sheet and income statement ratios. They find that ratio based on balance sheet and income statements perform as well or better than funds flow variables when used with a probit model. In particular, the former performs better as regressors when used in models utilizing new issues.

2.2.6 Bond Yield Models.

Reiter (1990) states that there are two primary debt valuation models and the choice of which to use depends on the question to be studied. Bond market models are analogous to models in the finance literature based on the capital asset pricing model, and provide a measure of abnormal returns. These models are used when attempting to answer questions about wealth transfers or reaction to events. Yield models explain the yield of an issue as a function of macro-economic factors (e.g. influences on the riskless rate), firm specific factors (e.g. default risk or financial variables that proxy for it), and issue characteristics (e.g. callability, subordination, maturity, and others). In other words, yield models work well for examining the determinants of price or yield.

2.2.7 Forms of the Dependent Variable

Lamy and Thompson (1988) examine the dependent variable used in yield models and compare specifications and results with various samples of primary (not convertible) corporate debt issues. They compare two types of yield or pricing: absolute yield spread and relative yield spread. Absolute yield is simply the rate of return at which the bond is sold. The absolute yield *spread* is similar to a risk premium, and is defined as the difference between the yield at which the bond is sold and an index yield like maturity matched U.S. Treasury issues. Backmon and Vickery (1997) use the absolute yield spread as the dependent variable in their study of the value relevance of contingent liability disclosures. Dependent variables based on relative yield spreads are the absolute yield spread divided by the index. Lamy and Thompson (1988) conclude that the absolute yield spread is less theoretically correct. The size of the spread has a different meaning when the underlying riskless rate is relatively small vs. periods when it is relatively large. Lamy and Thompson (1988) find that if interest rates have been relatively stable, then either relative or absolute yield spreads are approximately equivalent.

2.2.8 *Important Control Variables.*

Fung and Rudd (1986) examine an extant finding from a number of studies that asserts that new issues of corporate debt are under-priced (in part due to underwriting costs). The use of new issues is the most common method of studying bond yields, but if new issues are different from seasoned issues, then the results will not be generalizable. In their sample, they find there are no statistically significant differences between new issues and seasoned issues in terms of yield. In addition, abnormal returns could not reliably be earned by trading on this previously identified difference.

The determinates of the maturity of corporate debt issues was the focus of a study by Guedes and Opler (1996) who looked at all public debt issues between 1982 and 1993. They found that firm size and bond ratings are two of the most important indicators of maturity for new issues. Large firms tend to issue debt with either short-term or long-term maturities, while small firms tend to issue with mid-range terms (10-29 years). Risky firms tend to issue mid-range maturity debt and less risky firms choose short or long maturity.

Issue size has been an important control variable in most prior bond yield studies, and is often the most statistically important variable. The relationship in theory is that larger-sized issues have greater liquidity and therefore should have a lower yield (Lamy and Thompson 1988). This negative relationship is documented in a number of studies including Lamy and Thompson (1988) and Sengupta (1998). To investigate this issue, Crabbe and Turner (1995) compare different sized bond offerings by the same firm with similar maturities and similar ratings and find that there is no difference in yields for the comparative issues. In particular, they use regular straight debt issues by firms and medium term notes issued by the same firm and find that the medium term notes (average issue size of $5 million) are close substitutes in terms of yield for the larger bond issues. Crabbe and Turner suggest that the issue size variable used in earlier work was most likely proxying for other issuer characteristics. A secondary finding, useful for this study, is that medium term notes are not statistically different from other straight debt issues, and therefore can be pooled in regressions of public debt offerings.

The size of issue has been found to be less than statistically significant in some recent studies by Datta, et al. (1997, 1999) and Jewel, et al. (1998). Findings by Derosa-Farag, et al. (1999) suggest a reason why size of issue may be less important for bond yield studies in the mid-90s and after. They look at default rates for non-investment grade issues and find that the gap between small issues (less than $100 million), medium sized issues (between $100 and $299), and large issues (over $300 million) has decreased to be very minimal in the mid-1990s. In 1996, the losses from the medium sized issues actually exceeded the losses from the small issues. If the market has incorporated these default rates into required yields, irrespective of liquidity arguments, size may not be an important indicator of the yield premium for an issue in the sample period.

Barth, et al. (1998) examine the option features of corporate debt by using a fundamental components approach. They determined that options such as calls, puts, and sinking fund provisions have a measurable value as a component of the total bond value, and therefore may be relevant to financial statement users. However, they also find that the measures they use lacked reliability because the order of estimation of the option features affects the individual option values. For instance, if a bond is both convertible and callable, the order in which one determines the values of the conversion feature and the call feature will yield different results depending on which feature is estimated first.

2.2.9 Recent Bond Market Features and Innovations

2.2.9a Rule 144A Private Placements.

The SEC instituted Rule 144A in 1990 to streamline the offering process for sales to large investors. Rule 144A is technically concerned with private placements, but because offerings issued under the rule can be publicly traded after a short holding period, the offerings are often treated as public offerings. Initially, securities issued under 144A can be sold only to qualified institutional buyers (known as QIBs or Qualified Institutional Buyers). 144A private placements can be brought to market in about three weeks instead of the seven weeks normally required for a regular public offering and have far fewer disclosure requirements. Most of these private placements are issued with "reg rights" so that the issue can be converted to a public offering with additional filings at a later date. This process often begins immediately after the initial sale of the issue (Investment Dealer Digest (IDD) 6/9/1997). 144A placements became much more popular than the SEC anticipated. A senior executive of the SEC was quoted in Investment Dealer Digest (IDD 10/6/1997) saying 144A offerings were "“the exception that swallowed the rule.” As of 1997, Rule 144A offerings made up 50% of the high yield market and 60% of the convertible market in dollar volume (IDD 10/6/1997). Moody's and S&P both supply ratings on 144A deals just as though they were publicly traded (IDD 3/4/96). The bond rating agencies justify rating these private placements with the logic that most of the issues are eventually converted to public debt.

Two controversies surround 144A offerings. Most of the 144A deals are issued with high yield ratings and "junk" bond status (lower than Baa). In addition, the volume of these private placements has skyrocketed. Some investment bankers have questioned the usefulness of ratings at all with regard to these placements when they are so popular with investors and default rates are at their lowest in recent history (Derosa-Farag, et al. 1999). Moody's has even expanded the detail of its Caa rating to better differentiate between levels of the companies with the poorest credit risks (IDD 6/23/97). Some issuers are choosing to offer their debt to the market with no rating. Ironically, unrated debt is easier to place than very low rated debt because institutional buyers have more capacity under their portfolio rules for unrated debt than for low rated debt. In 1991, Moody's began issuing unsolicited ratings for new types of public and private debt, which in some cases included bank loans (IDD 2/12/96). These were termed by IDD as "ambush ratings" because the firms were compelled to go to Moody's for a refinement in the rating, which was often issued at a lower level than the firm anticipated. Such a rating would obviously frustrate a strategy of offering the Rule 144A debt as unrated.

The second controversy involves the rule itself. Because the issues are restricted to only QIBs, and Rule 144A has dominated the high yield markets, regular public debt investors have much less access to the best "junk" bonds. In addition, investors have much more due diligence to perform because the disclosure required is greatly reduced, and whatever research is performed must be done in much less time because the issue goes to market faster than a normal public issue. In these cases, an investor must rely much more on the ratings or the underwriters (IDD 4/14/97). This puts 144A offerings at odds with conventional wisdom concerning ratings as stated by Datta, et al. (1999). They suggest that investors use ratings primarily to evaluate investment grade issues, and that high yield debt buyers instead rely on knowledge of the issuing firm's business and its future prospects.

2.2.9b Make-Whole Provisions.

Another relatively recent feature of the public bond markets is the "make-whole" provision. A make-whole provision is a call option that, if executed, pays a premium to the investor. The premium is usually stated as a basis point spread over an equivalent term Treasury bond at the time of redemption. One of the first to be issued in the public debt market was by the Quaker State Corporation in September 1995 (IDD 10/23/95) and issued with no call premium. The feature had been used in the private debt market for some time, but until the Quaker State issue, had very rarely been used in the public market. The make-whole provision quickly gained popularity.

2.2.9c Greater Volume of Embedded Put Options.

Putable bonds have been issued with increasing frequency in the new issues markets. In 1996, bonds with puts outstripped those with calls by dollar volume for the first time (Crabbe and Nikoulis 1997). Putable bonds are particularly important for this study because they tend to be issued when the term structure is flat or negative (Crabbe 1991, Kalotay and Abreo 1999). During the early 90s, the term structure was sharply positive and putable activity reduced to nearly zero, but when the yield curve began to flatten in the mid-90s, the volume of putables increased (Crabbe and Nikoulis 1997).

2.2.10 External estimates of environmental liabilities and bond yields

How the public-debt side of the capital markets receive relevant information concerning contingent environmental liabilities is an important question to ask because the answer has implications for the usefulness of financial statements and the value of bond ratings in determining the cost of debt. The evidence discussed previously indicates that contingent liabilities appear to be important for the bond markets. Prior literature shows that they are an important determinate for the length of time that junk bonds spent in default (Helwege 1999), and that disclosure severity and frequency of contingent liabilities appears to be associated with bond yields (Backmon and Vickery 1997). More specifically, Maher and Thompson (1997) show that some measures of pension liabilities are associated with bond yields, even in the presence of debt ratings.

It would not be unreasonable to expect to find that external measures based on EPA data are associated with bond yields using data from the mid 1980s to the early 1990s as other studies have done. Yet, the above examination of the existing literature for environmental liabilities and their possible effects on the bond market still leaves several questions unanswered. Do external measures have explanatory power in the face of increasing disclosures (and accruals) by firms with such liabilities? If, in fact, the external measures still have a measurable association with bond yields and bond ratings, this would lend some support to the suggestion of Li and McConomy (1999) that the market values the accruals that firms make at more than face value.

The external measures could be useful proxies for the size of the expected future environmental liability that the debt markets believe the firms will bear. Large estimates, even though they appear to be unreasonable as a proxy for the actual costs that a firm will bear of the currently identified sites, may in fact be close to what expected costs are estimated to be by investors. Alternately, the explanatory power of external estimates could be an indication that accruals for environmental liabilities still lag even realistic expectations of the liability for currently identified sites, notwithstanding the improvements in the provisions that firms have made under increased regulatory scrutiny and public pressure.

A second important question concerns the manner in which the markets receive the information. Are bond investors apprised of the liability by its effect on bond rating, which would be an indirect effect on bond yields, or do these liabilities have a direct effect over and above the bond rating? If external measures for contingent environmental liabilities do have direct effects, then bond investors may be incorporating information about these liabilities beyond that available from the firm's publicly available financial statements or the bond ratings. On the other hand, a finding that the effects appear to be indirect would support the value of bond ratings for investors, especially for junk bonds which appear to be particularly impacted by contingencies (Helwege 1999). The next chapter phrases these questions into hypotheses that will be tested using some of the models and control variables discussed above and further detailed in Chapter 4.

Chapter 3

Hypotheses

External environmental cost estimates have been shown to be negatively related to firm value and bond ratings (Barth and McNichols 1994, Blacconiere and Northcut 1997, Graham, Maher, and Northcut 2000, Campbell, et al. 1998). Firms have been increasing their disclosures during the time frames of most prior research (Gamble, et al. 1995, Barth, et. al. 1997, and Stanney 1998). The SEC has taken a much more active role in requiring a better reporting environment for these contingent liabilities. As reporting improves and Superfund sites age, one would expect that the explanatory power of externally generated costs estimates to weaken as firms incorporate the information into their financial statements.

The initial hypothesis of this study is to establish that environmental remediation liabilities are significantly associated with bond ratings during the time period 1995-1997. Prior research indicates that these liabilities are important in equity markets (Barth and McNichols 1994) and for bond raters (Graham, Maher, and Northcut 2000). However, this prior research utilizes costs estimates and firm financial information before the SEC began to require more detailed disclosure regarding environmental liabilities. The first hypothesis is then:

H1: *Environmental remediation liabilities are positively related to a firm's bond rating.*

If externally generated environmental remediation liabilities continue to have statistically significant association with bond ratings in a superior reporting environment, then a second question arises. Will this contingent liability have explanatory power in a model of bond yields for new issues when included with other variables used to model bond ratings? The initial regressions for the bond yield model will use only the variables used to model bond ratings and not the bond ratings themselves. This is because bond ratings are expected to at least partially incorporate contingent environmental liabilities. Presuming the external estimates have explanatory power per hypothesis one, then hypothesis two states:

H2: *Environmental remediation liabilities are positively related to bond yield.*

A third hypothesis to be tested concerns the incremental information content of environmental remediation liabilities in a model of bond yield when the bond rating is also included. Evidence is divided concerning the additional information content of financial variables in a model of bond yields when ratings are included. As detailed in Chapter 2, Ederington, et al. (1987) found that financial variables do have incremental explanatory power beyond the bond ratings in a model of bond yields. Ziebart and Reiter (1992) find a similar result except that when ratings from Moodys are included in the model of bond yields, the financial variables are no longer statistically significant. They surmise that Moody's ratings appear to have more information content than do those from Standard and Poor's. Because Moody's ratings are used in this study, the incremental explanatory power that the environmental estimates provide over and above the ratings may be small or not important.

A possible critical difference in methodology between the Ederington, et al. (1987) and Ziebart and Reiter (1992) is the way that the ratings are modeled in their respective specifications. Ederington, et al. (1987) uses bond rating dummies which do not restrict the ratings to equal spacing among the different rating categories or equal slopes in the regression equations. On the other hand, Ziebart and Reiter (1992) use a single polychotomous variable to model the bond ratings. They use this because their regression technique involves simultaneous equations that do not lend themselves to the use of dummy variables. Unfortunately, an implicit assumption in the use of this formulation is that the ratings are ordinal and equally spaced, that is, the difference between a rating of BAA and A has the same magnitude as the difference between BA and BAA. Some prior research (Ederington 1985) has shown that the difference between the various rating categories is not equal, particularly between investment grade and non-investment grade ratings. Both the rating dummies and the polychotomous version of the rating variable will be examined in alternate specifications with third hypothesis:

H3: *Environmental remediation liabilities are positively related to bond yields in the presence of bond ratings.*

If hypothesis three is supported, then as Ederington, et al. (1987) found with other financial variables, environmental remediation liabilities will appear to have additional information content not included in the ratings.

Chapter 4

Research Design and Methodology

Model and Data Selection

Earlier work in bond ratings and bond yields indicate that a certain set of variables should be included in each type of model. Bond rating and bond yield models utilized in this study are described along with the control variables that prior research has indicated are important. In addition, the outside measures of environmental remediation liabilities are described and all sources of data are detailed.

4.1.1 General issues with Data and Models

One of the most common problems researchers face when doing studies concerning bond ratings and/or bond yields is whether or not to use exclusively new issues or to include seasoned issues (extant bond issues that are traded), or some combination. Many early studies used both (Pinches and Mingo 1973, Kaplan and Urwitz 1979, Ederington, et.al. 1987) but both Kaplan and Urwitz (1979) and Ederington, et. al. (1987) find that new issues are different from seasoned issues in bond rating models. Prediction models generated from new issue data sets have a much better classification rate for bond ratings, and the yield models result in a better fit with the new issue data.

Ederington, et. al (1987) and Reiter (1990) point out that using new issue data is particularly important for combination bond rating/bond yield studies because of non-synchronous trading bias (existing bond issues are thinly traded) and the fact that yields on seasoned issues tend to be much more affected by accounting data and external economic conditions and less by bond ratings. They argue that the ratings on seasoned issues are in essence "old" and less useful for investors.

Another important issue with both bond yield and bond ratings models is the transformation of certain independent variables to reduce skewness in the data. Some researchers take a log transformation of independent variables that measure firm size or leverage (Sengupta 1998). Fisher (1959) characterizes the problem as follows "if the influence of one variable is dependent on the magnitude of other independent variables then a transformation is appropriate". Pinches and Mingo (1973) like Fisher (1959) use a log transformation on some variables to "improve normality and reduce the heteroskedasticity in the distributions". Another method to overcome the problem of skewness is to scale by the skewed variable as in Barth and McNichols (1994) and Maher and Ketz (1993). Northcut (1997) and Barth and McNichols (1994) scale by shares outstanding whereas Maher and Ketz (1993) scale all appropriate variables by total assets.

Finally, some studies have used industry-adjusted data (Kaplan and Urwitz 1979) because industry may be an important factor in ratings or yields. Kaplan and Urwitz (1979) find that industry adjustments did not improve model fit or classification rates for bond rating models in their data set, although these adjustments may be important for some industries. An alternate method of accounting for industry using industry dummies was shown to be very useful in bond rating models by Graham, Maher, and Northcut (2000). Therefore, variables in this study are not adjusted by industry medians, but instead industry dummies are used for the bond rating models.

4.1.2 Data Sources

This study uses new issues for the period 1995-1997, and consequently uses firm financial information for the period 1994-1996. These dates are chosen to be relatively current but to contain a relatively uniform set of accounting reporting requirements. The SEC's Staff Accounting Bulletin 92 was to be implemented by publicly traded firms by 1993. Starting in 1997, the AICPA's Statement of Position 96-1, which is a restatement of extant accounting policies with audit guidance, was to be implemented. Choosing a sample period between these reporting events should insure that the levels of recognition and disclosure required by promulgation are relatively consistent.

EPA data was collected from a privately available collection of databases offered by the Olewine Company called Environmental Factor ™. Specifically, two of the databases were merged, the records of decision (ROD) and the site enforcement tracking data (that includes the names and addresses of potentially responsible parties). New bond issue information and bond rating information was collected from Moody's Bond Survey and Investment Dealer Digest. Finally, firm specific financial data was collected from the Compustat PST files.

4.1.2 Environmental Variables

Data concerning environmental liabilities come from independent estimates of the liabilities from the Environmental Protection Agency (EPA). A time and labor intensive combination of several publicly available data sets is necessary to generate the EPA estimates. The EPA does not create a liability estimate for each firm directly. Sites are identified as part of a National Priorities List (NPL) if the level of remediation is considered to be costly. Each NPL site requires a search for potentially responsible parties, and a special database is created called the Site Enforcement Tracking System (SETS) that lists the name and address of each PRP, and the date that the parties were notified of their potential liability.

Each Superfund site is evaluated, and ultimately an estimate of the cost of remediation, including both one-time costs and on-going maintenance costs, is generated by the completion of a feasibility study. After completion of the feasibility study, the EPA issues a document called a Record of Decision (ROD) that details the problem to be solved and the costs for doing the remediation. At each site, one or more responsible parties are identified that could include any transporter, generator, site owner, or intermediary in the process of using the site and creating toxic waste. Consequently, some of the potentially responsible parties (PRP) will have a very limited ability to pay for cleanup, especially those firms hired to transport the waste. To create a firm-specific liability estimate, the SETS and ROD databases are merged.

The mechanism for distributing the costs among the responsible parties is largely a matter of litigation, but prior research has identified some proxies. Barth and McNichols (1994), Blacconiere and Northcut (1997), and Graham, Maher, and Northcut (2000) all used the same three methods to allocate costs. Those three measures defined below are used in this study plus one additional apportionment scheme. The first liability estimate (RODSPLIT) is based on each PRP being apportioned an equal share of the cost of each site on which that firm is named as a PRP. A similar scheme is utilized to develop the second estimate (RODCOMP) except that the apportionment is done only across those firms listed on the Compustat database. This scheme is akin to the legal concept of "deep pockets" whereby the costs are borne by the PRPs with the greatest ability to pay. The third estimate (RODSUM) is the most conservative whereby each firm's liability is assumed to be the total costs of each site on which the firm is named as a PRP. A fourth measure (RODCAP), suggested by Barth, et al. (1998), may get closer to the legal concept of deep pockets, and apportions the ROD estimates over the firms listed on Compustat as a weighted-average based on market capitalization.

An additional measure that does not apportion costs (but is a proxy for the severity of the liability) is the number of times named as a PRP. The number of reports (termed PRPNO) is simply the number of sites on which a firm has been listed as a PRP. Prior research has found that all of these proxies are negatively associated with firm value. The associations are expected to be positive in this study because of the coding scheme used for bond ratings described in Chapter 1 and the natural relationship of liabilities and bond pricing in regard to bond yields.

4.1.4 Bond Rating Models and Variables

4.1.4a Dependent variable.

The ratings are represented by a categorical variable taking on values at six levels. Aaa is for the highest rating, followed by Aa, A, Baa, Ba, and B. In addition, each rating class contains modifiers (e.g. 1,2,3), except Aaa, that allow the above set to be expanded to sixteen levels utilizing all the information that Moody's provides with its rating qualifiers instituted in 1982. Bonds do exist that are rated lower than B, but most studies of ratings restrict the sample to the six levels (or sixteen) above because of the small number of lower grade debt offerings. There are also problems of correct classification of these very low categories with conventional models. Some studies look at only investment grade securities defined as those with a rating at or above Baa. Yet, it is often instructive to look at differences between investment grade issues and those issues considered junk bonds. In particular, if the capital markets see firms with high levels of environmental contingent liabilities as very risky, then a reasonably large number of the sample firms may fall into the lower rated categories.

4.1.4b Control Variables.

Bond ratings models should include proxies for firm size, earnings stability, leverage, interest coverage, profitability, and subordination status of the bond (Kaplan and Urwitz 1979, Ederington 1985, Ederington, et.al. 1987, Ziebart and Reiter 1992). A number of independent variables have been tested for bond rating models and are summarized in Reiter (1990). A brief description of the control variables selected for this study follows.

Firm size is often measured as total assets and in this study is defined as TASSET5. The S&P rating guide (1998) includes a bond rating worksheet that uses five years of data for various ratios and total assets. Kaplan and Urwitz (1979), Ederington (1985), and Maher (1987) among others use a five-year average for several of the independent variables including total assets and this study follows this convention.

Earnings stability is an important indicator variable for both bond ratings and bond yields to proxy for the market risk of the firm. This has been measured as the standard deviation of stock returns (Sengupta 1998), the coefficient of variation for net income (Pinches and Mingo 1973), Value Line beta (Ziebart and Reiter 1992), and the standard deviation on return on firm value (Blackmon and Vickery 1997). Kaplan and Urwitz (1979) split the risk variable into components representing the market systematic risk and the firm-specific unsystematic risk. They find that only the market risk was significant in their results and only for new issues. The beta variable actually had the wrong sign in their regressions using seasoned issues. Based on the strength of results from the Ziebart and Reiter (1992) study, this study uses betas (from *CRSP)* to represent this market risk aspect.

Leverage, interest coverage, and profitability are included in most models of bond ratings as part of the financial information typically examined in rating issues of debt (Ziebart and Reiter 1992). S&P (1982, 1998) raters use each of these ratios as a five-year average. Leverage is measured as the ratio of long-term debt to total assets as in Kaplan and Urwitz (1979) and S&P (1998). Interest coverage is measured as the ratio interest expense to income before interest and taxes as done by Ziebart and Reiter (1992), which is the inverse of the more typical ratio times interest earned used in some studies such as Sengupta (1998). Kaplan and Urwitz (1979) found a measure of profitability to be highly significant in their study, particularly for new issues, although it has not been used as a control variable in recent studies (e.g. Ziebart and Reiter 1992, Blackmon and Vickery 1997). Profitability is measured as the ratio of net income to total assets as in Pinches and Mingo (1973) and Kaplan and Urwitz (1979). Sengupta (1998) used profit margin instead of net income divided by total assets and found only weak significance for the variable.

Subordination status is important for both bond rating and bond yield models as a control variable. Subordination status was first suggested by Pinches and Mingo (1975) and has since become almost universally accepted in robust bond rating models. This variable is particularly important for issues rated at A or below and has been shown to improve classification rates dramatically for issues rated as Baa (Pinches and Mingo 1975). Subordination is the most significant variable in regressions by Kaplan and Urwitz (1979). Subordination is measured as a 0,1 variable with a value of 1 if the issue is subordinated, 0 otherwise.

4.1.5 Bond Rating Models

One of the difficulties inherent with existing bond rating models is the ability to rank the incremental usefulness of independent variables while at the same time maintaining the ability to definitively determine if one model specification is significantly better than another model. Maximum likelihood estimation techniques, such as logistic regression, possess the ability to rank the usefulness of independent variables (Kaplan and Urwitz 1979), but there are no definitive statistical tests for model comparison. Ordinary Least Squares, on the other hand, has a number of established statistical techniques for distinguishing among competing models. These include an examination of each competing model's mean square error, the Press statistic, adjusted R^2, and the conceptual predictive criteria (the C_p statistic) (Myers 1990). However, OLS possesses some statistically undesirable and theoretically incorrect characteristics with regard to the assumptions made concerning the ordinal nature of the dependent variable, bond rating (see Kaplan and Urwitz 1979).

This paper uses both logistic regression and OLS in estimating the model to facilitate comparison and completeness. Logistic regression is used to rank the importance of the variables for bond rating. OLS is then used to compare the models, particularly for differences between models with and without various EPA estimates. If there are major disagreements between the results of the two methods, logistic regression should be considered more theoretically sound given the characteristics of the dependent variable (Amemiya 1981).

Most recent bond rating studies (Reiter 1990) have used discrete or categorical modeling techniques such as logistic, probit, or multiple discriminate analysis to model the data, but some have used OLS (West 1970, Horrigan 1966, Pogue and Soldofsky 1969, and Kaplan and Urwitz 1979). In particular, the Kaplan and Urwitz (1979) study provides a direct comparison of OLS and logistic regression and concludes that the results with either model are similar with their data set. The OLS model is of the form:

$$Y_i = \boldsymbol{a} + X_i\boldsymbol{b} + \boldsymbol{u}_i$$

where X_i represents the various independent variables, Y_i represents the bond rating specified like a continuous variable (although only in discrete steps) and $\boldsymbol{u}_i$ represents the unexplained variance.

The referenced works above provide a large volume of potential variables for a robust bond-rating model. This study will use a combination that primarily includes variables constructed from a firm's basic financial statements along with a variable for market risk, beta, and a variable for issue character, subordination. In its complete form the model can be shown as:

$$\begin{aligned} &MRNO = \beta_0 + \beta_1 TASSET5 + \beta_2 BETAV + \beta_3 LTD\_TA5 + \\ &\beta_4 INTCOV5 + \beta_5 NI\_TA5 + \beta_6 SUBORD + \beta_7 IND_j \\ &\beta_8 PRPNO \text{ (or alternate external environmental measures)} + \upsilon \qquad (1) \end{aligned}$$

where:

Predicted <u>Sign</u>	<u>Variable</u>
	MRNO = variable ranging from Aaa = 1 to B = 6, or Aaa = 1 to B3 = 16;
-	TASSET5 = Five year average of the total assets of the firm in the year of issuance;
+	BETAV = Measure of market risk (beta) taken from CRSP database;
+	LTD_TA5 = Five year average of the total long term debt of the firm in the year of issuance, scaled (divided) by assets;
+	INTCOV5 = Five year average of interest expense to EBIT;
-	NI_TA5 = Five year average of the net income from operations of the firm in the year of issuance, scaled (divided) by assets;

+	SUBORD = Subordination status of the issue, value of 1 if subordinated, 0 otherwise;
?	IND_j = Series of dummy variables representing industry membership (see Table 3 for description of industry groupings)

and

environmental variables are:

Predicted Sign	Variable
+	RODSPLIT = Total Cost per Superfund site from the Record of Decision database divided by the number of PRPs per site summed across all sites for each firm for year of issuance, scaled (divided) by TASSET5;
+	RODSUM = Total Cost per Superfund site from the Record of Decision database summed across all sites for each firm for year of issuance, scaled (divided) by TASSET5;
+	RODCOMP = Total Cost per Superfund site from the Record of Decision database divided by the number of Compustat PRPs per site summed across all sites for each firm for year of issuance, scaled (divided) by TASSET5;
+	RODCAP = Total Cost per Superfund site from the Record of Decision database apportioned by weighted average market capitalization for the Compustat PRPs per site summed across all sites for each firm for year of issuance, scaled (divided) by TASSET5; and
+	PRPNO = Cumulative number of Superfund sites on which firm is listed as a PRP in the year of issuance, scaled (divided) by TASSET5.

The alternate specifications for the environmental variable are added to the base model individually (i.e. one per model). Prior research (Barth and McNichols 1994, Northcut 1997) has shown that the EPA estimates are highly collinear and therefore should not be combined in any model specification.

The logistic regression model is based on maximizing the likelihood that the predicted occurrence of the dependent variable will match the actual value of the dependent variable, given the values of the corresponding independent variables. The overall test of model significance follows a chi-square distribution, and the test of individual regressors is a comparison of the improvement in the log likelihood from one specification to another. The logistic model requires a categorical dependent variable and either continuous or categorical independent variables. In the event that all variables of interest are categorical, the model would resemble a multidimensional contingency table (Homer and Lemeshow 1989).

In the case of a single regressor and a dichotomous dependent variable (y=0,1), the maximum likelihood, p(x) is the conditional probability that y takes on the value 1 and 1-p(x) is the same for y=0. The maximum likelihood function is the product of all the pairs of observations such that if $\delta(x_i) = \pi(x_i)^{y_i}[1-\pi(x_i)]^{1-y_i}$ (for one pair of observations) then

$$l(\beta) = \Pi\, \delta(x_i) \text{ where } i = 1\ldots n\text{, and } \beta \text{ represents } \beta_0,\beta_1$$

For convenience, the log of the above equation is taken to ease computation such that the equation becomes:

$$L(\beta) = \ln[l(\beta)] = \Sigma\, \{y_i \ln[\pi(x_i)] + (1-y_i) \ln[1-\pi(x_i)]\}\text{, where } i = 1\ldots n$$

and $\pi(x)$ is defined as $\pi(x) = e^{\beta 0 + \beta 1(x)} / 1 + e^{\beta 0 + \beta 1(x)}$

and the functional form is given by $g(x) = \beta_0 + \beta_1(x)$ where g(x) is defined as the logit of the equation. In a polychotomous formulation where the dependent variable takes on more than two values, k-1 logits are estimated where k is the number of levels for the dependent variable, and hence k-1 intercepts are estimated. The test statistic for determining significance of the independent variables, and for determining overall model fit, is called the log likelihood ratio. This ratio is simply the measure of the incremental value of the independent variable when added to the model. The log likelihood ratio is expressed as:

$$\lambda(b) = -2\ln(L),$$

where L = maximum likelihood with q constraints/maximum likelihood without constraints. The larger the value of $\lambda(\beta)$ the more significant the regression (Stokes 1997). The value $\lambda(\beta)$ is distributed as a chi-square with n-q-1 degrees of freedom (Myers 1990) and is specifically termed the Wald's chi-square statistic. The functional form for the logistic regression will resemble the OLS model given above in equation (1).

4.16 Bond Yield Models and Variables

Bond Yield models should include variables for the term structure of interest rates, business cycle effects, term to maturity, sinking fund and secured status, call risk, marketability, default risk, and possibly the underwriting method (Reiter 1990). An alternate way to describe the type of the control variables is to classify them as falling into three categories: issue characteristics, market conditions, and issuer characteristics. This scheme is used by Sengupta (1998). Several studies have used a common set of variables in both the bond rating and the bond yield models (Ederington, et.al. 1987, Ziebart and Reiter 1992, Reiter and Ziebart 1991, Sengupta 1998). This is typically done to determine the incremental influence of the bond ratings over the variables used to predict default risk (or vice versa) in a bond yield model.

The yield of the bond serves as the dependent variable for the bond yield model and this variable can be specified in different ways. As discussed in Chapter 2, Lamy and Thompson find that the relative yield premium appears to be well specified and is theoretically sound. This study uses the relative yield premium, or the yield to maturity of an issue minus the yield on an U.S. Treasury issue with a comparable maturity at the time of issue, divided by the yield on an U.S. Treasury issue with a comparable maturity at the time of issue.

Control variables initially considered include issue size, a call option variable measured as the ratio of the number of years to call over the years to maturity, interest rate volatility, and a measure for the presence of a sinking fund provision. This set of variables accounts for issue characteristics and market conditions, and was shown to result in good model fit by Lamy and Thompson (1988). Issuer characteristics are modeled by including the firm's bond rating in the model, or alternately, using a set of variables utilized in previous studies to model default risk.

As detailed in Chapter 2, recent innovations and changing conditions in the bond market necessitate some other control variables to properly account for issue characteristics. The high incident of put options in the data set suggests a control variable similar to the call variable. Call options increase the bond buyer's interest rate risk and are therefore costly to the bond issuer (positively associated with yield). Conversely, the put option decreases the issuer's cost since it does the opposite in regard to the bond buyer.

A large number of issues in the sample period for this study had make-whole provisions. Because data on the timing of make-whole options is incomplete in the data sources available for this study, a simple indicator variable is utilized. Due to changing conditions, issue size may not be an important control variable. However, due to its past importance in previous research, issue size is included. The traditional sinking fund variable is discarded because of the extremely low incident of sinking fund provisions for the sample issues (only two issues had sinking fund provisions).

Based on control variables identified in prior research and the new variables described above, the bond yield model's functional form is represented as:

$$RP = \beta_0 + \beta_1 SIZELN + \beta_2 CALVAR + \beta_3 PUTVAR + \beta_4 MW + \beta_5 IVOL + \beta_6 DEFAULT + \upsilon \quad (2)$$

where:

Predicted <u>Sign</u>	<u>Variable</u>
	RP = the absolute yield premium or the yield to maturity of an issue minus the yield on an U.S. Treasury issue with a comparable maturity at the time of issue, divided by the yield on an U.S. Treasury issue with a comparable maturity at the time of issue;
+	SIZELN = natural log of the issue size;

+ CALVAR = ratio of years to call divided by years to maturity;

+ PUTVAR = ratio of years to put divided by years to maturity;

+ MW = indicator variable with a value of 1 if make-whole provision is included, 0 otherwise;

+ IVOL = volatility of the prior ten days of the U.S. Treasury constant maturity index; and

+ DEFAULT= ratings and/or collection of default risk variables including environmental estimates.

Similar to Ederington, et al. (1987), the complete model will include both the bond ratings, characterized as a series of 0,1 variables and the environmental estimates used above in the ratings model. Alternate specifications include either the ratings only or the default risk variables only combined in sequence with the environmental variables as in the bond rating model. Another alternate specification includes the rating variable as a single polychotomous-rating indicator.

4.2 Data Description

4.2.1 Sample size

The final sample consists of 357 new bond issues during the period March 1, 1995 to February 28, 1998. These dates correspond to the filing deadline imposed by the SEC for 10-k annual reports. Consequently, the dates were chosen so that a firm's annual financial data would be available to potential bond buyers and bond raters.

4.2.1a Bond Issues.

Moody’s Bond Survey is used for the initial collection of bond issues. Moody’s reported the bond rating for new issues in 1995, 1996, and part of 1997. As of July, 1997, Moody’s discontinued reporting the bond rating in the summary of new issue activity. For issues after July, 1997, ratings are collected primarily from Moody’s Bond Record (Special Annual Edition). A small percentage of the issues reported in Moody’s Bond Survey had insufficient information reported such as the offer yield or other issue characteristics. For these issues, Investment Dealer Digest is used to supplement the initial information from Moody’s.

Only issues that were from the primary bond issue market are collected. The sample is restricted to the firms that had a primary SIC code as defined by the Compustat database in the following ranges: 0-4899, 4922-4923, 5000-5999, and 7000-8099. These ranges are utilized to cover the broadest possible collection of firms with the exception of utilities, financial firms, and governmental agencies. Each new issue detailed in Moody's Bond Survey was checked against a list of all Compustat firms in the above SIC code ranges, and matched by name (and CUSIP number if available). In addition, credit subsidiaries of firms such as Sears or IBM, asset-backed issues, or guaranteed issues were ignored. After applying the appropriate screens, 844 bond issues were left in the sample. Included in the sample were Medium Term Notes and bonds issued under the SEC’s 144A private placement rule. A summary of the bond issue selection procedure is shown in Table 1.

To construct the dependent variable, relative risk premium (RP), for the bond yield model, constant maturity Treasury yields for the period 1995 – 1998 were collected. These were collected by downloading the data from The Federal Reserve Board web site at http://www.federalreserve.gov/releases/H15/data.htm (5/1/00). Specifically, the files labeled Federal Reserve Statistical Release H.15: Selected Interest Rates were collected. These files report a daily Constant maturity index for bond issue terms of 1, 2, 3, 5, 7, 10, and 30 years. In December 1986, the Federal Reserve discontinued reporting a twenty-year constant maturity yield index based on outstanding issues because the twenty-year bond was no longer issued. The twenty-year yield index was taken from a separate file, RIFLGFCY20_N.B, also on the Federal Reserve web site. For explanatory purposes, included below is a note from the web site, which explains the yield data used:

Note: The 20-year constant maturity estimated by the Department of the Treasury is based on outstanding Treasury bonds with approximately 20 years remaining to maturity. This series is not identical to the historical 20-year constant maturity series, which was based on actual 20-year bonds issued through 1986.

Yields on Treasury securities at constant, fixed maturity are constructed by the Treasury Department, based on the most actively traded marketable Treasury securities. Yields on these issues are based on composite quotes reported by U.S. Government securities dealers to the Federal Reserve Bank of New York. To obtain the constant maturity yields, personnel at Treasury construct a yield curve each business day and yield values are then read from the curve at fixed maturities.

4.2.1b Environmental data.

As of December 31, 1999 there were 1,135 NPL sites which had a total of 2,055 Record of Decisions issued. Of these decisions, 1061 have non-zero records of decision totaling over $23 billion. The EPA has identified 41,331 sites to investigate over the course of the Superfund program of which 30,661 have been deemed NFRAP (No further remediation action planned). For active sites, the EPA has notified 36,429 entities of potential responsibility.

Environmental data was gathered from a collection of databases called Environmental Factor™ that includes the SETS and ROD databases described above. All PRPs that had been notified of potential responsibility at a NPL Superfund site through December 31, 1996 were collected. The full list contained 29,421 entities. The list of entities (the list contains both firms and individuals) was matched with the list of Compustat firms from the current and research files. Matches were annotated by ticker symbol. Because the entities are listed in the EPA databases by name and address only, and because the firm name could have variations (for example, IBM may be listed as International Business Machines, Intl Bus. Machines, IBM, Inc, or IBM Company, Inc), this match was done by visual inspection. The Directory of Corporate Affiliations (1995-1997) was checked for subsidiaries of the 401 unique bond-issuing firms (401 firms issued 844 bonds during the sample period from above). If a subsidiary of one of the bond-issuing firms was named as a PRP, then this PRP notification was included in the totals for the number of times the parent bond-issuing firm was named as a PRP.

After the matching was completed, the matched firm list was restricted to firms that were not delisted from Compustat as of the beginning of the sample period. An attempt was made to trace firms that were delisted before the end of 1994 to account for possible mergers with the firms that remained in the Compustat-PRP sample. After examining the Directory of Corporate Affiliations by year from 1988-1996, the final sample retained 5,803 PRP notices for 896 Compustat firms. The number of Compustat firms named as PRPs is comparable to data collected by Northcut (1995, 1997) but is less than the number of firms identified by Barth and McNichols (1994). Even though more firms have been named as PRP's subsequent to the sample period used by Barth and McNichols (1994), a large number of firms were lost due to mergers, leveraged buyouts, or were otherwise delisted from the Compustat database.

Notifications of status as a potentially responsible party were issued beginning in the late 1970s. The matched data was organized by sorting on date of issue, and the PRP notices were accumulated by ticker by year to create the variable PRPNO, or the number of PRP notices by firm. The notices also had to be organized by NPL site to create other variables described below, which required the number of notices by site by year and the number of notices issued to Compustat firms by site by year. After completing this process, the final sample retained 5,547 notices through 1994, and 5,694 and 5,745 notices for 1995 and 1996 respectively.

Another variable required to develop the final dataset was the market capitalization of each Compustat firm listed at a particular site. This data was collected from the Compustat database. Data item 25, Common Shares Outstanding was multiplied by Data item 199, Price – Close – Fiscal Yearend to get total market capitalization (preferred stock was ignored).

To assign a dollar estimate to each site, record of decision cost estimates were accumulated by site (each Superfund site can have multiple RODs). The cost estimates are composed of remediation costs and on-going operation and maintenance costs. The on-going costs, if designated by EPA, are typically assigned for a number of years. The range can be as short as one year or as long as fifty years. The most common time frame is twenty years. The operation and maintenance costs were adjusted to present values by discounting the costs at a rate prescribed in the record of decision. If no rate was prescribed, a rate from a record of decision issued with the closest possible date in the same year was used to discount the costs.

4.2.1c Final Merge and Financial Data.

After collecting financial information from Compustat for the remaining firms with known PRP notices, the set of firms that issued bonds was merged with the firms with all environmental data. This matching resulted in complete data for 357 bond issues by 155 individual firms during the sample period. The financial data collected from Compustat were Item 6 - Total Assets, Item 9 - Total Long Term Debt, Item 15 - Interest Expense, Item 16 - Income Taxes – Total, and Item 18 - Income Before Extraordinary Items.

4.2.2 Data Assembly

4.2.2a Bond issue related variables.

To construct the dependent variable, RP, the appropriately matched Treasury constant maturity index is subtracted from the offer yield for an issue and then divided by the matching Treasury constant maturity index. If the term was different from one of the constant maturity indexes, the closest available term was used. For instance, if a bond issued with a term of nine years, the ten-year Treasury index was used for matching purposes.

For the variable IVOL, the average absolute deviation of the Treasury constant maturity index for a ten-day period preceding the issue date was calculated. The variables CALVAR and PUTVAR were calculated as a ratio of the years to option divided by years to maturity. SUBORD is a zero-one variable with a value of 1 if the issue is subordinated, zero otherwise. SIZELN is the natural log of the size of the issue in millions of dollars.

The bond rating variables MRNO (Moody’s Rating Number) and MRNOCONS (Moody’s Rating Number Condensed), are number equivalents of the rating assigned by Moody’s. MRNO ranges from 1 = AAA to 16 = B3. MRNOCONS are the ranges condensed into the form Moody's issued before 1982 with AAA = 1 and B = 6. As mentioned in Chapter 1, it is importatn to note, using this coding scheme, that higher risk bonds have a higher bond rating. Hence, a positive association is expected between bond rating and environmental liabilities.

4.2.2b Financial Variables.

Five-year averages of the appropriate financial variables used to proxy for the financial condition of the firm were constructed for use in both the bond rating model and the bond yield model. TASSETS5 is the five year average of the Compustat item 6 -Total Assets. LTD_TA5 is the five year average of Compustat item 9 - Long Term Debt – Total divided by TASSETS5. INTCOV5 is Compustat item 15 - Interest Expense, divided by Compustat item 18 - Income before extraordinary items, plus Compustat item 16 - Income Taxes – Total, plus Interest Expense. Finally, NETINC5 is the five year average of Income before extraordinary items divided by Total Assets.

4.2.2c Environmental Variables.

Four of the five environmental variables are similar in that they all use the Record of Decision (ROD) dollar estimates for a base. RODSUM_TA5 is the total of the ROD estimates for each site that a particular firm has been named as a PRP, divided by TASSETS5. RODSPLIT_TA5 is sum of the equal shares (total ROD estimate divided by the number of PRPs at the site) of the ROD dollar estimate at each site the firm has been named as a PRP, divided by TASSETS5. RODCOMP_TA5 is the same except that the ROD estimate is divided equally among only the Compustat firms at the site. RODCAP_TA5 is similar to RODCOMP_TA5, except that the ROD estimate is divided on a pro rata share among the Compustat firms based on market capitalization. The final environmental variable is PRPNO_TA5, which is the sum of all notices sent to a firm by the end of the year preceding the bond issue, divided by TASSETS5.

These control and response variables were used in the models described above. The statistical analyses and results of those analyses are discussed in Chapter 5 and illustrated in tables appended to this study.

Chapter 5

Analysis of Results

This chapter describes the results of analyzing the sample using the information sources, methodologies, and models described in previous chapters. This chapter also provides descriptive statistics for the sample, and the results of a number of diagnostic tests both formal and informal, which were done to verify the validity of the regression results. Results of Logistic and OLS regressions are shown for the bond-rating model, and results of OLS regressions are shown for the bond yield model. Finally, support for the hypotheses presented in Chapter 3 are discussed and the relationship of these findings with prior studies is analyzed.

5.1 Descriptive Statistics

Descriptive statistics are presented in Table 2. Table 2 is divided into three panels with three sections in each of Panels A and B. Panel C includes the variable definitions. Section 1 of Panel A, Table 2 contains the range of terms (maturity) for the bond issues in the sample, which range from 3 years to 100 years. The average term is slightly over 20 years but the distribution is highly skewed. A histogram of the range of maturities is presented in Figure 1. Most of the issues fell into two groups, ten years and thirty years with the largest single frequency at a maturity of ten years. The dominance of issues with terms of less than twenty years in the sample may help explain the paucity of sinking fund provisions for the sample bond issues.

The dependent variable yield measures are shown in Section 2 of Panel A, Table 2. The offer yields varied from a low of 5.65% to a high of 12 % with an average of 7.231%. The Treasury Yield Index ranged from 5.34% to 7.4% with an average of 6.391%. The average relative yield premium (RP) was 13.0% of the date-matched Treasury index. This means that issues of corporate debt required a premium of 13.0% over the Treasury yields during the sample period, or a spread of approximately 84 basis points. The averages are from the entire sample pooled across all maturities and all ratings. The interest rate environment appears to have been fairly stable for the period 1995 to 1997.

Also notice in Section 2 of Panel A, Table 2 that the range of the variable RP was from -0.173 to 1.027. A negative yield premium indicates that the Treasury index was higher than the issue's offer yield. To investigate this phenomenon the sample was sorted by RP, which revealed that 15 issues had negative yield premiums. The issue-specific information for 60 of the bond issues with the lowest RP was checked again in Moody's and Investment Dealer Digest. Two of the issues had incorrect data (Moody's and Investment Dealer Digest disagreed and I deferred to Investment Dealer Digest) but the preponderance of the issues with low RP had embedded put options. These issues appear to take on the character of an issue with a maturity closer to the put date than the stated maturity, as would be expected given the analysis of Kalotay and Abreo (1999). To model the presence of the embedded put options, a new variable is constructed similar to that used to model call features (CALVAR) and is calculated by dividing years to put by years to maturity (PUTVAR).

Bond yield control variables are reported in Section 3 of Panel A, Table 2. The average size of an issue is a little over $235 million and ranges from $10 million to $1 billion. A histogram of issue sizes is shown in Figure 2. MRNO and MRNOCONS are the numerical equivalent of ratings as described earlier. The average ten-day interest volatility was .058 or roughly six (6) basis points.

Of the total sample of 357 issues, thirty-six (36) issues were callable and twenty-seven (27) issues were putable. As discussed in Chapter 2, in 1995, bond issuers began to offer a new feature called a "make-whole" provision. The final sample included sixty-six (66) issues with a make-whole provision.

Section 1 of Panel B, Table 2 shows the descriptive statistics for the control variables used to model bond ratings. Ten issues of the total sample were subordinated. Investment risk is modeled by a firm's Beta (BETAV) taken directly from CRSP. The average Beta is slightly less than one at .981. Total Assets range from a low of $130 million up to $221 billion and average about $14 billion. Long Term Debt as a percentage of Total Assets (LTD_TA5) ranged from near zero to over ninety percent, with an average of approximately twenty-three percent. Net Income before extraordinary items as a percentage of Total Assets (NI_TA5) averaged nearly five percent. Interest Coverage ranged from -12 to almost 20, but these extreme values were rare in the sample. Only 5 issues were by issuers with negative interest coverage.

Environmental variables are shown both raw (Section 2 of Panel B, Table 2 in millions of dollars) and scaled (Section 3 of Panel B, Table 2) by the five-year average of total assets. The average for RODSUM_TA5 is six and one-half percent of total assets. Other environmental estimates are smaller than RODSUM_TA5, with RODCOMP_TA5, or the ROD estimates spread evenly among all Compustat firms at a site, at about one-half of one percent. The number of notices that a firm has received, PRPNO, ranges from one (1) to ninety-nine (99). The average number of notices for each bond issue is over fourteen (14) but the median is close to ten (10) and over twenty-five percent of the sample of issues had received three or less notices.

Panel A, Table 3 displays the frequency of occurrence for each two-digit SIC code included in the sample. The industry with the most members in the sample is the Chemicals and Allied Products industry with fifty-six (56) issues or about seventeen percent of the sample. Other well-represented industries include Food and Kindred Products, Paper and Allied Products, Railroad Transportation, Instruments and Related Products, Machinery, except Electrical, and General Merchandise. In all, thirty-three (33) two-digit SIC code industries are represented.

Panel B, Table 3 lists the groupings made to construct industry dummies for the bond rating models. Groups were formed to consolidate industries that contained only a small number of members, and to reduce the number of dummy variables to a parsimonious level. Generally, groups were formed with members within the same one-digit SIC code with the exception of the Petroleum and Coal products industry which was grouped with plastics and metal, and the service industries which were grouped with merchandising. Petroleum and Coal products appeared to fit better with metals and plastics than with other industries in the two-digit SIC code range of 20-27. Because of the small numbers of sample members among the service industries, these were arbitrarily grouped with merchandising industries. Alternate groupings were tested and the results were substantially the same.

A more detailed breakdown of ratings across the sample is shown in Table 4. Most of the issues are in the lower end of those issues termed investment grade, which include categories A and BAA. About ten percent of the issues (34 out of 357) are in the non-investment grade categories of BA and B, typically termed "junk" bonds. This percentage of junk bonds is small in comparison to the proportion of high-yield bonds issued in the sample period as reported in S&P's CreditWeek (1/7/1998), which reports a total of 602 issues rated below BBB (Moody's Baa) out of 1417 total issues for 1997. The aggregate numbers of issues by rating category include financials and utilities in addition to industrials. On the surface, it appears that firms with contingent environmental liabilities are not as likely as the general population of debt-issuing firms to issue high-yield debt.

Tables 5 and 6 contain correlation coefficients for the bond rating variables and the bond yield variables respectively. The Pearson correlation coefficients are listed in the lower diagonals and the Spearman rank order correlation coefficients are listed in the upper diagonal. Spearman correlations are useful for uncovering a possible non-linear pairwise relationship between variables because they are calculated with ranks instead of by linear association (Ott 1993). If the Pearson and Spearman correlations differ, this is an indication of a possible non-linear relationship. Note that the correlations between issue size (SIZELN) and total assets (TASSETS5) differs by a large amount with a Pearson correlation of .345 and a Spearman correlation of .572. Other potential difficulties in the behavior of some of the control variables are revealed in the tables. All of the environmental variables are positively related to risk premium (RP) and bond rating (MRNO) except RODCAP. RODCAP has very similar correlations with RP when compared to the relationship between total assets and RP. Beta (BETAV) also has a negative relationship with RP and MRNO, which is the opposite from what is expected based on prior research.

5.2 Diagnostics

Initial regressions for all model variations were run and diagnostic statistical output was generated to help determine if the models were well specified. In particular, four types of problems that are typical for regression results are examined: multicollinearity, outliers or high leverage data points, autocorrelation, and heteroscedasticity. Both formal and informal tests recommended by Myers (1990), Hair, et al. (1995), and Montgomery and Peck (1992), are utilized, most of which are available in SAS.

5.2.1 Multicollinearity

To determine if the results of the initial regressions were subject to multicollinearity, output was obtained that included condition indexes and variance inflation factors. As well, the regressions for different specifications were examined to see if variables appeared unstable in regards to sign and magnitude given inclusion or deletion of different variables. Generally, this informal test indicated that the regression estimates appeared stable. Several variables had the wrong sign or unstable signs under various specifications, although these variables had parameter estimates that were not statistically different from zero. One variable that had been shown to be a significant control variable in earlier research was SIZELN, or the size of the issue. In fact, if one examines Table 6, the Pearson Correlation Coefficients for the bond yield model, one can see that the correlation is negative, just as theory predicts it would be. Montgomery and Peck (1992) state that examining correlations in a multiple regression equation is not particularly useful because the simple correlation between two regressors is difficult to disentangle in a multiple variable environment. Therefore, a more formal test is to examine the statistical output of tests for multicollinearity, which include the condition indexes and variance inflation factors.

Some of the problems associated with multicollinearity are that the coefficient estimates are inflated so that significance is indicated when it is not warranted and that the model coefficient of determination is too large. A variance inflation factor for a variable represents the inverse of one minus the coefficient of determination for that variable regressed against the other independent variables in the model. A value near one indicates that the variable is not highly correlated with the other variables while a value greater than 5 to 10 indicates a problem with multicollinearity (Montgomery and Peck 1992).

Eigenvalues of the matrix of regressors is another indicator of multicollinearity. If the eigenvalues (one for each independent variable) are all near one, then the data is orthogonal and little collinearity exists among the variables. On the other hand, if any eigenvalues are near zero, then some linear dependence exists. A method of analyzing the near zero eigenvalues is to look at the proportion of variation that each variable contributes to the eigenvalue. A value of greater than .80 for more than one regressor shows that the problem is between the variables that contribute the high proportions. A measure of the distance between eigenvalues is the condition index. A condition index as reported in SAS is actually the square root of a condition index as defined by Montgomery and Peck (1992). Myers (1990) states that multicollinearity is a problem if the condition index (as defined in SAS) exceeds 30, while a value between 10 and 30 indicates that there is some collinearity among the variables.

Table 7 presents the condition indexes and related eigenvalues for the primary model of bond yields with bond rating model control variables included. Only one specification is shown because all of the specifications were nearly identical. One condition index is in excess of 30. The proportion of variation for that eigenvalue was examined, which revealed that the problem variable is SIZELN (the raw size variable presents similar problems). The primary problem is a correlation between size and the intercept, which is not a serious problem (Myers 1990). No Variance inflation factors are in excess of 1.5, which indicates that the variables are not highly correlated.

Two informal methods exist for detecting the extent of multicollinearity. The R^2 for the current regressions can be compared to prior research using similar models to determine if the coefficients of determination for the models are similar. In addition, the various variable selection procedures can be performed to determine if variables enter or leave the model in the same order (Myers 1990). One of the base model specifications (Table 14) has an R^2 of .718, while research by Maher and Thompson (1997) have a reported R^2 of .7102 for a similar model. This indicates that the current models appear to be well specified. Forwards, backwards, and stepwise variable selection was performed and the variables entered or left the model in the same order indicating informally that multicollinearity does not appear to be a problem.

5.2.2 Outliers and High Leverage points

Outliers and high leverage points are referred to as a part of a larger set of influential data points by Montgomery and Peck (1992). But Myers (1990) makes a distinction between them by defining outliers as "observations not fitted well by the model" and high leverage points as "a legitimate data point that is remote from the rest of the data". A method commonly used to detect outliers is the R-Student statistic, which detects large residuals (poor fitting data points). Montgomery and Peck (1992) suggest using an informal rule of thumb cutoff value of anything in excess of 2.0. Any data point that greatly exceeds this value should be investigated to determine if it should be deleted from the sample.

High leverage points can be detected for the entire model or on a variable by variable basis. The measure DFBETA was used to detect high leverage points for specific variables because the focus of this study is on the environmental variables. Significant values of DFBETA are computed for the sample as 2 divided by the square root of the sample size. That calculation yields a cutoff of .106.

The influence diagnostics were obtained for the sample using the influence option for PROC REG in SAS. Table 8 shows the sample data points that exceeded the respective cutoffs. Fifteen (15) outliers and thirteen (13) high leverage points were identified. Of the fifteen outliers, only three are greatly above the cutoff of 2, Great Lakes Chemical Corp., Interlake Corp. and to a lesser extent, an issue of Unisys Corp. Another model-wide diagnostic for influence is the DFFITS. An informal cutoff recommended for the DFFITS statistic is any value in excess of 1.0. Again, two observations are greatly in excess of the cutoff, while one is somewhat above it. Interestingly, the DFBETA diagnostic also indicates two data points with values greatly in excess of the calculated cutoff. One of the firms is Great Lakes Chemical Corp. identified above and the other is Lilly Industries, Inc., both of which are members of the Chemicals and Allied Products Industry (SIC Code 28). Later in the analysis, results are presented from regressions run excluding the data points identified in Table 8. Not surprisingly, the R^2 increases for the various specifications because the model now fits the data better, although the main results remain the same.

5.2.3 Autocorrelation

The data for this study is collected for three years. Some firms are in the sample for more than one year or issue bonds more than once in a year. The sample of 357 bond issues is pooled across the three years of the study. A possible problem is that the observations are correlated across time meaning that the regression assumption of uncorrelated (independent) error terms will be violated. A positive autocorrelation will give inflated significance to the independent variables because the mean square error for the model is underestimated (Montgomery and Peck 1992).

The Durbin-Watson statistic generated by SAS, tests for positive autocorrelation. If a Durbin-Watson statistic is close to 2.0 then no serious autocorrelation exists. A tabled cutoff is available from Myers (1990) which gives a value for $p<.01$ of 1.65 (for the largest sample size and independent variables (K) of 100 and 5 respectively). If the test statistic calculated by SAS exceeds this value then the researcher should fail to reject the hypothesis of no positive autocorrelation. The values for the primary regression of a bond yield model which includes bond rating model variables range from 1.77 to 1.798 indicating that positive autocorrelation is not a serious problem with the sample.

5.2.4 Heteroscedasticity

One of the important assumptions for regression analysis is that the model error terms are homogeneous over the range of values for the dependent variable. In a multiple regression environment, tests need to be performed for the entire model and not just one variable, because identifying and correcting one variable's relation to the residuals may cause problems for other variables (Myers 1990). SAS has two related procedures for testing the homogeneous error term assumption. The SPEC procedure is a Chi-square test for the first and second moment specification. Failing to reject means that the model has homogeneous variance. The second test is for individual variables. Each variable can be tested by using the results of an heteroscedastically consistent covariance matrix, to see if the parameter estimate is really different from zero (SAS/STAT User's Guide, Volume 2 1990). This procedure is similar to White's test (White 1980). The procedure in SAS that generates a restated covariance matrix is ACOV.

The results of testing for heteroscedasticity are shown in Table 9. Panel A indicates that each of the specifications except those for RODCAP_TA5 are deemed to have homogeneous variance. In a test for each of the individual environmental variables reported in Panel B, the results of using an ACOV estimate yields similar probabilities of the coefficients being different from zero. One of the difficulties of utilizing the Test statement in SAS is that indicator variables like SUBORD cause the procedure to violate an assumption of the test because the covariance matrix has singularities (many zeros in the column for a particular variable). To determine if the test results reported in Table 9 are correct, the tests were rerun without the variables SUBORD, CALVAR, and PUTVAR and similar results obtained. The models do not appear to be subject to heteroscedasticity of the error terms. In summary, the regressions appear to be well-specified.

5.3 Tests of Hypotheses

In Chapter 3, three hypotheses are proposed that relate to the manner in which environmental liabilities are expressed in the debt market. After completing the diagnostic tests above, the proposed regressions are run using the full data set of 357 issues. Later, results show that using a data set sans outliers, high leverage points, large observations and specifications with alternate variable formulations give similar results.

5.3.1 Hypothesis 1

Hypothesis 1 states that external estimates of a firm's environmental liabilities are positively related to a firm's bond rating. That is, the larger the liability estimate, the larger the bond rating based on a scale of AAA = 1 to B = 6 (or B3 = 16 in the expanded version of the rating variable). This hypothesis is tested using two different dependent variable formulations. As stated in Chapter 4, logistic regression is well suited to the modeling of bond ratings but some research has used OLS regression with reasonable results (Kaplan and Urwitz 1979, Ederington 1985). Industry dummies are used in addition to the other control variables because Graham, Maher, and Northcut (2000) found that industry dummies increase the model's likelihood ratio, a measure of model fit in logistic regression.

Table 10, Panel A, shows results using a logistic regression model where bond ratings are grouped into six rating categories, AAA=1 to B=6. Coefficients and related statistics for the intercepts and industry dummies are shown in Panel A, and only the financial variables, including the external estimates of environmental liabilities, are shown in Panel B. The model's likelihood ratio of 246.852 is significant at the .0001 level. The primary control variables are significant and have the correct signs except BETAV, which is the firm beta taken directly from CRSP; and INTCOV5, which is the ratio of interest expense to net income before extraordinary items, interest expense, and taxes. Both control variables with incorrect sign are not significant with p-values of .187 and .407 respectively.

Panel B shows the results of the logistic regression with the external estimates of environmental liability. The most significant estimates are PRPNO_TA5 with a Wald's Chi Square of 43.137, RODSUM_TA5 at 40.328, and RODCOMP_TA5 at 7.255. The ordering of significance level is similar to those reported in Graham, Maher, and Northcut (2000) and Barth and McNichols (1994) except that RODSPLIT_TA5 is not significant. As in Barth and McNichols (1994), the most significant estimate is the number of times named as a PRP at a Superfund site. The likelihood ratios for the various specifications indicate that the formulations with PRPNO_TA5 and RODSUM_TA5 dominate the other estimates by a wide margin. This trend of the ordering and significance of the environmental estimates continues in the other regressions reported later for both bond ratings and bond yields.

One of the environmental estimates that has the wrong sign and is significant only in the bond-rating model is the estimate RODCAP_TA5 (see Table 2, Panel C for variable definition). One possibility for the incorrect sign on the RODCAP variable is that because the ROD costs are apportioned based on market valuation, then RODCAP_TA5 is already scaled by a measure of firm size. Even after dividing through by assets, the correlation with assets is still strongly positive, while the other ROD variables are negatively correlated with assets (after scaling). The effects of RODCAP may be swamped by the firm size effect.

The logistic regressions were run with a more detailed breakdown of the dependent bond-rating variable. The rating variable, MRNO, has sixteen levels ranging from AAA = 1 to B3 = 16. The results reported in Table 11, Panels A and B, are similar to those in Table 10. The control variables and the environmental estimates have similar coefficients and levels of significance.

OLS regressions were run with the same set of control variables including industry dummies. Just as in the previous tables, the base specification is reported in Panel A of Table 12, and Panel B of Table 12 shows the results of adding the environmental liability estimates. Table 12 uses the rating variable with six levels, MRNOCONS and Table 13, Panels A and B, show results with the sixteen level rating variable, MRNO. The base model has an adjusted R^2 of .4817 (.5487 for the sixteen level rating variable), which indicates adequate model fit and compares favorable to the results reported by Kaplan and Urwitz (1979). All control variables have significant explanatory power except for BETAV and INTCOV5, which are insignificant with p-values of .312 and .218 respectively. This is similar to the logistic regression results. The results presented in Table 12, Panel B, are also similar to the logistic regression results in that PRPNO_TA5 and RODSUM_TA5 dominate the other environmental estimates. As in the logistic regressions, RODCAP_TA5 has an incorrect sign and is significant.

Despite increased regulatory scrutiny, greater public awareness of environmental matters, and attempts by firms to present a “green” image, the externally generated environmental estimates of the sample firms’ potential contingent liability still have significant explanatory power. This is interesting because many of the sites have been involved in the regulatory process for well over ten years. Given the Congressional Budget Office (CBO’s) prediction that sites take an average of 16 years to fully remediate, bond raters apparently feel that firms have not adequately accrued for the liability. Alternately, current remediation estimates may just be indicators of liabilities yet to be incurred even in a contingent sense. That is, bond raters may feel that current estimates are indicators of future undiscovered environmental liabilities and so assess the firm for liabilities that could not be estimable by the firm because they are yet to be known. The results reported in Tables 10, 11, 12, and 13 support Hypothesis 1. External estimates based on EPA data are significantly associated with bond ratings in a recent time period characterized by increasing regulatory scrutiny.

5.3.2 Hypothesis 2

The main thrust of this study is to show that environmental liability estimates are positively related to bond yields for new debt issues. The results suggest that the external estimates are important as indicator variables for bond yields when combined with control variables used to proxy for default risk. The results indicate that the ranking of the significance of the various external estimates is consistent with the results of the bond-rating model. The largest estimates are most associated with the cost of debt, although the best estimate is simply the number of times that the firm has been named as a PRP. Table 14 contains the main results.

The first column is the baseline specification that includes only the control variables for the issue itself (size of issue, call and put features, and interest rate volatility) and control variables from the bond rating model. This formulation has an adjusted R^2 of .473. This coefficient of determination is close to those reported in Lamy and Thompson (1988) which indicates that the specification does a reasonable job of modeling bond yields.

The environmental variables are added one at a time and the resulting R^2s range from a high of .489 to a low of .472. The rank order of the environmental estimates in terms of t-statistics is PRPNO_TA5, RODSUM_TA5, RODCOMP_TA5, RODSPLIT_TA5, and RODCAP_TA5, which is similar to the results from the bond rating models. The control variables that have significant t-statistics, CALVAR, PUTVAR, SUBORD, TASSETS5, LTD_TA5, and NI_TA5, have consistent signs across all the specifications.

The variable IVOL is not significant in any specification. This is consistent with results described in a recent study by Maher and Thompson (1997). Issue Size (SIZELN), Beta (BETAV), and interest coverage (INTCOV5) were not significantly associated with bond yields for any of the specifications. Beta has the wrong sign in the results reported here, which is consistent with the correlations presented in Tables 5 and 6. The CRSP betas do not appear to be useful indicator variables in any of the specifications. The lack of explanatory power for interest coverage is different from some recent studies (Sengupta 1998) but is consistent with the results presented in Kaplan and Urwitz (1979). The variable representing issue size is discussed more completely below.

To test for the influence of outliers and high leverage points, the regressions were run excluding those data points identified in Table 8. The results are presented in Table 15. The new parameter estimates are shown, along with each estimate's associated p-value, the revised model specification F-value, and the new adjusted R^2. The comparison statistics are taken from Table 14. The environmental estimates are similar in significance and parameter estimate but the adjusted R^2 has increased. Not surprisingly, the model fits the data better when data points that are well off the predicted regression hyperplane are discarded.

The variable SIZELN, or the natural log of issue size is predicted to have a negative relationship with risk premium. The fact that it is not significant in these regressions may be due to factors concerning defaults discussed in DeRosa-Farag, et al. (1999) or perhaps the variable proxies for some other issuer characteristic as suggested by Crabbe and Turner (1995). Datta, et al. (1999) and Jewel and Livingston (1998) have found similar (non) significance levels for issue size for samples drawn from the mid 1990s and Jewel and Livingston (1998) report a positive coefficient for issue size in their study of split ratings. But because the variable approaches significance in at least one specification in Table 14 (for the RODSUM_TA5 specification), and the sign is positive instead of negative, issue size is examined further.

To measure whether issue size interacts with firm size, a dummy variable was created that separates firm size into quartiles. Each dummy is then tested in interaction with issue size to see if issues by relatively small firms are different from issues by relatively large firms. The results (not tabled) indicate that issue size is positively related to risk premium for the smallest three quartiles of firm size but is negatively related (p-value of .0008) to risk premium for the largest quartile of firms in the sample as measured by total assets. Other variables in the regressions retain their signs and significance except that the variable for total assets is no longer significant, which may be a result of multicollinearity with the dummy variable. This may explain why issue size is not significant but positive for the sample as a whole. Given the results reported by Crabbe and Turner (1995), issue size may proxy for some other issuer characteristic that is related to firm size. Further research in this area may be warranted.

The results in Tables 14 and 15 indicate support for hypothesis 2. Externally generated environmental remediation liabilities appear to have significant explanatory power for modeling bond yields when the estimates are combined with other control variables used to proxy for default risk. The next section illustrates that when externally generated environmental liability estimates are combined in a model of bond yields with the issue's bond rating, the environmental liability estimates lose their explanatory power.

5.3.3 Hypothesis 3

The third hypothesis is tested by utilizing the bond yield model above, and including a measure(s) for bond rating. Two alternate measures are utilized. The bond rating as a polychotomous variable ranging from 1 = AAA to 16 = B3, and a series of rating dummies with MRNOCons1 = AAA and MRNOCons5 = BA and lower. Only the sixteen-level polychotomous rating variable is used to more closely simulate a continuous variable. The results reveal that under either formulation, the bond rating captures most of the explanatory power of the external environmental remediation liability estimates.

The results are presented in Table 16, which shows the polychotomous rating formulation, and Table 17, which shows the rating dummy formulation. Overall, the rating dummies provide a much better model fit, with an average R^2 of nearly .72, versus an average R^2 of .57 for the polychotomous version of the rating variable. The other control variables perform in the same manner in either model and the environmental estimates never approach significance in either formulation. These regressions were performed with the financial statement control variables used in the bond-rating model and none of the default risk financial variables were significant except subordination status. Thus, hypothesis 3 is not supported. Bond ratings appear to capture the firm's information concerning environmental liabilities, and these external estimates provide no additional explanatory power when included with the firm's bond rating in a model of bond yields for new issues.

5.4 Alternate specification for Make-Whole Call Provision

An alternate way of specifying the make-whole call provision is to recognize that the provision is a subset of callable bonds. Therefore, in addition to coding the provision as a dummy variable, any issue with a make-whole call provision is also coded in the CALVAR data as an issue that is immediately callable (value of 1). The logic is that a make-whole provision makes the call option initially less costly to the issuer. If the provision is coded as both a call option that is immediately callable and separately as a dummy variable, the coefficient on the MW variable should have the opposite sign from that reported in Tables 14, 16, and 17. Additionally, if the coefficients exactly offset each other, then the make-whole provision has no net effect on the cost of debt.

To determine the effect of the provision under this coding scheme, a test of the linear combination of the coefficients is performed. The test is an F-test under the hypothesis that the sum of the coefficients is equal to zero. Results of the alternate coding are presented in Tables 18 and 19. The new tables correspond to Tables 14 and 17. The results shown in the new tables are the same for all variables except for the make-whole dummy, which now has a negative coefficient. The sum of the coefficients for the call variable, CALVAR, and the make-whole variable, MW, is the amount of the premium (discount) required by the bond buyers, providing the sum is positive (negative). In these results, the difference is positive indicating that the issuer must pay an additional risk premium to include the make-whole provision in the bond issue. A test of the significance of the combination of the two offsetting coefficients indicates that the sum is significantly different from zero at a p-value of less than .01.

5.5 Analysis of Results

Taken as a whole, the results indicate that bond yields are impacted by the presence of contingent environmental liabilities for the firm. The effect is indirect, through the bond ratings. These results suggest that bond ratings are particularly important for bond issues offered by firms with contingent environmental liabilities.

The time frame of this study is a period characterized by increasing recognition levels by firms of their contingent environmental liabilities (Gamble, et al 1995, Barth, et al. 1997, Price Waterhouse 1994). To some extent, this is due to increased regulatory scrutiny by the SEC (Stanny 1998). Other causes for higher levels of reporting may include increased public policy pressure (Walden and Schwartz 1997) and the presence of publicly available external estimates (Li, et al. 1997). Given the better environmental reporting trends that studies have reported using data from earlier time periods (mainly from the mid 1980s to the early 1990s), the strength of the external estimates in this study using a later time period indicates one of two possible explanations.

The results suggest either that firms are still reporting their liabilities poorly, or that the capital markets impute a liability greater than what firms would reasonably estimate as their fair share of currently identified clean-up costs. The latter explanation appears more plausible for three reasons. Li and McConomy(1999) find that in a model for costs of capital, investors impute a greater than face value cost for environmental liabilities as reported by the firm. Second, this study, and others before it, have found that the largest estimates appear to have the most explanatory power in models of bond ratings and bond yields. These large estimates do not seem reasonable if investors and bond raters are imputing a liability that would only cover the currently identified clean-up costs. Finally, the SEC has indicated that it will not tolerate the poor reporting practices of earlier time periods (Stanny 1998). The position of the SEC with regard to reporting levels coupled with the average ages of currently identified sites means that firms are more likely to make at least a reasonable effort to recognize environmental liabilities. This is because the firms are under more pressure to report their liabilities and the uncertainty over the ultimate outcomes has decreased (Campbell, et al. 1998).

Ederington, et al. (1987) and Ziebart and Reiter (1992) report the incremental information content of financial statement information, over and above bond ratings in a model of bond yields. Ziebart and Reiter (1992) though, find that Moody's ratings appear to capture most of the information from financial statements. Findings in this study using Moody's bond ratings are similar to Ziebart and Reiter (1992) in that financial statement information does not appear to have incremental explanatory power beyond that included in the bond ratings in a model of bond yields.

One difference between this study and other studies (Backmon and Vickery 1997 and Graham, Maher, and Northcut's 2000), is that this study shows that the bond ratings appear to impound the information provided by contingent liabilities with regard to the bond yield of an issue. In the broader sense, the importance of contingent liabilities for default risk is suggested by the results reported by Helwege (1999), who found that contingent liabilities are a determinate for the length of time that a junk bond will spend in default. It is not surprising then, that as this study finds, contingent liabilities have an indirect influence on bond yields through the bond ratings.

Datta, et al. (1998) suggest that the conventional wisdom in the bond markets is that bond ratings are important for investment grade bonds because investment grade bonds are more of a commodity and are purchased primarily by rating. They also suggest that ratings are relatively unimportant for non-investment grade bonds because investors concentrate more on firm-specific information. Recent articles in Investment Dealer Digest reflect this sentiment by quoting various investment bankers about the irrelevance of bond ratings, particularly for junk bonds (IDD 6/9/97, IDD 4/14/97). The findings of this study and Helwege (1999) appear to contradict this sentiment concerning the usefulness of bond ratings. The length of time in default for junk bonds is affected by the presence of contingent liabilities. If the information concerning environmental liabilities (among other contingent liabilities) is contained in the bond ratings, then bond ratings should be quite important for those who wish to invest in bonds issued by firms with such liabilities.

In summary, the findings of this study suggest that bond yields are affected indirectly by contingent environmental liabilities through the bond ratings. Despite a probable increase in the levels of the reporting and recognition of these liabilities, external estimates still appear to be useful proxies for the amount of contingent environmental liabilities that bond raters and bond buyers believe that a firm will ultimate bear. The final chapter that follows concludes with contributions of this study to the existing literature, limitations of this study, and implications for future research.

Chapter 6

Contributions and limitations

6.1 Findings and Contributions

The primary findings of this study are that external measures of a firm's contingent environmental remediation liabilities based on EPA data are positively associated with a firm's cost of debt. The effect on the firm's cost of debt is indirect, through the bond ratings. The measures which are most associated with a firm's bond rating and its cost of debt are either the largest measures, or the simple measure of the number of times the firm has been named as a potentially responsible party at a Superfund site.

Earlier research has found that the external measures appear to be reasonable proxies for a firm's contingent environmental liabilities (Barth and McNichols 1994) and that the largest measures have the most explanatory power in bond ratings models (Graham, Maher, and Northcut 2000). Li and McConomy(1999) find that investors value the monetary disclosures that firms make at more than face value. The findings of Li and McConomy(1999) provide some intuition for the findings of the current study and Graham, Maher, and Northcut (2000) that the largest measures appear to be more associated with a firm's cost of debt. These findings are contrary to the notion that the best proxy for contingent liabilities should be the one that is closest to what the firm will bear of the currently identified contingencies. The market may, in fact, impute a larger estimate that accommodates the potential for future liabilities of a similar type.

The sample period of this study includes financial information for firms from 1994 to 1996. This period is subsequent to periods of increasing levels of recognition for contingent environmental liabilities as reported in Barth, et al. (1997), Mitchell (1997), Stanny (1998), and Gamble, et al. (1995), and is characterized by a much greater scrutiny of publicly listed firm's reporting practices by the SEC (Stanny 1998). That the external estimates are still important in the bond rating and bond yield models in the current time period indicates that firms may not be reporting as well as the capital markets require. Alternately, the capital markets may require a monetary estimate that firms cannot reasonably make, because the estimates would be based on information that is speculative and therefore not verifiable.

Li, et al. (1997), predicts the usefulness of external measures. The existence of external measures should move firms to greater recognition of their environmental liabilities because their ability to withhold information is decreased. The presence of external information coupled with increased regulatory pressure implies that firms are probably making reasonable attempts to recognize their contingent environmental liabilities. The ordering of the explanatory power of estimates based on EPA data is therefore somewhat surprising, unless the external estimates are proxying for costs that are not reasonably estimable by the firm.

The finding that the largest measures have the most explanatory power (other than the simple measure of the number of times named as a PRP) has implications for accounting regulators. Accounting policy is always a balance between reliability and usefulness. Current debate over the usefulness versus the reliability of measures for market exposure in derivatives related to bonds (Barth, et al. 1998) is an example of the problems accounting regulators have in striking the appropriate balance. Calls by recent studies for greater regulation in the reporting of environmental liabilities (Freedman and Jaggi 1996, Gamble, et al. 1995) may be misdirected if the users require information that is not reliably measured by firms as these findings imply.

Backmon and Vickery (1997) show that disclosures concerning contingent liabilities are positively associated with bond yields, and Helwege (1999) finds that the presence of contingent liabilities are a determinate of the length of time spent in default by a junk bond issuing firm. The findings of this study contribute to this stream of research on contingent liabilities and their effects on a firm's cost of capital by showing that contingent environmental liabilities have an indirect effect, through the bond ratings on a firm's new bond issue risk premiums. This result implies that bond ratings are particularly important for firms that have contingent liabilities.

Finally, this study contributes to the bond yield literature by showing the usefulness of including variables that model new features of the bond market. Medium term notes were found to be similar to other bond issues by the same firm despite a much smaller average issue size (Crabbe and Turner 1995). This study finds that medium term notes appear not to be statistically different from other bond issues. In addition, bond issues under the Rule 144A private placement section of the SEC's regulations appear to be poolable with other public debt for statistical purposes.

The effect of make-whole provisions, which are similar to call options, on bond yields is tested as a 0,1 dummy variable in this study and is found to be a useful addition to the bond yield model. No recent studies on this provision were found but the financial press implied that the feature has no value for the investor (IDD 10/23/95). In this study, the feature appears to function like a regular call option in that its presence is positively associated with an issue's relative risk premium.

6.2 Limitations

As in most studies, the use of statistical techniques implies that measurement error may be a problem. To the extent possible, various formulations of models were tested to verify that the findings were not the result of the particular model or statistical technique chosen. Because the data was collected by hand, errors could have been made in the recording or manipulation of the data. Although much care was taken to collect only the correct data, the most likely problem is an error of omission. Some firms that should have been identified as potentially responsible parties may not have been so designated, and some bond issues may have been omitted that should have been included.

The results are determined using only Moody's ratings. Prior research has found that the ratings issued by the large rating agencies are quite similar when used for statistical test, but there are some differences. Ziebart and Reiter (1992) found that Moody's ratings appeared to capture more of the information contained in financial statements as compared to Standard and Poor's ratings. The results may have been biased against finding any additional information content for contingent environmental liabilities in the model of bond yields, although the external estimates for environmental information were found not to be included in the financial statement information regardless.

One potential problem with the conclusions drawn from the results of the study is the value of disclosures by firms without associated accruals for contingent liabilities. The disclosure frequency and severity for contingent liabilities were shown to be associated with bond yields by Backmon and Vickery (1997). Further, disclosure levels and quality of disclosure was shown to be related to a firm's cost of capital (Botosan 1997) and to a firm's bond yield (Sengupta 1998). If firms disclose their environmental remediation liabilities with high quality but systematically have low accruals, then the external estimates may be proxying for this disclosure information. The disclosures would be included in the financial statements but not in the financial information gathered from the Compustat database. The results of prior research on the quality of firm disclosures concerning environmental liabilities mitigates against this explanation, but the possibility still exists.

6.3 Implications for Future Research

Something that cannot be determined from these findings is how the bond rating analysts receive their information. The analysts may be gathering information from external sources like EPA data, or they may gather private information from the firms themselves on likely future environmental remediation costs. In that case, the external measures are merely proxies for the private information obtained by the bond raters. Alternately, the bond rating agencies may use both sources of information by using the

EPA data as an external verification for the information received from the firm. Research on the details of the bond rating process with regard to a bond-issuing firm's contingencies would potentially be useful for accounting regulators.

The value of disclosures is a topic of concern to the accounting community (The Jenkins Report 1998). Further research on the interaction of a firm's disclosures, accruals, and external estimates for contingent liabilities and their value in the capital markets may be useful for accounting regulators. If disclosures about specific issues like contingent environmental liabilities have power in models designed to measure the effects on costs of capital, accounting regulators may find that simply prescribing disclosures without related provisions for accrual on the face of the financial statements is a highly effective remedy.

This study finds that the largest estimates among those tested in prior literature are the most highly associated with a firm's new bond-issue risk premium. A question that remains is what these large measures imply. Are the bond rating analysts imputing a liability which could not reasonably be determined by the firm (because the measures imply an estimate of future costs), or are the bond rating analysts simply using the most conservative measure? The meaning of these large estimates for the capital markets should be investigated.

Tables and Figures

Table 1
Sample Selection Screens

Bond Issues		
Total bond issues for the period 3/1/95 to 2/28/98 *		3,740
Less:	Issues for firms not included in the SIC code ranges: 0 - 4899, 4922-4923, 5000-5999, and 7000-8099, and	1,060
	issues that were asset-backed, guaranteed, Yankee bonds, or containing special features such as MIPS.	1,836
Final bond issue sample before environmental screens		844
Environmental Data		
Total PRP notices listed on the Site Enforcement Tracking System (SETS) through 12/31/99		36,429
Less:	Notices for sites not listed as an NPL site or notices for non-Compustat firms, individuals or government agencies	30,626
Total Compustat firm notices		5,803
Less:	Notices sent after sample end date for financial information - 12/31/96	58
Total PRP notices for sample		5,745
Total sites for Record of Decisions		1,135
Less:	Sites with Records of Decision with no dollar amount	74
Remaining possible NPL sites		1,061
Final Match of Compustat firms with PRP notices and bond issuing firms		
Bond issues before environmental screens		844
Less:	Issues by firms not named as a PRP and not named at an NPL site with estimated costs as evidenced by a non-zero dollar ROD	477
	and with less than five years of financial data on Compustat for computation of Bond Rating variables	10
Final Bond Issue Sample		357

* Excludes floating-rate, convertible and governmental agencies.
Source: Standard and Poor's CreditWeek

Table 2
Descriptive Statistics

Panel A

Variable		N	Mean	Median	Std Dev	Minimum	Maximum
General							
DNUM		357				1000	8051
TERM		357	20.670	12.000	19.360	3	100
Dependent Yield Variable							
YIELD		357	7.212	7.085	0.871	5.65	12
TREASYLD		357	6.391	6.410	0.440	5.34	7.4
RP		357	0.130	0.108	0.120	-0.173	1.027
Bond Yield Model Variables							
SIZE	*	357	235.200	200.000	162.394	10	1000
SIZELN		357	5.262	5.298	0.628	2.303	6.908
MRNO		357	7.493	7.000	2.662	1	16
MRNOCONS		357	3.477	3.000	0.905	1	6
CALVAR		357	0.047	0.000	0.154	0	1
PUTVAR		357	0.019	0.000	0.074	0	0.5
MW		357	0.180	0.000	0.385	0	1
IVOL		357	0.058	0.050	0.031	0.010	0.182

* in millions of dollars

Note : See Panel C for all variable definitions

Table 2, continued
Descriptive Statistics

Panel B

Variable		N	Mean	Median	Std Dev	Minimum	Maximum
Bond Rating Model Variables							
SUBORD		357	0.027	0.000	0.163	0	1
BETAV		357	0.981	0.947	0.414	-0.011	3.144
TASSETS5	*	357	13,986	4,982	31,298	130.386	220,997.440
LTD_TA5		357	0.230	0.217	0.134	0.000	0.912
INTCOV5		357	0.344	0.236	1.337	-12.692	19.702
NI_TA5		357	0.047	0.046	0.035	-0.084	0.178
Environmental Variables Unscaled							
PRPNO		357	14.428	10.000	15.710	1.000	99.000
RODSUM	*	357	292.264	183.430	323.848	1.264	2013.076
RODSPLIT	*	357	8.647	2.843	14.871	0.013	95.381
RODCOMP	*	357	26.995	9.643	44.010	0.049	341.017
RODCAP	*	357	40.024	8.788	91.235	0.001	672.511
Environmental Variables Scaled by Total Assets							
PRPNO_TA5		357	0.003	0.001	0.006	0.000071	0.068
RODSUM_TA5		357	0.065	0.030	0.098	0.000692	0.961
RODSPLIT_TA5		357	0.002	0.0004	0.003	0.000005	0.030
RODCOMP_TA5		357	0.005	0.002	0.008	0.000033	0.051
RODCAP_TA5		357	0.004	0.001	0.007	0.000001	0.059

* in millions of dollars
Note : See Panel C for all variable definitions

Table 2, continued
Descriptive Statistics

Panel C

Variable Definitions

RP	relative risk premium, which is the offer yield minus the matched constant maturity Treasury yield divided by the matched constant maturity Treasury yield
SIZELN	the natural log of the issue size in millions
CALVAR	the years to call divided by the years to maturity. The value ranges from 0, no call to 1, immediately callable.
PUTVAR	the years to put divided by the years to maturity. The value ranges from 0, no put to 1, immediately putable.
MW	a 0,1 dummy variable indicating the presence of a make-whole provision, 1 or no make-whole provision, 0.
IVOL	the absolute variation of the term matched Treasury constant maturity index ten days prior to the issue date.
MRNO	Moody's bond rating for the issue ranging from 1=AAA to 16=B3.
MRNOCONS	Moody's bond rating ranging from 1=AAA to 6=B (ratings above consolidated into six categories).
SUBORD	a 0,1 dummy variable indicating whether or not the issue is subordinated, 1 or not, 0.
BETAV	the firm's end of year BETA taken from CRSP for the year prior to issue.
TASSETS5	the five year average of the firm's end of year total assets taken from the Compustat database.
LTD_TA5	the five year average of the firm's total long-term debt divided by total assets.
INTCOV5	the five year average of the firm's interest expense divided by income before taxes and interest.
NI_TA5	the five year average of the firm's net income divided by total assets.
PRPNO_TA5	the number of times the firm has been issued a PRP notice letter, divided by the five year average of total assets.
RODSUM_TA5	the costs of remediation for a site summed across all sites at which the firm has been named as a PRP, divided by the five year average of total assets.
RODSPLIT_TA5	the costs of remediation for a site divided evenly among all PRPs at the site, then summed across all sites at which the firm has been named as a PRP, divided by the five year average of total assets.
RODCOMP_TA5	the costs of remediation for a site divided evenly among the Compustat PRP's named at the site, then summed across all sites at which the firm has been named as a PRP, divided by the five year average of total assets.
RODCAP_TA5	the costs of remediating a site divided proportionately among Compustat PRP's based on market capitalization, summed across all sites at which the firm has been named as a PRP

Table 3
Bond Issues by Two-Digit SIC Codes

Panel A

Industry Name	*Two Digit SIC Industry*	*Frequency*
Metal Mining	10	1
Oil and Gas Extraction	13	7
Heavy Construction Contractors	16	1
Food and Kindred Products	20	18
Tobacco Manufacturers	21	8
Textile Mill Products	22	3
Apparel and Other Textile Products	23	1
Lumber and Wood Products	24	3
Furniture and Fixtures	25	6
Paper and Allied Products	26	26
Printing and Publishing	27	12
Chemicals and Allied Products	28	55
Petroleum and Coal Products	29	7
Rubber and Misc Plastics Products	30	3
Stone, Clay, and Glass Products	32	3
Primary Metal Industries	33	13
Fabricated Metal Products	34	4
Machinery, Except Electrical	35	26
Electrical and Electronic Equipment	36	14
Transportation Equipment	37	18
Instruments and Related Products	38	22
Railroad Transportation	40	31
Communications	48	4
Electric, Gas, and Sanitary Services	49	10
Durable Goods	50	5
NonDurable Goods	51	16
General Merchandise	53	18
Food Stores	54	6
Furniture and Equipment Stores	57	1
Eating and Drinking Places	58	4
Hotels and Other Lodgings	70	3
Business Services	73	7
Health Services	80	1
Total Issues		357

Panel B

	Idustries were Grouped to form the following Industry Dummies:		*Frequency*
SIC Codes	10,13,16,20,21	Ind20	35
	22,23,24,25,26,27	Ind26	51
	28	Ind28	55
	29,30,32,33,34	Ind33	30
	35	Ind35	26
	36,37	Ind37	32
	38	Ind38	22
	40	Ind40	31
	48,49	Ind49	14
	50,51	Ind51	21
	53,54,57,58,70,73,80	Ind53	40
	Total Issues		357

Note: See text in Chapter 4 for explanation of industry groupings.

Table 4
Distribution of Sample Bond Issues Across Rating Catagories

MRNOCONS	Moody's Rating	Frequency
1	AAA	4
2	AA	28
3	A	171
4	BAA	120
5	BA	22
6	B	12
	Total sample issues	357

MRNOCONS is the condensed bond rating variable used as both a dependent variable in the bond rating models and as an independent variable in the bond yield model. See Table 2, Panel C for definitions.

MRNO	Moody's Rating	Frequency
1	AAA	4
2	AA1	4
3	AA2	5
4	AA3	19
5	A1	42
6	A2	64
7	A3	65
8	BAA1	42
9	BAA2	55
10	BAA3	23
11	BA1	12
12	BA2	4
13	BA3	6
14	B1	4
15	B2	3
16	B3	5
	Total sample issues	357

MRNO is the bond rating variable used as both a dependent variable in the bond rating models and as an independent variable in the bond yield model. See Table 2, Panel C for definitions.

Table 5

Pearson and Spearman Correlation Coefficients for the Bond Rating models

Pairwise correlations are presented with Spearman correlations in the upper diagonal and Pearson correlation coefficients in the lower diagonal.

Variable	BETAV	SUBORD	TASSETS5	LTD_TA5	INTCOV5	NI_TA5	PRPNO	RODSUM	RODSPLIT	RODCOMP	RODCAP	MRNO	MRNOCONS
BETAV	*****	-0.117	0.231	-0.054	0.097	-0.040	0.046	0.125	0.181	0.185	0.348	-0.135	-0.130
SUBORD	-0.040	*****	-0.175	0.096	0.064	-0.131	0.151	0.144	0.082	0.089	-0.103	0.228	0.240
TASSETS5	0.163	-0.055	*****	0.138	0.123	-0.057	-0.613	-0.445	-0.249	-0.274	0.223	-0.388	-0.310
LTD_TA5	-0.071	0.109	0.031	*****	0.592	-0.461	-0.243	-0.299	-0.200	-0.230	-0.209	0.350	0.343
INTCOV5	0.089	0.001	0.062	0.026	*****	-0.549	-0.109	-0.154	-0.048	-0.059	-0.030	0.316	0.309
NI_TA5	-0.060	-0.181	-0.185	-0.479	-0.118	*****	-0.002	0.027	-0.031	-0.019	0.078	-0.479	-0.467
PRPNO	0.065	0.130	-0.179	-0.099	-0.021	0.076	*****	0.901	0.784	0.802	0.424	0.286	0.266
RODSUM	0.092	0.231	-0.201	-0.121	-0.026	0.008	0.858	*****	0.839	0.862	0.558	0.200	0.188
RODSPLIT	0.027	0.150	-0.129	-0.107	-0.017	-0.023	0.497	0.599	*****	0.978	0.802	0.212	0.190
RODCOMP	0.084	0.115	-0.161	-0.126	-0.022	0.006	0.677	0.761	0.900	*****	0.795	0.223	0.209
RODCAP	0.189	-0.068	-0.064	-0.123	-0.019	0.055	0.208	0.354	0.580	0.690	*****	-0.105	-0.098
MRNO	-0.069	0.360	-0.204	0.447	0.015	-0.559	0.257	0.284	0.127	0.148	-0.104	*****	0.933
MRNOCONS	-0.068	0.325	-0.163	0.437	0.004	-0.551	0.259	0.275	0.102	0.138	-0.108	0.955	*****

Note: See Table 2, Panel C for variable definitions

Table 6

Pearson and Spearman Correlation Coefficients for Bond Yield Model without Ratings

Pairwise correlations are presented with Spearman correlations in the upper diagonal and Pearson correlation coefficients in the lower diagonal.

Variable	SIZELN	CALVAR	PUTVAR	IVOL	BETAV	SUBORD	MW	TASSETS5	LTD_TA5	INTCOV5	NI_TA5	PRPNO	RODSUM	RODSPLIT	RODCOMP	RODCAP	RP
SIZELN	*****	-0.053	-0.012	-0.089	0.157	-0.065	0.053	0.572	-0.051	-0.088	0.054	-0.325	-0.203	-0.090	-0.102	0.177	-0.036
CALVAR	-0.060	*****	-0.087	0.029	0.013	0.399	-0.154	-0.048	0.089	-0.001	-0.055	0.055	0.044	0.016	0.013	-0.078	0.229
PUTVAR	-0.007	-0.077	*****	-0.051	-0.079	-0.044	-0.036	-0.017	0.000	0.054	-0.082	0.009	-0.037	-0.027	-0.023	-0.011	-0.304
IVOL	-0.064	0.033	-0.064	*****	0.022	0.114	-0.063	0.033	-0.030	0.039	0.009	-0.009	-0.006	-0.022	-0.044	-0.022	-0.029
BETAV	0.122	0.067	-0.077	0.012	*****	-0.117	-0.103	0.231	-0.054	0.097	-0.040	0.046	0.125	0.181	0.185	0.348	-0.127
SUBORD	-0.094	0.307	-0.038	0.144	-0.040	*****	-0.078	-0.175	0.096	0.064	-0.131	0.151	0.144	0.082	0.089	-0.103	0.260
MW	0.047	-0.144	-0.015	-0.084	-0.134	-0.071	*****	-0.029	-0.216	-0.216	0.061	0.018	0.023	-0.021	-0.012	-0.048	0.131
TASSETS5	0.345	-0.008	-0.056	0.081	0.163	-0.055	-0.041	*****	0.138	0.123	-0.057	-0.613	-0.445	-0.249	-0.274	0.223	-0.186
LTD_TA5	-0.081	0.109	-0.004	-0.028	-0.071	0.109	-0.166	0.031	*****	0.592	-0.461	-0.243	-0.299	-0.200	-0.230	-0.209	0.307
INTCOV5	-0.049	-0.074	-0.024	-0.016	0.089	0.001	-0.034	0.062	0.026	*****	-0.549	-0.109	-0.154	-0.048	-0.059	-0.030	0.192
NI_TA5	0.078	-0.097	-0.057	0.005	-0.060	-0.181	0.067	-0.185	-0.479	-0.118	*****	-0.002	0.027	-0.031	-0.019	0.078	-0.329
PRPNO	-0.167	0.179	-0.009	-0.034	0.065	0.130	0.023	-0.179	-0.099	-0.021	0.076	*****	0.901	0.784	0.802	0.424	0.069
RODSUM	-0.234	0.176	-0.053	-0.018	0.092	0.231	-0.010	-0.201	-0.121	-0.026	0.008	0.858	*****	0.839	0.862	0.558	0.067
RODSPLIT	-0.156	0.059	0.011	-0.060	0.027	0.150	-0.021	-0.129	-0.107	-0.017	-0.023	0.497	0.599	*****	0.978	0.802	0.051
RODCOMP	-0.162	0.050	-0.027	-0.070	0.084	0.115	0.000	-0.161	-0.126	-0.022	0.006	0.677	0.761	0.900	*****	0.795	0.044
RODCAP	-0.016	-0.071	-0.044	-0.079	0.189	-0.068	0.001	-0.064	-0.123	-0.019	0.055	0.208	0.354	0.580	0.690	*****	-0.170
RP	-0.072	0.462	-0.154	0.036	-0.014	0.473	-0.006	-0.069	0.343	0.000	-0.397	0.201	0.228	0.120	0.124	-0.096	*****

Note: See Table 2, Panel C for variable definitions.

Table 7
Collinearity Diagnostics

Panel A

Condition indexes are presented for one specification of the bond yield model used to generate the results in Table 14. Other specifications had nearly identical Condition Indexes.

Number	Eigenvalue	Condition Index
1	5.844	1.000
2	1.286	2.132
3	1.016	2.398
4	0.918	2.524
5	0.885	2.570
6	0.653	2.993
7	0.606	3.104
8	0.388	3.883
9	0.195	5.477
10	0.149	6.254
11	0.055	10.305
12	0.006	32.433

Panel B

Variance Inflation Factors (VIFs) are presented for one specification of the bond yield model used to generate the results in Table 14. Other specifications had nearly identical VIFs.

Variable	VIF
INTERCEPT	0.000
SIZELN	1.212
CALVAR	1.162
PUTVAR	1.027
IVOL	1.050
BETAV	1.079
SUBORD	1.185
TASSETS5	1.263
LTD_TA	1.342
INTCOV5	1.038
NI_TA5	1.447

Panel C

Variance Inflation Factors are shown for the Environmental variables from separate specifications as presented in Table 14.

Variable	VIF
PRPNO_TA5	1.119
RODSUM_TA5	1.211
RODSPLIT_TA5	1.089
RODCOMP_TA5	1.105
RODCAP_TA5	1.078

Table 8
Bond Issues identified as Outliers or High Influence Points

Panel A - Outliers with an R-Student of > 2.0

CompanyName	Issue Year	SIC Code	Issue Date	Residual	RStudent	Hat Diag	Cov Ratio	DFFITS
GREAT LAKES CHEMICAL CORP	95	2890	15-Dec-95	0.6283	8.164	0.0603	0.1316	2.0677
INTERLAKE CORP	95	2540	20-Jun-95	0.5693	7.6243	0.1337	0.1835	2.9946
UNISYS CORP	96	7373	1-Oct-96	0.4433	5.575	0.0836	0.4002	1.6837
XEROX CORP	97	3577	11-Jun-97	-0.2904	-3.4184	0.008	0.6991	-0.3079
IMO INDUSTRIES INC	96	3560	24-Apr-96	0.2644	3.3929	0.1655	0.8359	1.5112
MILLIPORE CORP	97	3826	26-Mar-97	-0.2537	-3.204	0.1415	0.8475	-1.3009
MCDONALDS CORP	97	5812	19-Sep-97	-0.2321	-2.9498	0.1564	0.9095	-1.2702
MILLIPORE CORP	97	3826	26-Mar-97	-0.221	-2.7844	0.1436	0.9253	-1.1402
HARRIS CORP	96	3663	8-Aug-96	-0.2203	-2.6573	0.0676	0.8702	-0.7153
LEAR CORP	96	2531	9-Jul-96	-0.2076	-2.595	0.1326	0.946	-1.0145
PEPSICO INC	96	2080	14-May-96	-0.2038	-2.4653	0.0753	0.9075	-0.7035
MISSISSIPPI CHEMICAL CORP	97	2870	20-Nov-97	0.1947	2.423	0.1267	0.9677	0.9228
EXIDE CORP	95	3690	21-Apr-95	0.1935	2.2906	0.0367	0.8963	0.4469
MCDONALDS CORP	95	5812	5-Sep-95	-0.1694	-2.053	0.0837	0.9764	-0.6205
PHILIP MORRIS COS INC	96	2111	5-Jun-96	-0.1684	-2.0055	0.0523	0.9504	-0.4712

Panel B - High Influence Points with a DFBETA of > 2/Sqrt(n=357)

CompanyName	Issue Year	SIC Code	Issue Date	DFBETA for PRPNO_TA5
LILLY INDS INC -CL A	97	2851	5-Nov-97	0.6145
GREAT LAKES CHEMICAL CORP	95	2890	15-Dec-95	-0.5624
MCDONALDS CORP	97	5812	19-Sep-97	0.2785
EXIDE CORP	95	3690	21-Apr-95	0.2498
IMO INDUSTRIES INC	96	3560	24-Apr-96	-0.2099
MILLIPORE CORP	97	3826	26-Mar-97	-0.2009
MILLIPORE CORP	97	3826	26-Mar-97	-0.1705
PEPSICO INC	96	2080	14-May-96	0.1668
FISHER SCIENTIFIC INTL INC	95	5040	13-Dec-95	0.1414
MISSISSIPPI CHEMICAL CORP	97	2870	20-Nov-97	0.1402
INTERLAKE CORP	95	2540	20-Jun-95	-0.139
MCDONALDS CORP	95	5812	5-Sep-95	0.1353
UNISYS CORP	96	7373	1-Oct-96	-0.1346

Table 9
Tests for Heteroskedasticity

Panel A - Specification Tests

Specification for Variable	Testof First and Second Moment Specification DF	Chi-Square	Pr > ChiSq
PRPNO_TA5	82	83.410	0.436
RODSUM_TA	82	84.550	0.402
RODSPLIT_TA5	82	94.850	0.162
RODCOMP_TA5	82	84.390	0.407
RODCAP_TA5	82	130.830	0.001

Panel B - Asymptotically Consistent Covariance Matices (ACOV) Tests

	Test Environmental Results using ACOV Estimates			
	From regressions in Table 14		Using ACOV Estimates	
	t - statistic	Pr > | t |	Chi-Square	Pr > ChiSq
PRPNO_TA5	3.420	0.001	16.210	<.0001
RODSUM_TA5	2.990	0.003	6.680	0.010
RODSPLIT_TA5	1.700	0.090	3.650	0.056
RODCOMP_TA5	2.220	0.026	4.590	0.032
RODCAP_TA5	-0.760	0.432	1.590	0.207

TABLE 10

Logistic Regression Results of Bond Rating Model with Dependent Variable of Ratings as a Polychotomous Variable Ranging from AAA = 1 to B = 6 (n = 357 bond issues for period March, 1995 to February, 1998)

Panel A Base model with industry dummies

Variable	**Parameter Estimate**	**Wald's Chi Square**	***Pr* > |*t*|**
Intercept1	-5.207	41.214	<.0001
Intercept2	-3.201	21.176	<.0001
Intercept3	-0.139	0.048	0.827
Intercept4	3.692	27.775	<.0001
Intercept5	6.864	49.388	<.0001
IND35	1.407	6.312	0.012
IND37	0.773	2.070	0.150
IND38	2.451	16.986	<.0001
IND40	2.170	17.795	<.0001
IND49	-0.204	0.097	0.756
IND51	1.135	3.919	0.048
IND20	0.774	2.530	0.112
IND26	0.165	0.136	0.713
IND28	0.861	3.223	0.073
IND33	1.917	12.994	0.0003
BETAV	-0.374	1.745	0.187
SUBORD	4.459	20.809	<.0001
TASSETS5	-0.00002	22.936	<.0001
LTD_TA5	5.913	28.683	<.0001
INTCOV5	-0.068	0.688	0.407
NI_TA5	-42.002	75.610	<.0001
Likelihood Ratio	246.852		
Model P-Value	<.0001		

TABLE 10

Logistic Regression Results with a Bond Rating Model with a dependent variable of Ratings as a Polychotomous Variable Ranging from AAA = 1 to B = 6 (n = 357 bond issues for the period March, 1995 to February, 1998)

Panel B Base model with industry dummies and environmental estimates

Variable	**Parameter Estimate** **Wald's Chi Square** ***Pr* > |*t*|**				
BETAV	-0.530 3.349 0.067	-0.601 4.316 0.038	-0.394 1.923 0.166	-0.444 2.434 0.119	-0.265 0.856 0.355
SUBORD	4.078 17.397 <.0001	3.532 13.437 0.0002	4.397 20.351 <.0001	4.368 20.151 <.0001	4.339 19.690 <.0001
TASSETS5	-0.00002 15.577 <.0001	-0.00002 12.402 0.0004	-0.00002 20.993 <.0001	-0.00002 17.772 <.0001	-0.00002 26.090 <.0001
LTD_TA5	6.315 30.899 <.0001	6.524 33.529 <.0001	5.940 28.965 <.0001	6.049 29.974 <.0001	5.954 28.819 <.0001
INTCOV5	-0.052 0.406 0.524	-0.033 0.160 0.689	-0.063 0.600 0.439	-0.055 0.457 0.499	-0.077 0.866 0.352
NI_TA5	-44.744 77.165 <.0001	-41.952 70.617 <.0001	-41.672 74.022 <.0001	-41.332 72.629 <.0001	-42.682 77.184 <.0001
PRPNO_TA5	149.400 43.137 <.0001				
RODSUM_TA5		8.841 40.328 <.0001			
RODSPLIT_TA5			48.110 1.521 0.217		
RODCOMP_TA5				42.770 7.255 0.007	
RODCAP_TA5					-38.685 5.257 0.022
Likelihood Ratio	294.755	284.545	248.442	253.488	252.314
Model P-Value	<.0001	<.0001	<.0001	<.0001	<.0001

Note: This model and the statistics reported in Panel A contain industry dummies. The industry dummies are reported in Panel A but not here. See Table 3 for an illustration of industry groupings.

TABLE 11

Logistic Regression Results of a Bond Rating Model with a dependent variable of Ratings as a Polychotomous Variable Ranging from AAA = 1 to B3 = 16 (n = 357 bond issues for the period March, 1995 to February, 1998)

Panel A Base model with industry dummies

Variable	Parameter Estimate	Wald's Chi Square	*Pr* > |*t*|
IND20	1.431	11.566	0.001
IND26	0.572	2.236	0.135
IND28	1.427	12.206	0.001
IND33	2.449	28.124	0.0003
IND35	2.141	19.645	<.0001
IND37	1.892	16.596	<.0001
IND38	3.181	38.238	<.0001
IND40	2.676	35.017	<.0001
IND49	0.837	2.273	0.132
IND51	2.096	16.870	<.0001
BETAV	-0.403	2.729	0.099
SUBORD	3.497	19.959	<.0001
TASSETS5	-0.00002	45.062	<.0001
LTD_TA5	6.938	50.405	<.0001
INTCOV5	-0.024	0.108	0.742
NI_TA5	-38.324	90.052	<.0001
Likelihood Ratio	301.380		
Model P-Value	<.0001		

TABLE 11

Logistic Regression Results with a Bond Rating Model with a dependent variable of Ratings as a Polychotomous Variable Ranging from AAA = 1 to B3 = 16
(n = 357 bond issues for the period March, 1995 to February, 1998)

Panel B Base model with industry dummies and environmental estimates

Variable	**Predicted Sign**	**Parameter Estimate** / **Wald's Chi Square** / ***Pr* > |*t*|**				
BETAV	-	-0.530 4.722 0.030	-0.542 4.878 0.027	-0.423 3.003 0.083	-0.452 3.401 0.065	-0.281 1.298 0.255
SUBORD	+	3.306 17.320 <.0001	2.960 13.720 0.0002	3.451 19.056 <.0001	3.486 19.429 <.0001	3.392 18.786 <.0001
TASSETS5	-	-0.00002 34.677 <.0001	-0.00002 30.250 <.0001	-0.00002 41.267 <.0001	-0.00002 37.354 <.0001	-0.00003 51.112 <.0001
LTD_TA5	+	7.423 55.983 <.0001	7.405 56.371 <.0001	6.992 51.054 <.0001	7.046 51.820 <.0001	7.005 51.152 <.0001
INTCOV5	+	0.013 0.032 0.857	0.027 0.143 0.706	-0.014 0.040 0.842	-0.007 0.008 0.927	-0.037 0.269 0.604
NI_TA5	-	-38.453 86.928 <.0001	-36.131 78.339 <.0001	-37.494 84.990 <.0001	-37.100 83.369 <.0001	-39.383 94.400 <.0001
PRPNO_TA5	+	138.200 50.937 <.0001				
RODSUM_TA5	+		7.316 37.129 <.0001			
RODSPLIT_TA5	+			59.347 3.328 0.068		
RODCOMP_TA5	+				35.909 6.999 0.008	
RODCAP_TA5	+					-36.927 6.550 0.011
Likelihood Ratio		348.549	331.177	304.942	307.779	308.593
Model P-Value		<.0001	<.0001	<.0001	<.0001	<.0001

Note: This model and the statistics reported in Panel A contain industry dummies. The industry dummies are reported in Panel A but not here. See Table 3 for an illustration of industry groupings.

TABLE 12

OLS Regression Results with Bond Rating Model with dependent variable of Ratings as Polychotomous Variable Ranging from AAA = 1 to B3 = 16 (n = 357 bond issues for period March, 1995 to February, 1998)

Panel A Base model with industry dummies

Variable	Parameter Estimate	(t-statistic)	*Pr* > |*t*|
Intercept	3.469	18.100	<.0001
IND20	0.233	1.550	0.123
IND26	0.045	0.330	0.742
IND28	0.334	2.320	0.021
IND33	0.590	3.660	0.0003
IND35	0.356	2.100	0.037
IND37	0.267	1.620	0.107
IND38	0.677	3.790	0.0002
IND40	0.577	3.680	0.0003
IND49	-0.105	-0.520	0.602
IND51	0.317	1.770	0.078
BETAV	-0.089	-1.010	0.312
SUBORD	1.222	5.080	<.0001
TASSETS5	-0.00001	-4.970	<.0001
LTD_TA5	1.890	5.810	<.0001
INTCOV5	-0.032	-1.240	0.218
NI_TA5	-12.167	-9.450	<.0001

Model F Value	21.68
Adj R-Sq	0.4817

TABLE 12

OLS Regression Results with Bond Rating Model with dependent variable of Ratings as Polychotomous Variable Ranging from AAA = 1 to B3 = 16 (n = 357 bond issues for period March, 1995 to February, 1998)

Panel B Base model with industry dummies and environmental estimates

Variable	**Parameter Estimate (t-statistic) *Pr* > |*t*|**				
Intercept	3.449 19.250 <.0001	3.406 18.580 <.0001	3.450 17.900 <.0001	3.430 17.990 <.0001	3.461 18.210 <.0001
BETAV	-0.122 -1.480 0.139	-0.131 -1.550 0.121	-0.089 -1.010 0.312	-0.101 -1.160 0.248	-0.052 -0.590 0.556
SUBORD	1.018 4.490 <.0001	0.910 3.850 <.0001	1.191 4.900 <.0001	1.162 4.840 <.0001	1.185 4.950 <.0001
TASSETS5	-0.00001 -3.950 <.0001	-0.00001 -3.630 0.0003	-0.00001 -4.780 <.0001	-0.00001 -4.370 <.0001	-0.00001 -5.350 <.0001
LTD_TA5	1.822 5.970 <.0001	1.924 6.180 <.0001	1.909 5.850 <.0001	1.920 5.930 <.0001	1.880 5.800 <.0001
INTCOV5	-0.026 -1.070 0.286	-0.024 -0.950 0.343	-0.031 -1.190 0.233	-0.029 -1.120 0.264	-0.035 -1.340 0.180
NI_TA5	-11.714 -9.720 <.0001	-11.169 -9.000 <.0001	-11.970 -9.170 <.0001	-11.710 -9.070 <.0001	-12.332 -9.650 <.0001
PRPNO_TA5	43.230 7.060 <.0001				
RODSUM_TA5		2.294 5.800 <.0001			
RODSPLIT_TA			9.996 0.910 0.363		
RODCOMP_TA5				11.580 2.460 0.015	
RODCAP_TA5					-13.190 -2.570 0.011
Model F Value	26.260	24.340	20.440	21.060	21.130
Adj R-Sq	0.547	0.527	0.481	0.489	0.490

Note: This model and the statistics reported in Panel A contain industry dummies. The industry dummies are reported in Panel A but not here. See Table 3 for an illustration of industry groupings.

TABLE 13

OLS Regression Results with Bond Rating Model with dependent variable of Ratings as Polychotomous Variable Ranging from AAA = 1 to B3 = 16 (n = 357 bond issues for period March, 1995 to February, 1998)

Panel A Base model with industry dummies

Variable	**Parameter Estimate**	**(t-statistic)**	***Pr* > |*t*|**
Intercept	6.963	13.330	<.0001
IND20	1.123	2.740	0.007
IND26	0.348	0.930	0.355
IND28	1.471	3.750	0.0002
IND33	2.154	4.900	<.0001
IND35	1.454	3.140	0.002
IND37	1.648	3.660	0.0003
IND38	2.468	5.070	<.0001
IND40	1.998	4.670	<.0001
IND49	0.439	0.800	0.423
IND51	1.693	3.470	0.001
BETAV	-0.258	-1.080	0.281
SUBORD	3.952	6.020	<.0001
TASSETS5	-0.00002	-6.740	<.0001
LTD_TA5	6.078	6.840	<.0001
INTCOV5	-0.075	-1.060	0.291
NI_TA5	-35.733	-10.180	<.0001

Model F Value	28.06
Adj R-Sq	0.5487

TABLE 13

OLS Regression Results for Bond Rating Model with dependent variable of Ratings as Polychotomous Variable Ranging from AAA = 1 to B3 = 16 (n = 357 bond issues for period March, 1995 to February, 1998)

Panel B Base model with industry dummies and environmental estimates

Variable	**Parameter Estimate (t-statistic) *Pr* > |*t*|**				
Intercept	6.912 14.030 <.0001	6.807 13.510 <.0001	6.898 13.140 <.0001	6.876 13.190 <.0001	6.940 13.440 <.0001
BETAV	-0.344 -1.520 0.129	-0.363 -1.570 0.117	-0.259 -1.080 0.279	-0.288 -1.210 0.228	-0.141 -0.590 0.556
SUBORD	3.426 5.490 <.0001	3.171 4.880 <.0001	3.841 5.790 <.0001	3.806 5.800 <.0001	3.831 5.890 <.0001
TASSETS5	-0.00002 -5.830 <.0001	-0.00002 -5.500 <.0001	-0.00002 -6.490 <.0001	-0.00002 -6.160 <.0001	-0.00002 -7.200 <.0001
LTD_TA5	5.897 7.030 <.0001	6.157 7.190 <.0001	6.137 6.900 <.0001	6.145 6.950 <.0001	6.029 6.860 <.0001
INTCOV5	-0.059 -0.890 0.377	-0.054 -0.790 0.433	-0.071 -1.010 0.315	-0.067 -0.950 0.342	-0.083 -1.180 0.237
NI_TA5	-34.566 -10.430 <.0001	-33.244 -9.740 <.0001	-35.037 -9.850 <.0001	-34.632 -9.820 <.0001	-36.255 -10.440 <.0001
PRPNO_TA5	111.350 6.610 <.0001				
RODSUM_TA5		5.723 5.270 <.0001			
RODSPLIT_TA			35.226 1.180 0.239		
RODCOMP_TA5				27.848 2.160 0.031	
RODCAP_TA5					-41.903 -3.010 0.003
Model F Value	32.300	30.110	26.520	26.970	27.560
Adj R-Sq	0.599	0.582	0.549	0.554	0.559

Note: This model and the statistics reported in Panel A contain industry dummies. The industry dummies are reported in Panel A but not here. See Table 3 for an illustration of industry groupings.

TABLE 14

OLS Regression Results for Bond Yield Model that includes Financial Variables from Bond Rating model (n = 357 bond issues for the period March, 1995 to February, 1998)

Variable	Predicted Sign	**Parameter Estimate (t-statistic)** ***Pr* > |*t*|**	base model including PRPNO_TA5	base model including RODSUM_TA5	base model including RODSPLIT_TA5	base model including RODCOMP_TA5	base model including RODCAP_TA5
Intercept		0.080	0.053	0.043	0.063	0.058	0.083
		1.730	1.150	0.910	1.340	1.220	1.780
		0.085	0.251	0.362	0.183	0.223	0.075
SIZELN	-	0.009	0.013	0.014	0.011	0.012	0.009
		1.170	1.620	1.730	1.370	1.460	1.140
		0.244	0.106	0.085	0.171	0.146	0.254
CALVAR	+	0.262	0.245	0.251	0.261	0.262	0.260
		8.040	7.550	7.760	8.050	8.070	7.960
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
PUTVAR	-	-0.220	-0.222	-0.211	-0.220	-0.215	-0.222
		-3.530	-3.610	-3.420	-3.540	-3.470	-3.560
		0.0003	0.0002	0.0005	0.0003	0.0006	0.0003
IVOL	+	0.004	0.033	0.034	0.029	0.038	-0.004
		0.030	0.210	0.220	0.190	0.250	-0.030
		0.975	0.831	0.824	0.851	0.806	0.977
MW	+	0.033	0.031	0.033	0.034	0.033	0.033
		2.660	2.550	2.670	2.720	2.700	2.650
		0.008	0.011	0.008	0.007	0.007	0.009
BETAV	+	-0.003	-0.007	-0.007	-0.004	-0.006	-0.001
		-0.250	-0.590	-0.640	-0.320	-0.490	-0.090
		0.805	0.555	0.524	0.748	0.624	0.926
SUBORD	+	0.246	0.235	0.226	0.238	0.237	0.245
		7.260	7.020	6.620	6.970	7.010	7.230
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Table 14, Continued

TASSETS5	-	-	-	-	-	-	-
		-2.870	-2.510	-2.470	-2.740	-2.610	-2.920
		0.004	0.013	0.014	0.007	0.009	0.004
LTD_TA5	+	0.151	0.162	0.170	0.161	0.165	0.148
		3.720	4.060	4.200	3.950	4.040	3.630
		0.0002	<.0001	<.0001	<.0001	<.0001	0.0003
INTCOV	+	-0.00003	-0.00005	0.00030	0.00014	0.00020	-0.00014
		-0.010	-0.020	0.090	0.040	0.070	-0.040
		0.992	0.987	0.926	0.968	0.941	0.967
NI_TA5	-	-0.944	-0.969	-0.926	-0.924	-0.923	-0.945
		-5.880	-6.120	-5.830	-5.760	-5.780	-5.890
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
PRPNO_TA5	+		2.830				
			3.420				
			0.001				
RODSUM_TA5	+			0.153			
				2.990			
				0.003			
RODSPLIT_TA	+				2.380		
					1.700		
					0.090		
RODCOMP_TA5	+					1.312	
						2.220	
						0.027	
RODCAP_TA5	+						-0.489
							-0.760
							0.447
Model F Value		30.030	29.350	28.900	27.910	28.250	27.540
Adj R-Sq		0.473	0.489	0.485	0.476	0.479	0.472

Table 15
Selected Regression Results after deletion of Outliers and High Influence Points

Panel A Outliers are selected by identifying those data points with R-Student statistics of greater than 2. The selected statistics are from regressions using a data set reduced by deletion of 14 outliers (See Table 8, Panel A). The parameter estimate and the P-value are for the individual variable of interest and the Model F and Adjusted R-Square are for the entire model.

Variable	Parameter Estimate	*Pr* > |*t*|	Model F	Adj R square
PRPNO_TA5	2.983	<.0001	48.200	0.604
RODSUM_TA5	0.177	<.0001	47.510	0.600
RODSPLIT_TA	2.286	0.018	43.330	0.577
RODCOMP_TA5	1.287	0.002	44.300	0.583
RODCAP_TA5	-0.313	0.476	42.200	0.571

Panel B High Influence points are selected by identifying those data points with DFBETA of greater than 2/Sqrt(N). The selected statistics from regressions using a data set reduced by deletion of 13 high influence points (See Table 8, Panel B). The parameter estimate and the P-value are for the individual variable of interest and the Model F and Adjusted R-Square are for the entire model.

Variable	Parameter Estimate	*Pr* > |*t*|	Model F	Adj R square
PRPNO_TA5	2.757	0.001	40.770	0.561
RODSUM_TA5	0.155	0.0001	41.390	0.564
RODSPLIT_TA	1.684	0.098	38.810	0.548
RODCOMP_TA5	0.864	0.056	39.000	0.549
RODCAP_TA5	-0.190	0.676	38.280	0.545

TABLE 16

OLS Regression Results for Bond Yield Model that includes Ratings as Polychotomous Variable Ranging from AAA = 1 to B3 = 16 (n = 357 bond issues for the period March, 1995 to February, 1998)

Variable	**Predicted Sign**	**Parameter Estimate (t-statistic) *Pr* > |*t*|**	base model including PRPNO	base model including RODSUM	base model including RODSPLIT	base model including RODCOMP	base model including RODCAP
Intercept		-0.134	-0.133	-0.135	-0.140	-0.138	-0.131
		-3.300	-3.250	-3.270	-3.420	-3.350	-3.200
		0.001	0.001	0.001	0.001	0.001	0.002
SIZELN	-	0.008	0.008	0.008	0.009	0.008	0.008
		1.140	1.110	1.140	1.270	1.220	1.120
		0.254	0.269	0.253	0.204	0.225	0.263
CALVAR	+	0.215	0.216	0.215	0.215	0.215	0.214
		7.380	7.340	7.320	7.360	7.370	7.340
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
PUTVAR	-	-0.260	-0.260	-0.259	-0.260	-0.259	-0.261
		-4.650	-4.640	-4.620	-4.650	-4.620	-4.660
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
IVOL	+	-0.006	-0.007	-0.005	0.004	0.001	-0.012
		-0.050	-0.050	-0.040	0.030	0.010	-0.090
		0.964	0.957	0.969	0.975	0.995	0.930
MW	+	0.027	0.027	0.027	0.027	0.027	0.027
		2.460	2.470	2.460	2.470	2.460	2.450
		0.014	0.014	0.015	0.014	0.015	0.015
MRNO	+	0.029	0.029	0.029	0.029	0.029	0.029
		16.880	16.550	16.400	16.710	16.660	16.760
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
PRPNO_TA5	+		-0.133				
			-0.180				
			0.860				
RODSUM_TA5	+			0.006			
				0.140			
				0.893			
RODSPLIT_TA	+				1.238		
					1.000		
					0.318		
RODCOMP_TA5	+					0.306	
						0.590	
						0.558	
RODCAP_TA5	+						-0.305
							-0.540
							0.590
Model F Value		80.020	68.410	68.400	68.730	68.510	68.490
Adj R-Sq		0.571	0.570	0.570	0.571	0.570	0.570

Table 17

OLS Regression Results with the Bond Yield Model that includes Rating Dummies
Where AAA=Mrnocons1 and B=Mrnocons6
(n = 357 bond issues for the period March, 1995 to February, 1998)

Variable	Predicted Sign	Parameter Estimate (t-statistic) *Pr > |t|* **Base Model**	PRPNO_TA5	RODSUM_TA5	RODSPLIT_TA5	RODCOMP_TA5	RODCAP_TA5
Intercept		0.607	0.612	0.617	0.601	0.606	0.606
		16.000	15.770	15.420	15.380	15.450	15.950
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS1	-	-0.570	-0.571	-0.573	-0.568	-0.569	-0.570
		-14.660	-14.660	-14.660	-14.550	-14.570	-14.640
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS2	-	-0.490	-0.492	-0.495	-0.488	-0.490	-0.490
		-20.120	-20.020	-19.830	-19.790	-19.820	-20.090
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS3	-	-0.480	-0.482	-0.484	-0.479	-0.480	-0.480
		-21.960	-21.910	-21.750	-21.720	-21.780	-21.890
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS4	-	-0.443	-0.444	-0.446	-0.441	-0.442	-0.443
		-19.890	-19.870	-19.770	-19.620	-19.710	-19.580
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS5	-	-0.294	-0.294	-0.296	-0.293	-0.294	-0.294
		-11.840	-11.790	-11.870	-11.690	-11.780	-11.820
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
SIZELN	-	-0.007	-0.008	-0.008	-0.007	-0.007	-0.007
		-1.300	-1.380	-1.450	-1.200	-1.270	-1.300
		0.195	0.168	0.148	0.232	0.205	0.196

Table 17 Continued

CALVAR	+	0.080	0.082	0.081	0.078	0.080	0.080
		3.080	3.130	3.130	3.090	3.080	3.080
		0.002	0.002	0.002	0.002	0.002	0.002
PUTVAR	-	-0.213	-0.213	-0.215	-0.213	-0.213	-0.213
		-4.690	-4.690	-4.730	-4.690	-4.670	-4.670
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
IVOL	+	-0.041	-0.044	-0.046	-0.036	-0.040	-0.040
		-0.360	-0.390	-0.400	-0.310	-0.360	-0.350
		0.716	0.698	0.686	0.754	0.723	0.723
MW	+	0.028	0.029	0.029	0.028	0.028	0.028
		3.170	3.200	3.190	3.170	3.170	3.170
		0.002	0.002	0.002	0.002	0.002	0.002
PRPNO_TA5	+		-0.404				
			-0.650				
			0.515				
RODSUM_TA5	+			-0.031			
				-0.830			
				0.410			
RODSPLIT_TA	+				0.557		
					0.550		
					0.583		
RODCOMP_TA5	+					0.033	
						0.080	
						0.938	
RODCAP_TA5	+						0.040
							0.090
							0.931
Model F Value		91.550	83.130	83.220	83.090	82.990	82.990
Adj R-Sq		0.718	0.717	0.718	0.717	0.717	0.717

TABLE 18

OLS Regression Results for Bond Yield Model that includes Financial Variables from Bond Rating model with different MW coding (n = 357 bond issues for the period March, 1995 to February, 1998)

Variable	Predicted Sign	**Parameter Estimate (t-statistic)** ***Pr* > |*t*|**	base model including PRPNO_TA5	base model including RODSUM_TA5	base model including RODSPLIT_TA5	base model including RODCOMP_TA5	base model including RODCAP_TA5
Intercept		0.080	0.053	0.043	0.063	0.058	0.083
		1.730	1.150	0.910	1.340	1.220	1.780
		0.085	0.251	0.362	0.183	0.223	0.075
SIZELN	-	0.009	0.013	0.014	0.011	0.012	0.009
		1.170	1.620	1.730	1.370	1.460	1.140
		0.244	0.106	0.085	0.171	0.146	0.254
CALVAR	+	0.262	0.245	0.251	0.261	0.262	0.260
		8.040	7.550	7.760	8.050	8.070	7.960
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
PUTVAR	-	-0.220	-0.222	-0.211	-0.220	-0.215	-0.222
		-3.530	-3.610	-3.420	-3.540	-3.470	-3.560
		0.0005	0.0004	0.0007	0.0004	0.0006	0.0004
IVOL	+	0.004	0.033	0.034	0.029	0.038	-0.004
		0.030	0.210	0.220	0.190	0.250	-0.030
		0.975	0.831	0.824	0.851	0.806	0.977
MW	-	-0.229	-0.214	-0.219	-0.228	-0.228	-0.227
		-6.820	-6.410	-6.550	-6.800	-6.830	-6.750
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
BETAV	+	-0.003	-0.007	-0.007	-0.004	-0.006	-0.001
		-0.250	-0.590	-0.640	-0.320	-0.490	-0.090
		0.805	0.555	0.524	0.748	0.624	0.926
SUBORD	+	0.246	0.235	0.226	0.238	0.237	0.245
		7.260	7.020	6.620	6.970	7.010	7.230
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Table 18 Continued

TASSETS5	-	-0.0000005	-0.0000004	-0.0000004	-0.0000005	-0.0000004	-0.0000005
		-2.870	-2.510	-2.470	-2.740	-2.610	-2.920
		0.004	0.013	0.014	0.007	0.009	0.004
LTD_TA5	+	0.151	0.162	0.170	0.161	0.165	0.148
		3.720	4.060	4.200	3.950	4.040	3.630
		0.0002	<.0001	<.0001	<.0001	<.0001	0.0003
INTCOV5	+	-0.00004	-0.00005	0.00030	0.00014	0.00030	-0.00014
		-0.010	0.020	0.090	0.040	0.070	-0.040
		0.992	0.987	0.926	0.968	0.941	0.967
NI_TA5	-	-0.944	-0.969	-0.926	-0.924	-0.923	-0.945
		-5.880	-6.120	-5.830	-5.760	-5.780	-5.890
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
PRPNO_TA5	+		2.830				
			3.420				
			0.001				
RODSUM_TA5	+			0.153			
				2.990			
				0.003			
RODSPLIT_TA5	+				2.380		
					1.700		
					0.090		
RODCOMP_TA5	+					1.312	
						2.220	
						0.027	
RODCAP_TA5	+						-0.489
							-0.760
							0.447
Model F Value		30.030	29.350	28.900	27.910	28.250	27.540
Adj R-Sq		0.473	0.489	0.485	0.476	0.479	0.472

Table 19

OLS Regression Results with the Bond Yield Model that includes Rating Dummies Where AAA=Mrnocons1 and B=Mrnocons6 and different MW coding (n = 357 bond issues for the period March, 1995 to February, 1998)

Variable	Predicted Sign	Parameter Estimate (t-statistic) *Pr > |t|* **Base Model**	PRPNO_TA5	RODSUM_TA5	RODSPLIT_TA5	RODCOMP_TA5	RODCAP_TA5
Intercept		0.607	0.612	0.617	0.601	0.606	0.606
		16.000	15.770	15.420	15.380	15.450	15.950
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS1	-	-0.570	-0.571	-0.573	-0.568	-0.569	-0.570
		-14.660	-14.660	-14.660	-14.550	-14.570	-14.640
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS2	-	-0.490	-0.492	-0.495	-0.488	-0.490	-0.490
		-20.120	-20.020	-19.830	-19.790	-19.820	-20.090
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS3	-	-0.480	-0.482	-0.484	-0.479	-0.480	-0.480
		-21.960	-21.910	-21.750	-21.720	-21.780	-21.890
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS4	-	-0.443	-0.444	-0.446	-0.441	-0.442	-0.443
		-19.890	-19.870	-19.770	-19.620	-19.710	-19.580
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
MRNOCONS5	-	-0.294	-0.294	-0.296	-0.293	-0.294	-0.294
		-11.840	-11.790	-11.870	-11.690	-11.780	-11.820
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
SIZELN	-	-0.007	-0.008	-0.008	-0.007	-0.007	-0.007
		-1.300	-1.380	-1.450	-1.200	-1.270	-1.300
		0.195	0.168	0.148	0.232	0.205	0.196

Table 19 Continued

CALVAR	+	0.080	0.082	0.081	0.078	0.080	0.080
		3.080	3.130	3.130	3.090	3.080	3.080
		0.002	0.002	0.002	0.002	0.002	0.002
PUTVAR	-	-0.213	-0.213	-0.215	-0.213	-0.213	-0.213
		-4.690	-4.690	-4.730	-4.690	-4.670	-4.670
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
IVOL	+	-0.041	-0.044	-0.046	-0.036	-0.040	-0.040
		-0.360	-0.390	-0.400	-0.310	-0.360	-0.350
		0.716	0.698	0.686	0.754	0.723	0.723
MW	-	-0.051	-0.053	-0.053	-0.052	-0.051	-0.051
		-1.950	-1.990	-1.980	-1.950	-1.940	-1.940
		0.052	0.047	0.048	0.052	0.053	0.053
PRPNO_TA5	+		-0.404				
			-0.650				
			0.515				
RODSUM_TA5	+			-0.031			
				-0.830			
				0.410			
RODSPLIT_TA	+				0.557		
					0.550		
					0.583		
RODCOMP_TA5	+					0.033	
						0.080	
						0.938	
RODCAP_TA5	+						0.040
							0.090
							0.931
Model F Value		91.550	83.130	83.220	83.090	82.990	82.990
Adj R-Sq		0.718	0.717	0.718	0.717	0.717	0.717

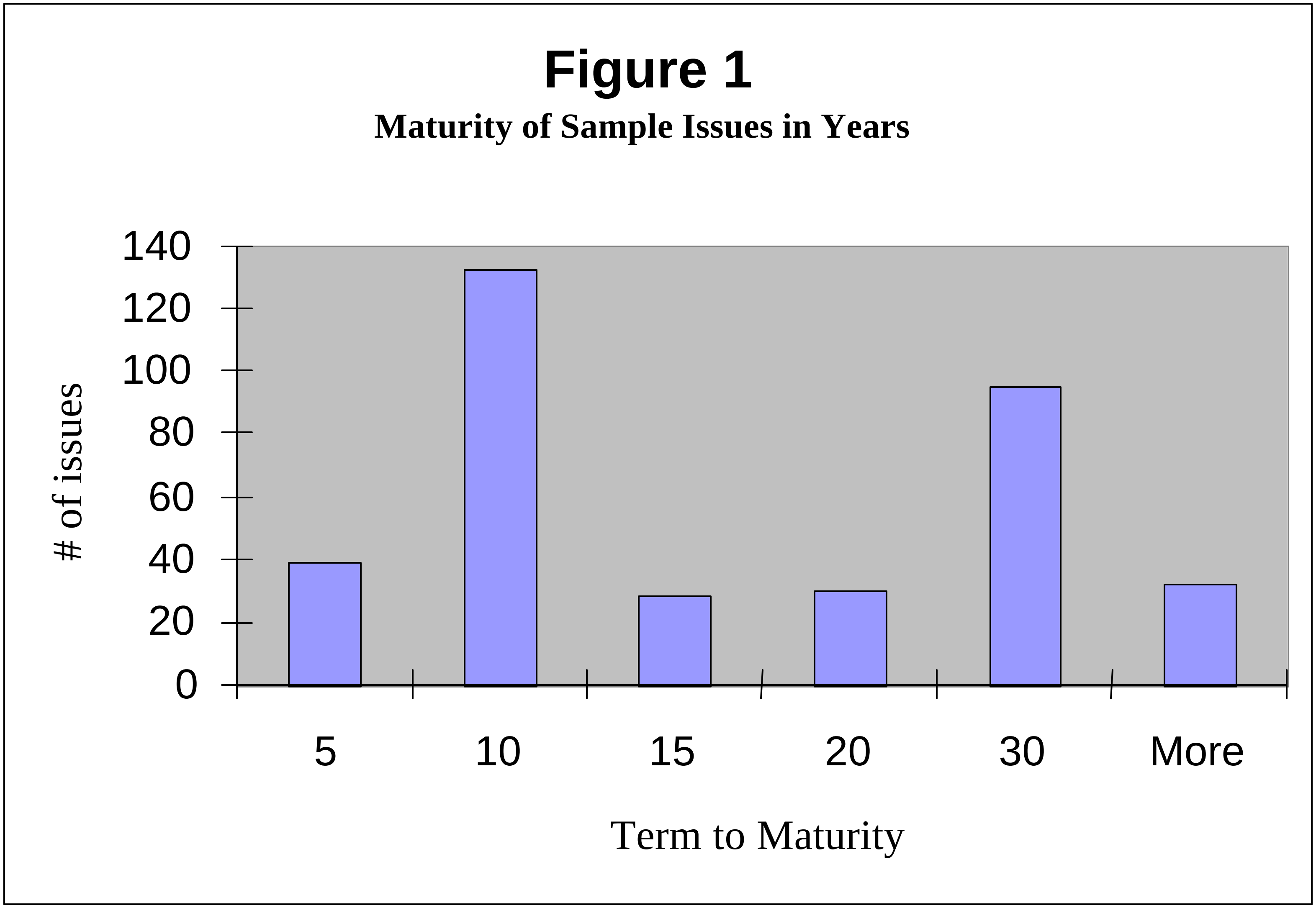
Figure 1
Maturity of Sample Issues in Years
140
120
100
80
60
40
20
0
# of issues
5
10
15
20
30
More
Term to Maturity

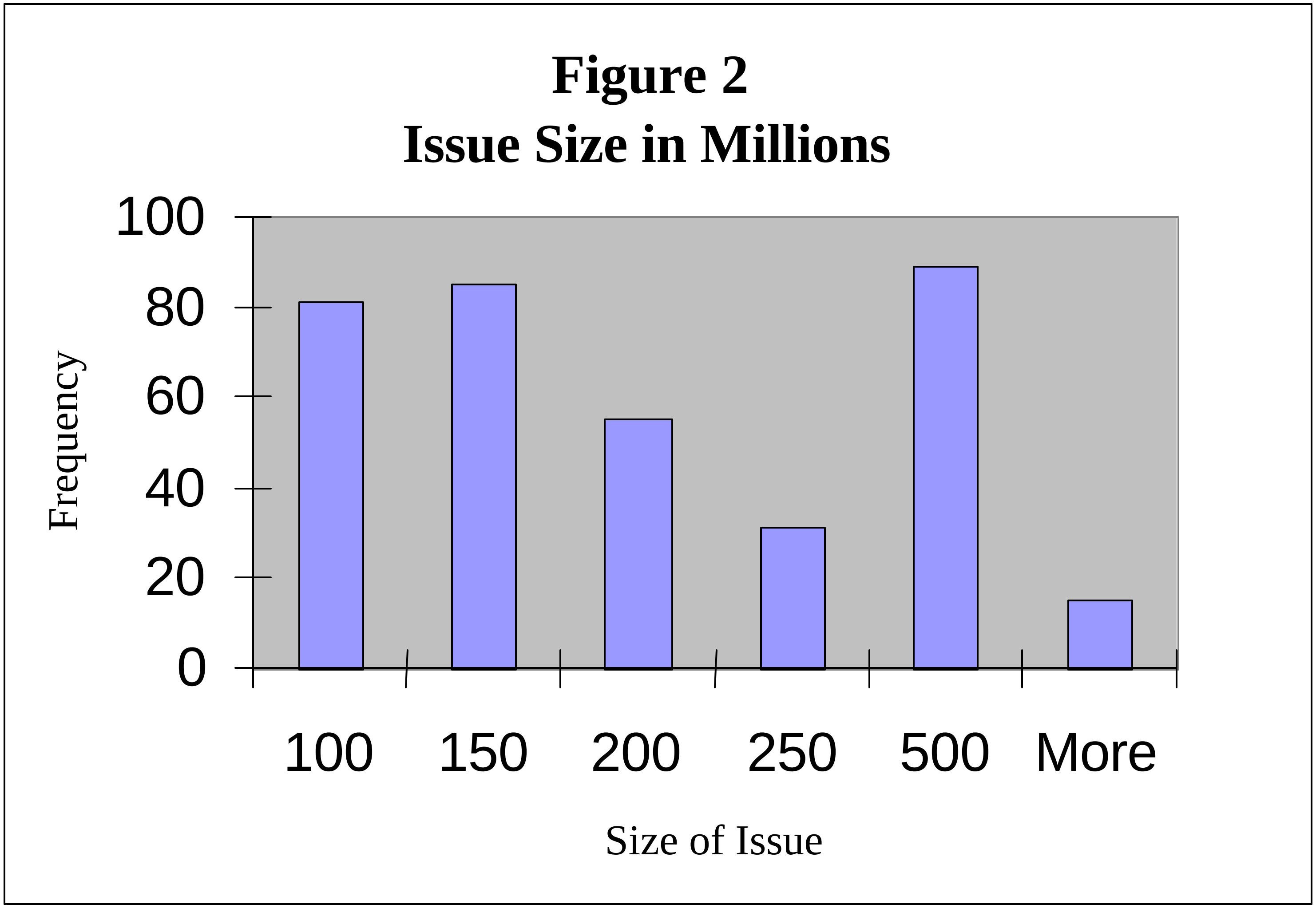
Figure 2
Issue Size in Millions
Frequency
100
80
60
40
20
0
100
150
200
250
500
More
Size of Issue

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Appendix A
Sample Firms with Two-Digit SIC Code

Company Name	Two-Digit SIC Code
AAR CORP	50
ABBOTT LABORATORIES	28
AIR PRODUCTS & CHEMICALS INC	28
ALLEGHENY LUDLUM CORP	33
ALLIEDSIGNAL INC	37
ARCHER-DANIELS-MIDLAND CO	20
ARMCO INC	33
ARROW ELECTRONICS INC	50
ASARCO INC	33
BAUSCH & LOMB INC	28
BAXTER INTERNATIONAL INC	38
BECTON DICKINSON & CO	38
BEMIS CO	26
BOEING CO	37
BOISE CASCADE CORP	51
BORDEN CHEM&PLAST -LP COM	28
BORG WARNER AUTO	37
BRIGGS & STRATTON	35
BRISTOL MYERS SQUIBB	28
BRLNGTN NTHRN SANTA FE	40
BROWNING-FERRIS INDS	49
BRUNSWICK CORP	35
BURLINGTON INDS INC	22
CAMPBELL SOUP CO	20
CASE CORP	35
CATERPILLAR INC	35
CHAMPION INTERNATIONAL CORP	26
COASTAL CORP	49
COCA-COLA BTLNG CONS	20
COLLINS & AIKMAN CORP	22
COMINCO LTD	33
COMMERCIAL METALS	33
CONAGRA INC	20
CONE MILLS CORP	22
COOPER TIRE & RUBBER	30
CROWN CORK & SEAL CO INC	34
CSX CORP	40
CUMMINS ENGINE	35
CYPRUS AMAX MINERALS CO	10
DEAN FOODS CO	20
DIAMOND SHAMROCK INC	29
DILLARDS INC -CL A	53
DOVER CORP	35
DU PONT (E I) DE NEMOURS	28
EASTMAN CHEMICAL CO	28
EATON CORP	36
EMERSON ELECTRIC CO	38

Company Name	Two-Digit SIC Code
ENGELHARD CORP	33
ENRON CORP	51
ENRON OIL & GAS	13
EXIDE CORP	36
FERRO CORP	28
FINA INC -CL A	29
FISHER SCIENTIFIC INTL INC	50
FLUOR CORP	16
FMC CORP	28
FORD MOTOR CO	37
GAYLORD CONTAINER CP	26
GENERAL MOTORS CORP	36
GOODRICH (B F) CO	37
GOODYEAR TIRE & RUBBER CO	30
GREAT LAKES CHEMICAL CORP	28
GTE CORP	48
HALLIBURTON CO	13
HARRIS CORP	36
HERCULES INC	28
HILLENBRAND INDUSTRIES	25
HILTON HOTELS CORP	70
HONEYWELL INC	38
HOUGHTON MIFFLIN CO	27
IMC GLOBAL INC	28
IMO INDUSTRIES INC	35
INGERSOLL-RAND CO	35
INTERLAKE CORP	25
INTL BUSINESS MACHINES CORP	73
INTL MULTIFOODS CORP	51
INTL PAPER CO	26
JOHNSON CONTROLS INC	25
K N ENERGY INC	49
KELLWOOD CO	23
KERR-MCGEE CORP	28
KIMBERLY-CLARK CORP	26
KNIGHT-RIDDER INC	27
KROGER CO	54
LEAR CORP	25
LILLY (ELI) & CO	28
LILLY INDS INC -CL A	28
LITTON INDUSTRIES INC	38
LTV CORP	33
LUBRIZOL CORP	28
MALLINCKRODT INC	28
MANOR CARE INC	80
MARK IV INDUSTRIES INC	37
MARRIOTT INTL INC	70
MARTIN MARIETTA MATERIALS	14
MCDONALDS CORP	58
MCI COMMUNICATIONS	48

Company Name	Two-Digit SIC Code
MCKESSON CORP	51
MEAD CORP	26
MERCK & CO	28
MILLIPORE CORP	38
MINNESOTA MINING & MFG CO	26
MISSISSIPPI CHEMICAL CORP	28
MONSANTO CO	28
MOTOROLA INC	36
NIKE INC -CL B	30
NOBLE DRILLING CORP	13
NORFOLK SOUTHERN CORP	40
NORTHROP GRUMMAN CORP	37
ORYX ENERGY CO	13
OWENS-ILLINOIS INC	32
PANENERGY CORP	49
PARKER-HANNIFIN CORP	34
PENNEY (J C) CO	53
PEPSICO INC	20
PHELPS DODGE CORP	33
PHILIP MORRIS COS INC	21
PITNEY BOWES INC	35
PLAINS RESOURCES INC	51
POLAROID CORP	38
POTLATCH CORP	26
PPG INDUSTRIES INC	28
PRECISION CASTPARTS CORP	33
PROCTER & GAMBLE CO	28
QUAKER STATE CORP	29
RALSTON PURINA CO	20
RAYTHEON CO -CL B	38
SAFEWAY INC	54
SHERWIN-WILLIAMS CO	28
SMITH INTERNATIONAL INC	28
SNAP-ON INC	34
SONAT INC	49
SONOCO PRODUCTS CO	26
TANDY CORP	57
TEXAS INSTRUMENTS INC	36
TEXTRON INC	37
THOMAS & BETTS CORP	36
TIME WARNER INC	27
TIMES MIRROR COMPANY -SER A	27
TOKHEIM CORP	35
TORO CO	35
TRW INC	37
TYCO INTERNATIONAL LTD	35
ULTRAMAR DIAMOND SHAMROCK	29
UNION CAMP CORP	26
UNION CARBIDE CORP	28
UNION PACIFIC CORP	40

Company Name	Two-Digit SIC Code
UNION TEXAS PETRO HLDGS INC	13
UNISYS CORP	73
USG CORP	32
WARNER-LAMBERT CO	28
WESTVACO CORP	26
WEYERHAEUSER CO	24
WHIRLPOOL CORP	36
WHITMAN CORP	20
WILLAMETTE INDUSTRIES	26
WITCO CORP	28
WORTHINGTON INDUSTRIES	33
XEROX CORP	35