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Board characteristics, accounting report integrity, and the cost of debt ☆

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Abstract

Creditor reliance on accounting-based debt covenants suggests that debtors are potentially concerned with board of director characteristics that influence the integrity of financial accounting reports. In a sample of S&P 500 firms, we find that the cost of debt is inversely related to board independence and board size. We also find that fully independent audit committees are associated with a significantly lower cost of debt financing. Similarly, yield spreads are also negatively related to audit committee size and meeting frequency. Overall, these results provide market-based evidence that boards and audit committees are important elements affecting the reliability of financial reports.

JEL classification: M4; K0; G3

Keywords: Audit committee composition; Board composition; Corporate governance; Financial statements; Accounting information

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1. Introduction

Accounting-based numbers are a persistent and traditional standard that creditors use to assess firm health and viability. Smith and Warner (1979) note for instance, that such criteria have been used in lending agreements and debt covenants for hundreds of years. Firms violating these accounting-based standards allow debt holders, as senior claimants, to liquidate projects or renegotiate lending contracts (DeFond and Jiambalvo, 1994). Managers as such, may have incentives to issue misleading financial statements to conceal negative news and thereby provide private personal benefits or potential shareholder benefits (Dechow et al., 1996). The importance creditors place on accounting numbers and the countervailing managerial incentives to manipulate these reports suggests that bondholders potentially exhibit great concern over factors influencing the reliability and validity of the financial accounting process (Smith, 1993 and Leftwich, 1983).[1]

From a creditor's perspective, perhaps one of the most important factors influencing the integrity of the financial accounting process involves the board of directors.[2] Boards of directors, among other tasks, are charged with monitoring and disciplining senior management, and lending agreements typically require that boards supply audited financial statements to the firm's creditors (Daley and Vigeland, 1983; DeFond and Jiambalvo, 1994; and Dichev and Skinner, 2002). Klein (2002a), Carcello and Neal (2000), Beasley (1996), and Dechow et al. (1996) examine the importance of directors monitoring the financial accounting process and document a relation between board characteristics and manipulation of accounting information. Board attributes that influence the validity of accounting statements may thus be of great importance to creditors. Smith and Warner (1979) suggest that creditors price the firm's debt to reflect the difficulties in ensuring the validity of the lending agreement, indicating that if board structure is an important oversight element in the financial accounting process, debt prices may be sensitive to board of director characteristics.

In this study, we examine the relation between board structure and the cost of debt financing. Assuming independent directors are superior monitors of management and likely to provide credible financial reports, we test whether the firm's cost of debt (yield spread) decreases in the proportion of independent directors on the board. We also examine the relation between board size and the cost of debt financing. Klein (1998, 2002b) indicates that the number of directors on the board affects committee assignments and board monitoring. Similarly, Adams and Mehran (2002) suggest

[1] Anecdotal accounts in the popular press are illustrative. For example, recent announcements concerning the reliability of the financial statements at Levi Straus led to a sharp reduction in the price of Levi's bonds (see Wall Street Journal, June 2, 2003, p. A3).

[2] Swiss Venture Funds for instance, typically requires a non-voting seat on a firm's board of directors (board observation rights) for the firm to obtain Swiss Venture's private-unsecured debt. Similarly, Caltius, UPS, Alliance Capital, and numerous other firms in the private debt market typically seek observation rights for board of director meetings. Thus, as Standard & Poor's note in their credit rating documentation, board oversight of the accounting information process is a paramount concern in assessing firm default risk.

that bigger boards increase monitoring effectiveness and provide for greater board expertise. As such, we posit that debt yields are negatively related to board size as larger boards may increase the level of managerial monitoring (i.e., a greater number of guards) and enhance the financial accounting process.[3]

For most large firms, boards of directors delegate direct oversight of the financial accounting process to a subcommittee of the full board, the audit committee. Audit committees are responsible for recommending the selection of external auditors to the full board; ensuring the soundness and quality of internal accounting and control practices; and monitoring external auditor independence from senior management. Recent regulations put forth by the major stock exchanges requiring that a minimum of three independent directors serve on the audit committee suggest that committee independence and size may be integral factors for firms in delivering meaningful financial reports (Klein, 2002a). Carcello and Neal (2000) provide support for this argument by documenting a relation between greater audit committee independence and the quality of financial reporting. If audit committee composition influences the financial accounting process, we then anticipate that corporate debt yields will exhibit an inverse relation to committee independence and size.

Using a sample of 252 industrial firms from the Lehman Brothers Fixed Income database and the S&P 500, we find that board independence is associated with a lower cost of debt financing. After controlling for industry and firm specific attributes, our analysis indicates that debt costs (using non-provisional publicly traded debt) are 17.5 basis points lower for firms with boards dominated by independent directors (51% independents) relative to firms with insider-stacked boards (25% independents). We also find a negative relation between board size and the cost of debt financing. Specifically, we find that an additional board member is associated with about a 10 basis point lower cost of debt financing. The results are robust to various measures of board independence, board size, endogeneity, non-linear specifications, and are both economically and statistically significant. Overall, our empirical results indicate that bondholders view board independence as an important element in the pricing of the firm's debt, suggesting that creditors are sensitive to board attributes that affect reporting validity.

The analysis also indicates that creditors view audit committees and their characteristics as important elements in the financial accounting process. Specifically, we find that the cost of debt is about 15 basis points lower for firms with fully independent audit committees relative to those with insiders or affiliates on the committee. Focusing on the size of audit committees, we find that committee size ranges from one to 12 directors, with most committees having either 4 or 5 members. The analysis indicates that for the average-size audit committee, an additional board member is associated with a 10.6 basis point lower cost of debt. Although, the reduction in the cost of debt for this additional audit committee member appears large, an additional member results in approximately a 20% change in committee

[3] Lipton and Lorsch (1992), Jensen (1993), and Yermack (1996) argue that larger boards are less effective in group decision-making and strategy formulation, which suggests that equity holders would have divergent interests from debtors on board size. We explore this issue in greater detail in Section 2.

size.[4] One implication of these results is that creditors view audit committees with four or five members very differently than those with only one or two members. Overall, these results suggest that creditors view audit committees as an important device in ensuring the reliability of accounting reports.

We also conduct supplemental analysis on independent director attributes. Monks and Minow (1995) and Beasley (1996) suggest that director expertise or occupational characteristics may influence the board's ability to effectively monitor management and the firm. Our results indicate that independent-director employment characteristics (executive, retired, academic, etc.), while all significantly related to lower debt costs, are not substantively different from one another. Recent passage of the Sarbanes-Oxley Act by the US Congress also requires that at least one "financial expert" serve on the firm's audit committee.[5] In light of this new regulation, we also investigate whether financial experts influence the cost of debt financing. Consistent with our earlier results on director employment characteristics, we find no relation between debt costs and financial experts serving on the audit committee. In sum, these tests suggest that the primary concern of creditors is the presence of independent directors on the board and audit committee, as opposed to director expertise.

The investigation also suggests that director equity ownership is not related to the cost of debt financing. In contrast, board tenure is positively related to corporate yield spreads, suggesting that as director tenure increases, managers are potentially more able to influence or sway board opinion. Audit-committee meeting frequency also exhibits a negative relation to debt costs, indicating bondholder concern with directors actively monitoring the financial accounting process.

Although our results are consistent with the hypothesis that board structure influences the accounting reports that creditors use in managing lending agreements, an alternative explanation for the observed relation focuses on firm performance. Specifically, Monks and Minow (1995) argue that board monitoring can improve the quality of managerial decision-making and lead to better firm performance; suggesting that better firm performance results in lower yield spreads. Prior literature however, provides little evidence of independent boards improving firm

[4] One potential concern is that the audit committee size results are an artifact of firm size. Although we control for firm size in our primary regressions, we also perform subsequent tests in Section 5 that use audit committee size scaled by firm size and size-based subset tests (with similar results). In addition, it is important to note that this lower cost of debt is for an additional audit committee member in the average size committee. As audit committee size continues to increase, we find a diminishing cost of debt for each additional member. For example, at the top decile of the distribution for audit committee size, the analysis suggests only a 5 basis point lower cost of debt.

[5] The Sarbanes-Oxley Act specifies that for a director to be classified as a financial expert that the individual should have knowledge through education or work experience of: (i) Generally Accepted Accounting Principles (GAAP), (ii) preparing or auditing public company financial statements, (iii) applying GAAP in connection with accounting estimates, accruals and reserves, (iv) internal accounting controls and, (v) the audit committee function. Due to a large number of registrant complaints, the SEC expanded the definition of a financial expert to include any director that has supervised any finance or accounting personnel—essentially suggesting that any executive who has managed a financial/accounting employee is a financial expert. For the tests in this paper, we use a narrower definition of financial expert. Section 3 provides greater detail on our categorization.

performance (see Hermalin and Weisbach, 2003). Still, we include several proxies for firm performance (e.g. cash flows, credit ratings, etc.) in our analysis to alleviate this concern. In addition, the results indicate that audit committee structure—a direct link between boards and financial reporting—affects the cost of debt. Finally, because audit committee characteristics may simply capture full board attributes, we examine whether audit committee characteristics exhibit incremental explanatory power over full board traits. Again we observe a negative relation between audit committee attributes and the cost of debt financing; suggesting that the link between debt costs and audit/board characteristics is the financial accounting process. However, to the extent that these measures do not fully capture firm performance, both the accounting process hypothesis and firm performance potentially explain the documented relation.

This research contributes to the literature in several important ways. First, our analysis suggests that debt holders exhibit interest in board and audit committee monitoring of the financial accounting process. Second, our analysis supports the notion that board independence and board size influence the cost of debt financing. We interpret this to suggest that bondholders are concerned with governance mechanisms that limit managerial opportunism and improve the financial accounting process. Third, our analysis suggests larger, more independent audit committees provide a measurable and significant benefit to the firm, namely through a lower cost of debt financing. These results support recent regulatory and listing requirements (see NYSE, NASDAQ, recent SEC proposals, and the Sarbanes-Oxley Act) concerning audit committee independence; as well as calls for more actively involved audit committees. Fourth, we find that director independence, rather than director expertise, is the more relevant issue in the cost of debt capital. In aggregate, our analysis provides market-based evidence to suggest that boards and audit committees are important mechanisms in overseeing the financial accounting process.

The remainder of this paper is organized as follows. Section 2 develops our testable hypothesis and Section 3 describes our sample and gives summary statistics. Section 4 provides the multivariate analysis and Section 5 examines alternative specifications and test procedures. Section 6 concludes the paper.

2. Board characteristics and monitoring the financial accounting process

The Securities and Exchange Commission, the Financial Accounting Standards Board, and the major stock exchanges regularly emphasize the role of board of directors in overseeing the financial accounting process. Boards comprising mostly employee or employee-related directors may be more willing to conceal negative information to gain private benefits or to limit stakeholder intervention in the firm. Recent reports in the financial press suggest that some boards "shut their eyes when the numbers are squishy or even fraudulent," leading to several well-publicized scandals.[6] Yet, Beasley (1996), Dechow et al. (1996), and Fama and Jensen (1983)

[6] *New York Times* (1/26/03) pages B1 and B12 (The Revolution That Wasn't).

suggest that independent directors are more willing to provide effective oversight and disclosure due to their desire to maintain their reputations. In the debate over director efficacy, prior literature primarily focuses on four board characteristics; (i) board independence, (ii) board size, (iii) committee structure, and (iv) specific occupational characteristics or expertise of independent directors. In the following sub-sections, we develop testable hypotheses on the relation between debt yields and board structure.

2.1. Board independence, the financial accounting process, and the cost of debt financing

Smith and Warner (1979) and Kalay (1982) observe that bondholders' concerns lie with protecting their investment.[7] One of the more important elements in bondholders' ability to protect their investments is the firm's financial accounting numbers. Creditors use accounting numbers to judge compliance with debt covenants and to administer lending agreements (DeFond and Jiambalvo (1994) and Daley and Vigeland, 1983).

Boards of directors have a primary responsibility of overseeing the firm's financial reporting process. Boards meet routinely with the firm's accounting staff and external auditors to review financial statements, audit procedures, and internal control mechanisms (Klein, 2002a). As such, bondholder's potentially view boards of directors and, in particular, board structure as critical elements in delivering credible and relevant financial statements.

Prior literature generally posits that board of director independence from senior management provides, among other things, the most effective monitoring and control of firm activities. Byrd and Hickman (1992) for instance, suggest that independent directors contribute expertise and objectivity that minimizes managerial entrenchment and expropriation of firm resources. Beasley (1996) and Dechow et al. (1996) find that the proportion of independent directors on the board (board independence) is inversely related to the likelihood of financial statement fraud. More recently, Klein (2002a) documents a negative relation between abnormal accruals and director independence from senior management. If independent boards provide superior oversight of the financial accounting process, then we expect bondholders to directly benefit through greater transparency and validity in accounting reports. This leads to our first testable hypothesis:

Hypothesis 1: Greater board independence is associated with lower corporate-debt yield spreads.

[7] Branch (2000) and Perumpral et al. (1999) discusses creditor rights and fiduciary responsibilities in bankruptcy. Mansi et al. (2003) discuss the impact of auditor choice and tenure on creditors, while Begley (1990) discusses debt covenants and accounting choices. Betker (1995) examines creditor and board issues in default and Duke and Hunt (1990) discuss creditor demands for monitoring.

2.2. Board size, the financial accounting process, and the cost of debt financing

Recent research also indicates that board size may play an important role in directors' ability to monitor and control managers. Lipton and Lorsch (1992) and Jensen (1993) for instance, argue that because of difficulties in organizing and coordinating large groups of directors, board size is negatively related to the board's ability to advise and engage in long-term strategic planning. In contrast, Adams and Mehran (2002) and Yermack (1996) suggest that some firms require larger boards for effective monitoring. Chaganti et al. (1985) posit that large boards are valuable for the breadth of their services. Klein (2002b) for instance, finds that board committee assignments are influenced by board size since large boards have more directors to spread around. As such, she suggests that board monitoring is increasing in board size due to the ability to distribute the work load over a greater number of observers. Monks and Minow (1995) and Lipton and Lorsch (1992) extend this argument by suggesting that larger (smaller) boards are able to commit more (less) time and effort to overseeing management.[8] If large boards are more effective monitors of the financial accounting process, then bondholders should benefit through improved financial transparency and reliability. This leads to our second testable hypothesis:

Hypothesis 2: *Larger boards of directors are associated with lower corporate-debt yield spreads.*

2.3. Audit committee structure and cost of debt financing

Although boards of directors are responsible for oversight of the financial accounting process, this task is often delegated to a subcommittee of the full board, the audit committee. The audit committee plays an important role because it is concerned with establishing and monitoring the accounting processes to provide relevant and credible information to the firm's stakeholders (Pincus et al., 1989; Beasley, 1996). The *1999 Blue Ribbon Committee Report* (co-sponsored by the New York Stock Exchange (NYSE) and the National Association of Security Dealers (NASD)) indicates that independent audit committee members are better able to protect the reliability of the accounting process. Following the report, the NYSE and the NASD, along with the SEC, proposed that listed firms maintain standing audit committees with at least three independent directors; with the express purpose of monitoring the accounting information process (Klein, 2002a). If independent audit committees provide more reliable accounting information (relative to insider-stacked

[8] Monks and Minow (1995) note that most companies typically have several committees and that larger boards allow for fewer committee assignments per director. In this context, a larger board provides for greater task sharing and potentially better monitoring. However, the negative aspects to larger boards may be quite relevant to shareholders, such as increased formalism, slower decision-making, and greater inflexibility.

committees), then we expect the cost of debt to be related to audit committee composition. This leads to our third hypothesis:

Hypothesis 3: *Greater audit committee independence is associated with lower corporate-debt yield spreads.*

2.4. Audit committee size and cost of debt financing

The recent regulations put forth by the major stock exchanges stipulating that audit committees comprise at least three members implies that governing bodies deem audit committee size as an integral attribute in controlling the accounting process. Pincus et al. (1989) suggest that audit committees are an expensive monitoring mechanism and that firms with greater agency costs are potentially more willing to bear these expenses. In this context, firms with larger audit committees are willing to devote greater resources to overseeing the financial accounting process. A firm with an audit committee composed of only a couple of members would, on average, have less time to devote to overseeing the hiring of auditors, questioning management, and meeting with internal control system personnel. If large audit committees better protect and control financial standards than small committees, we then expect greater accounting transparency and a lower cost of debt financing. This leads to our fourth testable hypothesis:

Hypothesis 4: *Larger audit committees are associated with lower corporate-debt yield spreads.*

2.5. Director characteristics, the financial accounting process, and the cost of debt financing

Effective monitoring also requires both expertise and proper incentives (Beasley, 1996). Fama and Jensen (1983) suggest that independent directors are effective monitors because of reputation concerns and their desire to obtain additional director positions. Jensen and Meckling (1976) argue that director equity-ownership creates powerful incentives for directors to monitor management. Generally, the literature suggests that professional directors and directors with equity stakes are associated with greater monitoring.

Brickley et al. (1994) report that retired executives from other companies are also effective monitors. Similarly, Monks and Minow (1995) suggest that academics are less effective directors relative to those with business experience. As monitoring expertise increases, managerial opportunism becomes less prevalent, causing the value of investor claims to increase. Furthermore, effective monitoring is potentially an acquired skill, suggesting boards with greater tenure provide greater monitoring. However, as board tenure increases, managers may be better able to influence or sway director opinion, indicating director tenure exhibits an inverse relation to oversight of the financial accounting process. If director experience, tenure, or equity ownership creates incentives for independent directors to more closely monitor firm

management, then we expect bondholders to benefit through credible and transparent financial statements. This leads to our fifth testable hypothesis:

Hypothesis 5: *Greater board expertise (ownership) is associated with lower corporate-debt yield spreads.*

Finally, we focus on audit-committee director attributes and committee meeting frequency. The Sarbanes-Oxley Act requires that audit committees include at least one "financial expert." Similar to our arguments on director experience, we posit that financial experts on the audit committee lead to greater rigor in financial reporting. The *1999 Blue Ribbon Committee Report* likewise advocates that the audit committee, as the watchdog of the financial accounting process, can best assure the quality of the financial statements by having at least 4 meetings a year (Morrissey, 2000). If financial expertise on the audit committee or committee meeting frequency improves the financial accounting process, we anticipate a negative relation between these attributes and debt costs. This leads to our final two hypotheses:

Hypothesis 6: *Financial expertise on the audit committee is associated with lower corporate-debt yield spreads.*

Hypothesis 7: *Audit committee meeting frequency is associated with lower corporate-debt yield spreads.*

3. Data description

3.1. The sample

For our sample, we collect information on firms that are in both the Lehman Brothers Fixed Income database (LBFI) and the S&P 500 Industrial Index (as of December 31, 1992). The LBFI provides month-end security-specific information on bonds that are in the Lehman Brothers Indices. The goal of the database is to provide a representative sample of outstanding publicly traded debt. Information is provided on coupons, yields, maturities, credit ratings from Moody's and S&P, bid prices, durations, convexities, holding period returns, call and put provisions, and sinking fund provisions. Lehman Brothers selects bonds for inclusion in the database based on firm size, liquidity, credit ratings, subordination, and maturity. The database contains non-provisional bonds of differing maturities, differing credit ratings, and differing debt claims (senior and subordinated debt). Although the database does not contain the universe of traded debt, we have no reason to suspect any systematic bias within the sample. We exclude financial and utility firms from the sample because of the potential effect of regulations on debt yields.

We manually collect data from corporate proxy statements on board structure, audit committee composition, and other governance characteristics for the S&P 500 Industrial firms. To gather firm-specific financial data not already included in the

Lehman Brothers Database, we use the Compustat Industrial Files. Combining the three data sets yields a sample of 1052 firm-year observations on 252 firms for the period 1993 through 1998.[9]

3.2. Measuring board structure and yield spreads

We categorize directors similar to Brickley et al. (1994). Directors employed by the firm, retired from the firm, or immediate family members are insiders. Affiliate directors are directors with existing or potential business ties to the firm, but are not full time employees. Examples of affiliated directors are consultants, lawyers, financiers, and investment bankers. Independent directors are individuals whose only business relationship with the firm is their directorship.

Our primary measure of board independence is the number of independent directors divided by board size (fraction of independent directors). We also use two alternative proxies for the influence of independent directors on the board. First, we develop a binary variable that equals one when independent directors hold over 50% of the board seats and zero otherwise, denoted as Independent Dominated board. Second, we use the number of independent directors on the board. The actual number of independent directors may be important because of how committee assignments are allocated, relative differences in expertise, or because it increases the probability that someone will ask the tough/right questions. In subsequent testing, we also examine the fraction of seats held by both inside and affiliated directors.

For consistency with prior research, our primary measure of board size is the natural log of the total number of directors serving on the board. In addition, because firm size exhibits a positive correlation with board size, we also develop two other measures to assess the robustness of our results. Our first alternative measure is the ratio of the number of board members to the natural log of total assets. Our second alternative measure of board size uses binary variables that denote boards as either large (top quartile of board size) or small (bottom quartile of board size).

We use similar procedures for measuring audit committee independence and size. Our primary measure of audit committee independence is the number of independents on the audit committee divided by audit committee size (fraction of independent directors on the audit committee). We also develop two binary variables to denote audit committee independence. The first binary variable, fully independent audit committees, equals one when the committee consists of only independent directors and zero otherwise. The second binary variable, audit committees dominated by independent directors, equals one when the committee comprises at least 50.1% independent directors and zero otherwise. Our primary measure of audit committee size is the natural log of the total number of directors on the committee. We also develop two alternative measures of audit committee size. The first is the number of directors serving on the committee divided by the natural log firm size.

[9] A potential concern is survival bias. To reduce this concern we allow firms to exit and reenter the sample.

The second alternative measure of committee size uses binary variables that denote committees as either large (top quartile of committee size) or small (bottom quartile of committee size).

We also gather information on board qualifications such as average board age, average board tenure, and the occupation of independent directors. Board age is the sum of all director ages divided by the number of directors and proxies for director business experience. Board tenure is the sum of the number of years that the directors serve on the board divided by the number of directors. This measure captures the ability of managers to influence directors; longer tenure potentially allows managers greater influence over directors' decisions. As in Brickley et al. (1994), we categorize independent directors into one of four occupations: executives from other firms, retired executives from other firms, academics, and other.

The Sarbanes-Oxley Act requires that at least one "financial expert" serve on the audit committee. The definition of a financial expert, as stipulated by the act, includes directors with educational or occupational experience in; generally accepted accounting principles (GAAP), auditing public companies, applying GAAP in connection with accruals or reserves, internal accounting controls, and the audit committee function. The SEC later expanded the definition of the Act to include supervisory experience of individuals involved with these functions, suggesting that any director who manages (or managed) an accounting/financial employee can be classified as a financial expert. Although the Sarbanes-Oxley Act provides for a wide breadth of experience to be classified as a financial expert, we use a narrower and more empirically manageable definition for our tests. Specifically, we classify the following types of directors serving on the audit committee as financial experts; chief financial officers (CFOs), investment bankers, investment managers (mutual funds, etc.), bankers, financial consultants, auditors, and chief executive officers (CEOs) of financial firms. Because of the varying background of many academics that serve on audit committees, some ambiguity arises as to their specific financial expertise. Consequently, we conduct our tests both including and excluding academics as financial experts.

Our dependent variable, yield spread (Spread), is measured as the difference between the weighted-average yield to maturity on the firm's outstanding (non-provisional) publicly traded debt and the yield to maturity on a Treasury security with a corresponding duration, where the weight of each debt issue is the fraction of amount outstanding for that issue divided by the total market value of all outstanding traded debt for the firm. The yield on a corporate debt security is defined as the discount rate that equates the present value of the future cash flows to the security price. The yields on Treasury securities are constant maturity series published by the Federal Reserve Bank of New York in its H15 release.[10]

[10] In cases with no equivalent Treasury maturity, the yield is computed using the Nelson and Siegel (1987) interpolation function.

3.3. Control variable measures

We incorporate control variables into the analysis on firm and security specific attributes. Firm specific measures include firm size (Size), leverage (Leverage), risk (Volatility), Firm Performance (Perform), and blockholdings (Block). Security specific measures relate to our dependent variable (Spread) and include duration (Duration), credit ratings (Rating), age of the debt (Age), and non-linear credit ratings (NLCredit).

Firm size is the natural log of sum of the firm's debt and equity. That is

$$\text{Size} = \text{Ln}(\text{Debt} + \text{Equity}), \tag{1}$$

where Debt is the sum of the firm's publicly traded (market value) and non-traded (book value) debt, and Equity is the market capitalization of the firm. The market value of debt is computed by multiplying the face value of the outstanding debt by its trading debt price (as a fraction of par). The market value of equity is computed by multiplying the number of shares outstanding by the traded closing stock price. Our results are robust to alternative measures of firm size (log of total sales or total assets). Furthermore, adding additional terms for firm size (such as the square and cube of size) also lead to similar results with regards to the hypotheses, as does size-based subset regressions.

We measure leverage as the ratio of long-term debt (LT Debt) to total capital (Debt and Equity). That is

$$\text{Leverage} = \frac{\text{LT Debt}}{(\text{Debt} + \text{Equity})}, \tag{2}$$

where Debt is measured as the sum of the firm's publicly traded (market value) and non-traded (book value) debt, and Equity is the market value of equity multiplied by the number of shares outstanding.

Although leverage controls for variations in the firm's capital structure and may proxy for default risk (as do credit ratings, firm size, and duration), to reinforce our results, we also control for bankruptcy risk using a measure of stock return volatility. *Volatility* is the standard deviation of stock returns for the prior 60 months.[11] We measure firm performance (Perform) as the ratio of cash flows (net income plus depreciation and amortization) to total assets. Finally, equity blockholdings (*Block*) represent the holdings of large shareholders who own 5% or more of the firm's outstanding equity.[12] Because shareholders can benefit from a lower long-term cost of debt, blockholders potentially have incentives to protect bondholder interests.

Security specific variables include duration, credit ratings, and liquidity. We use duration to control for differences in maturity and coupon of the firm's outstanding debt. Duration refers to Macaulay duration, computed as the discounted time

[11] Alternative measures of firm risk include cash flow volatility and Ohlson's (1980) bankruptcy prediction model. The results are robust to using either of these methods (see section IV.C.).

[12] Shleifer and Vishny (1997), Anderson et al. (2003), and Bhojraj and Sengupta (2003) suggest decomposing blockholders into founding family and institutional ownership. Our results are robust to using either approach.

weighted cash flow of the security divided by its price. That is

$$\text{Durat} = \sum_{t=1}^{K} \frac{t \times \text{CF}_t}{P(1+Y)^t}, \tag{3}$$

where CF_t is the security cash flows at time t, t is the number of periods until the cash flow, P is the market bid price of the security, Y is the yield to maturity, and K is the number of cash flows. For our analysis, we compute Duration, or the weighted average duration of the outstanding debt, as a linear combination of the weighted duration of each bond for each firm.

Credit ratings are used to control for differences in default risk. This measure is computed as the average of both Moody's and S&P bond ratings and represents the average of the firm's credit rating at the date of the yield observation. Reeb et al. (2001) suggest using the average of the Moody's and S&P ratings to proxy for the default risk premium. Bond ratings are computed using a conversion process in which *AAA* rated bonds are assigned a value of 22 and *D* rated bonds receive a value of one. For example, a firm with an *A*1 rating from Moody's and an *A*+ from S&P would receive an average score of 18.

A potential problem is that credit ratings may already incorporate the impact of board structure. To mitigate this concern we use an estimate of the debt credit rating without the board structure component. We achieve this by regressing credit ratings on board size and independence. The error term from this regression incorporates the credit rating information without the influence or impact of board structure. We label the error term from this regression as Rating and use it as our primary measure of credit ratings in the multivariate analysis. In addition, credit ratings may exhibit non-linearities as many institutions are barred from holding securities below a certain grade. Therefore, we also include a binary variable (NLCredit) to denote those firms with non-investment grade debt.

For bond liquidity, the fixed income literature provides three proxies: the age of the bond, the amount available for trade, and the bid-ask spread (Sarig and Warga, 1989). We use age of the bond as a measure of liquidity. Bond age (Age) is the number of years that a bond has been outstanding.

3.4. Descriptive and univariate statistics

Table 1 provides descriptive information for our sample. Panel A shows means, medians, standard deviations, and minimum and maximum values for our key variables and Panel B presents a correlation matrix between bond yields and board characteristics.

The average yield spread for the publicly traded debt in our sample is about 136 basis points over its duration equivalent Treasury Security. The standard deviation of the yield spread is about 109 basis points, with a maximum and minimum value of 1068 and two basis points, respectively. The average bond in our sample has duration of about 6.3 years, has been outstanding for about 3.9 years, and has Moody's credit rating of *A*3.

Table 1
Sample description

Panel A: Descriptive statistics for variable measures

This table provides summary statistics for the data employed in our analysis. The data set is comprised of 1,052 firm-year observations for the period 1993–1998. The yield spread (Spread) is the difference between the yield to maturity on the firm's debt less its duration equivalent Treasury rate. Independent directors represents the number of independents on the board of directors; Board Independence is the ratio of independent directors to total directors; Inside directors represent the number of insiders on the board of directors; Board (Audit) size is the number of directors on the board (audit committee); Board tenure is the average length of time a director has been on the board; Board age is the average age of the board of directors. The variables academic, retired, executive, and other represent the most recently reported occupation of each independent director on the board.

Audit committee Independence is the fraction of independents on audit committee, audit committee size is the number of directors on the audit committee, audit committee meetings is the number meetings held each year, Financial experts on audit committee is someone who is a CFO, investment banker, financial consultant or CEO of a financial firm.

Firm size is the natural log of total assets; leverage is the ratio of long-term debt to total capital; Volatility is the stock return variability for each firm for the past 5 years; Duration is the Macualy duration and proxies for effective maturity; credit ratings is the average of Moodys and S&P ratings, and age is the difference between the bond issue date and quote date in years. Firm performance is the ratio of the firms cash flows divided by total assets.

Variables	Mean	Median	Std. dev	Maximum	Minimum
Spread (bps)	136	103	109	1068	2.2
Board characteristics					
Independent directors (Number of)	6.9	7.0	2.4	16.0	0.0
Board independence	0.57	0.58	0.17	0.93	0.0
Number inside directors	3.3	3.0	1.9	12.0	1.0
Board size	12.1	12.0	2.5	24.0	6.0
Tenure on board	9.2	8.9	3.1	24.9	0.3
Age of directors	60.3	60.3	2.6	67.8	49.6
Independent board member occupation					
Number academic	0.9	1.0	0.99	6.0	0.0
Number retired	1.7	2.0	1.44	7.0	0.0
Number executive	3.9	4.0	1.95	10.0	0.0
Number other	0.4	0.0	0.65	6.0	0.0
Audit committee independence	0.7	0.8	0.3	1.0	0.0
Audit committee size	4.5	4.0	1.4	12.0	1.0
Audit committee meetings	3.5	3.0	1.4	14.0	1.0
Financial expert on audit committee	0.9	1.0	0.8	4.0	0.0

Firm and security specific variables					
Firm size	8.9	8.7	1.3	12.8	4.4
Total capital (billions)	17.5	6.0	38.2	355.9	0.8
Firm leverage	0.22	0.20	0.13	0.94	0.0
Duration (years)	6.3	6.3	2.5	13.6	0.1
Credit ratings	16.0	16.0	3.2	22.1	1.0
Bond age (years)	3.9	3.5	2.7	25.7	0.03
Volatility	0.26	0.24	0.08	0.17	0.13
Perform	0.14	0.13	0.08	0.79	−0.12

Panel B: Correlation matrix

This table provides correlation data for the yield spread (spread), board structure, audit committee structure, and other firm specific variables. Spread is the difference between the weighted average yield to maturity on the firm's debt less its duration equivalent treasury rate. Fraction independent is the ratio of independent directors to total directors; board size is the number of directors on the board; audit independence is the fraction of independent directors on the committee; audit comm. size is the number of directors on the committee, firm size is the natural log of total assets, board tenure is the average length of time a director has been on the board; board age is the average age of board of directors; meeting frequency is the number of audit committee meetings in a year; financial experts are audit committee members who CFOs, investment bankers, financial consultants, or CEOs of a financial firm; executive, retired executive, academic, and other represent the last occupation of each independent director on the board

	Yield spd	Board ind.	Board size	Audit ind.	Audit size	Firm size	Board ten	Board age	Meet freq	Fin exp	Exec	Ret	Acad
Yield spread	1.0												
Board independence	−0.12	1.0											
Board size	−0.26	−0.00	1.0										
Audit independence	0.01	0.60	0.04	1.0									
Audit comm. size	−0.13	0.12	0.39	0.06	1.0								
Firm size	−0.36	0.15	0.37	0.06	0.244	1.0							
Board tenure	0.04	−0.34	0.18	0.06	−0.067	−0.16	1.0						
Board age	−0.00	−0.04	0.06	−0.24	0.081	0.05	0.36	1.0					
Meeting frequency	−0.06	0.02	0.12	0.03	0.13	0.24	−0.16	0.01	1.0				
Financial expert	−0.05	−0.20	0.03	−0.26	0.26	−0.01	0.09	0.00	0.09	1.0			
Executive	−0.21	0.56	0.37	0.33	0.20	0.34	−0.20	−0.11	−0.01	−0.12	1.0		
Retired executive	0.01	0.36	0.19	0.24	0.17	0.05	−0.05	0.31	0.06	−0.08	−0.13	1.0	
Academic	−0.14	0.23	0.20	0.14	0.05	0.09	−0.05	−0.17	0.07	0.01	−0.03	−0.14	1.0
Other	0.05	0.19	0.05	0.16	−0.03	−0.07	−0.19	−0.08	0.07	−0.03	−0.03	−0.04	0.03

The average board size in our sample is 12.1 directors, of which 3.3 are inside directors (27%), 6.9 are independent directors (57%), and the remaining two are affiliate directors (15%). Board independence varies widely across our sample from 0 to 92.9%. Average director age on the boards is 60.3 years and average tenure is 9.2 years. There is also substantial variability in board size, ranging from a minimum of six directors to a maximum of 24 directors. With respect to audit committees, the average size is 4.5 directors, ranging from a minimum of one director to a maximum of 12 directors. Independent directors hold 70.1% of all audit committee seats and the median audit committee meets 3 times per year.

The average firm in the sample has total capital of about $17.45 billion. Firm size, the natural log of total capital (in millions), has a mean of about $8.88, a standard deviation of $1.28, and a maximum and a minimum size of $12.78 and $4.40, respectively. Long-term debt, on average, comprises 21% of our sample-firms total capital.

Panel B of Table 1 provides correlation coefficients between yield spreads and board characteristics. In general, the board structure variables exhibit a negative relation to debt yields with the exceptions of audit committee independence and board tenure. This analysis indicates that firms with large, independent boards are more likely to have lower debt costs, which is consistent with the hypothesis that independent directors provide superior monitoring of the financial accounting process, leading to lower debt costs. However, because firm size has an effect on board independence, board size, and debt yields, we use a multivariate framework to further explore our hypotheses.

4. Multivariate testing results

4.1. Bond yield spread and board structure

In the primary specification, we test the cross-sectional relation between board structure variables and the cost of debt financing, and various control measures. That is

$$\begin{aligned}\text{Spread}_{i,t} = {} & A_0 + A_1(\text{Fraction independent}_{i,t}) \\ & + A_2(\text{Log board size}_{i,t}) + A_3(\text{Firm size}_{i,t}) \\ & + A_4(\text{Leverage}_{i,t}) + A_5(\text{Duration}_{i,t}) \\ & + A_6(\text{Bond age}_{i,t}) + A_7(\text{Rating}_{i,t}) \\ & + A_8(\text{Block}_{i,t}) + A_8(\text{NLCredit}_{i,t}) \\ & + A_9(\text{Volatility}_{i,t}) + A_{10}(\text{Perform}_{i,t}) \\ & + A_{11}(\text{Time\_Dum}_{i,t}) + A_{12}(\text{Ind\_Dum}_{i,t}) + \varepsilon_{i,t}, \end{aligned} \tag{4}$$

where Spread is the weighted average debt yield to maturity in excess of the duration equivalent Treasury yield. Our primary interest lies in the coefficient estimates on board independence (A_1) and board size (A_2). Negative estimates are consistent with

the hypotheses that independent directors and board size improve the financial accounting process and thus, are associated with a lower cost of debt financing.

Our firm specific control variables include: firm size, leverage, blockholdings, volatility, and performance. We expect firm size and performance to be negatively related to yield spread as larger, more profitable firms enjoy greater stability and cash flows and therefore may have a lower cost of debt financing. Firm leverage should be positively related to yield spreads, as firms with high debt usage are associated with higher bankruptcy costs, causing an increase in the required rate of return to the bondholders. We expect stock return volatility to exhibit a positive relation to yield spreads, as price fluctuations are associated with higher risk and higher yield spreads.

The remaining control variables, duration, age, rating, and non-linear credit are debt specific. The fixed income literature suggest that duration should be increasing in maturity, but decreasing in coupon and yield to maturity. Since the interaction of all these variables may produce a negative or positive sign, we have no expectation on the sign of the relation between duration and yield spreads. Also, as the yield spread is computed using the duration-equivalent Treasury security, the construction of the dependent variable may mitigate this concern. Age of the firm's outstanding debt should be positively related to yield spread, as seasoned securities demand higher prices and lower yields. The variable Ratings should be negatively related to the yield spread as firms with lower ratings have a higher cost of debt financing. An indicator variable (NLCredit) is added to account for those firms with debt below investment grade status. We expect these firms to be positively associated with yield spreads as lower quality firms demand higher yields and higher spreads. Finally, we include year and industry dummy variables to control for possible time and industry effects. Column 1 of Table 2 provides the predicted sign for each of the coefficient estimates.

Column 2 of Table 2 provides the primary regression results using Eq. (4). The *t*-values are corrected for heteroskedasticity using White standard errors.[13] Our results indicate that greater board independence is associated with a lower cost of debt financing. The coefficient estimate on independent directors is −67.2 with a *t*-statistic of −4.0, consistent with the concept that board independence provides greater managerial oversight. Economically, the coefficient indicates that debt costs are about 17.47 basis points higher for firms with inside boards (25% independent) relative to those with independent boards (51% independent directors).

The coefficient estimate on the natural log of board size is –122.2 with a *t*-statistic of −7.1, indicating that firms with larger boards enjoy a lower cost of debt financing. Thus, comparing a firm with the average board size (12 members) to a firm with one additional board member (13 members), suggests about a 9.8 basis point lower cost of debt financing. These results are also economically significant and are consistent

[13] We control for serial correlation by subtracting the Treasury security yield from the firm yield and by including yearly dummy variables. Repeating the analysis using a random effects model and using Fama-MacBeth regressions both lead to similar results (See Section 5).

Table 2
Yield spread and board structure ($n = 1052$)

Variables	Sign	Dependent variable = yield spread				
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept		374.679*	239.921*	222.363*	288.032*	86.029**
		(6.161)	(5.565)	(5.264)	(5.709)	(2.324)
Board independence	?	−67.180*			−64.511*	−50.432*
		(−4.019)			(−3.979)	(−3.163)
Independent dominated	?		−19.185*			
			(−3.575)			
Number of independents	?			−5.457*		
				(−4.091)		
Board/firm size ratio	?		−69.289*	−53.053*	−77.968*	
			(−6.565)	(−5.221)	(−6.531)	
Log (Board size)	?	−122.241*				
		(−7.054)				
Big boards	?					−32.665*
						(−5.372)
Small boards	?					23.123*
						(2.686)
Firm size	—	−9.899*	−21.777*	−18.695*	−22.574*	−13.138*
		(−4.172)	(−8.531)	(−7.945)	(−8.547)	(−5.291)
Leverage	+	0.405	0.574**	0.461***	0.444***	0.569**
		(1.566)	(2.381)	(1.818)	(1.723)	(2.265)
Duration	+	3.923*	4.121*	4.041*	4.029*	4.301*
		(4.811)	(5.048)	(4.931)	(4.945)	(5.303)
Bond age	+	7.849*	8.048*	7.945*	7.914*	8.012*
		(6.534)	(6.838)	(6.731)	(6.678)	(6.764)
Rating	—	−8.185*	−6.459*	−7.451*	−7.499*	−5.095*
		(−6.590)	(−6.429)	(−6.445)	(−6.400)	(−5.426)
NLCredit	+	121.052*	128.970*	125.218*	124.724*	136.643*
		(9.123)	(9.871)	(9.431)	(9.321)	(10.051)
Block	+	1.961	9.063	4.961	3.736	3.081
		(0.133)	(0.607)	(0.336)	(0.253)	(0.209)
Volatility	+	203.461*	227.880*	220.212*	220.856*	238.361*
		(4.014)	(4.606)	(4.378)	(4.381)	(4.902)
Perform	—	−71.878**	−89.507*	−80.802*	−79.403*	−99.852*
		(−2.442)	(−3.015)	(−2.728)	(−2.662)	(−3.355)
Adjusted R^2		0.643	0.637	0.639	0.639	0.635

*, **, *** Denotes significance at the 1%, 5%, and 10% levels, respectively. The two-tailed t-values given in parenthesis below each estimate are corrected for heteroskedasticity.

This table provides the estimated coefficients from regressing yield spreads on board structure variables (the fraction of independent directors and the natural log of board size) and various firm and security specific controls.

$\text{Spread}_{i,t} = A_0 + A_1(\text{Board independence}_{i,t}) + A_2(\text{Log board size}_{i,t}) + A_3(\text{Firm size}_{i,t}) + A_4(\text{Leverage}_{i,t}) + A_5(\text{Duration}_{i,t}) + A_6(\text{Bondage}_{i,t}) + A_7(\text{Rating}_{i,t}) + A_8(\text{Block}_{i,t}) + A_8(\text{NLCredit}_{i,t}) + A_9(\text{Volatility}_{i,t}) + A_{10}(\text{Perform}_{i,t}) + A_{11}(\text{Time\_Dum}_{i,t}) + A_{12}(\text{Ind\_Dum}_{i,t}) + \varepsilon_{i,t}$.

Column 2 reports the results for the primary specification. Board independence is the ratio of independent directors to total directors. Board size is the natural log of the number of directors on the board. Firm size is the natural log of total capital. Leverage is the ratio of long-term debt to total capital. Duration is the Macualy duration. Age is the difference between the bond issue date and quote date in years. Rating is the security specific adjusted credit rating. NLCredit is a binary variable to indicate non-investment grade debt. Block is the number of outside blockholders. Volatility is the stock return variability for each firm for the past 60 months. Firm performance is the ratio of the firms cash flows divided by total assets. The time period and industry dummy variable results are not reported. In columns 3 through 6, we use different measures of independent director influence and board size variables for robustness.

with the hypothesis that larger boards improve the financial accounting process, resulting in lower debt yields.

In terms of the control variables, the coefficient estimates for rating and firm size are negative and significant at the 1% level, while the leverage coefficient estimate is positive but not significantly different from zero. However, credits rating potentially incorporate differences in capital structure suggesting that leverage will be unrelated to debt spreads. The coefficients on duration, age, and volatility are positive and significant at the 1% level. The variable blockholdings is insignificant suggesting that large blockholders (e.g., mutual funds, insurance companies, and investment bankers, etc.) do not have an effect on the cost of debt financing. Finally, the non-linear credit indicator is positive and significant suggesting that non-investment grade debt requires a higher rate of return and a therefore higher spread.

4.2. Alternative specifications for board structure variables

To further test the relation between board structure and the cost of debt financing, we consider alternative measures of board independence and board size. Column 3 of Table 2 presents the results on board independence using a binary variable that equals one for boards dominated by independent directors (fraction of independent directors greater than 50%) and zero otherwise. Again, we find strong evidence that firms with independent boards experience a lower cost of debt financing (about 19 basis points). Column 4 of Table 2 presents the results using the number of independent directors on the board to measure board independence. These results suggest that an independent director, relative to an inside director is associated with about a 5.5 basis point lower cost of debt financing.

Because board size and firm size are positively correlated, we also use alternative measures of board size in columns 5 and 6 of Table 2 to correct for any firm size effects. Using the number of directors divided by firm size, we again find that larger boards are associated with lower debt yields. Column 6 of Table 2 shows regression results using two indicator variables for board size; big boards and small boards. Big board equals one when board size falls in the largest quartile of the board of director sample and zero otherwise. Small board equals one when board size falls in the smallest quartile of our board of director sample. Consistent with our prior results, we find that firms with larger boards have a lower the cost of debt financing. Overall, our analysis indicates that board structure influences the cost of debt financing, consistent with our prediction that board monitoring affects the financial accounting process.

4.3. Yield spreads and audit committee structure

To examine the relation between audit committee structure and the cost of debt financing, we use the specification in Eq. (4) and replace the board variables with those for audit committees. Column 1 of Table 3 provides the results of regressing audit committee independence (fraction of independents) and audit committee size (log of committee size) on corporate yield spreads. The results indicate that greater

Table 3
Yield spread and audit committee structure ($n = 1052$)

Variables	Dependent variable = yield spread				
	Audit com. ind. and size			Incremental impacts	
	(1)	(2)	(3)	(4)	(5)
Intercept	181.099*	154.161*	90.589**	190.511*	385.390*
	(3.956)	(3.753)	(2.511)	(4.398)	(4.025)
Audit independence	−33.168*		−21.534**	−37.583*	−55.258**
	(−2.759)		(−1.967)	(−3.149)	(−2.459)
Fully independent		−14.675**			
		(−2.381)			
Log (Audit size)	−57.899*	−53.492*		−13.183***	−128.327**
	(−4.155)	(−4.134)		(−1.723)	(−2.293)
Board independence				−9.048*	
				(−4.563)	
Log (Board size)				−10.496*	
				(−6.486)	
Big committee			−34.478*		
			(−3.584)		
Small committee			18.504**		
			(2.521)		
Firm size	−13.715*	−14.278*	−15.301*	−10.386*	−10.282
	(−5.609)	(−5.976)	(−6.576)	(−4.429)	(−1.632)
Leverage	0.503***	0.589**	0.660*	0.4574***	0.191
	(1.915)	(2.337)	(2.694)	(1.796)	(0.364)
Duration	4.343*	4.439*	4.349*	4.162*	4.013
	(5.284)	(5.369)	(5.234)	(5.217)	(1.581)
Bond age	7.904*	8.171*	8.020*	7.748*	8.982**
	(6.567)	(6.831)	(6.702)	(6.460)	(2.331)
Rating	−6.244*	−5.170*	−4.539*	−8.198*	−9.919**
	(−5.111)	(−5.334)	(−4.504)	(−6.456)	(−2.397)
Non-linear credit	129.224*	132.764*	137.195*	121.258*	101.241*
	(9.657)	(10.095)	(10.557)	(9.273)	(2.808)
Block holdings	7.796	9.261	8.554	−0.851	11.933
	(0.525)	(0.606)	(0.569)	(−0.057)	(0.357)
Volatility	237.363*	246.298*	254.768*	201.746*	33.579
	(4.576)	(4.928)	(5.033)	(4.043)	(0.264)
Perform	−86.749*	−97.241*	−103.092*	−74.330*	−114.747
	(−2.851)	(−3.253)	(−3.448)	(−2.508)	(−1.330)
Adjusted R^2	0.636	0.635	0.633	0.646	0.667

*, **, *** Denotes significance at the 1%, 5%, and 10% levels, respectively. The two-tailed t-values given in parenthesis below each estimate are corrected for heteroskedasticity.

This table provides the estimated coefficients from regressing yield spreads on audit committee structure variables (the fraction of independent directors and the natural log of audit committee size) and various controls.

$\text{Spread}_{i,t} = A_0 + A_1(\text{Audit independence}_{i,t}) + A_2(\text{Audit size}_{i,t}) + \text{Control variables} + \varepsilon_{i,t}$.

Column 1 reports the results for the primary specification. Audit independence is the ratio of independent directors to total directors on the audit committee. Audit size is the natural log of the number of directors on the audit committee. In columns 2 and 3 we use alternative measures of audit committee independence and size. Columns 4 adds board independence and board size to examine the incremental explanatory power of audit committee characteristics over board characteristics. Because board and audit committee characteristics are correlated (motivating this test) we orthogonalize the board and audit committee variables in this particular regression. In column 5, we take a different approach and repeat the analysis using only those boards that are in the top quintile of corporate insider control ($n = 190$). Both approaches provide additional evidence on whether the channel through which board structure affects the cost of debt is improved financial reporting and disclosure. The control variables are described in Table 2.

audit committee independence is associated with a lower cost of debt financing. The coefficient estimate on independent directors is –33.2 with a *t*-statistic of –2.8, consistent with the concept that audit committee independence provides greater oversight of the financial accounting process. The coefficient estimate on the natural log of audit committee size is –57.9 with a *t*-statistic of –4.2, indicating that firms with larger audit committees have a significantly lower cost of debt financing. Thus, comparing a firm with 6 committee members relative to a firm with 5 members, suggests a debt savings of about 10.6 basis points. These results are consistent with the hypothesis that larger, more independent audit committees are important to creditors, resulting in lower debt yields.[14]

To further test the relation between audit committee structure and the cost of debt financing, we consider alternative metrics of audit committee independence and size. Column 2 presents the results of using an alternative measure of audit committee independence (fully independent), suggesting that firms with greater audit committee independence experience a lower cost of debt financing (about 14.7 basis points for fully independent committees). Column 3 gives the results of using an alternative proxy for audit committee size (binary variables to denote large and small committees). Again the results indicate a significant and negative relation between corporate yield spreads and the board size.[15] Overall, this analysis indicates that audit committee structure influences the cost of debt financing, consistent with the prediction that audit committee monitoring of the financial accounting process is important to creditors.

4.4. Incremental impact of audit committees

Although our results are consistent with the hypothesis that board structure influences the financial accounting process, another potential explanation focuses on the notion that board structure improves firm performance and thereby reduces the cost of debt. While prior research (see Hermalin and Weisbach, 2003) provides little evidence of independent boards improving firm performance, we attempt to disentangle these competing explanations by examining whether audit-committee characteristics exhibit additional explanatory power over full-board attributes. If the direct link between boards and the financial accounting process—audit committees—continues to exhibit a negative relation to debt costs even after controlling for full board attributes, then this provides additional evidence that the relation between

[14] Comparing the impact of other firm characteristics (such as firm size and risk) on debt costs relative to the impact that board characteristics have on debt costs is complicated by the fact that credit ratings incorporate many firm characteristics such as size, risk and performance. However, focusing on a series of regressions that isolate the impact of firm size, risk, and performance on the cost of debt, we find that the average impact of a change of one standard deviation in these variables is associated with about a 26 basis point change in the cost of debt. In comparison, the average impact of one standard deviation change in the board/audit committee variables is about 13 basis points.

[15] We also repeat the tests using additional measures of audit committee characteristics (binary variable for independent dominated audit committees and the ratio of audit committee size to firm size) and find similar results to those reported in Table 4.

debt costs and boards/audit committees is the financial accounting process rather than firm performance. We use two approaches to examine the incremental explanatory power of audit committees relative to the full board.[16] First, we repeat the analysis in Table 3 but include variables for both board and audit committee characteristics in the same regression. The strong correlation between audit and board structure variables (board and audit independence correlation is 0.50, Table 1, Panel B) indicates that multicollinearity may be a concern in regression analysis.[17] Consequently, we orthogonalize the board and audit committee variables in this test. Column 4 of Table 3 shows the results and indicates that audit committee characteristics continue to exhibit a negative relation to debt costs even after including full-board characteristics.

In a second approach to assess whether audit committees exhibit additional explanatory power over full boards, we investigate those firms where insiders control a substantial portion of all board seats and then examine whether audit committee characteristics continue to exhibit a negative association with debt costs. For this test, we examine firms in the top quintile of insider control of the board of directors. Full-board independence for this subsample is 0.30 and audit committee independence is 0.47, with a correlation between the two variables of 0.37. The regression results for this subsample are shown in Column 5 of Table 3 and indicate a negative relation between debt costs and audit committee independence. Thus, even with a non-independent full board, we continue to find an inverse relation between audit committees and the cost of debt financing, suggesting that the financial accounting process (rather than improved firm performance) is the linkage between board structure and debt costs.

4.5. Board member characteristics

Column 2 of Table 4 provides the results of regressing board age, board tenure, and officer and director holdings on yield spread. Board age is the average age of all directors and proxies for business experience. Board tenure is the average number of years that directors serve on the board and proxies for the ability of managers to influence director opinion—with longer director tenure, managers potentially capture director decision-making. The officers and director equity ownership variables measure directors' immediate economic interests in the firm. The coefficient estimates for board age, and officer and director holdings are not statistically significant, suggesting that directors' business experience and immediate economic

[16] Another test is to directly examine whether board structure affects future firm performance. After including a 1-year lead for firm performance, we continue to observe a negative relation between board (audit committee) structure and the cost of debt.

[17] In regressions without orthogonalizing board and audit committee independence, we note relatively high variance inflation factors (VIFs). Specifically, VIFs of 10.99 for board independence, 6.56 for board size, 1.74 for audit committee independence, 1.64 for audit committee size, and 2.02 for firm size. In addition, without the orthogonalized variables, we find that the coefficient estimate for audit committee independence changes sign, suggesting multicollinearity concerns in regressions including both board and audit committee variables.

Table 4
Yield spread and independent director attributes ($n = 1052$)

Variable	Dependent variable = yield spread				
	Board of director attributes		Audit committee attributes		All attributes
	(1)	(2)	(3)	(4)	(5)
Intercept	306.463*	226.595*	201.474*	197.042*	389.909*
	(3.963)	(5.325)	(3.981)	(4.575)	(4.355)
Board independence	−64.482*				−16.268*
	(−4.025)				(−4.385)
Board size	−83.903*	−58.672*			−21.732*
	(−6.750)	(−5.781)			(−9.313)
Audit com independence			−33.712*	−22.192*	−90.227*
			(−2.624)	(−2.601)	(−3.605)
Audit com size			−55.681*	−66.053*	−48.404*
			(−3.922)	(−5.733)	(−5.080)
Board age	−0.888				−0.299
	(−0.915)				(−0.258)
Board tenure	2.465**				2.567**
	(2.336)				(2.172)
Officer and dir holdings	−31.442				−13.443
	(−1.529)				(−0.691)
Academic		−7.324*			2.464
		(−3.223)			(0.782)
Retired		−4.224**			3.892
		(−2.489)			(1.245)
Executive		−5.389*			1.106
		(−3.632)			(0.394)
Other		−6.401***			
		(−1.673)			
Financial expert on audit			−3.436		−9.660***
			(−0.751)		(−1.948)
Academic on audit			−1.045		−5.688
			(−0.222)		(−1.094)
Audit committee meetings				−25.231*	−25.782*
				(−3.857)	(−3.696)
Adjusted R^2	0.639	0.629	0.637	0.651	0.612

*, **, *** Denotes significance at the 1%, 5%, and 10% levels, respectively. The two-tailed t-values given in parenthesis below each estimate are corrected for heteroskedasticity.

This table provides the estimated coefficients from regressing corporate yield spreads on board and audit committee director attributes and various control variables. Columns 1 and 2 focus on director attributes of the whole board. Specifically, in column 1 we examine the impact of board age, board tenure, and officer and director holdings on the cost of debt financing. In column 2 we test for differences based on independent director occupation on corporate yield spreads. Columns 3 and 4 focus on audit committee director attributes. In column 3 we examine the impact of Financial Experts and if a committee member was a former employee of on the firm's auditor. In column 4, we focus on the natural log of the number of meetings held by the audit committee (Audit Committee Meetings as a measure of audit committee activity). In Column 5 we repeat the analysis including all of the variables used in testing of the seven hypotheses.

Firm size is the natural log of total capital. Leverage is the ratio of long-term debt to total capital. Duration is the Maculay duration and proxies for effective maturity. Age is the difference between the bond issue date and quote date in years. Rating is the board structure adjusted credit rating based on Moodys and S&P ratings. Volatility is the stock return variability for each firm for the past 60 months. Firm performance is the ratio of the firms cash flows divided by total assets. We also include time period and industry dummy variables. The results for the control variables are similar to prior tables and are not reported.

interests have little discernible impact on the cost of debt financing. However, board tenure is positive and significant; indicating that as director tenure increases, managers are potentially more able to influence or sway board opinion. The magnitude of the coefficient estimate is relatively small (when compared to the coefficients on board independence and size), suggesting that an increase in average board tenure from 7–8 years increases debt costs by 2.5 basis points.

We also examine whether specific occupational characteristics of independent directors are associated with different costs of debt. Executives of other companies may have different incentives to monitor (or not to monitor) compared to other board members or have incentives to vote with management in the hopes of justifying actions at their own firms. We classify independent directors into four groups: independent directors who are executives from other firms, retired executives from other firms, academics, and other. Other includes clergy, government officials, and charity and community workers. Column 2 of Table 4 provides the regression results. Interestingly, we find that each director type is associated with a lower cost of debt financing. From a bondholder's perspective, there appears to be little difference in monitoring among academics, executives, retired executives, or other job categorizations. In general, our analysis suggests that bondholders' primary concern is independent director monitoring rather than the specific expertise of the directors.

Next, we examine the impact of having financial experts on the audit committee and the frequency of audit committee meetings on corporate yield spreads. We denote CFOs, financial consultants, investment bankers, investment managers, bankers, auditors, and CEOs of financial companies as financial experts. Because academics may or may not be considered financial experts we measure them separately (similar results if combined). Column 3 of Table 4 shows the results of including financial experts in the analysis. We find little evidence to indicate that financial experts are an important consideration to creditors in our sample.[18] However, in regards to audit committee meeting frequency, the evidence suggests that audit committee activity is quite important to creditors. The coefficient estimate (Table 4, Column 4) on the natural log of audit committee meetings is -25.2 with a t-statistic of -3.9, indicating that firms with more audit committee meetings are associated with a significantly lower cost of debt financing. Thus, comparing a firm with 4 committee meetings relative to a firm with only 3 meetings, suggests a reduction in debt costs of 7.3 basis points. These results are consistent with the hypothesis of the *1999 Blue Ribbon Report* that more actively involved audit committees are associated with greater financial statement reliability.[19]

[18] Passage of the Sarbanes-Oxley Act bans firms from hiring former-audit firm personnel in the positions of CEO, CFO, or controller within one year of the leaving the audit firm. Although the Act does not extend to the board of directors, of the 824 audit committee members, we find only one instance of a former audit-firm employee on the audit committee.

[19] Another potential issue related to disclosure quality is auditor choice (Big 4/5) and whether the firm receives a clean audit opinion (Mansi et al., 2003). Within our sample of S&P 500 firms, we find that all firms employed a Big 5 auditor and received an unqualified audit opinion or an unqualified audit opinion with explanation. The distinction between unqualified and unqualified with explanation is unrelated to the cost of debt.

In our final test, we combine all of the variables for hypotheses 1 through 7 in a single regression. The individual tests indicate that several of these board governance characteristics are related to the cost of debt; including all these factors into a single regression focuses on their incremental explanatory power. However, because of multicollinearity concerns, we again orthogonalize the board and audit committee variables, and exclude one independent director job classification (other) from the regression.

The regression results are shown in Column 5 of Table 4. Again, we find that the board (audit committee) independence and size are related to a lower cost of debt financing. Board tenure is positively related to the cost of debt, while audit committee meeting frequency is negatively related to the cost of debt. In addition, we still find that board age, director equity holdings, and director occupation are not significantly related to the cost debt. However, contrary to our previous results, we note a marginally significant coefficient estimate on financial expert on the audit committee, suggesting that committees with a financial expert enjoy about a 9.7 basis point lower cost of debt.

5. Sensitivity and robustness tests

Our analysis assumes that the specifications and proxies adequately measure the appropriate attributes. As such, we further examine non-linearities in board structure and credit ratings, outliers and influential observations, and endogeneity. We find that our results (which are not reported but available from the author's upon request) are also robust to various alternative specifications.

First, we included the square of board size and audit committee size to examine the issue of non-linearities in our board size analysis. We find the squared terms (of board/audit size) are insignificantly different from zero. While our results unambiguously indicate that larger boards and audit committees are better, a potential caveat is that the largest board in our sample consists of 24 directors. To further examine the issue of non-linearities in board (audit committee) independence and board/audit committee size we use piecewise regressions. Specifically, we repeat the analysis using binary variables to indicate the second through fifth quintiles for both board and audit committee size. The results of this analysis again indicate that large boards are associated with a lower cost of debt financing.

We also allow for a non-linear relation between bond yield spreads and credit ratings using a piecewise linear regression and consider additional approaches to capturing default risk such as including cash flow volatility, the square of credit ratings, the square of leverage, the coverage ratio, and composite bankruptcy prediction scores (e.g. Ohlson's, 1980measure). In further tests, we consider alternative methods of measuring bond liquidity and also of using raw credit scores in our analysis. Regressions using these alternate specifications and measures are consistent with our primary regressions, suggesting that board and audit committee structure are associated with a lower cost of debt. Although credit ratings capture some of the board and audit committee effects, the tests with raw credit ratings

suggest that investors also focus on the information about governance devices reported in proxy statements.

To test the sensitivity of our analysis to serial correlation and to the impacts of outliers and influential observations, we consider several alternative techniques. First, we repeat the tests using a random effects model, year-by-year regressions, and using the year-by-year results in the Fama-MacBeth procedure. All three approaches lead to similar inferences. Second, to identify observations that are outliers and/or influential observations, we use the use the R-Student statistic and the DFFITS statistic. The results were similar to those reported in Tables 2–4 and do not change substantively when truncated for outliers at the largest 1%, 3% and 5% levels at each tail of the distribution for each variable in the model. In addition, both least absolute deviation and least median deviation regressions give similar results.

We also consider the issue of endogeneity. We use three approaches to address this concern. First, to the extent that board structure could be a function of bond yields, we use two-stage least squares, instrumental variable (2SLS-IV) regressions to estimate the relation between board structure and bond yields and find similar results to our reported results. Second, following Klein (1998) we also control for simultaneity by incorporating the yield spread from the prior period (first lag) into the regression. Again we find the results are consistent with our reported results. Finally, we use first-difference regressions, and consistent with our levels tests, we find that changes in yield spreads are negatively associated with changes in board size and independence. We also examined additional control variables, such as intangible assets, CEO pay-mix, CEO on the nominating committee, and corporate diversification in Eq. (4). The results of adding these control variables confirm our initial findings that board structure is associated with a lower cost of debt.

6. Conclusion

Boards of directors are responsible for monitoring, evaluating, and disciplining firm management. Perhaps one of the most important responsibilities of the board from a creditor's perspective is oversight of financial reporting. Because debt holders rely on accounting based covenants in lending agreements, creditors may have concerns with board and audit committee monitoring of the financial accounting process. Consistent with this idea, we find that board and audit committee independence are associated with significantly lower debt financing costs.

Our analysis also indicates that board and audit committee size are inversely related to the cost of debt, suggesting that larger boards and audit committees provide greater monitoring of the financial accounting process. The results are statistically and economically significant, and robust to a variety of board size and board independence measures. Additional tests (non-linear specifications and changes regression) provide additional support for the hypothesis the board structure is relevant to debtholders.

Finally, we investigate the relation between independent director attributes and debt yields. Our results indicate that employment characteristics (executive, retired,

academic, etc.), while all significantly related to lower debt costs, are not statistically different from one another. While the evidence on financial experts on the audit committee is mixed, the frequency of audit committee meetings is associated with lower debt costs. We interpret this to suggest that active monitoring by independent directors of the financial accounting process is quite important to creditors.

In conclusion, we find compelling evidence that board and audit committee monitoring substantially impact the cost of debt financing. The results indicate that firms with large independent boards and audit committees are associated with a lower cost of debt financing, suggesting that boards of directors are an important element of the financial accounting process.

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